

Language Assessment: Links to Literacy for Deaf and Hard-of-Hearing Bilingual Learners 

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Abstract and Keywords

Assessment is an essential component of an effective bilingual literacy program. The relationship between language and literacy is complex. For bilingual individuals, the complexity of that relationship is increased. When bilingualism involves a signed language, the relationship becomes even more complicated, and disentangling the critical strands of language and literacy learning can be an ongoing challenge. This chapter provides a strengths-based perspective to guide educators in their assessment considerations when developing the literacy abilities of deaf and hard-of-hearing (DHH) bilingual learners, defined as children who are learning a signed language and concurrently a spoken/written language, such as ASL-English. In particular, the chapter explores the valuable ways that signed language abilities contribute to literacy development. Also highlighted is the critical and ongoing need for effective and culturally responsive signed language measures to better inform literacy teaching approaches.

Keywords: assessment, signed language, bilingual deaf education, literacy development, reading

The relationship between language and literacy is complex, but it is well established in relation to monolingual and bilingual spoken language users (Bialystok, Luk, Anderson, Craik, & Grady, 2010; Seidenberg, 2013). Educators and researchers agree that early language abilities provide the foundation for literacy development (Duff & Tomblin, 2018; Jasinska & Petitto, 2017; Mayberry, 2010). In fact, for children with typical hearing “the relationship between early spoken language and later reading development is considered causal in nature, such that spoken language skills, especially phonological awareness and listening comprehension, are precursors to later successful reading” (Duff & Tomblin, 2018, p. 4). This connection makes sense and appears more direct when children are speaking the same language they are learning to read and write. Even children who are bilingual or multilingual spoken language learners are typically taught literacy skills through approaches that emphasize a comparison of each spoken language to the same language in print (Paradis, Genesee, & Crago, 2011). The situation with profoundly deaf children, who do not have access to, or have limited access to, the sounds of spoken lan-

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guage, challenges these approaches because the language of face-to-face interaction (i.e., signed language) is different from the language represented in print. The key factor, however, is that the different languages are not separate systems but are connected to a common underlying proficiency (Cummins, 1991). Each language has distinct forms (phonology, vocabulary, morphology, syntax) that language learners must master specifically; however, background knowledge, concepts, and cognitively demanding tasks, such as content learning, problem-solving, and abstract thinking, are shared across languages (for additional discussion, see Lubke, McGill-Franzen, & Ward; Trezek, Mayer, & Wang; and Dostal & Graham, this volume).

The long-standing debate challenging a bilingual model of literacy development for deaf and hard-of-hearing (DHH) students, where the first language (L1) is a signed language and the second language (L2) is the print form of a spoken language, is premised on a theoretical argument that language transfer cannot occur between these different language forms (see Mayer & Akamatsu, 1999; Mayer & Wells, 1996; Paul, 1988). This argument presents a view of literacy that is defined narrowly as “reading and writing” and assumes that with no written form of the language, literacy in signed languages is not possible. When literacy is defined more broadly as communicative competence, demonstrated through effective use of language in contextualized and decontextualized situations and at an academic level, then bilingual proficiency and literacy would be expected to develop even where one language does not have a written form. Indeed, in recent years, the evidence that positive cross-language associations and interaction between signed and spoken languages in DHH bimodal bilinguals does occur (see review in Ormel & Giezen, 2014) supports a more contemporary view of bilingual literacy development that acknowledges that “there is no privileged knowledge source; reading in a second language is difficult enough that individual readers will benefit from recruiting any and all resources” (Hoffmeister & Caldwell-Harris, 2014, p. 235). As outlined by Cummins (1991), if L1 language skills are strong, then learners can rely on transfer from L1 to facilitate L2 reading. If L1 linguistic ability is weak, L2 reading can be improved by enhancing both L1 and L2 language skills (Cummins, 1991).

The importance of building on all language abilities and knowledge is particularly relevant for DHH children because they frequently have inconsistent exposure to any early language and significant variations can occur in language acquisition patterns (see review in Mayberry, 2007). During the key preschool years, families with DHH children often attempt various forms of amplification to develop speaking and listening skills and may limit the child’s exposure to signed language. The result is that the children acquire neither a fully spoken nor a fully signed language by the time they enter school. Bilingual programming for these children requires developing proficiency in signed language at the same time as they are learning their second language in print. Language assessment becomes critical in determining the strengths and gaps that exist in children’s development; therefore, all aspects of DHH children’s communication, not just their abilities in spoken/written language, must be monitored. Assessment results can influence decisions regarding school setting, support and specialist services, and approaches to instruction and programming. One goal of programming is to build on children’s strengths, but as linguistic

profiles will be unique to each learner, first it is essential to determine those strengths accurately, and this can be accomplished only by thoroughly assessing the range of language abilities across all modalities.

Links to Reading: Exploiting Assets from Signed Languages

Reading is a complex task, and learning to read is undoubtedly one of the most important skills children must master during their early school life. For typically hearing (TH) learners (see review in Melby-Lervåg, Lyster, & Hulme, 2012) and monolingual DHH learners (see review in Lederberg, Schick, & Spencer, 2013), there is widespread consensus that learning to read is tightly linked to a spoken language foundation (also see chapters by Connor & Greenberg; and Lubke, McGill-Franzen, & Ward, this volume). The process of learning to read, however, is more multifaceted when children's primary language is a signed language and different from the spoken/written language they encounter in school. For DHH signing learners, learning to read is tightly linked to a signed language foundation (see Hoffmeister & Caldwell-Harris, 2014; Petitto et al., 2016). While evidence of positive relationships between signed language and literacy at cognitive and linguistic levels is well documented in the literature (e.g., Chamberlain & Mayberry, 2008; Hirschorn, Dye, Hauser, Supalla, & Bavelier, 2015; Hoffmeister, 2000; MacSweeney, Capek, Campbell, & Woll, 2008; Morford, Kroll, Piñar, & Wilkinson, 2014; Pan, Shu, Wang, & Yan, 2015) comparatively little is known about how young DHH signers deploy their dual language resources in learning to read.

