



## An Adequate Model for the Development of English Reading Skills

*Review scientific paper*

Peter V. Paul

*Department of Educational Studies, The Ohio State University*

Received: 2024/06/10

Accepted: 2024/08/16

### Abstract

*The focus of this article is on the development of adequate English reading skills. To delineate necessary components for a phonemic-based language, it is necessary to compare two broad frameworks--the Qualitative Similarity Hypothesis (QSH) and the American Sign Language (ASL)—English sign-print bilingual model. Both frameworks have been invoked to address the language and literacy challenges of d/Deaf and hard of hearing (d/Dhh) children and adolescents. Descriptions of the QSH and ASL are provided, and a synthesis of salient research findings is presented. The selection of relevant sources for both frameworks is the result of both a systematic and a professional review, focusing on early and recent investigations. There are benefits associated with the use of American Sign Language in a sign-print ASL-English bilingual education program, especially when combined with fingerspelling and English orthography. However, these benefits seem to diminish during the later early literacy period, particularly in the alphabetic stage. Thus, it is argued that, at present, the QSH and other extant developmental models proffer not only stronger evidence, but also a better explanation for the difficulties of d/Dhh students in developing early and advanced English reading skills. The article concludes with recommendations for further research.*

**Keywords:** *American Sign Language-English bilingualism; d/Deaf and hard of hearing students; English language; English literacy; Qualitative Similarity Hypothesis*

Strong empirical evidence for the English language and literacy levels of d/Deaf and hard of hearing (d/Dhh) students emerged with the inception of achievement testing in the 20<sup>th</sup> century (e.g., Allen, 1986; Quigley & Paul, 1986). Subsequently, it is

well documented that a number of d/Dhh children, particularly those with moderately-severe to profound hearing acuity/loss (see *Note*), are not reading on a level commensurate with their typical literacy (often hearing) peers (Mayer & Trezek,

2020; Qi & Mitchell, 2012). In fact, upon graduation from high school (12<sup>th</sup> grade in the USA), the median reading level has been documented to be the 4<sup>th</sup> grade level, particularly for students with moderately-severe to profound hearing losses.

In the 21<sup>st</sup> century, there is accruing evidence that the English reading scores have been improving, due mostly to early intervention and early amplification involving digital hearing aids and cochlear implantations (Easterbrooks & Beal-Alvarez, 2012; Mayer & Trezek, 2018; Mayer et al., 2016). The interpretation of this improvement trend is not without challenges. For example, estimates of the reading grade level of d/Dhh children and adolescents have been inconsistent and may be unreliable; however, these estimates should be viewed as gross averages due to the uneven progress of cohorts of students. Some students are reading at or above grade level whereas others are reading below grade level. Overall, approximately 30% of graduates leave school functionally print illiterate (i.e., lower than 6<sup>th</sup> grade reading level), based on reading grade level scores from the *Stanford Achievement Test-Hearing Impaired* [SAT-HI] (Mayer & Trezek, 2018; Qi & Mitchell, 2012). In general, these findings mostly concern d/Deaf and hard of hearing students who have attended schools and/or programs for the d/Deaf and hard of hearing. Unidentified students, that is, those not receiving special education services, have not participated in the SAT-HI test; thus, the scores do not reflect the performance of this cohort.

A number of d/Dhh students struggle with the acquisition of foundational print access skills associated with English such as phonemic awareness, letter-sound relations, and others that contribute to rapid word identification skills. Challenges with these learning-to-read skills pervasively impede the acquisition and use of higher-level skills such as comprehension and interpretation, especially for later development of English reading (e.g., Wang et al., 2017; Yan & Paul, 2021). Much of the controversy in the research on d/Dhh children, particularly children who are predominantly dependent on signing, has revolved around the role of English phonology in the development of word identification and later reading skills (e.g., Allen & Morere, 2020; Hoffmeister et

al., 2022; McQuarrie & Parrila, 2014; Paul & Lee, 2010; Paul & Yan, 2023).

To address these reading challenges, one model that has been proposed focuses on the role of American Sign Language (ASL) in the acquisition of English literacy. This model seems to be relevant mostly for children in ASL-English bilingual programs or children who are predominantly dependent on signing for receptive and expressive communication (e.g., Allen, 2015; Allen et al., 2014; Hoffmeister, 2000). This line of research has highlighted the role of ASL visual phonology in conjunction with fingerspelling and English orthography as the avenue for developing early literacy skills (Allen & Morere, 2020; Hoffmeister et al. 2022; McQuarrie & Parrila, 2014). This model can be labeled the *ASL-English Sign-Print Bilingual Approach*.

