OXFORD

Journal of Deaf Studies and Deaf Education, 2018, 1–10

doi:10.1093/deafed/eny014
Theory/Review Manuscript

THEORY/REVIEW MANUSCRIPT

Recent Issues in the use of Signed Language Assessments for Diagnosis of Language Disorders in Signing Deaf and Hard of Hearing children

Jon Henner*[1], Rama Novogrodsky[2], Jeanne Reis[3], and Robert Hoffmeister[3]

[1]University of North Carolina at Greensboro, [2]University of Haifa, and [3]Center for Research and Training

*Correspondence should be sent to Jon Henner, School of Education Building, 1300 Spring Garden St, Greensboro, North Carolina 27412. (e-mail: j_henner@uncg.edu)

Abstract

In recent years, normed signed language assessments have become a useful tool for researchers, practitioners, and advocates. Nevertheless, there are limitations in their application, particularly for the diagnosis of language disorders, and learning disabilities. Here, we discuss some of the available normed, signed language assessments and some of their limitations. We have also provided information related to practices that should lead to improvement in the quality of signed language assessments.

This paper provides an overview of several signed language assessments and discusses appropriate applications when attempting to diagnose language-related disabilities with a wide variety of Deaf and Hard of Hearing (DHH) children, including those with atypical language backgrounds and profiles. Here we focus on the goals of signed language assessments, which track production and receptive abilities in signed language through analysis of phonology, morphology, syntax, and vocabulary. We do not discuss the application of other kinds of assessments in language disorder and learning disability diagnosis, such as those that measure cognitive, memory, and behavioral abilities. For researchers and advocates, we have also provided information related to practices that can improve the quality of signed language assessments.

In this paper, we use *language deprivation* as a label for a variety of language dysfluency issues that tend to appear for DHH children who have absent or inconsistent language exposure (Hall, Levin, & Anderson, 2017; Humphries et al., 2016). In the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5), language disorders exist, but a language deprivation diagnosis does not. Therefore, in the case of signed language, there is a scientific schism between biological language disorders and ones that are caused by language deprivation, although one of the exclusionary criteria for language disorder is no lack of exposure to language (DSM-5; Leonard, 1998, among others). As such, there is no specific diagnosis for the numerous and varied difficulties that language deprivation causes. At the time of this writing, teams of researchers are working on ways to accurately define and describe what has been termed "language deprivation disorder." Hall et al. (2017) point to three markers of language deprivation: language dysfluency, knowledge deficits (a lack of concept and contextual knowledge), and disruptions in thinking, mood, or behavior. These markers partially overlap with those of other diagnosed disorders including language disorders. We argue here that distinguishing between the different disorders requires accurate language assessments, and that the type and range of atypical language exposure in DHH signing children who grow up without consistent and stable language exposure makes diagnosis of a language disorder difficult. Furthermore, we highlight the complex nature of developing accurate assessments.

Language assessments are often used to evaluate educational progress and medical functioning from preschool to the elder years; the information gleaned from them allows professionals to diagnose properly, design targeted instruction, select medical approaches, and develop appropriate interventions.

Received January 4, 2018; revisions received March 22, 2018; editorial decision April 10, 2018; accepted April 11, 2018

These critical evaluations are only valid when they are norm referenced, or standardized assessments that have been developed in the language of the child or adult to be evaluated, whether spoken, written, or signed.

The need for standardized assessments that evaluate signed language knowledge and fluency is well documented. Enns and Herman (2011) write that adequate and appropriate signed language assessments provide valuable information about the signed language knowledge of DHH children. Gallaudet Research Institute (GRI, 2011) reports that as of 2009–2010, at least 40% of deaf children have experienced some form of signed language in their education; however, the quality and type of signed language experienced varies greatly from one student to another. About 12% of students are exposed to simultaneous communication, where teachers endeavor to sign and speak at the same time. The remaining 27% are reportedly in signing classrooms. No additional distinction between the types of signed communication is made in the GRI report. It is not known what percentage of that group is taught in American Sign Language (ASL) or what percentage of instruction is delivered via manual communication systems. Here, the term "manual communication systems" refers to constructed or artificial signed systems, such as signed exact English, or cueing systems such as Cued Speech. The lack of granularity in reporting makes it difficult to determine the extent, type, and quality of ASL instruction afforded to DHH children.

Immersion in and masterful command of a fluent native language is invaluable. Yet, it is estimated that only 5% of the DHH population in the United States have access to acquisition level immersion in ASL, from their Deaf, ASL signing parents (Mitchell & Karchmer, 2005). The remaining 95% of signing DHH children are at higher risk for atypical language input in signed language, due to lack of exposure, and in spoken language due to their hearing loss (Humphries et al., 2016). Some parents opt to learn to sign as their children do, in order to connect and engage with their child more freely and readily.

When the home language is not available to the child, language acquisition cannot proceed on a typical trajectory, incidental learning is not possible, and even simple conversations are likely to be fraught with misunderstanding. This is the ongoing challenge of language deprivation in the DHH community, highlighting the need for reliable and high quality signed language assessment. Such assessment can provide an accurate picture of language knowledge and inform the design of critical intervention services (Henner, Caldwell-Harris, Novogrodsky, & Hoffmeister, 2016; Humphries et al., 2016; Humphries, Kushalnagar, Mathur, Napoli, Padden, & Rathmann, 2014; Mellon et al., 2015). When evaluating and selecting signed language assessments, we must consider which of the available tools have the power, validity, and rigor to evaluate specified language skills and provide an accurate picture of a child's language capacities.

In the past few years, Humphries and colleagues have been working to make language deprivation and subsequent language deprivation disorders more well known in medical, language, and pedagogy communities (Humphries et al., 2012, 2017; Humphries, Kushalnagar, Mathur, Napoli, Padden, & Rathmann, 2014; Humphries, Kushalnagar, Mathur, Napoli, Padden, Pollard, et al., 2014; Mellon et al., 2015). Similarly, the DHH in the United States has responded to the issue of language deprivation community through legal action. The Language Equality and Acquisition for Deaf Kids campaign and the Nyle DiMarco Foundation, two grassroots organizations, have campaigned to legally mandate frequent language testing for DHH children and to hold states and school districts accountable for ensuring DHH children meet language milestones in both spoken (English) and signed languages (ASL). Several states have enacted bills that make monitoring DHH children's language acquisition in both spoken and signed modalities mandatory. For example, Section 1.1 of North Carolina has approved House Bill 317 reads:

> [The State Board of Education shall…] develop assessment procedures and protocols to measure, at least annually, or more frequently if specified in the child's Individualized Education Program (IEP), the acquisition of language skills necessary for literacy using linguistically and culturally appropriate assessment tools. The results of these assessments shall be used to determine whether further support and services, if any, are needed for a child (H. 317, Session 2013, General Assembly of North Carolina).

