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American Annals of the Deaf, Volume 161, Number 3, Summer 2016, pp. 342-368 (Article)

Published by Gallaudet University Press
DOI: 10.1353/aad.2016.0026

Nielsen, D. C., Luetke, B., McLean, M., & Stryker, D. (2016). The English-language and reading achievement of a cohort of deaf students speaking and signing Standard English: A preliminary study. *American Annals of the Deaf, 161*(3), 342–368.

The English-Language and Reading Achievement of a Cohort of Deaf Students Speaking and Signing Standard English: A Preliminary Study

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Research suggests that English-language proficiency is critical if students who are deaf or hard of hearing (D/HH) are to read as their hearing peers. One explanation for the traditionally reported reading achievement plateau when students are D/HH is the inability to hear insalient English morphology. Signing Exact English can provide visual access to these features. The authors investigated the English morphological and syntactic abilities and reading achievement of elementary and middle school students at a school using simultaneously spoken and signed Standard American English facilitated by intentional listening, speech, and language strategies. A developmental trend (and no plateau) in language and reading achievement was detected; most participants demonstrated average or above-average English. Morphological awareness was prerequisite to high test scores; speech was not significantly correlated with achievement; language proficiency, measured by the Clinical Evaluation of Language Fundamentals-4 (Semel, Wiig, & Secord, 2003), predicted reading achievement.

Keywords: English-language development, morphology, reading achievement, Signing Exact English, syntax

Introduction to the Problem

Most students who are deaf or hard of hearing (D/HH) do not achieve the same reading levels as their hearing peers despite early identification and improved assistive listening technology such as cochlear implants (CIs; Spencer & Marschark, 2010). One possible explanation for D/HH students' plateauing in reading achievement is that they cannot always hear grammatically accurate English (Guo, Spencer, & Tomblin, 2013), especially pronouns, conjunctions, articles, and the bound morphemes of English. As students move beyond primary-grade reading materials, words get longer and the demands of vocabulary increase, making comprehension more challenging (Carlisle, 2004; RAND Reading Study Group, 2002). Many vocabulary words have the same root word, yet differ on the basis of changes in pronunciation and audibly insalient spelling, which makes these words' meaning difficult to comprehend when they are read. Knowing how to unlock the morphol-

ogy of multimorphemic words is an essential reading skill, and facilitates independent comprehension of age-appropriate vocabulary as well as larger chunks of school-subject text (see, e.g., Nagy, Berninger, Abbott, Vaughan, & Vermeulen, 2003; see also Nagy, Carlisle, & Goodwin, 2014, for a review). Morphological awareness (MA) predicts the reading achievement of hearing students (Nagy, Berninger, & Abbott, 2006) and English-language learners (Kieffer & Lesaux, 2008).

Few studies have investigated the relationship between morphology, syntax, and reading when students are D/HH, although Moores and Sweet (1990) substantiated the correlation of MA knowledge to reading achievement more than a quarter century ago. Most of the research on morphology with students who are D/HH has been conducted with middle-grade through college-age students (e.g., Gaustad, Kelly, Payne, & Lylak, 2002; Kelly & Gaustad, 2007), however it is during the primary grades when MA begins to develop for use as a decoding reading strategy (Berninger, Abbott, Nagy, & Carlisle, 2010).

In discussing the findings of their study of the MA abilities of hearing middle-school and college students who were D/HH, Gaustad et al. (2002) suggested that using Signing Exact English (SEE; Gustason & Zawolkow, 1993) had the potential to improve the "insufficient morphological skills of deaf students" (p. 17). Gaustad and Kelly (2004) observed that incidental learning of MA did not seem to occur, but suggested that exposure to the "morphological aspects of conversational language acquisition" (p. 283) be provided, noting that "the morphological component of conversational competence in English is dependent on the mode and completeness of the models of English to which deaf students are exposed" (p. 283). When the reader is D/HH and unable to hear the various morphemes of spoken words or to hear them well, visually signed support of affixes (i.e., bound morphemes) and small words (e.g., articles, pronouns) is necessary. For students who are below the norm in comprehension development, "through the air" conversational use of signed morphology can make a difference. After all, C. Mayer (2007) concluded in discussing the literacy abilities of deaf children, "it is not the presence of ASL [American Sign Language] but the absence of some form of face-to-face English that is at issue and the challenge for educators" (p. 416). There are few programs for children who are D/HH in which staff and students sign in a such a manner that bound morphemes are visibly salient (as is done with SEE), and no recent research that investigated the English morphological and syntactic as well as reading abilities of such students was found.