A second proposed model, coined the *Qualitative Similarity Hypothesis* (QSH), has been proffered to pertain to all d/Dhh children, regardless of level of hearing loss and communication preference (speaking or signing) (Paul, 2021; Paul & Alqraini, 2019; Paul & Lee, 2010; Paul et al., 2013). The model is based on extant developmental theories of English reading/literacy development. It asserts the necessity of English phonemic awareness, letter-sound relations, and others that contribute to rapid word identification skills for early literacy development (e.g., Mayer & Trezek, 2014; Paul & Lee, 2010; Paul et al., 2013). The QSH and other developmental models also assert the importance of additional factors such as English language proficiency and comprehension skills such as prior knowledge and metacognition for both early and later reading development.

Both the QSH and the ASL-English sign-print models are the main focus of the present article. This is a critical comparison of these two models, particularly the implications for developing reading (and writing) skills. In essence, the outcomes of this comparison offer important avenues for theory, research, and, most importantly, the development of relevant literacy instructional practices.

The plan for the present manuscript is as follows. First, the rationale and main tenets of the QSH model are briefly discussed, followed by a similar approach for the ASL-English Sign-Print model.

Then, via a systematic and professional review, a selection of empirical and research-integrative investigations is critically analyzed. The article concludes with recommendations for further research.

### Methodology

The selection of sources to review for the present manuscript is based primarily on a systematic and professional review. Similar to the approach utilized by Mayer and Trezek (2020) and Paul and Yan (2023), the following keywords and combinations were applied: deaf or hard of hearing or hearing impaired or d/hh, American Sign Language, sign bilingual, and English reading and entered into five databases: Education Full Text, Education Research Complete, ERIC, APAPsycInfo, and Academic Search Complete (all associated with EBSCOhost). Via a professional review, several sources were selected for the discussion of the rationale of this approach, and several additional articles were selected for the general research findings. Some of the cited articles in Paul and Yan (2023) were selected and examined further for the present study.

For the Qualitative Similarity Hypothesis, these keywords and combinations were used for the databases: deaf or hard of hearing or hearing impaired or d/hh; qualitative similarity hypothesis; English reading. Via a professional review, several sources were selected for the discussion of the rationale of this approach, and several additional articles were selected for the general research findings. Some of the major points for the rationale for the QSH have also been discussed in Paul (2021). Thus, for the above, only a few articles and other publications (chapters, books) were selected, via a professional review, that exemplified the main points expressed in this manuscript. The inclusion criteria were as follows:

- Most of the participants were d/Deaf and hard of hearing students from PreK to 12<sup>th</sup> grade.
- Empirical or research-integrative research was focused specifically on the development or acquisition of American English reading (achievement or comprehension).
- Research and scholarly information were

available from January 1990 up to the end of December 2023. A few earlier sources were included for emphasis and support of the rationales for the models.

The following questions were addressed in the present manuscript:

1. What are the rationale and research effects of the Qualitative Similarity Hypothesis?
2. What are the rationale and research effects of the ASL-English sign-print bilingual program?
3. What are the recommendations for addressing the persistent English literacy challenges of d/Deaf and hard of hearing children and adolescents?

### The Qualitative Similarity Hypothesis: Rationale

Paul and colleagues have argued that d/Dhh students follow a developmental learning trajectory that is similar to that of typical literacy learners (many of whom have typical hearing) (Paul, 2009; Paul & Lee, 2010; Paul et al., 2013; Trezek et al., 2011; Wang et al., 2008). With respect to reading, the QSH asserts that, regardless of degree of hearing loss or communication preference (spoken or signed), becoming a proficient reader (or writer) requires gaining competency in the same set of fundamental skills such as through-the-air language-related (e.g., phonology, morphology, syntax, semantics, pragmatics), code-related (e.g., alphabet knowledge, phonological awareness, word identification, spelling), and comprehension-related (e.g., vocabulary, prior knowledge, metacognition) constructs that are necessary for typical English literacy learners. Other factors that affect literacy can be categorized broadly as sociocultural, including teacher-student interactions, teacher competency, and the characteristics of the home environment. Proponents have also argued that the QSH applies to d/Dhh individuals for whom English is a second language or who are attempting to become bilingual with English being one of the languages (e.g., Mayer & Trezek, 2014, 2015; Paul et al., 2013).