A similar but more comprehensive bill passed by the California Senate in October of 2015. Senate Bill No. 210, Chapter 652 (S. 210, Senate of California) specifically requires that the California Schools for the Deaf, in conjunction with the state's legal committee for the DHH, set up assessment centers to track language acquisition in the state's population of DHH children. It further requires that language acquisition milestones for signing children must be based on established norms backed by research. If, based on the results of assessments selected by educators and school officials, children fail to meet the milestones, parents must be advised on additional or different intervention strategies. Thus, educational outlooks and individual education planning for young, signing children hinges on providing quality signed language assessments based on accurate representations of ASL milestones, and accurately interpreting and applying the results.

The current paper aims to address the complex condition of developing signed language assessment tools and interpreting their results in the diagnosis of language disorder. Before advising parents on additional or different strategies for ensuring appropriate language exposure and intervention, one must determine if the DHH child is language deprived, or if they have a language disorder. The former derives from environmental conditions; the latter is biological in origin. Professionals agree that standardized, high quality signed language assessments must be available for educators and language specialists. Yet, limited information exists on what signed language assessments are available, and if those available are quality assessments. First, we will describe the state of signed language assessments as of this writing. Then we will examine how these assessments can be used in diagnosing language disorders. Finally, we will explore whether signed language assessments can currently distinguish between language disorder and language deprivation.

The Current State of Signed Language Assessments

In general, two options are available for those who wish to produce a signed language assessment: adapting an existing standardized test into signed language or creating a new one. Although the promises and pitfalls of both approaches are well documented (Translation: Allen, White, & Karchmer, 1983; Enns & Herman, 2011; Haug, 2011a, 2011b, Test Creation: Henner, Hoffmeister, & Reis, 2017; Herman, Holmes, & Woll, 1999; Hermans, Knoors, & Verhoeven, 2010), the following provides a short summary of both. In this article, we mainly discuss assessment tools for ASL as a case study for our arguments and

add references to other signed languages for further support. The Language Equality and Acquisition for Deaf Kids bills often require measuring whether DHH children between birth and 5;0 years of age are meeting appropriate signed language milestones in both expressive and receptive language. Few available standardized signed language tests are valid for use with this age range in ASL. Following is a short list of the available assessments that can be used for DHH children who are younger than 5;0, and identifies briefly some of the language skills the assessments cover.

Signed language assessments can be broadly categorized as either production or receptive based. Production-based assessments generally require that the test taker produces a language sample, which in the case of signed language means that the test taker will sign in response to a stimulus. Receptive-based assessments require test takers to select a response to a stimulus instead of producing it themselves. The American Sign Language Assessment Instrument (ASLAI; Hoffmeister et al., 2015) has norms starting at age 3;6 for some of the tests in its battery. The ASLAI is a receptive test battery with subtests focusing on specific ASL language measures. These measures include: vocabulary (simple, complex, synonyms, antonyms, definitions, and analogical reasoning), syntax (topicalization, subject-verb-object, complement, relative clauses, verb agreement, conditionals, negation, wh-questions, rhetorical questions, and pronominalization), and reasoning (causal, antonym, whole-part, noun verb pairs, and ASL phonology) (Henner et al., 2016; Henner et al., under review; Novogrodsky, Caldwell-Harris, Fish, & Hoffmeister, 2014a; Novogrodsky, Fish, & Hoffmeister, 2014c; Novogrodsky, Henner, Caldwell-Harris, & Hoffmeister, 2017). Another receptive test is the American Sign Language Receptive Skills Test (ASL-RST; Enns, Zimmer, Boudreault, Rabu, & Broszeit, 2013) which has norms for ages 3;0–13;0. The test is adapted from the British Sign Language (Herman, Holmes, & Woll, 1999) and focuses on comprehension of ASL morphology and syntax. The MacArthur Communicative Development Inventory (ASL-CDI; Anderson & Reilly, 2002) has norms from 8 to 36 months; it is a parental report of a child's ASL vocabulary. Finally, the Visual Communication and Sign Language Checklist (VCSL; Simms, Baker, & Clark, 2013) is a language scale with norms from birth to age five. While some schools for the DHH use the Sign Language Proficiency Interview (SLPI; Newell, Caccamise, Boardman, & Holcomb, 1983) for limited purposes, the SLPI was never intended to be used with young children (G. Poor, personal communication, September 18, 2017).

In general, the available assessments are either production assessments with rater checklists (ASL-CDI, VCSL, SLPI) or receptive assessments that are either computer based or have presentations where test takers can point to the correct answer (ASLAI, ASL-RST). We briefly explained the differences between the two, but the next section will explain these differences. Additionally, we discuss the further challenges of using signed language tests from two perspectives: the examiner using the test and the development of the test.

Production assessments or checklists are rater based, criterion referenced assessments (Cox, 1974). For example, the VCSL test score shows whether a 3;0 to 4;0-year-old DHH child has mastered the use of plain verbs (e.g., LIKE). In the case of the ASL-CDI, parents or professionals familiar with the child record if the child knows a particular test item. The results of checklists and other rater based language assessments depend in part on the skills and goals of the rater (Chalhoub-Deville, 1995a, 1995b). In the case of assessment of DHH children, often checklists may be employed by raters who are not fluent in signed language (Beal-Alvarez & Scheetz, 2015). For example, second language (L2) learners of signed language tend to perceive phonological details differently than first language (L1) learners (Geer & Keane, 2017; Morford, Grieve-Smith, MacFarlane, Staley, & Waters, 2008; Rosen, 2004). The literature hints that some L2 signing practitioners are not proficient enough to assess signed language skills in DHH children. They may mark correct productions as incorrect or incorrect productions as correct. Nevertheless, some researchers have demonstrated that the differences in signed language rating abilities between L1 and L2 users may not be critically different. Beal-Alvarez & Scheetz (2015) studied pre-service teachers of the DHH and signed language interpreting students who rated the signed language abilities of DHH children using a modified version of the Signed Reading Fluency Rubric for Deaf Children (SRFR; Easterbrooks & Huston, 2008). These ratings were compared to the ratings of two fluent signers and no differences were found between ratings. Still, high inter-rater reliability does not indicate that the ratings themselves are accurate, only that a group of raters have similar judgments about a production sample. Additionally, a recent study suggested that early exposed signers appear to be better judges of visual communication use than later-exposed signers (Carrigan & Coppola, 2017). Another challenge with observational and production assessments is that raters may have inherent biases against test takers of different sexes, genders, disabilities, or races/ethnicities which can make accurate and fair ratings difficult (Schaefer, 2008). Additionally, biases may also exist in favor of more English-like signing rather than more ASL like signing (Bebko, Calderon, & Treder, 2003). While intense rater training may produce more efficient ratings (see Henner et al., 2017 for a discussion on rater training), it does not account for rater bias because signers cannot yet be anonymized. These issues are not unique to signed language assessments, but they are important considerations related to the use of production-based signed assessments.