The role of spoken language phonological codes in reading for DHH readers remains an area of active research (see Kyle, Campbell, & MacSweeney, 2015; Mayberry, del Giudice, & Lieberman, 2011; McQuarrie & Parrila, 2009; Webb, Lederberg, Branum-Martin, & Connor, 2015). Research on the role of signed language phonological codes in reading is increasing in light of emerging evidence that DHH learners are flexible in the ways that they choose to code words based on the inputs available/accessible in their linguistic environment (see Barca, Pezzulo, Castrataro, Rinaldi, & Caselli, 2013; see review in McQuarrie & Parrila, 2014). Importantly, over the last decade there has been considerable progress in understanding the linguistic and cognitive predictors of individual differences in literacy development for both monolingual and bilingual DHH readers.

Of note, a recent study by Lederberg et al. (2019) examined multivariate associations among reading, language, spoken phonological awareness, and fingerspelling abilities in three groups of DHH beginning readers. The three groups consisted of monolingual children acquiring spoken language, unimodal bilingual children acquiring signed language, and bimodal bilingual children acquiring both spoken and signed languages. Results revealed "both similarities and differences in the abilities that underlie reading in these three groups" (p. 1), with reading abilities related to both language and the ability to manipulate the sublexical structure of words. The groups were differentiated by whether the constructs were based on signed or spoken language. Lederberg et al. (2019) concluded

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that, “Whereas all DHH children learning to read rely on the same fundamental abilities of language and phonological processing, the modality, levels, and relations among these abilities differ” (Lederberg et al., 2019, p. 1). These results align with findings from a meta-analysis by Mayberry et al. (2011) that general language skill (signed or spoken) was the strongest predictor of reading ability in DHH children and reinforce the important role that phonological processing (signed or spoken) plays in all language learning (MacSweeney, Waters, Brammer, Woll, & Goswami, 2008; Mayberry, 2007; Wagner & Torgesen, 1987).

Research conducted over the past 10 years has investigated the role of both sets of factors (i.e., language and sublexical abilities in sign) to signing DHH children’s reading outcomes. Investigators have achieved consensus in some areas, whereas questions still predominate in others. Areas of convergence point to an important role for signed language skills relating to lexical and sublexical processing. Consistent with this, recent studies suggest that both orthographic and signed language lexicons are activated during written language processing for DHH bilinguals. For example, Ormel, Hermans, Knoors, and Verhoeven (2012) investigated cross-language activation of print and signs in Dutch DHH bilingual school-age children (who were not yet proficient bilinguals). Here, participants were asked to complete a print–picture matching task using written word–picture pairs with and without phonological overlap in the underlying Dutch Sign Language (NGT) translation equivalents. The authors reported that accuracy and response times were inhibited in nonmatching conditions (i.e., printed word and picture did not match) where the sign translation equivalents of the print–picture pairs had strong sign phonological overlap in comparison to nonmatching print–picture pairs whose NGT sign translation equivalents were phonologically unrelated. Morford, Wilkinson, Villwock, Piñar, and Kroll (2011) report similar findings for bilingual (ASL–English) adult readers. Morford and colleagues (2011) compared processing of written English word pairs with ASL translation equivalents that shared at least two of three phonological parameters (handshape, location, movement) to word pairs with ASL translation equivalents that did not overlap phonologically. Participants were shown pairs of written English words and asked to decide whether the words were semantically related. Results indicated that semantic similarity judgments were faster when semantically related written word pairs had sign translation equivalents with strong sign phonological overlap and slower when semantically unrelated written word pairs also had sign translation equivalents with strong sign phonology overlap. Evidence of cross-language sign phonology–text activation has also been reported in German bilingual deaf adult readers (Kubus, Villwock, Morford, & Rathmann, 2015). These studies evaluating lexical access in both DHH children and adult signers provide experimental evidence of co-activation between various signed languages and written languages in DHH bimodal bilinguals (also see Barca et al., 2013; Morford et al., 2014; Pan et al., 2015). Evidence that signed language users engage sign representations when processing written words highlights the contribution of sign phonology to lexical access (see review in Petitto et al., 2016). In fact, evidence that written language orthographic forms automatically activate signed language phonological forms demonstrates that cross-language lexical connections can occur across modality, and, important-

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ly, that cross-language activation is not restricted to languages that share phonological form similarities, as previously asserted (see Mayer & Wells, 1996).

Recent studies that have investigated associations between sensitivity to sublexical phonological structure in signed languages (i.e., signed language phonological awareness) demonstrate a positive relationship between signed language phonological awareness and word reading (McQuarrie & Abbott, 2013; McQuarrie & Enns, 2015) and reading comprehension (McQuarrie & Abbott, 2013) in DHH (ASL-English) bilingual children (ages 7 to 18). Further, a positive association between Swedish Sign Language (SSL) phonological awareness and word reading has also been reported in DHH bilingual (SSL-Swedish) school-age children (Holmer, Heimann, & Rudner, 2016, 2017). These findings are consistent with a supramodal account of processes underlying phonological awareness (see MacSweeney, Waters, et al., 2008) and lend support to the hypothesis that phonological awareness may be a general metalinguistic competence that can be deployed across different languages and modalities (see Corina, Hafer, & Welch, 2014; Koda, 2007). Taken together, studies investigating interactions between signed, spoken, and written modalities contribute to a rapidly growing evidence base that suggests DHH signing readers can use an alternate sign-based phonological encoding strategy during reading. Additional research is needed to understand better the underlying mechanisms responsible for the sign phonology-reading relationship and to fully establish the causal links between signed language phonological awareness and reading (Corina et al., 2014). In particular, longitudinal investigations are needed that examine whether these relationships vary in terms of developmental importance and/or contribution to specific aspects of reading-skill development as signing DHH children's reading abilities develop throughout elementary school (see Hoffmeister & Caldwell-Harris, 2014; McQuarrie & Abbott, 2013).