Paul et al. (2013) analyzed the tenets of several major frameworks of reading/literacy such as the *Simple View of Reading* (Gough & Tunmer, 1986; Hoover & Gough, 1990), the *Convergent Skills Model of*

*Reading* (Vellutino et al., 2007), and the *Componential Model of Reading* (Joshi & Aaron, 2012) as well as those associated with the National Early Literacy Panel (2008) and the National Reading Panel (2000). Paul et al. argued that the integrative findings of these models support the principles of developmental similarity frameworks such as the QSH and Stanovich's *Developmental Lag Hypothesis* (Stanovich, 1986, 2000; Stanovich et al., 1988). These principles include the fundamental skills mentioned above as well as the strong reciprocal and continuous relations between the through-the-air (receptive and expressive) form of a language (e.g., English) and the early and later development of corresponding English reading skills. In short, the acquisition and manipulation of the language of print, particularly its components (e.g., phonology, morphology, syntax, etc.), and other comprehension-related skills is necessary for the development of English reading skills, especially during the alphabetic stage.

### **The Qualitative Similarity Hypothesis: Research Effects**

Early evidence for the viability of the QSH or any other developmental similarity model can be found in the works of Lenneberg (1967) for language development and Stanovich and others for reading development (Stanovich, 2000; Stanovich et al., 1988). The details of these development can be found in Paul (2021) and Paul et al. (2013). This early research concluded that the rate of acquisition was quantitatively slower than that of typical language learners but the manner of acquisition was qualitatively (developmentally) similar with respect to mental age. This was interpreted to mean that there are language fundamentals (what all learners need to know) and that there are similar acquisition stages or periods. These fundamentals can be related to the basic tenets of both the National Early Literacy Panel (2008) and the National Reading Panel (2000).

With respect to d/Dhh children and adolescents, the two early classic lines of work that provided additional support for the QSH were the studies of Quigley and colleagues (see summary review in Paul, 2009) and Hanson (1989; Hanson et al., 1984). Quigley and his associates

examined the performance of a national sample of deaf students (i.e., with profound hearing impairment) between the ages of 10 and 19 years on tests of comprehension of various syntactic structures presented singly in sentences. Despite the quantitative delays in syntax, Quigley and his associates demonstrated that deaf students were acquiring syntactic structures in the same manner (i.e., qualitatively similar) as that of younger hearing students (i.e., typical literacy learners). Thus, deaf students proceed through stages, produce errors, and use several strategies that seem to be similar to those of younger hearing students.

Hanson (Hanson, 1989; Hanson et al., 1984) contributed to the notion of fundamentals and qualitative similarity with her work on the role of phonology in research on short-term or working memory (WM) and reading in deaf students, including students who signed. Hanson found that individuals who use predominantly a phonological-based code in WM tend to be better readers than other deaf students who use predominantly a nonphonological-based code. The merits of phonological coding were evident at the word level (i.e., lexical retrieval) and at the connected discourse level as in syntax. It was argued that deaf readers who do not use a phonological code have difficulty making simultaneous use of both syntactic and semantic information at the sentence level and beyond. Consider the following passage: "What makes phonological coding in working memory so important? In reading and listening, individual words of a sentence must be retained while the grammatical relations among words are determined. Evidence suggests that working memory is most efficient for verbal material (including written material) when the processing involves phonological coding. For readers suffering from impaired phonological coding in working memory, processing individual words and putting these words together into phrases and sentences can be computationally overloading, impairing overall reading performance" (Lillo-Martin et al., 1991, p. 147).

Recent support for the QSH can be found in the narrative meta-analysis of Schirmer and McGough (2005) and Wang and Williams (2014) and empirical investigations such as Wang et al. (2017) (also, see the discussions in Paul,

2021; Paul & Alqraini, 2019). Both Schirmer and McGough and Wang and Williams related research findings and instructional implications to the findings and recommendations of the National Reading Panel (2000). Although both groups of researchers recognized the need for additional research on d/Dhh students, they concluded that effective instruction needs to consider the areas of phonemic awareness, phonics, fluency, vocabulary, and text comprehension. Wang et al. demonstrated that morphology—similar to other research on typical literacy learners—plays an important role in early and, and more specifically, advanced English reading development.

It should be highlighted that the development of English language knowledge—particularly phonology, morphology, and syntax—has been a long-standing challenge for a number of d/Dhh children and adolescents. This impacts the development of English literacy skills, albeit there is more to literacy than competency in the language of print. Although the QSH and other developmental models might offer the best explanation and potential implications for teaching English literacy, there are still challenges for a number of d/Dhh students, particularly those with moderately-severe to profound hearing loss. It is important to start with what is known about the development of typical literacy and differentiate instructional strategies to meet the needs of individual d/Dhh children and adolescents. Per the findings of Stanovich and his colleagues (e.g., Stanovich, 2000; Stanovich et al., 1988), this differentiation needs to be intensive for struggling literacy learners during the learning to read stage (i.e., up to about the third-grade level).