Receptive assessments are either computer based, or artifact-based assessments where test takers are exposed to stimuli and then choose an answer from a preselected set of possible solutions. Typically, individual results are then compared to a pool of results that have been compiled from other test takers. These results usually have been normed using classical test theories or item response analysis approaches (see Magno, 2009 for the differences). Available receptive assessments for ASL include the ASLAI and the ASL-RST; both are multiple choice tests. Receptive assessments do not entirely escape the accusation of biases directed at production assessments. Yet, receptive assessments differ from production assessments because while biases can be inadvertently built into the questions themselves, item level norming algorithms can detect these biases and compensate for them at the question/item level. The biggest problem with receptive assessments is that the pool of DHH is so small that it is difficult to norm for all the possible variations of DHH children (e.g., DHH with mild hearing loss versus those with severe to profound hearing loss, DHH children of color, DHH + disabled) (Morere, 2013).

The exact definition of a normative sample of DHH children is still unclear. As Furr and Bacharach (2008) remind us, a normative sample has to be representative of the whole population. For the authors of the ASL-RST, this necessitated at least 200 children, or 20 children for each normative age group (Enns & Herman, 2011). In comparison, the ASLAI collected data from approximately 1,400 DHH children during its Institute of Education Sciences (IES) funded data collection period (2010–2015). Given that only 1.3 to 5 per 1,000 children are born with a hearing loss, and a much smaller percentage of that use

signed language as a primary language of communication, the actual number of signing DHH children available to use in normative test development is extremely small (Centers for Disease Control and Prevention, 2017). Norming for different sub-communities within signing DHH populations is necessary for good, accurate, and equitable signed language test development. Unfortunately, getting representative populations on which to make accurate norms requires overcoming extraordinary barriers. Thus, results from current signed language assessments must be considered carefully depending on the individual test taker.

Faced with limited signed language assessment choices, professionals who work with signing DHH children may opt to translate or adapt an existing assessment. Existing normed, signed language assessments in the United State focus on ASL rather than the varied constructed signed systems used in many self-contained and mainstreamed classrooms. Thus, children who use those constructed signed systems may be at a language disadvantage when taking ASL assessments. Nevertheless, because ASL is a natural language, and constructed signed systems are not, ASL ought to be the point of comparison when the aim is to test language acquisition. A possible solution for the many DHH children who use constructed signed languages is to use dynamic assessment tools, which measure learning capacity (Kohnert, 2010; see Mann, Pena, & Morgan, 2014 for further information).

Translating or adapting assessment tools based on an existing validated tool can, in theory, save money. Haug and Mann (2007) explain that adaptation is not the same as translation. Translation "refers to a one to one transfer without consideration of linguistic differences" (p. 139). Adaptation, on the other hand, considers "linguistic and cultural" differences between the two languages: the original language of the test and the target adoption language. Cultural differences can occur not only between languages but also within them. For example, when collecting data for the ASLAI (Hoffmeister et al., 2015), a teacher of the DHH brought to one of the author's notice that one of the items required participants to identify SNOW/BLIZZARD. As the assessment was being conducted in a location where snow rarely falls, none of the participants had ever experienced snow. In theory, the participants should have understood snow abstractly. Yet the test construction assumed they had experienced it personally.

The Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 2007) is one test that many researchers may want to adopt from English to ASL. Versions of the PPVT in other languages (e.g., Italian) have been translated to their equivalent signed languages (e.g., Lingua dei Segni Italiana [LIS]) (Pizzuto, Ardito, Caselli, & Volterra, 2002). In the United States, the PPVT has been used to assess the receptive vocabulary knowledge of children aged 2;6—adult for over 50 years. Two issues are usually encountered by teams wanting to adapt the PPVT from English to ASL: differences in lexical frequency between English and ASL lexical items, and one-to-many translations. First, highly frequent words in English are not always highly frequent signs in ASL (Mayberry, Hall, & Zvaigzne, 2014). Also, lexical frequency is easier to compile in English because of the availability of print and the ease of computer analysis of printed language. While frequency ratings are available in ASL, the ratings tend to be subjective and based on a smaller number of participants compared with calculating from print corpora (Caselli, Sehyr, Cohen-Goldberg, & Emmorey, 2016; Mayberry et al., 2014; Morford & MacFarlane, 2003). Second, professionals attempting to adapt tests like the PPVT to ASL may confront the "one to many" problem with what Johnston (2009) called partly lexical signs. Not all English words have one to one correspondences with signs in ASL (e.g., *photosynthesis* vs LIGHT + EXHANGE or *target* vs LEFT (CL:F[OPEN] + RIGHT (CL:1[TRACE CIRCLE] + CL:1[DOT]). Several teams in the United States have worked on or are working on translating the PPVT from English to ASL, included Contreras and Coppola (in progress). These translations; however, are not yet generally available at the time of this writing. In spite of the difficulties with adaptation and translation, some assessments appear to have been successfully adapted from English to a signed language. The British Sign Language Cognitive Screening Test (BSL-CST), for example, was adapted from the Revised Addenbrookes Cognitive Examination (Atkinson, Denmark, Marshall, Mummery, & Woll, 2015).

The same issues need to be resolved when adapting tests from one signed language to another. The BSL-Receptive Skills Test (Herman et al., 1999) has been adapted into ASL (Enns & Herman, 2011) and German Sign Language (Deutsche Gebardensprache; DGS; Haug, 2011a). When adapting the BSL-Receptive Skills Test into the ASL-Receptive Skills Test, Enns and Herman (2011) employed a six-step approach. The first two steps are relevant for the current discussion and thus are further explained. The first step was focused on determining whether the BSL items could be directly translated into ASL. A panel of DHH and non-deaf experts, including native signers, university researchers, college instructors, and teachers of the DHH were assembled. The panel worked to determine if the BSL items could be directly translated into ASL (e.g., ICECREAM+NOTHING for representing *negation*) or if the items had to be adapted (e.g., PENCIL/ WRITE noun/verb distinction in BSL was changed to CHAIR/ SIT for ASL) (see Supalla & Newport, 1978 for further discussion). The second step was to ensure that the ASL version of the test was linguistically and culturally appropriate for the target population.

To sum, researchers and practitioners currently have access to a wide variety of signed language assessments. Nevertheless, the available signed language assessments may not be appropriate for every need, and some assessments may be cost prohibitive. Researchers and practitioners may choose to translate or develop their own signed language assessments, but these options have their own advantages and disadvantages. Because the disadvantages of translating or developing remain severe, researchers and practitioners should select from existing signed language assessments when possible. In the next section, we talk about how these assessments can be used for the diagnosis of Language Disorders in signing DHH children.

Assessment of Language Disorders and Learning Disabilities in the Signed Modality

Having discussed the different kinds of standardized assessments of ASL, we can now examine how they may be used in the assessment of language disorders for signing DHH children. Standardized language assessments have long been used in the diagnosis of language and learning disorders, like learning disability (Restori, Katz, & Lee, 2009) and language disorder (termed specific language disorder, Leonard, 1998). In recent years, the language disorder diagnosis has also been used for children using signed languages (in BSL, Mason et al., 2010; in ASL, Quinto-Pozos et al., 2013; Quinto-Pozos, Forber-Pratt, & Singleton, 2011; Quinto-pozos, Singleton, & Hauser, 2017). Some forms of Learning Disability (e.g., developmental dyslexia) may be partially similar to language disorder (see Bishop & Snowling, 2004 for more discussion); however; there is enough of a distinction between the two diagnoses to maintain separate definitions. Language disorder (termed also as specific language impairment) is defined by consistent impairment in phonology, morphology, and syntax as

well as semantics and pragmatics (for example in a signed language, Mason et al., 2010) or in combinations of these linguistic domains (Bishop & Rosenbloom, 1987; Leonard, 1998; Novogrodsky, 2015).