Relatedly, current pedagogical approaches to teaching reading have had limited success with signing DHH individuals. A more hopeful picture comes from recent intervention work with beginning readers in which we found a functional relation between explicit signed language phonological awareness instruction and increases in both sign vocabulary and print vocabulary learning (McQuarrie & Enns, 2015, 2018). Here, we implemented a single-case multiple baseline across-skills design to examine the effects of explicit signed language phonological awareness instruction on acquisition, maintenance, and generalization of new sign vocabulary and new print vocabulary targets with six DHH signing students (ages 6-10 years). Like spoken language phonological awareness instruction, instruction in signed language phonological awareness focused on phonological analysis skills. Instruction was designed to make phonological patterns explicit and to enhance awareness of fine-grained phonological contrasts between ASL handshape (HS) phonemes (not manual alphabet handshapes, i.e., fingerspelling, used in signed languages to represent orthographic symbols). In this study we did not address connections between fingerspelling and reading skills (but see Haptonstall-Nykaza & Schick, 2007; Stone, Kartheiser, Hauser, Petitto, & Allen, 2015, for reviews). Instruction consisted of HS phoneme identity and categorization activities using two ASL HS phonemes from a high-density phonological neighborhood (i.e., "5 HS" family) and two HS phonemes from a

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phonologically sparse neighborhood (i.e., “8 HS” family). The dependent variable was the number of new vocabulary items (in sign and/or in print) for each HS correctly signed and/or read by the child when the word was presented to the student on a picture (sign) and/or text (print) stimulus card. DHH children worked individually with a trained Deaf bilingual teacher for 30 min daily for 20 days. Results of this multiple-probe design across unfamiliar sign and print word sets demonstrated a functional relation between the intervention and the children’s acquisition of new sign and print vocabulary to 100% mastery on at least three consecutive sessions for each participant. Participants maintained their learning of all sign and print words acquired at 4 weeks after intervention and generalized their learning to novel (untrained/untaught) sign vocabulary but not to novel print vocabulary.

Demonstrations that DHH children were able to use HS phonemes successfully to learn new sign vocabulary and also to use sign phonology to print mapping (i.e., sign-symbol learning) to rapidly learn print words suggests that exploiting assets from signed languages (i.e., phonological processing) appears to facilitate both sign and print vocabulary learning. These results converge with earlier empirical observations (see Hermans, Knoors, Ormel, & Verhoeven, 2008; Wauters, Knoors, Vervloed, & Aarnoutse, 2001) and lend support to theoretical notions (see Goldin-Meadow & Mayberry, 2001; Hoffmeister & Caldwell-Harris, 2014) suggesting that sign-based representations do support reading development in DHH signing children. Thus, interventions aimed at enhancing children’s acquisition of segmental high-quality signed language phonological representations and at establishing connections between written words and signed language phonological representations (i.e., developing a sign-symbol aptitude) may be an effective way of supporting and strengthening early word reading development in DHH signing children.

In summary, “Reading in a second language is an ability that combines L2 and L1 reading resources into a dual-language processing system” (Grabe, 2009, p. 129). That DHH signing children develop a unique mix of strategies and competencies as they learn to mediate between a signed language and spoken/written language underscores the need for continued research on the innovation of reading instructional practices that are sensitive to cross-modal (i.e., signed and spoken) language interaction and to individual developmental learning trajectories in dual-language learning. What emerges across these lines of research is increased understanding of multiple routes to literacy and recognition that variability and diversity in children’s language repertoires may result in qualitative differences in the way that some DHH children learn to read (Lederberg et al., 2019; see review in McQuarrie & Parrila, 2014). As noted by Swanwick (2016, p. 15), “This new knowledge also highlights the need for more integrated approaches to assessment which recognize the fluctuating dominance of different languages in children’s lives and different language proficiencies across different domains.”

Challenges to Signed Language Assessment

There are several significant challenges in developing assessment measures for signed languages due to the variation in language acquisition, which also influences decisions regarding normative samples, the training and experiences of test administrators, and the scarcity of tests both across different signed languages and across various language components within signed languages.

Normative Samples

A considerable challenge for signed language assessments is determining how to establish norms (Enns & Herman, 2011; Herman, 1998; Johnston, 2004). (See Morere, this volume, for further discussion of assessment challenges.) Specifically, given the diversity of DHH people and their language experiences, factors such as nativity and early vs. late language acquisition/exposure must be considered. One approach that has been used when adapting spoken language tests for use in signed language is to include all DHH children in a particular age group regardless of their exposure to signed language (e.g., Peabody Picture Vocabulary Test; Dunn & Dunn, 2007; and Test of Early Reading Ability; Reid, Hammill, Wiltshire, & Hresko, 1991). This approach may indeed be representative of the general population of DHH children, but it results in delaying the norms or reducing the expectations for what DHH children may be capable of if they are given appropriate access to signed language.