Reading Theories and Deafness

In the present section, our purpose is to provide a brief discussion of the theories of reading relating to children who are D/HH, including the role of morphology in these theories. Although Trezek, Wang, and Paul (2010) suggested that reading theories about children who are D/HH provide numerous and sometimes conflicting ideas, McGuinness (2005) stated that there appear to be fundamental skills that apply to all children in the United States, among them English-language proficiency. Wang and Andrews (2014) called for "interdisciplinary dialogue regarding literacy research with d/Deaf and hard of hearing (d/Dhh) students" (p. 319) and provided an overview of the qualitative similarity hypothesis (QSH) of Paul and his colleagues (Paul, Wang, & Williams, 2013). They explained that the QSH suggests that "the English language and reading development of all students, regardless of hearing status, is qualitatively or developmentally similar; whereas some students who are d/Dhh might demonstrate a quantitative delay when compared with their typically developing hearing peers" (p. 321). It might be that this delay is due in part to the quality of English input to which students who are D/HH have access. For example, if English is being transmitted to such students via sign, LaSasso and Crain (2010) posited a structural limitation hypothesis that included the irregular success of manually coded English systems to encode all morphemes that are spoken or read. Other theorists have underscored the importance of signing a grammatically correct version of Standard English, such as is assumed in the "input hypothesis" developed by Krashen (1985), a (hearing) bilingual educator. A modification of Standard English for D/HH students was developed by Luetke-Stahlman (1998) that includes a comprehendible, grammatically complete input (i.e., English syntax and morphology) that is consistently signed and provided at a level just slightly more difficult than the student's assessed level of linguistic ability.

Morphology, the structure and formation of words, is a key element of theories of reading for both hearing students (Alvermann, Unrau, & Ruddell, 2013) and students who are D/HH. The *Cambridge Encyclopedia of the English Language* (Crystal, 1995) presents a comprehensive model of English that includes attention to sign as one of the forms of language "transmission" (p. 2), along with graphology and phonology. Crystal (1995) noted that most sign languages used in English-speaking countries by deaf people are "independent of the structure of the English language," with the exception of "devised sign languages that do reflect the properties of English, as in the case of Signing

Exact English in the USA" (p. 434). For many years, morphology has been a major area of study for linguists, with numerous books written on the subject. It now is widely accepted that "measures of student knowledge of morphology account for more variance in reading comprehension than phonological awareness, which for some time was thought to be key to success in learning to read" (Nagy et al., 2014, p. 3). Empirical support for MA as an essential skill in reading was the focus of a special issue of the *Journal of Learning Disabilities* in 2014. More recently, researchers have studied the role of morphology as a decoding strategy (Gilbert, Goodwin, Compton, & Kearns, 2014; Goodwin, Gilbert, & Cho, 2013; Nagy et al., 2014; van Hoogmoed, Knoors, Schreuder, & Verhoeven, 2013). Although the relationship between English grammar and reading achievement has been extensively studied in deaf education over the past 40 years (see, e.g., Quigley & King, 1980; see also a review by Cannon & Kirby, 2013), research regarding MA, reading, and deafness is more recent.

Morphological Awareness and Students Who Are D/HH

The purpose of the present section is to review current research on the development of MA when students are D/HH. A few years ago, Nielsen, Luetke, and Stryker (2011) defined and exemplified terms related to MA (e.g., *bound morphemes*, *derivational morphology,* and *inflectional morphology*). Nielsen et al. also reviewed the empirical literature on MA as an essential reading strategy for both hearing students and students who are D/HH, including the research of Moores and Sweet (1990) with high school students and studies by Gaustad and colleagues with college students (e.g., Gaustad et al., 2002; Kelly & Gaustad, 2007). Subsequent to publication of the 2011 article by Nielsen et al., Cannon and Kirby (2013) reviewed the research regarding knowledge of receptive and expressive English syntax and morphological structures when students are D/HH. They noted that multiple factors appear to contribute to the knowledge of lexical items, such as pronouns and auxiliaries, possessed by students who are D/HH. These factors included age at identification, socioeconomic status, level of intelligence, intervention history, acquisition of assistive listening devices, quality of linguistic input and level of language proficiency, degree of parent involvement, and modality of language instruction. With regard to MA, Cannon and Kirby wrote in summary that students who are D/HH might have vocabularies characterized by delayed acquisition, smaller size, and less sophistication; struggle with the English verb system; and evidence difficulties that appear unimportant but that can significantly affect academic achievement.