Using a two-step process, Mason et al. (2010) identified DHH children who may have had language disorder. In the first step, children were screened via an in-depth questionnaire, which was sent to 72 schools for the DHH. In this questionnaire, teachers and language therapists were asked to determine if children possessed specific kinds of challenges that indicate a possible language disorder, such as language retention problems. Forty-four children were recruited at the first stage and were given a wide variety of cognitive and language tasks, including the BSL–RST. Thirteen children were identified as having a possible language disorder. Results from the BSL–RST indicated that seven of the children had Z-scores that were 1.3 standard deviations below the mean and were specifically diagnosed with a language disorder. The remaining six other children were identified as possibly having a language disorder through other assessments.

Quinto-Pozos and colleagues have been researching language disorders in users of ASL for much of this decade. Their 2011 study used a qualitative approach to determine whether or not practitioners, including teachers of the DHH and language specialists, believed that language disorders existed in students using signed language (Quinto-Pozos et al., 2011). The bulk of the participants indicated that they had known native signing DHH children who had language disorder patterns. Quinto-Pozos et al. (2013 and 2017) built on their 2011 study using case studies. The 2013 case study focused on a native signing DHH adolescent female named Alice. Two different signed language assessments were used to measure her signing skills: the American Sign Language Proficiency Assessment (ASL-PA; Maller, Singleton, Supalla, & Wix, 1999) and the American Sign Language Sentence Reproduction Test (ASL-SRT; Hauser, Paludneviciene, Supalla, & Bavelier, 2008). The ASL-SRT presents participants with 40 sentences of increasing complexity. Participants must recall and reproduce sentences after being shown them (the stimuli sentences disappear after production). Global language fluency is calculated by determining the number of sentences produced accurately and the degree of accuracy on each sentence.

Alice's ASL-SRT results indicated that she was proficient in 21 of 23 target linguistic structures, which is considered highly fluent. While the ASL-SRT is considered a global fluency task, it is also fundamentally a working memory processing task. Children with language disorders may have intact working memory abilities. The ASL-PA, on the other hand, was successful in lending data to the language disorder diagnosis. Alice showed difficulty in classifiers and referential shifting, indicating a deficit in aspects of topographical uses of space with intact grammatical uses of space (Quinto-Pozos, et al., 2013). Another case study was Adam, a native signing DHH male in late adolescence (Quinto-Pozos et al. 2017). Adam also took the ASL-PA and the ASL-SRT. Adam, like Alice, demonstrated that he was a highly fluent signer. His ASL-PA results indicated that he was proficient in 22 of 23 target linguistic forms. However, his ASL-SRT scores were markedly different from Alice's scores, exhibiting selective deficits in sequencing and memory, which likely affected his ability to comprehend fingerspelling. These two case studies support the fact that diagnosis of language disorder within the DHH population is possible with the appropriate information and an understanding of how language deprivation can interfere with diagnosis (Novogrodsky, 2015).

Another advantage of case studies is the ability to document child language over time. Novogrodsky et al. (2014b) explored the language of two school-aged native signers who were suspected of having a language disorder. Each child was tested three to four times using four different subtests of the ASLAI: rare vocabulary, synonyms, antonyms, and plurals. Additionally, reading comprehension and academic profile scores as rated by teachers were compared to scores derived from the ASLAI subtests. Although both children demonstrated improvement on the ASL tasks over the years, qualitative differences emerged when these children's scores were compared with the performance of native signers in their mean age group. These findings suggest that qualitative information can help describe divergent language acquisition trajectories in DHH children. Certainly, the children's low performance on the subtests was in line with their low reading comprehension scores and low academic profile scores.

The work of Mason et al. (2010), Quinto-Pozos et al. (2013, 2011, 2017), and Novogrodsky et al. (2014b) demonstrates that signed language assessments can be instrumental in the diagnosis of language disorders in DHH children, particularly those who are native signers. However, these studies also pinpoint the lack of concurrent validity of the tools (Quinto-Pozos et al., 2017). The concept of concurrent validity refers to the comparisons of test results, or measurements, with previously established measurements for the same construct. If two assessments purport to measure overall signed language abilities, then their results should be similar. While signed language assessments have been around for 30 years, concurrent validity is difficult to establish because of variability not only in the assessed constructs, but in the norming population itself.

An example how the developers of the ASLAI confronted the challenge of concurrent validity can be found in Novogrodsky et al. (2014a). In this study, typically developing DHH children showed positive correlations between the antonym subtest of the ASLAI and an established reading comprehension test, the Stanford Achievement Test Reading Comprehension Test. Although these tests measure different languages (ASL and printed English), the correlations showed that the underlying constructs may be similar. These findings follow assumptions that in bilingual children L1 skills predict L2 abilities (e.g., Proctor, August, Carlo, & Snow, 2006). However, knowing antonyms in ASL does not necessarily improve English reading skills. Rather, the metalinguistic skills that come from learning ASL antonyms (i.e., identifying that two concepts are relational opposites) may be associated with learning print English. Establishing concurrent validity with existing spoken and printed language assessments is one way of validating signed language tests. Still, developers of signed language assessment should seek to establish the concurrent validity of their assessment with other signed language assessments.

Language assessment is part of learning disability diagnosis. Regardless of whether learning disability is diagnosed through the response to intervention approach or the IQ achievement discrepancy approach, language assessments are an integral part of the process (Restori et al., 2009). Common descriptions of learning disability are based on "disorders of listening, thinking, talking, reading, writing, or arithmetic" (Hammill, 1990, p.73) or "a substantial deficiency in a particular aspect of academic achievement" (Hammill, 1990, p. 74). Recent definitions of learning disability focus on an inability to respond to intervention designed to improve academic achievement (Restori et al., 2009).

The field has historically recognized that diagnosing learning disability in DHH children is difficult, but is required to

ensure adequate intervention services (Calderon, 1998; Morgan & Vernon, 1994; Roth, 1990; Soukup & Feinstein, 2007). The etiology of deafness is sometimes comorbid with disabilities presenting as developmental delays that lead to the diagnosis of various learning disabilities (Mauk & Mauk, 1992; Paul & Quigley, 1990). There are also those who wonder if hearing loss (that is, a decrease in hearing ability) itself contributes to challenges in cognitive and academic abilities (Conway, Pisoni, & Kronenberger, 2010). Crump and Hamerdinger (2017) point out that sometimes the etiology of a disorder can manifest not only in hearing loss, but also in language disorders. For example, they argue that DHH people who have Congenital Rubella Syndrome suffer from language incoherence, language difficulties in all modalities, slower prosodic systems, and, among other language challenges, difficulty learning new words and retrieving them from mental lexical systems.