Researchers have implemented an alternative approach to developing tests specifically for signed language assessment, which is to restrict the normative sample to DHH children with early exposure (before the age of 3 years) to sign language (e.g., *Assessing British Sign Language Development: Receptive Skills Test*; Herman, Holmes, & Woll, 1999; and *American Sign Language Receptive Skills Test*; Enns, Zimmer, Boudreault, Rabu, & Broszeit, 2013). Using these norms maintains high expectations for DHH children and more accurately reflects the impact of sign language deprivation during the preschool years. Some researchers (Hoffmeister et al., 2014) take this one step further and provide different sets of norms for native sign language users (i.e., DHH children with Deaf parents) and nonnative sign language users (i.e., DHH children with hearing parents with varying levels of exposure to sign language). In this way, scores may be compared to the group that is most representative of the child's experience, or to the group that represents a goal the child can work to achieve.

Another important factor when determining inclusion criteria for normative samples is cognitive abilities, because they are closely linked with language skills. Cognitive abilities are best assessed with measures of nonverbal IQ to reduce the impact of language differences and cultural bias (Fraine & McDade, 2009). It is important for examiners to be aware of the approach to normative sampling that was implemented in the signed language tests they are administering, to make accurate comparisons and interpretations of the scores for each individual child being tested. The interpretation of the scores should be enhanced with other nonnormative observations to conclude a holistic assessment of

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the DHH child's sign language proficiency. Obtaining an accurate assessment of sign language abilities that are situated within the typical developmental context allows for language and literacy instruction to target identified gaps and to build on the child's strengths.

Test Administrators

It is not clear, particularly within the school system, who has the responsibility for signed language assessment. The requirements for effective administration and scoring of signed language assessment include fluency in the signed language, skills and experience communicating with DHH children, knowledge of signed language linguistics (including language acquisition), and knowledge of assessment (test administration and interpretation; Woll, 2016). Formal training or experience with administering tests in general, and each test specifically, is critical to having valid and reliable results. Such training can be a challenge because there is no profession specifically focused on signed language assessment, similar to speech-language therapists/pathologists for spoken language. Some professionals working with DHH children, such as psychologists, specialist teachers, and speech-language pathologists, will have general knowledge of test administration, but they may not have any experience administering signed language tests.

The examiner's signed language proficiency is an important consideration. Children, like adults, naturally modify their signing in the presence of a nonfluent signer (Stone, 2011). This is also related to whether the examiner is deaf, as DHH children may be influenced by the phenomenon of contact language, which is unique to the Deaf community due to the use of different modalities. DHH children naturally shift to signing that follows spoken language patterns to accommodate hearing signers (Valli & Lucas, 2000). If the examiner is unable to use direct communication, the presence of an interpreter can also influence test results, especially if the interpreter is not familiar with the purpose of the test and inadvertently modifies standardized instructions or the child's responses. In a guide for collaborating with interpreters and translators when conducting language assessments, Langdon and Cheng (2002) outlined how training is needed to ensure accurate and purposeful translation of test items and responses. In general, DHH children's signing may differ from adult signing, in that DHH children may sign more slowly, use shorter sentences with less complex morphological structures, and use smaller or fewer spatial references, which a less experienced or proficient test administrator may miss and inappropriately assess, thereby skewing the test scores (Quinto-Pozos, 2007). In summary, the examiner's proficiency can influence the validity and accuracy of interpretation of the child's signed language proficiency, and this in turn influences the specificity and effectiveness of language and literacy programming and instruction.

Test Availability

In the past, the assessment of sign language abilities in DHH children was generally not considered necessary because it was deemed unrelated to their academic programming. In programs focusing on a monolingual approach, there was no recognition of signed lan-

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languages as separate languages, even those incorporating sign systems of a spoken language (e.g., Signed English, Total Communication). So signed language assessments were either not done at all or were done using informal measures (Hoffmeister, Kuntze, & Fish, 2013). As educational programming shifted to incorporate a cultural perspective on Deaf people and bilingual programming in the 1980s, more emphasis was placed on assessing and monitoring children's signed language skills. However, the development of signed language abilities was seen primarily as a way of enhancing spoken and written language skills. For this reason, formal assessments typically consisted of simply adapting existing spoken language tests by administering them in signed language. Using translated tests is problematic because they are not developed for DHH children or signed languages, the norms based on spoken languages do not apply to signed languages, and often translated tests may not be assessing the same things in another language (Woll, 2016). For example, naming body parts is often used to assess preschool English vocabulary, but in ASL, simply pointing to the body part represents the name/sign, so the test item does not measure the same developmental construct and level of vocabulary acquisition. In general, the results of these translated assessments were not accurate and often did not focus on relevant or appropriate structures of signed languages.

There has been increased research interest over the past decade to create tests specifically developed and designed to assess signed languages and to fit with the visual learning needs of DHH children. As only a few of such signed language tests have been developed, the variety of assessments available is limited in comparison to tests for spoken language, particularly regarding different components of language (receptive, expressive, phonology, vocabulary, syntax, discourse). Research regarding signed language assessment is only possible due to increased knowledge and data related to signed language acquisition (Baker & Woll, 2009), because identifying atypical development cannot occur until there is a solid understanding and definition of the typical developmental sequence. As a result, test development is not possible for signed languages where limited linguistic research is available. The connection between sign language acquisition research and the development of practical assessment tools continues to be strengthened and extended across signed languages in the creation of important experimental and formal measures. The increased accuracy of these measures contributes to determining a more complete picture of children's overall linguistic abilities to more effectively guide their literacy development.