In studies with samples of children who were hard of hearing (i.e., not including children who were deaf), both McGuckian and Henry (2007) and Koehlinger, Van Horne, and Moeller (2013) described irregular morphemic development. Koehlinger et al. found that children who were hard of hearing were less accurate in their use of verb-related morphemes than hearing peers, and that undeveloped grammatical morphology was a risk if adult input was "inconsistent and distorted" (p. 1702). For example, children who are hard of hearing may have difficulty processing and storing grammatical morphemes that have "low phonetic substance," such as "contracted forms of *be*, third-person singular -s, and regular past tense -ed," due to inconsistent and/or distorted access (pp. 1702–1703). If inconsistent grammatical access indeed puts children who are hard of hearing at risk, it can be assumed that it will negatively influence the morphemic development of children who are deaf as well.

Similarly, Guo et al. (2013) noted that children with CIs receive a "degraded electrical signal" (p. 188). The researchers conducted a carefully designed study of the tense-marking development of children with CIs (who did not sign) over a 3-year period. Guo et al. found that at 4–5 years postimplantation, the children produced tense markers at a significantly lower rate than their hearing peers. Two findings suggest potential effects on academic outcomes: that participants' errors tended to be ones of omission, and that the participants fell further behind academically as they grew older. The researchers concluded, "Taken together, the group and the individual data suggested that children with CIs tended to have difficulties in learning tense markers because of the early deprivation of auditory input and the nature of the electrical signals they receive" (pp. 202–203). One explanation for this difficulty was that "these morphemes in English are acoustically insalient . . . have relatively shorter duration and/or weaker energy as compared to surrounding content words" (p. 187).

Also in 2013, van Hoogmoed et al. compared sixth-grade deaf students with their hearing peers and confirmed that many children who are D/HH were delayed in comparison to hearing children in accurate reading of both monomorphemic and polymorphemic words. The researchers found that "the delay was larger for derivational words compared to compounds and monomorphemic words" (p. 1087) and concluded that the differences might be due to "unfamiliarity with derivational morphemes . . . that are only encountered in mor-

phologically complex words" (p. 1087).

In summary, research has demonstrated MA's importance to reading achievement, and studies conducted with students who were D/HH have concluded that it is challenging to gain access to and acquire English morphology, and that development of MA is often delayed. Many bound morphemes and short words are difficult to hear, no matter how mild the hearing loss, even with the advancement of early detection of hearing loss and the early acquisition of high-powered hearing aids and CIs. A typical finding was that children with CIs had lower levels of English-grammar ability than their hearing peers and were challenged by tense markers and derivational morphemes (e.g., Guo et al., 2013). Sometimes researchers added invented measures of MA to test inflectional and derivational morphology due to the lack of such an available measure (Gaustad et. al., 2002; Moores & Sweet, 1990). In later studies, tests of the English language—including morphology and syntax—that were normed on hearing children replaced those normed on students who were D/HH. Many studies lacked information on individual participants' background characteristics, including aided hearing acuity or device use. With the exception of the work of Bow, Blamey, Paatsch, and Sarant (2004), who focused on primary-grade students, the extant studies on MA and reading were conducted with middle school and college students (e.g., Gaustad et al. 2002; Moores & Sweet, 1990). Findings at the word level of reading (e.g., Gaustad & Kelly, 2004; Gaustad et al., 2002; van Hoogmoed et al., 2013) were that MA was underdeveloped for many students, even those who had been in school for many years. The few studies available that were conducted with students who were D/HH indicated that higher MA corresponded to higher reading achievement.