DHH children are not the only population for whom language challenges make the diagnosis of learning disability and language disorders difficult. Research exists on the challenges of learning disability and language disorder diagnosis in English language learners (ELL) (Shenoy, 2014). Shenoy (2014), for example, lists three barriers to the appropriate diagnosis and intervention of learning disability and language disorders in ELL populations: (a) discriminatory testing practices, (b) inappropriate intervention and instruction, and (c) the "Wait to Fail" model. The first barrier, discriminatory testing practices, refers to using English focused assessments for diagnosis when many ELL are not yet fluent in English. The second barrier refers to intervention and instruction focused on providing assistance towards the symptoms listed by the learning disability and language disorder diagnosis rather than providing language support for achieving fluency in English as L2. The third barrier is that many education programs wait for ELL students to begin showing the effects of poor English language fluency in their classes before starting an intervention, rather than scaffolding language across their entire educational experience. Readers familiar with practice in Deaf education will find many similarities between ELL students and DHH students.

Researchers and practitioners have tried to avoid language-related issues in assessing IQ in DHH children by depending on nonverbal tests, such as Raven's Matrices (Raven, 1989, 2000), which have been used in research with the DHH for over 50 years (Goetzinger & Houchins, 1969). Goetzinger and Houchins (1969) identified no significant difference in performance between DHH and non-deaf test takers. Blennerhassett, Strohmeier, and Hibbett (1994) found significant correlations between performance on the Raven's Matrices and both the Weschler Intelligence Scales for Children Revised and the Stanford Achievement Test for the Hearing Impaired. Thus many researchers and practitioners use nonverbal assessments when diagnosing learning disability in DHH children as a way to circumvent possible language-based challenges (Morgan & Vernon, 1994). However, Phillips, Wiley, Barnard, and Meinzen-Derr (2014) showed that the connection between nonverbal assessments and language is more complex than previously considered. The authors found relationships between language abilities and performance on nonverbal assessments. In a study of 54 DHH children, Phillips and colleagues found significant correlations between the Leiter International Performance Scale Revised (Leiter-R Brief IQ), the Differential Abilities Scales—Second Edition (DAS-II Nonverbal Reasoning Index), and the Preschool Language Scale 5th Edition. The close relationship between language abilities and nonverbal reasoning skills in this work indicates that nonverbal tests may not be truly nonverbal. It also serves to heighten the need for quality signed language assessments in the diagnosis of Learning Disability in signing DHH children to ensure that assessment of signing skills is accurate.

Language Disorder Versus Deprivation: Can We Distinguish Between the Two in the Case of Signing DHH Children

One challenge in the diagnosis of language disorders, and learning disabilities specifically in non-native signing DHH, is separating language disorders and learning disability from language deprivation since, as Hall et al. (2017) allude to, the symptoms and downstream consequences of language disorders, language dysfluency, and language deprivation overlap. DHH children of DHH parents are likely to have typical language development. Therefore, signed language assessments can accurately track atypical development of language in that specific population. Signing DHH children of hearing parents, generally, have more varied language acquisition experiences, which makes it much more difficult to use signed language assessments, in their current state, to diagnose language disorders and learning disabilities.

Many researchers indicate that rather than being intrinsically tied the etiology of deafness, it is likely that learning disability develops later in childhood for DHH children. Calderon (1998), for example, suggests that DHH children are often deprived of necessary language stimulation during their early years. That is, DHH children are language deprived and may not be biologically learning disabled. The description of language deprivation hews to markers of Learning Disability described in Hammill (1990) and to descriptions of language dysfluency in Crump and Hamerdinger (2017). The similarities in the definitions may mean that at least part of what Crump and Hamerdinger believe to be etiology related language dysfluency may in fact be consequences of language deprivation. Furthermore, practitioners often use language assessments with signing DHH children that are designed to capture spoken or written language, which is not always the dominant language of DHH children. This adds to the missed diagnosis of learning disability or missed diagnosis of language disorder in that population, particularly among native signers.

In lieu of effective assessments for learning disability and language disorders in signing DHH children, teachers of the DHH and speech practitioners often depend on their intuition for determining which children may have language disorders or learning disability (Samar, 1999). Traditionally, teachers and speech practitioners tend to be effective front-line resources for identifying Language Disorders in children (Quinto-Pozos, Forber-Pratt, & Singleton, 2011). Yet, in DHH populations, the confluence of possible language deprivation and the remarkable similarities language deprivation has with learning disability makes informal teacher-based diagnosis difficult. Work by Novogrodsky, Henner, Caldwell-Harris, & Hoffmeister (2017) demonstrates that while teachers of the DHH have good intuition for identifying possible language disorders in native signing DHH children, they do less well with non-native signers. Novogrodsky and colleagues examined the receptive ASL grammatical judgment abilities of 421 DHH children, ages 7;6–18;5. One hundred sixty-nine of those participants were native signers. The remaining 252 were non-native signers. The sample was further divided by whether participants had a diagnosed learning disability, were suspected to have a learning disability

by teachers of the DHH, or had no disability. For native signers, having a learning disability or being suspected of having a disability were significant predictors of poor ASL grammatical judgment abilities. For non-native signers, though, having a learning disability, or being suspected of having learning disability was not a significant predictor of ASL grammatical judgment. There were no differences in grammatical judgment scores between those with no diagnosis, those suspected of having learning disability, and those who had learning disability within the group of non-native signers. The ASL grammatical judgment of all three non-native groups was roughly equally poor compared to native signers.

A recent analysis by Walker, Henner, and Hoffmeister (2017) examined what factors predicted diagnosis of a learning disability in DHH children. A logistic analysis was performed on data from 810 DHH children, 266 native signers, and 544 non-native signers using grade (elementary, middle, or high school), signing status (native or non-native), gender (binary female or male), and a composite score of five different ASLAI vocabulary subtests (antonym, synonym, vocabulary in sentence [rare vocabulary], definitions, and analogies). The data were collected during the years that the ASLAI was being funded by the IES. Participant schools provided the Center for Research Training information about whether participants had a learning disability diagnosis. The results showed that being a middle schooler, being male, and being a non-native signer, all significantly increased the chances of being diagnosed with a learning disability. Thus, signed language assessments at the current stage may not be granular enough to separate language deprivation from language disorders because disorder diagnoses are often reflective of multiple societal biases, in addition to being complicated by language deprivation.

To conclude, the limitations of signed language assessment tools in the diagnosis of language disorders and learning disabilities in signing DHH children must be fully understood. Signed language assessments, as well as other types of appropriate assessments, can be used to diagnose a language disorder or a learning disability in native signing DHH children. Deviations in the comprehension and production of phonology, morphology, syntax, and vocabulary can be tracked and compared to an appropriate normative sample. However, when using these tools with non-native signing DHH children the interpretation of the scores becomes more complex. Specifically, when non-native signers experience language deprivation it becomes difficult to separate the effects of language experience from the effects of a language disorder or a learning disability on performance. We suggest that to avoid inaccurate diagnosis, researchers and other professionals should take care in these cases. The case study approach suggested by Quinto-Ponzos et al. (2013), including a battery of language and cognitive assessments, and parent/guardian interviews, is one such possible method for determining if a subject truly has a language disorder or a learning disability rather than language deprivation. In-depth evaluations such these are likely the best way to help ensure accurate diagnoses in both native and non-native signing DHH. Establishing normative data of the signed language acquisition of language deprived signers are difficult because the effects of language deprivation depend on individual circumstances. Each DHH child born to hearing parents must confront different intersecting challenges, such as those related to race/ethnicity, SES, access to successful auditory aids, and access to signed language.