Diagnostic Signed Language Assessment

The purpose of administering a signed language assessment with DHH children varies and includes both educational objectives and research objectives (Enns & Herman, 2011). Often, the purpose of assessment is to determine overall signed language proficiency, or the level of knowledge of particular aspects of signed language. For educators, key purposes of assessment are to guide instruction and to monitor progress (Stiggins, 2002). Language assessment for the purpose of guiding literacy development needs to provide diagnostic information about the specific components of language that contribute to liter-

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acy learning. Assessment should be comprehensive and should address a range of language features (i.e., phonology, vocabulary, morphology, syntax), as well as the use of language in various contexts (i.e., narrative, expository, academic, conversational). Targeted instruction to support language and literacy development requires knowledge of signed language acquisition so that assessment is accurate. Such assessment requires knowledge of signed language acquisition, so that assessment can focus on the components and structures of signed language that are most indicative of delays or disorders in development. In ASL, syntactic structures, such as role shift and complex sentences, reflect higher-level language skills. For example, emerging research in this area suggests that accurate expression of role shift (embodiment of different characters) is linked to perspective-taking and narrative abilities (Enns, McQuarrie, Cundy, & Zimmer, 2018), and late exposure (in adolescence) to ASL limits syntactic development to the level of simple sentences (Mayberry & Kluender, 2018). Effective signed language assessment can be accomplished through both formal and informal measures (e.g., checklists, observations, elicited tasks), as long as they accurately identify language strengths and difficulties (i.e., provide diagnostic information). While research in signed language delay and disorders is relatively recent in comparison to research in spoken language, delay/disorder in any language can contribute to difficulties in literacy development.

Several different tests are often needed to provide a complete picture of a child's signed language abilities. For example, if a child with limited exposure to signed language is entering a new educational program where instruction is provided in signed language, administering a signed language vocabulary test to monitor the child's acquisition of new signs would be appropriate for determining the effectiveness of the new programming. In the situation where a DHH child appears to use ASL fluently in conversation, but is struggling to read English print, assessment beyond ASL vocabulary would be necessary to diagnose the child's metalinguistic awareness and academic abilities in ASL. The assessments could identify specific areas of delay and determine potential objectives for future programming and instruction. The common misconception is that all children with Deaf parents (native signers) are equally proficient while other DHH children are considered to have problematic language development. But all DHH L1 users, regardless of their nativity, face possible language dysfunction, delay, and impairment, similar to TH individuals who are acquiring spoken language, as was demonstrated in a longitudinal case study by Quinto-Pozos, Singleton, and Hauser (2017). Their findings revealed that despite native exposure to ASL, average intelligence, and intact visual perceptual skills, the child demonstrated atypical language development in both ASL and written English. Assessment is needed to distinguish and identify possible causes of language differences and difficulties and determine appropriate programming and instruction. Building understanding and the use of strategies that are shared across languages, such as background knowledge, concepts, problem-solving, and abstract thinking, can facilitate dual-language and literacy learning.

There is a need for assessment tools in different signed languages. More information is available for some sign languages, for example, ASL and BSL, and researchers use knowledge of the linguistic features of these languages and their relative grammatical complex-

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ity to develop guidelines regarding the sequence of acquisition across other signed languages (Baker, van den Bogaerde, & Woll, 2009). Such cross-linguistic application was used in adapting test items from the BSL Receptive Skills Test for use in other signed languages, because the use of space, and specifically the importance of spatial verb constructions, transfers across signed languages (Enns & Herman, 2011; Haug, 2011). These are exciting developments, but more data are needed to support researchers in the development of assessment measures for different signed languages.

There is also a need for a greater variety of signed language tests focused on different language components. Research is needed into how specific components of signed languages can contribute to the development of reading, or literacy in written language. To address this question further, we need additional assessment tools and developmental data regarding signed language phonology, vocabulary, syntax, and discourse to provide reliable indicators of linguistic skills in young bilingual DHH children.

The following sections outline some of the currently available signed language tests for assessing specific components of language that contribute to literacy learning, including phonological awareness, vocabulary, grammar, and narrative. For more detailed descriptions of many of the tests listed here, please refer to Enns et al. (2016). More information on signed language assessment is also available at www.signlang-assessment.info. The tests are described separately, according to each of the language components, but test results must be considered in combination and must be compiled to form a complete picture of a child's language abilities.

Signed Language Phonological Awareness

The causal connection between spoken language phonological awareness and learning to read has caused concern for researchers and educators in determining how DHH students without access to speech sounds can “crack the code.” This has resulted in various methods of making spoken language phonology visible, for example, Visual Phonics, speechreading, and fingerspelling. These methods may facilitate knowledge and development of the spoken language (L2), and possibly its written form (orthography), but they do not access the psycholinguistic principles of sublexical processing that are the essence of phonological development. Although DHH children may not have access to the sound-based phonology of a spoken language, they do acquire the same brain-based skills through the acquisition of signed language phonology. As already noted, the knowledge transfer of sign segmentation correlates with success in word-reading and reading comprehension (also see review in McQuarrie & Parrila, 2014). For this reason, assessing children's signed language phonological awareness can provide insights into their readiness for learning to read. For TH children, spoken language phonological awareness provides the linguistic and cognitive underpinnings for successful early use of written language. Predictably then, children with deficits in these basic processing skills can be expected to experience difficulties in acquiring basic reading skills, “in spite of typological differences in features of the language and the script involved, and regardless of whether they are learning to read in their L1, their L2, or both” (Geva, 2008, p.168). Importantly,

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evidence arising from studies of L2 reading processes suggests that, irrespective of the language in which early literacy instruction occurs, if children can establish the basic concepts of phonological awareness in any language, L2 reading will be facilitated (see review in Bialystok, 2007). Two assessments are described below: the ASL Phonological Awareness Test, and the BSL Nonsense Sign Repetition Test.