### **The ASL-English Sign-Print Bilingual Model: Rationale**

The other major framework is a sign-print bilingual education framework—that is, American Sign Language (ASL)-English bilingualism-biculturalism. Sign-print refers to the use of ASL as the medium of instruction and communication and the connection to English is primarily via print (reading and writing). Part of this approach is the use of fingerspelling and English orthography as well as the techniques of

chaining and sandwiching.

Explanatory processes that have been proffered for supporting sign-print bilingual programs include code-switching, tranlanguaging, and heteroglossia (e.g., see Paul & Yan, 2023, for a critical review of these processes).

The ASL-English sign-print bilingual model has been proposed as a solution to the so-called failures of the current education system or, rather, to the restrictive focus of a so-called deficit view, especially in areas such as language and literacy—that is, with the focus predominantly on the use of spoken and written English. In light of the persistent low achievement levels, a number of scholars have argued for the use of American Sign Language as the primary language of instruction with English being a second language or being used in a bilingual-bicultural situation (Allen et al., 2014; Allen & Morere, 2020; Hirshorn et al., 2015; Holmer et al., 2016; Kuntz et al., 2014). Thus, ASL should be used to teach English literacy skills, especially in a sign-print bilingual program. Some scholars have argued that the education of d/Dhh students (indeed nearly all d/Dhh students) should be a form of bilingual education (e.g., Evans, 2004; Grosjean, 2001).

In short, ASL is asserted to be the “natural” or most accessible language for d/Dhh students. In addition, with a fully developed first language, such as ASL, it is hypothesized that d/Dhh students can learn English as a second language, specifically English literacy skills. These proponents also argue that there is no need to learn or use English in the through-the-air mode and that even English phonology is not necessary for acquiring English reading skills (Allen et al., 2014; Hoffmeister, 2000; Hoffmeister et al., 2022). With respect to correlation and regression studies, it has been documented that children and adolescents with good sign language phonological awareness may be better at reading written words.

Essentially, the above discussion is an argument against one major component of the QSH, not the entire framework itself. Allen et al. (2014) asserted that the QSH is a modality-dependent hypothesis—namely, it applied to children who have adequate access to the phonology of a spoken language. They reasoned that it does not and cannot apply to children and adolescents with limited or no

functional hearing.

### **The ASL-English Sign-Print Bilingual Model: Research Effects**

Much of the support for the ASL-English sign-print bilingual model is based on correlational and regression analyses. In an early study, Strong and Prinz (1997) examined the correlations between linguistic proficiency in a signed language and the corresponding achievement level in a written language (English). In general, these researchers reported that d/Deaf children with higher levels of ASL significantly performed better than those d/Deaf children with low ASL levels on written English, controlling for age and nonverbal intelligence. However, this strong relationship between ASL proficiency and English literacy did not hold for the subgroup of older children (12-15 years). Similar findings for older deaf students, 16 to 18 years old, were also reported by Moores and Sweet (1990)—that is, a weak relationship between ASL proficiency and English literacy levels.

In a series of investigations in the 21<sup>st</sup> century, the findings of the comparisons of proficient and non-proficient ASL users as well as early ASL users versus later-ASL-learning users became well established (Hoffmeister et al., 2022; Hrastinski & Wilbur, 2016; Novogrodsky et al., 2014). For example, in one of their two analyses, Hoffmeister et al. (2022) examined the relations of several ASL aspects such as vocabulary, syntax, and analogical reasoning to performance on English reading comprehension measures in deaf participants, aged 7 to about 19 years old. The researchers found that knowledge of ASL syntax was correlated with knowledge of English syntax and that age and analogical reasoning in ASL were the strongest predictors of English reading comprehension on a standardized reading measure.

Despite the above robust findings, it seems that knowledge and proficiency in ASL alone is not sufficient for maintaining grade-level English language and reading achievement. In investigations that did report English reading achievement scores, most of the students were reading below the 50<sup>th</sup> percentile (e.g., Hrastinski & Wilbur, 2016; Novogrodsky et al., 2014). In short, the beneficial effects of ASL, especially for

ASL-using students, are not questionable. What is questionable is whether these effects persist and whether they are eventually sufficient for facilitating reading grade-level outcomes for most ASL-using students throughout their compulsory education years.