Even so, some of the tools used in case studies have their own problems because behavior and cognition are language dependent, and case studies do not scale well when large populations need to be assessed quickly (Hall et al., 2017). While future longitudinal studies should explore the different profiles of language disorders, learning disabilities, and language deprivation, ultimately practitioners and researchers must weigh the relative value of a specific diagnosis. The interventions appropriate for each profile appear to be similar; the profiles may only differ in etiology. Therefore, our true goal should always be to prevent language deprivation when possible, and to figure out the best interventions to ameliorate damage when language deprivation has occurred.

Conflict of interest

No conflicts of interest were reported.

References

Allen, T., White, C., & Karchmer, M. (1983). Issues in the development of special edition for hearing impaired students of the seventh edition of the Stanford Achievement Test. *American Annals of the Deaf*, *128*, 34–39.

Anderson, D., & Reilly, J. (2002). The MacArthur communicative development inventory: Normative data for American Sign Language. *Journal of Deaf Studies and Deaf Education*, *7*. https://doi.org/10.1093/deafed/7.2.83.

Atkinson, J., Denmark, T., Marshall, J., Mummery, C., & Woll, B. (2015). Detecting cognitive impairment and dementia in deaf deople: The British Sign Language Cognitive Screening Test. *Archives of Clinical Neuropsychology: The Official Journal of the National Academy of Neuropsychologists*, acv042. https://doi.org/10.1093/arclin/acv042.

Beal Alvarez, J., & Scheetz, N. (2015). Preservice teacher and interpreter American Sign Language Abilities: Self evaluations and evaluations of deaf students' narrative renditions. *American Annals of the Deaf*, *160*, 316–333. https://doi.org/10.1353/aad.2015.0027.

Bebko, J. M., Calderon, R., & Treder, R. (2003). The Language Proficiency Profile-2: Assessment of the global communication skills of deaf children across languages and modalities of expression. *Journal of Deaf Studies and Deaf Education*, *8*. https://doi.org/10.1093/deafed/eng034.

Bishop, D. V. M., & Rosenbloom, L. (1987). Childhood language disorders: Classification and overview. In Yule, W., & Rutter, M. (Eds.), *Language Development and Disorders*. London: MacKeith Press.

Bishop, D. V. M., & Snowling, M. J. (2004). Developmental dyslexia and specific language impairment: Same or different? *APA Psychological Bulletin*, *130*, 858–886. https://doi.org/10.1037/0033-2909.130.6.858.

Blennerhassett, L., Strohmeier, S. J., & Hibbett, C. (1994). Criterion related validity of Raven's progressive matrices with deaf residential school students. *American Annals of the Deaf*, *139*, 104–110. https://doi.org/10.1353/aad.2012.0053.

Calderon, R. (1993). Learning disability, neuropsychology, and deaf youth: Theory, research, and practice.

Calderon, R. (1998). Learning disability, neuropsychology, theory, research, and practice. *Journal of Deaf Studies and Deaf Education*, *3*, 1–3.

Carrigan, E., & Coppola, M. (2017). Successful communication does not drive language development: Evidence from adult homesign. *Cognition*, *158*, 10–27. https://doi.org/10.1016/j.cognition.2016.09.012.

Caselli, N., Sehyr, Z., Cohen-Goldberg, A., & Emmorey, K. (2016). ASL-LEX: A lexical database for American Sign Language. *Behavior Research Methods*, 49, 784–801. doi:10.3758/s13428-016-0742-0.

Center for Disease Control and Prevention (2017). *Hearing Loss in Children*. Retrieved from https://www.cdc.gov/ncbddd/hearingloss/data.html.

Chalhoub-Deville, M. (1995a). A contextualized approach to describing oral language proficiency. *Language Learning*, 45, 251–281. https://doi.org/10.1111/j.1467-1770.1995.tb00440.x.

Chalhoub-Deville, M. (1995b). Deriving oral assessment scales across different tests and rater groups. *Language Testing*, 12, 16–33.

Contreras, J., & Coppola, M. (in progress). Adapting standardized English vocabulary measures (PPVT) into American Sign Language: Preliminary findings

Conway, C. M., Pisoni, D., & Kronenberger, W. G. (2010). The importance of sound for cognitive sequencing abilities: The auditory scaffolding hypothesis. *Medicine*, 18, 275–279. https://doi.org/10.1111/j.1467-8721.2009.01651.x.

Cox, R. C. (1974). Confusion between norm referenced measurement and criterion referened measurement. *The Phi Delta Kappan*, 55, 319–319.

Crump, C. J., & Hamerdinger, S. H. (2017). Understanding etiology of hearing loss as a contributor to language dysfluency and its impact on assessment and treatment of people who are deaf in mental health settings. *Community Mental Health Journal*, 53, 922–928. doi:10.1007/s10597-017-0120-0.

Dunn, L., & Dunn, D. (2007). *PPVT-4: Peabody picture vocabulary test*. Pearson Assessments.

Easterbrooks, S. R., & Huston, S. G. (2008). The signed reading fluency of students who are deaf/hard of hearing. *Journal of Deaf Studies and Deaf Education*, 13, 37–54. https://doi.org/10.1093/deafed/enm030.

Enns, C. J., & Herman, R. C. (2011). Adapting the assessing British Sign Language Development: Receptive skills test into American Sign Language. *Journal of Deaf Studies and Deaf Education*, 16, 362–374. https://doi.org/10.1093/deafed/enr004.

Enns, C. J., Zimmer, K., Boudreault, P., Rabu, S., & Broszeit, C. (2013). American Sign Language: Receptive Skills Test. Winnipeg, MB: Northern Signs Research, Inc.

Furr, M., & Bacharach, V. (2008). *Psychometrics: An Introduction* (2nd Ed.). Thousand Oaks, CA: Sage Publications Inc.

Gallaudet Research Institute (2011). *Regional and National Summary Report of Data from the 2009-2010 Annual Survey of Deaf and Hard of Hearing Children and Youth*. Washington, D.C: Gallaudet University.

Geer, L. C., & Keane, J. (2017). Improving ASL fingerspelling comprehension in L2 learners with explicit phonetic instruction. *Language Teaching Research*, 136216881668698. https://doi.org/10.1177/1362168816686988.

Goetzinger, M., & Houchins, R. (1969). The 1947 colored Raven's progressive matrices with deaf and hearing subjects. *American Annals of the Deaf*, 114, 95–101.

Hall, W. C., Levin, L. L., & Anderson, M. L. (2017). Language deprivation syndrome: A possible neurodevelopmental disorder with sociocultural origins. *Social Psychiatry and Psychiatric Epidemiology*, 52, 761–776. https://doi.org/10.1007/s00127-017-1351-7.