ASL Phonological Awareness Test (ASL-PAT)

The ASL-PAT (McQuarrie & Cundy, 2019) is a computer-based test designed to assess knowledge of the phonological properties of sign formation: handshape (HS), location (L), and movement (M). The ASL-PAT measures a child's ability to identify phonological similarity relations in signs under three comparison conditions: signs with three (HS + L + M), two (HS + M, L + M, and HS + L), or single (HS, M, or L) shared parameters. The test includes a vocabulary check (to ensure the child associates the correct sign with each picture), instruction video, practice trials, and test block.. Video instructions are presented in ASL by a deaf adult native signer, followed by practice items, where examiners provide feedback, although no feedback is provided for the test items. Each practice and test item consists of a signed cue (video) with three picture items below it that represent the target/phonological match as well as two distracter items. Test-takers are required to select the picture that matches the signed cue along the phonological parameter(s) tested. The 48 item test is expected to give reliable indicators of the development of ASL phonological awareness in young bilingual DHH children (ages 4-13 years), which may allow educators to establish targeted phonological learning objectives and plan effective sign phonological instructional interventions for bilingual DHH students.

A 4 year norming study is currently underway; results from pilot studies conducted to date offer support for the plausibility of assessing signed language phonological awareness by targeting key phonological parameters (i.e., handshape, movement, and location) identified in the literature and converge with earlier experimental evidence of positive relationships between signed language phonological awareness and measures of English word recognition and reading comprehension (see McQuarrie & Abbott, 2013). Additionally, and as described previously, McQuarrie and Enns (2015), using multiple single-case studies incorporating a multiple-probe across skills design, found a clear functional relation between explicit instruction in ASL phonological awareness and increases in sign vocabulary and print vocabulary learning in young, DHH dual-language learners. Changes on the ASL-PAT administered at the beginning and end of the study confirmed these results.

Nonsense Sign Repetition Test (NSRT) for BSL

The NSRT (Mann, Marshall, Mason, & Morgan, 2010) assesses signing DHH children's ability to repeat nonsense signs of differing phonological (handshape and movement) complexity in BSL. It is not possible to manipulate the length of a sign, because most signs are only one syllable long (Brentari, 1998). Therefore, adapting a nonword repetition paradigm for signed language offers the possibility of manipulating signs with regard

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to their phonological complexity along two parameters: handshape and movement. The chosen methodology is based on the nonword repetition methodology used in spoken language acquisition research (see Dollaghan & Campbell, 1998; Gallon, Harris, & van der Lely, 2007; Gathercole et al., 2004). Items of the NSRT for BSL consist of items that are possible phonological combinations but do not carry any meaning in BSL. Each child is tested individually, and the three practice items and 40 test items are presented by a deaf signer on video. The child's responses are coded according to overall correctness, whether any errors were made on the phonological parameters, and whether one of the movements in a movement cluster was deleted. This assessment makes it possible to investigate the DHH children's abilities to perceive, retain, and produce novel phonological forms.

Vocabulary

The relationship between vocabulary and reading is critical (see Nation, 2008; National Early Literacy Panel, 2008). DHH children who establish new understandings and concepts in signed language (L1), can use this knowledge and information when approaching words in print (L2). A particularly important principle in bilingual teaching is to emphasize that knowing a word or sign is not an all-or-none event—the process of understanding nuances or innuendos of word meaning is ongoing. Translations of written and signed language must be conceptual, and children must be taught that context determines the correct interpretation between languages.

Certainly, some important information is gained by simply having children match a sign or word to a corresponding picture, but to truly assess the vocabulary knowledge that links to literacy development requires more in-depth assessment. The following descriptions of the American Sign Language Assessment Instrument (ASLAI; Hoffmeister et al., 2014), and the British Sign Language Vocabulary Test (BSL VT; Mann & Marshall, 2012) provide some examples of vocabulary knowledge that contributes to developing language in print.

ASLAI

The ASLAI is modeled on tests for spoken language development and tests of reading achievement, measuring conversational abilities, academic language knowledge, language comprehension, analogical reasoning, and metalinguistic skills (Hoffmeister et al., 2014). The ASLAI is designed to test DHH students between 4 and 18 years old. There are 12 subtasks in the total battery, divided into four categories: tests of vocabulary, tests of reasoning skills, tests of syntax, and tests of ASL text comprehension. Importantly, the ASLAI provides a measure of the relationship between specific areas of children's receptive signed language abilities and the comparable, and critical, areas of their English literacy skills.

The vocabulary tasks in the ASLAI examine breadth and depth of vocabulary via antonymy, synonymy, and sign/word knowledge. These tasks require some level of metalinguistic judgment. Antonyms and synonyms require students to make use of metalin-

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guistic knowledge to understand and identify differences and similarities among vocabulary items. The Vocabulary in Sentences task is a higher-level vocabulary task, in that participants must know both the meaning of the vocabulary item as well as its appropriate use in different syntactic environments (sentences).

BSL VT

The Web-based BSL VT (Mann & Marshall, 2012) consists of four tasks to assess different degrees of vocabulary knowledge: (a) meaning recognition (test-taker sees a prerecorded BSL sign followed by four pictures and must select the picture that corresponds to the meaning of the signed prompt), (b) form recognition (test-taker sees a picture followed by four prerecorded BSL signs and must select the sign that matches the meaning of the picture prompt), (c) meaning recall (test-taker sees a prerecorded BSL sign and must generate another BSL sign with an associated meaning), and (d) form recall (test-taker sees a picture and must produce the corresponding BSL sign).