A somewhat clearer picture has emerged from an analysis of the studies on the effects of ASL and emergent English literacy skills. Allen and colleagues also found a strong relationship between early sign language exposure and positive outcomes for English letter knowledge (e.g., alphabetic knowledge) and even social-cognitive measures (e.g., Allen, 2015; Allen et al., 2014; Allen & Morere, 2020.). These researchers asserted that the use of a sign phonological processing (along with fingerspelling and English orthography) was sufficient for segmenting phonological information necessary for early English reading. Nevertheless, these early benefits seemed to diminish when d/Dhh children encounter greater challenges with the alphabetic systems at around 8 years of age (Allen & Morere (2020).

### **Concluding Remarks: Summary and Recommendations**

With respect to the QSH and other developmental similarity models, it can be argued that the findings of Allen and colleagues indicate that certain fundamentals, particularly English phonological processes, cannot be neglected. This is particularly the case for growth in the alphabet writing system and other early or emergent English literacy skills that are dependent on letter-sound knowledge. In addition, the fact that most ASL-using students are not reading on grade level in the later grades (late elementary, middle and high school) also indicates that there are challenges not only in the learning-to-read phase, but also subsequent negative effects during the reading to learn phase. That is, the lack of or poorly developed foundational skills seem to impede the development of advanced English reading comprehension skills, and this in turn affects the acquisition of knowledge in the other academic content areas, depending on the use of print via textbooks or the electronic media.

It has been reported that phonological awareness (or processing) only accounts

for about 11% of the variance in d/Dhh readers (e.g., see discussions in Mayer & Trezek, 2014; Paul et al., 2013)---and this is the case even for typical literacy learners. However, it should be highlighted that much of the influence of phonological awareness is evident in the early literacy years (i.e., learning to read) whereas morphology and other language variables exert a larger influence (and much of the variance) in the later literacy years (i.e., the reading to learn phase) (e.g., see Wang et al., 2017). That is, phonological awareness plays a more limited role for good readers. Again, most of the participants in the reviewed studies in this article were not good readers and seemed to be affected, in part, by their English phonological processing ability. It should be reiterated that phonology is necessary, but not sufficient, for the development of adequate reading skills in English for all literacy learners.

The present review contains a few potential limitations or, perhaps, caveats. The selection of salient articles for discussion was conducted via a professional review. This type of review, by an “expert”, can still be affected by confirmation or citation bias despite the inclusive intentions of the reviewer. In addition, there may also be a bias in the interpretations of the findings; clearly, there can be other interpretations.

Although it is critical to acknowledge the possibility of multiple pathways, it is argued here that the critical bulk of the available research findings reveal that most d/Dhh children and adolescents in ASL-English sign-print bilingual education programs are not reading (or writing) at age or grade level when compared to the norms. Based on correlation and regression analyses, however, there are benefits associated with the use of ASL, given its positive effects on early English literacy development. Considering students who use ASL predominantly, it is also clear that proficient ASL users perform significantly better than non-proficient users on selected English language and literacy measures.

Future investigators should examine possible successful components of a sign-print ASL-English program such as chaining and sandwiching and even constructs such as translanguaging and heteroglossia (e.g., see Hoffmeister et al., 2022). These latter constructs entail strategies used by bilingual

and multilingual individuals such as code-switching and language preference to meet the demands of communicative situations. However, it needs to be emphasized that translanguaging and heteroglossia are most evident in individuals who are already proficient in two or more languages. This is not the case for most of the participants in the cited studies in the present article. In addition, these constructs might not apply to languages with different modalities (e.g., signed languages and spoken languages).

Based on the tenets and research on the QSH and other developmental similarity models, the characteristics of sign-print bilingual programs need to be reevaluated. That is, the teaching and use of English in the through-the-air mode need to be reconsidered. The present review indicated that the early positive results of ASL-using students are not maintained as they move throughout the early literacy period. In line with principles proffered by the National Early Literacy Panel (2008) and the National Reading Panel (2000), the QSH model asserts that English phonological-related processes, at least, are critical for continued growth in English literacy, especially during the learning-to-read stage. Possible differentiation techniques for teaching letter-sound relationships that have been proposed with some positive results for d/Dhh students include the use of visual and kinesthetic approaches such as visual phonics and cued speech (e.g., Trezek, 2017; Trezek & Wang, 2017).

With respect to both the QSH and the ASL-English sign-print bilingual approaches, there is a need for intervention, longitudinal, and experimental investigations employing sophisticated research designs. These investigations should document quality indicators (i.e., technical merits) such as the socio-demographics of participants, the quality of bilingual programs, and the competency of teachers. At the least, it is important to develop and/or use relevant, appropriate standardized measures of both English (language and literacy) and ASL in addition to researcher-developed measures.