Hammill, D. (1990). On defining learning disabilities: An emerging consensus. *Journal of Learning Disabilities*, 23, 74–84.

Haug, T. (2011a). Approaching sign language test construction: Adaptation of the German sign language receptive skills test. *Journal of Deaf Studies and Deaf Education*, 16, 343–361. https://doi.org/10.1093/deafed/enq062.

Haug, T. (2011b). Methodological and theoretical issues in the adaptation of sign language tests: An example from the adaptation of a test to German Sign Language. *Language Testing*, 29, 181–201. https://doi.org/10.1177/0265532211421509.

Haug, T., & Mann, W. (2007). Adapting tests of sign language assessment for other sign languages—A review of linguistic, cultural, and psychometric problems. *Journal of Deaf Studies and Deaf Education*, 13. https://doi.org/10.1093/deafed/enm027.

Hauser, P. C., Paludneviciene, R., Supalla, T., & Bavelier, D. (2008). American Sign Language – Sentence Reproduction Test: Development & implications. In R. M. de Quadros (Ed.), *Sign Languages: spinning and unraveling the past, present and future. TISLR9, forty five papers and three posters from the 9th. Theoretical Issues in Sign Language Research Conference* (pp. 155–167).

Henner, J., Caldwell-Harris, C. L., Novogrodsky, R., & Hoffmeister, R. J. (2016). American Sign Language syntax and analogical reasoning skills Are influenced by early acquisition and age of entry to signing schools for the deaf. *Frontiers in Psychology*, 7, 1982. https://doi.org/10.3389/FPSYG.2016.01982.

Henner, J., Caldwell-Harris, C., Novogrodsky, R., & Hoffmeister, R. (2018). The development of American Sign Language based analogical reasoning in signing deaf children. Manuscript submitted for publication.

Henner, J., Hoffmeister, R., & Reis, J. (2017). Developing sign language assessments for the deaf and hard of hearing. In Cawthon S., & Lou Garberoglio C. (Eds.), *Research Methodology in Deaf Education*. Oxford: Oxford University Press.

Henner, J., Novogrodsky, R., Caldwell-Harris, C. L., & Hoffmeister, R. J. (under review).

Herman, R., Holmes, S., & Woll, B. (1999). *Assessing Sign Language Development*. Coleford, UK: Forest Books.

Hermans, D., Knoors, H., & Verhoeven, L. (2010). Assessment of sign language development: the case of deaf children in the Netherlands. *Journal of Deaf Studies and Deaf Education*, 15, 107–119. https://doi.org/10.1093/deafed/enp030.

Hoffmeister, R., Fish, S., Benedict, R., Henner, J., Novogrodsky, R., & Rosenburg, P. (2015). American Sign Language Assessment Instrument (ASLAI): Revision 4. Boston University Center for the Study of Communication and the Deaf.

Humphries, T., Kushalnagar, P., Mathur, G., Napoli, D., Padden, C., Rathmann, C., … Smith, S. R. (2012). Language acquisition for deaf children: Reducing the harms of zero tolerance to the use of alternative approaches. *Harm Reduction Journal*, 9, 16. https://doi.org/10.1186/1477-7517-9-16.

Humphries, T., Kushalnagar, P., Mathur, G., Napoli, D. J., Padden, C., Rathmann, C., … Smith, S. (2016). Avoiding linguistic neglect of deaf children. *Social Service Review*, 90, 589–619. https://doi.org/10.1086/689543.

Humphries, T., Kushalnagar, P., Mathur, G., Napoli, D. J., Padden, C., Rathmann, C., … Smith, S. (2017). Discourses of prejudice in the professions: The case of sign languages. *Journal of Medical Ethics*. https://doi.org/10.1136/medethics-2015-103242.

Humphries, T., Kushalnagar, P., Mathur, G., Napoli, D. J., Padden, C. A., Pollard, R., … Smith, S. (2014a). What medical education can do to ensure robust language development in deaf children. *Medical Science Educator*, 24, 409–419. https://doi.org/10.1007/s40670-014-0073-7.

Humphries, T., Kushalnagar, P., Mathur, G., Napoli, D. J., Padden, C. A., & Rathmann, C. (2014b). Ensuring language acquisition for

deaf children: What linguists can do. *Language*, *90*, e31–e52. https://doi.org/10.1353/lan.2014.0036.

Johnston, T. (2009). Creating a corpus of Auslan within an Australian national corpus. In *Selected proceedings of the 2008 HCSNet Workshop on Designing the Australian National Corpus* (M. Haugh et al. Eds.). Somerville, MA: Cascadilla Proceedings Project.

Kohnert, K. (2010). Bilingual children with primary language impairment: Issues, evidence and implications for clinical actions. *Journal of Communication Disorders*, *43*, 456–473.

Leonard, L. (1998). *Children with Specific Language Impairment*. Cambridge, MA: MIT Press.

Magno, C. (2009). Demonstrating the difference between Classical Test Theory and Item Response Theory using derived test data. *The International Journal of Educational and Psychological Assessment*, *1*, 1–11.

Maller, S., Singleton, J., Supalla, S., & Wix, T. (1999). The development and psychometric properties of the American sign language proficiency assessment (ASL-PA). *Journal of Deaf Studies and Deaf Education*, *4*, 249–269. https://doi.org/10.1093/deafed/4.4.249.

Mann, W., Pena, E. D., & Morgan, G. (2014). Exploring the use of dynamic language assessment with deaf children, who use American Sign Language: Two case studies. *Journal of communication disorders*, *52*, 16–30.

Mason, K., Rowley, K., Marshall, C. R., Atkinson, J. R., Herman, R., Woll, B., … Morgan, G. (2010). Identifying specific language impairment in deaf children acquiring British Sign Language: Implications for theory and practice. *The British Journal of Developmental Psychology*, *28*, 33–49. https://doi.org/10.1348/026151009×484190.

Mauk, G. W., & Mauk, P. P. (1992). Somewhere, out there: Preschool children with hearing impairment and learning disabilities. *Topics in Early Childhood Special Education*, *12*, 174–195. https://doi.org/10.1177/027112149201200204.

Mayberry, R., Hall, M. L., & Zvaigzne, M. (2014). Subjective frequency ratings for 432 ASL signs. *Behavior Research Methods*, *46*, 526–539. https://doi.org/10.3758/s13428-013-0370-x.

Mellon, N., Niparko, J., Rathmann, C., Mathur, G., Humphries, T., Napoli, D. J., … Lantos, J. (2015). Should all deaf children learn sign language? *Pediatrics*, *136*. https://doi.org/10.1542/peds.2014-1632.

Mitchell, R. E., & Karchmer, M. A. (2005). Parental hearing status and signing among deaf and hard of hearing students. *Sign Language Studies*, *5*, 231–244. doi.org/10.1353/sls.2005.0004.

Morere, D. A. (2013). Methodological issues associated with sign based neuropsychological assessment. *Sign Language Studies*, *14*, 8–20. https://doi.org/10.1353/sls.2013.0021.