One advantage of having an assessment that provides more detailed information about a child's different levels of vocabulary knowledge is the impact it can have on guiding and improving intervention (Mann, Roy, & Marshall, 2013). The BSL VT enables comparison of identical items across more than one task, which makes it possible to identify unusual language profiles. Mann et al. (2013) demonstrated this when administering the BSL VT to a larger, more diverse sample ($N = 67$), including 21 DHH children with additional needs, such as attention deficit hyperactivity disorder, autism spectrum disorder, and dyslexia. The study did not find a significant effect of additional needs on vocabulary performance, but it revealed an unusual response pattern in one student diagnosed with autism spectrum disorder. These findings stress the value of studies assessing vocabulary development in diverse groups of DHH children and contribute important information about possible effects of disabilities on word learning (Mann et al., 2013). In this context, the BSL VT is particularly valuable because of its unique format. Mann, Roy, and Morgan (2015) developed an ASL version of this test (ASL VT) for children 6 to 10 years old, and it demonstrated similar findings that vocabulary knowledge had different degrees of strength based on the mapping between form and meaning of signs.

Grammar

DHH children must approach reading with metalinguistic awareness so they can understand the mechanics of language and be mindful of how to access both ASL and English (Czubek & Di Perri, 2017). Increased knowledge of grammatical structures contributes to developing metalinguistic awareness, which is an important aspect of facilitating transfer between L1 and L2 (Dillon, 2009; Nagy & Anderson, 1995). Specifically, Dillon (2009) found that more balanced bilinguals, who demonstrated relatively equal proficiency in multiple languages, displayed higher levels of metalinguistic awareness and cross-linguistic transfer. In addition, assessment of signed language morphology and syntax can aid in identifying specific learning and language difficulties, which can lead to improved instruction and classroom placement. The assessments described in this section include the BSL Receptive Skills Test (RST; Herman et al., 1999), which has also been adapted for

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use in a variety of different signed languages, and the remaining subtests of the ASLAI (tests of reasoning abilities, syntax, and text comprehension).

BSL RST

The BSL RST targets comprehension of selected aspects of BSL morphosyntax (negation, number and distribution, verb morphology, noun-verb distinction, size and shape specifiers, and handling classifiers) and was designed for signed language users between 3 and 12 years old (Herman et al., 1999). The RST consists of 40 items organized in order of difficulty. Children view a signed phrase/sentence on video, and then must select the picture (from a choice of four) that most appropriately corresponds with the meaning of the sentence.

Use of the test enables professionals working with DHH children to make baseline assessments, identify language difficulties, and evaluate the outcomes of language therapy programs (Herman, 1998; Herman, Holmes, & Woll, 1998). The test provides an overall level of functioning that can be determined to be age appropriate or not (above/below, or significantly above/below average) and also a profile of errors to guide instruction about which grammatical structures students are struggling to understand. Identifying the grammatical structures the child understands in signed language (L1) can facilitate the teaching of these same concepts in written form (L2).

Test designers have adapted the test into many different signed languages, including DGS (Haug, 2011), ASL (Enns & Herman, 2011), Spanish Sign Language (Valmaseda, Pèrez, Herman, Ramírez, & Montero, 2013), and Italian Sign Language (Meristo et al., 2007), among others.

ASLAI

The areas of the ASLAI that assess grammar include the test of reasoning skills, the tests of syntax, and the test of ASL text comprehension (Hoffmeister et al., 2014). Reasoning skills are assessed through the Analogies Task, where the analogical stimulus sentence (A is to B, as C is to what?) is signed, and then participants view four possible signed lexical responses, from which they select the correct one. The types of relationship categories include: (a) causal, (b) purpose, (c) antonym, (d) noun-verb pairs, (e) whole to part/part to whole, and (f) phonology.

The tests of syntax include tasks that assess comprehension of different types of ASL sentences, classifiers, verbs of motion/location, and pluralization. Knowledge of nine different types of ASL sentences is measured, including: (a) plain, (b) conditionals, (c) topic-comment, (d) complement, (e) relative clause, (f) negation, (g) rhetorical question, (h) *wh*-question, and (i) subject-object agreement. Classifiers represented are semantic, handling, and size and shape specifiers. Scores indicate age-related knowledge of which classifier represents which object(s) (singular or plural) appropriately, and how the classifier forms function in verbs of motion and verbs of location. These underlying concepts (plu-

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rality, location, movement) are directly connected to verb structures in English and can inform linguistic transfer between L1 and L2.

The ASL Text Comprehension test presents ASL texts (1–1.5 min in duration) and then asks five multiple-choice comprehension questions in ASL about that text. This task examines the ability of participants to extract both literal and inferential meaning from ASL texts. The ability to infer information from text is a critical skill for literacy development.

The ASLAI has been used with more than 1,500 students, and preliminary results based on this sample demonstrate that fluency in ASL predicts English reading ability (Hoffmeister & Caldwell-Harris, 2014; Novogrodsky, Caldwell-Harris, Fish, & Hoffmeister, 2014; Novogrodsky, Fish, & Hoffmeister, 2014). Furthermore, the types of language errors fluent L1 users of ASL make are similar to the types of language errors fluent L1 users of English make (Novogrodsky et al., 2014). These findings indicate that a positive relationship exists between ASL and English.

Narrative

Narrative skills are linked to later literacy achievements and educational progress (Norbury & Bishop, 2003); therefore, narrative assessment is an effective way to monitor development. Specifically, a study assessing children's ($N = 39$, age 7 years) story retelling found that the quality of their narratives accurately predicted their reading skill 1 year later, even when controlling for their receptive vocabulary and early decoding (Reese, Suggate, Long, & Schaughency, 2010). A narrative task allows assessment of language skills in depth and of the developmental process of acquiring the complex cognitive, linguistic, and social skills involved in narrative production. Producing narratives is a complex task and, as a result, develops over a long period of time. Development of narrative abilities is based on communication with adults about key events and exposure to stories told by adults, through activities like reading books and imaginative play. Narrative skills are poor when children have not been exposed to good adult models, which is why DHH children with late exposure to language find narrative abilities hard to master. Key narrative features in ASL stories, and stories in other signed languages, are conveyed by the higher-level grammatical structures of role shift, classifiers, and verb agreement. The use of higher-level syntax, cohesion mechanisms, and awareness of narrative structure all build academic language, and these abilities facilitate transfer of knowledge to develop L2 literacy.