Via the QSH and other developmental models, the acquisition of adequate English literacy requires competency in a complex array of skills within domains that are code-related (e.g., word identification) and comprehension-

related (e.g., vocabulary, prior knowledge, and metacognition). It is also critical to develop proficiency in the language of print (e.g., English, in our case) in the through-the-air mode—that is, receptive and expressive skills. Although research on the merits of ASL should continue, it is argued that investigators need to consider the merits of extant developmental literacy models. Whether the QSH and other developmental models, based on the major findings of extant reading/literacy models, is sufficient for the improvement of English literacy skills in d/Deaf and hard of hearing students still needs further investigation. Of course, with respect to d/Dhh students, instruction of the fundamentals might need to be differentiated to fit the cognitive and language capacities of individual students. Such instruction should play a facilitative role in improving the literacy levels of d/Deaf and hard of hearing children and adolescents.

### Note

The use of the phrase *d/Deaf and hard of hearing* in this article entails both audiologic and cultural parameters and is meant to be

inclusive of the wide range of individuals who have been identified with a hearing loss or hearing acuity level, including those who are members of the Deaf culture, DEAF-WORLD, or have a Deaf identity. Individuals who are *deaf and hard of hearing* (dhh) are those with slight to profound hearing losses based on the pure-tone decibel (dB) average in the better of their two unaided ears as follows:

Slight:	16 to 25 dB
Mild:	26 to 40 dB
Moderate:	41 to 55 dB
Moderately severe	56 to 70 dB
Severe:	71 to 90 dB
Profound:	91+

Individuals who are identified as *Deaf* (D) typically have Deaf parents/caregivers who use American Sign Language (ASL) or some other type of signed language, which is not based on English. *Deaf* (D) individuals also can be those who use ASL or some other type of signed language themselves, regardless of the hearing status of their parents/caregivers (taken and adapted from Paul et al., 2013).

## References

- Allen, T. E. (1986). Patterns of academic achievement among hearing impaired students: 1974 and 1983. In A. Schildroth & M. Karchmer (Eds.), *Deaf children in America* (pp. 161-206). Little, Brown.
- Allen, T. E. (2015). ASL skills, fingerspelling ability, home communication context, and early alphabetic knowledge of preschool-aged deaf children. *Sign Language Studies, 15*(3), 233–265. <https://doi.org/10.1353/sls.2015.0006>
- Allen, T. E., Letteri, A., Choi, S. H., & Dang, D. (2014). Early visual language exposure and emergent literacy in preschool deaf children: Findings from a national longitudinal study. *American Annals of the Deaf, 159*(4), 346–358. <https://www.jstor.org/stable/26234975>
- Allen, T. E., & Morere, D. A. (2020). Early visual language skills affect the trajectory of literacy gains over a three-year period of time for preschool aged deaf children who experience signing in the home. *PLoS ONE 15*(2): e0229591. <https://doi.org/10.1371/journal.pone.0229591>
- Easterbrooks, S. R., & Beal-Alvarez, J. (2012). States' reading outcomes of students who are d/Deaf and hard of hearing. *American Annals of the Deaf, 157*(1), 27-40. <https://www.jstor.org/stable/26235186>
- Evans, C. J. (2004). Literacy development in deaf students: Case studies in bilingual teaching and learning. *American Annals of the Deaf, 149*(1), 17-27. doi:10.1353/aad.2004.0011
- Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education, 7*(1), 6-10. <http://rave.ohiolink.edu/ejournals/article/327028788>
- Grosjean, F. (2001). The right of the Deaf child to grow up bilingual. *Sign Language Studies, 1* (2), 110-114. <https://www.jstor.org/stable/26204832>
- Hanson, V. (1989). Phonology and reading: Evidence from profoundly deaf readers. In D. Shankweiler & I. Liberman (Eds.), *Phonology and reading disability: Solving the reading puzzle* (pp. 69–89). Ann Arbor: University of Michigan Press.