Morford, J., Grieve-Smith, A. B., MacFarlane, J., Staley, J., & Waters, G. (2008). Effects of language experience on the perception of American Sign Language. *Cognition*, *109*, 41–53. https://doi.org/10.1016/j.cognition.2008.07.016.

Morford, J., & MacFarlane, J. (2003). Frequency characteristics of American Sign Language. *Sign Language Studies*, *3*, 213–225. doi.org/10.1353/sls.2003.0003.

Morgan, A., & Vernon, M. (1994). A guide to the diagnosis of learning disabilities in deaf and hard of hearing children and adults. *American Annals of the Deaf*, *139*, 358–370. https://doi.org/10.1353/aad.2012.0276.

Newell, W., Caccamise, F., Boardman, K., & Holcomb, B. R. (1983). Adaptation of the Language Proficiency Interview (LPI) for assessing sign communicative competence. *Sign Language Studies*, *41*, 311–331. doi.org/10.1353/sls.1983.0012.

Novogrodsky, R. (2015). Specific Language Impairment (SLI) is not specific enough: Sub-types of SLI and their implications for the theory of the disorder. In Stavrakaki, S. (Ed.), *Language Acquisition and Language Disorders* (pp. 113–124). Amsterdam, Netherlands: John Benjamins Publishing Company.

Novogrodsky, R., Caldwell-Harris, C., Fish, S., & Hoffmeister, R. J. (2014a). The development of antonym knowledge in American Sign Language (ASL) and its relationship to reading comprehension in English. *Language Learning*, *64*, 749–770. https://doi.org/10.1111/lang.12078.

Novogrodsky, R., Fish, S., & Hoffmeister, R. (2014c). The acquisition of synonyms in American Sign Language (ASL): Toward a further understanding of the components of ASL vocabulary knowledge. *Sign Language Studies*, *14*, 225–249. https://doi.org/10.1353/sls.2014.0003.

Novogrodsky, R., Henner, J., Caldwell-Harris, C., & Hoffmeister, R. (2017). The development of sensitivity to grammatical violations in American Sign Language native signers versus nonnative. *Language and Learning*, *67*, 791–818. doi.org/10.1111/lang.12245.

Novogrodsky, R., Hoffmeister, R., Fish, S., Benedict, R., Henner, J., Rosenburg, P., … Caldwell Harris, C. (2014b). Two case studies of SLI in American Sign Language (ASL). A poster presented at a workshop of Specific Language Impairment, Experimental Psycholinguistics Conference (ERP), Madrid, Spain.

Paul, P., & Quigley, S. (1990). Education and Deafness. Reading, MA: Longman.

Phillips, J., Wiley, S., Barnard, H., & Meinzen-Derr, J. (2014). Comparison of two nonverbal intelligence tests among children who are deaf or hard of hearing. *Research in Developmental Disabilities*, *35*, 463–471. https://doi.org/10.1016/j.ridd.2013.11.020.

Pizzuto, E., Ardito, B., Caselli, M. C., & Volterra, V. (2002). Cognition and language in Italian deaf preschoolers of deaf and hearing families. In Marschark, M., Clark, D., & Karchmer, M. (Eds.), *Cognition ,Context, and Deafness* (pp. 49–70). Washington, DC: Gallaudet University Press.

Proctor, C. P., August, D., Carlo, M. S., & Snow, C. (2006). The intriguing role of Spanish language vocabulary knowledge in predicting English reading comprehension. *Journal of Educational Psychology*, *98*, 159–169.

Quinto-Pozos, D., Forber-Pratt, A., & Singleton, J. (2011). Do developmental communication disorders exist in the signed modality? Perspectives from professionals. *Language, Speech, and Hearing Services in Schools*, *42*, 423–443. https://doi.org/10.1044/0161-1461(2011/10-0071).

Quinto-Pozos, D., Singleton, J., & Hauser, P. (2017). A case of a specific language impairment in a Deaf signer of American Sign Language. *Journal of Deaf Studies and Deaf Education, Advance Ac*, 1–15. doi.org/10.1093/gbe/evw245.

Quinto-Pozos, D., Singleton, J., Hauser, P. C., Levine, S. C., Garberoglio, C. L., Hou, L., … Levine, S. C. (2013). Atypical signed language development: A case study of challenges with visual spatial processing. *Cognitive Neuropsychology*, *30*, 332–359. https://doi.org/10.1080/02643294.2013.863756.

Raven, J. (1989). The Raven Progressive Matrices: A review of national norming studies and ethnic and socioeconomic variation within the United States. *Journal of Educational Measurement*, *26*, 1–16. https://doi.org/10.1111/j.1745-3984.1989.tb00314.x.

Raven, J. (2000). The Raven's Progressive Matrices: Change and stability over culture and time. *Cognitive Psychology*, *41*, 1–48. https://doi.org/10.1006/cogp.1999.0735.

Restori, A. F., Katz, G. S., & Lee, H. B. (2009). A critique of the IQ / Achievement Discrepancy Model for identifying specific learning disabilities. *Europe's Journal of Psychology*, *5*, 128–145. https://doi.org/10.5964/ejop.v5i4.244.

Rosen, R. S. (2004). Beginning L2 production errors in ASL lexical phonology: A cognitive phonology model. *Sign Language & Linguistics*, *7*, 31–61. doi.org/10.1075/sll.7.1.04beg.

Roth, V. (1990). Students with learning disabilities and hearing impairment: issues for the secondary and postsecondary teacher. *Journal of Learning Disabilities*, *24*, 391–397. https://doi.org/10.1177/002221949102400703.

Samar, V. (1999). Identifying learning disabilities in the deaf population: The leap from Gibraltar. *NTID Research Bulletin*, *4*, 1–4.

Schaefer, E. (2008). Rater bias patterns in an EFL writing assessment. *Language Testing*, *25*, 465–493. https://doi.org/10.1177/0265532208094273.

Shenoy, S. (2014). Assessment tools to differentiate between langage differences and disorders in English language learners. *Berkeley Review of Education*, *5*, 33–52.

Simms, L., Baker, S., & Clark, M. D. (2013). The Standardized Visual Communication and Sign Langauge Checklist for signing children. *Sign Language Studies*, *14*, 14–17. dx.doi.org/10.1108/17506200710779521.

Soukup, M., & Feinstein, S. (2007). Identification, assessment, and intervention strategies for deaf and hard of hearing students with learning disabilities. *American Annals of the Deaf*, *152*, 56–62. https://doi.org/10.1353/aad.2007.0014.

Supalla, T., & Newport, E. (1978). How many seats in a chair? The derivation of nouns and verbs in American Sign Language. In Siple P. (Ed.), *Understanding Language Through Sign Language Research* (pp. 91–131). New York, New York, USA: Academic Press, Inc.

Walker, K., Henner, J., & Hoffmeister, R. (2017). *Language Deprivation: The Neglected Factor in Learning Disability Diagnosis in Deaf Children*. San Antonio, Texas: Presented at the American Educational Research Association.