Assessment of Cognitive Academic Language and Reading

Because knowledge of English morphology and syntax is an essential component of reading theory and achievement, the purpose of the present section is to explain why morphology and syntax should be assessed on tools that measure the theoretical construct of *cognitive academic language proficiency*, or CALP (Cummins, 1980, 1984). Thus, of interest in the present study were tests designed to capture morphological and syntactic elements of English language, both receptively and expressively, as well as reading comprehension. Such measures assess the ability to analyze, understand, express, and read English with little pictorial support, repetition, or example because these are the skills intrinsic to functioning in the decontextualized academic arena with hearing peers (Kieffer & Lesaux, 2008). Such measures offer more information about a student's CALP than a test designed to assess only one element (e.g., receptive vocabulary) with pictorial support (e.g., the Peabody Picture Vocabulary Test, or PPVT; Dunn & Dunn, 1997). As Wang and Andrews (2014) stated, following an overview of concerns about the fact that some students who are D/HH do not have full access to English language, "It is the child's competence in language . . . that provides the foundation for reading" (p. 320). Parents and educators are interested in the development of the academic language of children who are D/HH in preparation for higher education and employment (Spencer & Marschark, 2010).

Two examples of standardized tools that measure CALP are the Structured Photographic Expressive Language Test (SPELT; Werner & Kresheck, 1983) and the Clinical Evaluation of Language Fundamentals-4 (CELF-4; Semel, Wiig, & Secord, 2003). Recently, Bennett, Gardner and Rizzi (2014) reviewed the literature on assessment to identify which assessments researchers and practitioners used with D/HH students. Bennett et al. suggested that tools be reliable and valid, citing the CELF-4 as an example. Yet in reviewing the current research in which both English-language and reading achievement were measured, we found few studies that utilized a CALP test, such as the SPELT and CELF, *in addition to* a standardized reading measure, and that focused on school-age students.

For example, Gilbertson and Kamhi (1995) used the SPELT to match the linguistic abilities of young hearing and deaf school-age students, but administered no reading measure. Guo et al. (2013) used the SPELT in a study that investigated the development of the spoken past-tense marker (i.e., /-ed/, /s/, /are/) in children with CIs (who did not sign) over a 3-year period when they were 5–7 years old, but included no reading measure.

Most studies that used standardized measures of both English and reading were several decades old, did not involve school-age children, and were used to verify English-language delay (e.g., Catts, 1993). Summarized below in the order of publication date are the more recent studies that included both a standardized English test and a reading test.

Tomblin, Spencer, and Gantz (2000) investigated the development of 17 children who had prelingual, profound bilateral deafness and who had received CIs between 2.6 and 10.0 years of age, using the Woodcock Reading Mastery Test-Revised (WRMT-R; Woodcock, 1998) and three CELF subtests.

The tests were readministered a year later. Results were reported as group means, and individual scores were plotted on a regression line by percentile and grade level, but were not mentioned in the narrative. Tomblin et al. did not report correlations between language and reading data nor run any other analyses, but they concluded that the language and reading abilities of children who receive CIs at earlier ages coincided with those of same-age hearing peers.

Moog (2002) studied 17 children ages 5–11 years who wore CIs. The children were described as prelingually, profoundly deaf, but no unaided or aided pure tone averages (PTAs) were reported. They had received CIs between the ages of 2.4 and 7.7 years and were between 5.8 and 11.8 years old when tested. All 17 students attended an oral educational program that offered a concentrated focus on reading. Both the CELF and the Gates-MacGinitie Reading Test (GMRT; MacGinitie, MacGinitie, Maria, & Dryer, 2000) were administered to children younger than 8 years, and the Stanford Achievement Test (SAT) to children age 8 years and older. Moog did not clarify whether she used the SAT designed and normed on deaf children or the one designed and normed on hearing children. She did not include statistical information or correlations for language and reading; however, she reported that more than 70% of the participants scored within the average range for overall reading achievement. It is assumed that for the GMRT this would be an average range compared to that of hearing peers, since only hearing norms are available. With regard to the SAT, it is possible that this average range is based on deaf, rather than hearing, norms. Other than CI information, no subject background characteristics were discussed relating to language and reading ability.

One longitudinal case study also was found in the review of the literature pertaining to English language and reading that utilized formal test measures (Nielsen & Luetke-Stahlman, 2002). It included analyses of 9 years of language and literacy data on a child who was profoundly deaf (unaided) who had received a CI at age 5 years (PTA = 40 dB) and used SEE at both home and school. As documented by CELF scores, the child's English was below average in preschool and kindergarten, but improved as she matured. For example, on comprehension of sentence-level grammar, her scores rose from the 9th percentile to the 50th percentile from first to second grade on the CELF Sentence Structure subtest. By fourth grade, the student demonstrated improvement "in her ability to deal with decontextualized language" (p. 47) as exemplified by her CELF Word Classes subtest score (i.e., the 37th percentile in fourth grade and the 50th percentile in fifth grade). The student's reading comprehension was low-average in grades 1–3 and between low-average and high-average in grades 4–6, as assessed by both the GMRT and the WRMT-R.