There are additional challenges in developing measures of expressive signed language, due to difficulties with eliciting and standardizing scoring procedures, so the only formal test available is the BSL Production Test (Herman et al., 2004), but an adapted ASL version is currently under development (Enns et al., 2018), as well as versions for other signed languages (Hodge, Schembri, & Rogers, 2014; Jones et al., 2015).

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BSL Production Test (BSL PT)

The BSL PT targets narrative skills and use of BSL grammar in signed language users between 4 and 11 years old (Herman et al., 2004). The test uses a narrative recall task, based on having the children watch a 3-min language-free video (no communication in signed or spoken language) and then tell the story to a deaf BSL user, as well as answer three comprehension and inferencing questions. The child's story is video-recorded for later analysis. To use the BSL PT, testers must have advanced fluency in BSL and complete a training course to learn the coding system. Scoring is based on narrative content (mentioning the 16 episodes), narrative structure (based on high point analysis), and BSL grammar (including spatial verbs, agreement verbs, manner and aspect inflections, and role shift). The test has been effectively used to assist in the assessment of language and learning difficulties and to monitor progress after intervention (see Herman, Rowley, Mason, & Morgan, 2014; Kennedy et al., 2006; Mason et al., 2010).

Summary

Language assessment for the purpose of guiding literacy development needs to provide diagnostic information about the specific components of both spoken and signed language that contribute to literacy learning. In the past, DHH children's dual-language resources were often not acknowledged and therefore could not be leveraged for literacy instruction. As more research becomes available regarding bilingual and multilingual learners, there is also more evidence for the ways that a robust signed language foundation can facilitate spoken and written language abilities. In particular, signed language skills (as L1) contribute to establishing background knowledge, concepts, and content and facilitate the development of strategies, like problem-solving and abstract thinking. Assessing the degree to which DHH children have acquired these concepts and strategies sheds light on how best to scaffold their ongoing literacy learning process.

The most effective way to obtain diagnostic information regarding children's signed language abilities is through a combination of standardized tests and informal measures. This ensures that evaluators assess a variety of language components in a range of communication contexts, and it provides meaningful insights for literacy instruction. Informal measures can include classroom-based assessment (developed by teachers based on specific classroom goals), observational checklists (often norm-based or criterion-referenced for a comparison to typical acquisition patterns), or interviews/self-reports, which require children to reflect on their own development and progress.

All formal tests should be valid, reliable, and realistic (Woll, 2016). Valid, in that they measure what they claim to measure, which can be verified by correlating results with other tests. Reliable, in that they can be replicated by different examiners at different times, through standardized administration and scoring procedures and qualified examiners. Realistic, in that they accurately reflect the child's abilities and also require a reasonable amount of time to administer and score. As noted previously, although there is an ongoing need for additional valid and reliable assessments of signed language abilities, there are currently some tools available, particularly in ASL and BSL, that can assist edu-

cators and researchers in determining the strengths and gaps in children's signed language abilities that contribute to literacy development.

Conclusion

Dickinson, Golinkoff, and Hirsh-Pasek (2010) stated, "Language is unique among precursor abilities in its pervasiveness for both early and later reading competencies" (p. 308). Existing evidence indicates that strong signed language skills can provide the necessary foundation for literacy learning (see Hoffmeister & Caldwell-Harris, 2014). Similarly, although sublexical and lexical associative relations between sign and print are not as obvious as those between speech and print, there is growing evidence that DHH signers are indeed making those links. Such discoveries serve to revitalize discussions regarding the role of languages and sublexical abilities (in sign and/or speech) in reading acquisition for DHH learners.

It is important to emphasize that each language has different surface structures (phonology, vocabulary, morphology, syntax) that bilingual DHH children must learn specifically, but that their languages share a common underlying proficiency. Identifying (through accurate assessment) and accessing (through appropriate instruction) this shared proficiency provide a way to build on DHH children's strengths when addressing the gaps in their spoken/written language development. It is not the language forms that transfer between languages, but rather the learning mechanisms. Understanding signed language phonological features of handshape, movement, and location does not facilitate an understanding of spoken language phonological features (voicing, manner, place of articulation), but it does help DHH children understand how signs/words are formed and how the sublexical features can be manipulated, sequenced, and recombined. Similarly, different vocabulary forms and grammatical structures must be learned in each language, but the concepts and meaning are shared across languages. Even the ways that language is modified in different contexts are unique to each language, but the understanding that different situations require different discourse structures is shared. These are the potential resources and the fundamental knowledge structures and learning mechanisms that signed languages can contribute to DHH children's literacy development.

Additional research is needed to understand better how DHH learners deploy their dual-language resources to make meaning and to resolve existing questions about the contributions of these factors to particular learners. Future research should examine whether relationships between signed and spoken/written languages vary in terms of developmental importance and/or contributions to specific aspects of reading skill development across learners with diverse linguistic profiles and repertoires (McQuarrie & Abbott, 2013). In addition, increased efforts must be made to develop assessment instruments that meet the particular needs of DHH bilingual children. Administering culturally responsive assessments that are specifically designed for DHH children and to assess components of signed languages provides a strengths-based approach and truly values the contribution of signed language abilities to cognitive, academic, and literacy develop-

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ment. A clear understanding and application of the knowledge gained from assessing all language abilities, including signed language skills, are needed in determining effective instruction for literacy development in DHH bilingual learners.

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