- Hanson, V., Liberman, I., & Shankweiler, D. (1984). Linguistic coding by deaf children in relation to beginning reading success. *Journal of Experimental Child Psychology*, 37, 378–393. 0022-0965/84
- Hirshorn, E. A., Dye, M. W. G., Hauser, P., Supalla, T. R., & Bavelier, D. (2015). *Frontiers in Psychology*, 6, 1153. doi:10.3389/fpsyg.2015.01153
- Hoffmeister, R. (2000). A piece of the puzzle: ASL and reading comprehension in deaf children. In C. Chamberlain, J. P. Morford, & R. I. Mayberry (Eds.), *Language acquisition by eye* (pp. 165-189). Erlbaum.
- Hoffmeister, R., Henner, J., Caldwell-Harris, C., & Novogrodsky, R. (2022). Deaf children's ASL vocabulary and ASL syntax knowledge supports English knowledge. *Journal of Deaf Studies and Deaf Education*, 27(1), 37-47. doi.org/10.1093/deafed/enab032
- Holmer, E., Heimann, M., & Rudner, M. (2016). Evidence of an association between sign language phonological awareness and word reading in deaf and hard-of-hearing children. *Research in Developmental Disabilities*, 48, 145-159. doi:10.1016/j.ridd.2015.10.008
- Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing*, 28, 127-160. [https://journals.ohiolink.edu/apexprod/rws\\_ejcssearch/r/1507/99?p99\\_entity\\_id=13022256&p99\\_entity\\_type=MAIN\\_FILE&cs=3NGzszpgCfrdD0CneJLOH7NN4K6\\_HNSUcSM7zjQPJaKC33uhgfkoyqUJ5RxqUbEANZ4ugTnTR71rR\\_dQYBPMsew](https://journals.ohiolink.edu/apexprod/rws_ejcssearch/r/1507/99?p99_entity_id=13022256&p99_entity_type=MAIN_FILE&cs=3NGzszpgCfrdD0CneJLOH7NN4K6_HNSUcSM7zjQPJaKC33uhgfkoyqUJ5RxqUbEANZ4ugTnTR71rR_dQYBPMsew)
- Hrastinski, I., & Wilbur, R. B. (2016). Academic achievement of deaf and hard-of-hearing students in an ASL/English bilingual program. *Journal of Deaf Studies and Deaf Education*, 156-170. doi:10.1093/deafed/env072
- Joshi, R. M., & Aaron, P.G. (2012). Componential model of reading (CMR): Validation studies. *Journal of Learning Disabilities*, 45(5), 387-390. <https://doi-org.proxy.lib.ohio-state.edu/10.1177/0022219411431240>
- Kuntze, M., Golos, D., & Enns, C. (2014). Rethinking literacy: Broadening opportunities for visual learners. *Sign Language Studies*, 14(2), 203–224. doi:10.1353/sls.2014.0002
- Lenneberg, E. (1967). *Biological foundations of language*. Wiley.
- Lillo-Martin, D., Hanson, V., & Smith, S. (1991). Deaf readers' comprehension of complex syntactic structure. In D. Martin (Ed.), *Advances in cognition, education, and deafness* (pp.146–151). Gallaudet University Press.
- Mayer, C., & Trezek, B. J. (2014). Is reading different for deaf individuals? Reexamining the role of phonology. *American Annals of the Deaf*, 159(4), 359–371. <https://www.jstor.org/stable/26234976>
- Mayer, C., & Trezek, B. J. (2015). *Early literacy development in deaf children*. Oxford University Press.
- Mayer, C., & Trezek, B. J. (2018). Literacy outcomes in deaf students with cochlear implants: Current state of the knowledge. *Journal of Deaf Studies and Deaf Education*, 23(1), 1-16. doi.org/10.1093/deafed/enx043
- Mayer, C., & Trezek, B. J. (2020). English literacy outcomes in sign bilingual programs: Current state of the knowledge. *American Annals of the Deaf*, 164(5), 560–576. doi.org/10.1353.aad.2020.0003
- Mayer, C., Watson, L., Archbold, S., Ng, Z. Y., & Mulla, I. (2016). Reading and writing skills of deaf pupils with cochlear implants. *Deafness & Education International*, 18(2), 71-86. doi:10.1080/14643154.2016.1155346
- McQuarrie, L., & Parrila, R. (2014). Literacy and linguistic development in bilingual Deaf children: Implications of the “and” for phonological processing. *American Annals of the Deaf*, 159(4), 372-384. <https://www.jstor.org/stable/26234977>
- Moore, D., & Sweet, C. (1990). Relationships of English grammar and communicative fluency in reading in deaf adolescents. *Exceptionality*, 1, 97–106. doi:10.1080/09362839009524746
- National Early Literacy Panel. (2008). *Developing early literacy: Report of the National Early Literacy Panel – A scientific synthesis of early literacy development and implications for interventions*. Washington, DC: The Institute for Literacy and National Center for Family Literacy.
- National Reading Panel. (2000). *Report of the National Reading Panel: Teaching children to read – An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction*. Jessup, MD: National Institute for Literacy at EDPubs.
- Novogrodsky, R., Caldwell-Harris, C., Fish, S., & Hoffmeister, R. J. (2014). The development of antonym knowledge in American Sign Language (ASL) and its relationship to reading comprehension. *Language Learning*, 64(4), 749-770. doi: 10.1111/lang.12078

- Paul, P. V. (2009). *Language and deafness* (4<sup>th</sup> ed.). Jason & Bartlett.
- Paul, P. V. (2021). The qualitative similarity hypothesis: A commentary. *Human Research in Rehabilitation*, 11(2), 56-61. doi:10.21554/hrr.092101
- Paul, P.V., & Alqraini, F. (2019). Conclusion: Perspectives on language, literacy, and deafness. *Education Sciences*, 9, 286. doi:10.3390/educsci9040286
- Paul, P. V., & Lee, C. (2010). Qualitative-similarity hypothesis. *American Annals of the Deaf*, 154(5), 456-462. <https://www.jstor.org/stable/26235005>
- Paul, P. V., Wang, Y., & Williams, C. (2013). *Deaf students and the qualitative similarity hypothesis: Understanding language and literacy development*. Gallaudet University Press.
- Paul, P. V., & Yan, P. (2023). The effects of American Sign Language on English reading proficiency. *American Annals of the Deaf*, 166(5), 745-760. DOI: <https://doi.org/10.1353/aad.2023.0010>
- Qi, S., & Mitchell, R. E. (2012). Large scale academic achievement testing of deaf and hard-of-hearing students: Past, present, and future. *Journal of Deaf Studies and Deaf Education*, 17, 1-18. doi:10.1093/deafed/enr028
- Quigley, S., & Paul, P. (1986). A perspective on academic achievement. In D. Luterman (Ed.), *Deafness in perspective* (pp. 55-86). College-Hill Press.
- Schirmer, B. R., & McGough, S. M. (2005). Teaching Reading to children who are deaf: Do the conclusions of the National Reading Panel apply? *Review of Educational Research*, 75(1), 83-117. <https://doi.org/10.3102/00346543075001083>
- Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly*, 21, 360-407. <https://www.jstor.org/stable/747612>
- Stanovich, K. E. (2000). *Progress in understanding reading: Scientific foundations and new frontiers*. Guilford.
- Stanovich, K. E., Nathan, R., & Zolman, J. (1988). The developmental lag hypothesis in reading: Longitudinal and matched reading-level comparisons. *Child Development*, 59, 71-86. <http://www.jstor.org/stable/1130390>
- Strong, M., & Prinz, P. M. (1997). A study of the relationship between ASL and English literacy. *Journal of Deaf Studies and Deaf Education*, 2(1), 37-46. doi:10.1093/oxfordjournals.deafed.a014308
- Trezek, B. J. (2017). Cued speech and the development of reading in English: Examining the evidence. *Journal of Deaf Studies and Deaf Education*, 22(4), 349-364. doi:10.1093/deafed/enx026
- Trezek, B. J., & Wang, Y. (2017). Evaluating evidence-based practices in reading interventions for deaf students. In S. W. Cawthon, & C. L. Garberoglio (Eds.), *Research in deaf education: Contexts, challenges, and considerations* (pp. 277-308). Oxford University Press.
- Trezek, B. J., Wang, Y., & Paul, P. V. (2011). Processes and components of reading. In M. Marschark & P. Spencer (Eds.), *Handbook of deaf studies, language, and education* (Vol. 1, 2<sup>nd</sup> ed.; pp. 99-114). Oxford University Press.
- Vellutino, F. R., Tunmer, W. E., Jaccard, J. J., & Chen, R. (2007). Components of reading ability: Multivariate evidence for a convergent skills model of reading development. *Scientific Studies of Reading*, 11, 3-32. <http://rave.ohiolink.edu/ejournals/article/324904141>
- Wang, Y., Paul, P. V., Falk, J. L., Jahromi, L. B., & Ahn, S. (2017). Predictors of English reading comprehension for children who are d/Deaf or hard of hearing. *Journal of Developmental and Physical Disabilities*, 29, 35-54. doi:10.1007/s10882-016-9520-2
- Wang, Y., Trezek, B. J., Luckner, J. L., & Paul, P. V. (2008). The role of phonology and phonological-related skills in reading instruction for students who are deaf or hard of hearing. *American Annals of the Deaf*, 153(4), 396-407. <https://www.jstor.org/stable/26234536>
- Wang, Y., & Williams, C. (2014). Are we hammering square pegs into round holes? An investigation on the meta-analyses of reading research with students who are d/Deaf or hard of hearing and students who are hearing. *American Annals of the Deaf*, 159(4), 323-345. <https://www.jstor.org/stable/26234974>
- Yan, P., & Paul, P. V. (2021). Metacognition and English reading-related outcomes for d/Deaf and hard of hearing students: A narrative review. *Human Research in Rehabilitation*, 11(2), 88-106. doi:10.21554/hrr.092103