Wake, Hughes, Poulakis, Collins, and Richards (2004) studied 86 seven- and eight-year-old Australian children who used hearing aids and did not have intellectual or major physical disabilities. The mean age at diagnosis was 21.6 months, with 19% having a mild hearing loss, 27% a moderate loss, 15% a severe loss, and 26% a profound loss. The authors did not clarify whether the students' level of hearing loss was unaided or aided. Both the CELF and the PPVT (a non-CALP test) were administered, as well as a reading measure referred to only as the "Reading Progress Test." (No citation or details as to content were provided.) Only group results, not individual scores, were included in the report. It was found that the greater the hearing loss, the lower the language scores on both the CELF and PPVT. No information was provided on reading achievement other than that the "mean delay on the Reading Progress Test was 9.9 months" (p. 4).

In summary, an explanation for the use of tools that measured English morphology and syntax to capture the construct of CALP was offered when students were D/HH and their language and reading achievement were of interest. The use of standardized tests normed on hearing children of both English-language and reading achievement is relatively new in the field of deaf education, replacing the use of tests normed on deaf children. Three group and one case study were found (all used the CELF for language assessment), and two of these involved 17 participants each. Standard scores often were reported as group means rather than in a manner that revealed individual scores, and correlations between language scores and reading comprehension typically were not included. Some background characteristics were collected in previous research (e.g. age, unaided hearing loss, date of identification of loss, and length of device use); however, participants' aided hearing acuity was not commonly reported.

The Potential of Sign to Support English Syntax and Morphological Awareness for Reading

Because some of the authors who investigated MA and reading ability when students were D/HH suggested that signing in English might support acquisition of the essential reading skill

of MA (Gaustad et al., 2002; C. Mayer, 2007; C. Mayer & Akamatsu, 2000), various systems are described in the present section, with a focus on SEE. For example, C. Mayer and Trezek (2014) stated that "for the purpose of learning to read, children must have an age-appropriate level of proficiency in the *same language that is to be read and written*" (italics in the original, p. 360). The systems that include signs to code audibly insalient English words (i.e., articles, pronouns, conjunctions) and bound morphemes (the hearing difficulty substantiated empirically by Guo et al., 2013) are Seeing Essential English, or SEE 1 (referred to today as Morphemic Sign Systems, or MSS, as described in Luetke-Stahlman, 1996) and Signing Exact English (SEE or SEE 2; Gustason, Pfetzing, & Zawolkow, 1973; Gustason & Zawolkow, 1993). MSS is used only in Amarillo, TX. Signed English (SE; Bornstein, Saulnier, & Hamilton, 1983), unstudied since the early 1990s, includes only 14 sign markers for bound morphemes, and thus cannot represent Standard English grammar accurately.

SEE is currently used in several school districts in the state of Washington, in more than a dozen regional day-school programs in Texas, and in individual cities in California, Indiana, Kansas, and Nebraska. The primary rationales for its use are that (a) "many word endings are difficult to hear and not visible via speechreading" (e.g., *interest, interesting, interests*, and *interested* are nearly impossible to distinguish) and "some involve hard-to-hear sounds" (Gustason, 1990, p. 109); (b) it makes English morphemes visually apparent and useful as word-decoding tools (Nielsen et al., 2011); and (c) knowledge of Standard English morphology and syntax has been found to facilitate reading comprehension (Knoors & Marschark, 2012).

Attention to the morphemes of English and the syntax of English is a focus of SEE. It was designed to correspond accurately to the number of morphemes of English utterances (Luetke-Stahlman, 1998), providing signs for root words and about 80 affixes (e.g., -al, -ity, re-, un-, -ness, non-), the majority of which do not exist in SE. Different signs exist for different but similar words in SEE. For example, it is possible to use SEE to sign derivations of the word *electric* (e.g., *electrical, electrician, electricity*, and *nonelectrical*), but these derivations cannot be signed in SE. In SEE, an attempt is made to simultaneously speak and sign grammatically accurate English (i.e. Standard English) with all the morphemes of the language included (Gustason, 1990). Moores (2000) noted that the invented systems do not perfectly represent English, and he compared their accuracy to that of written English, which, he claimed, indisputably represented English. His point was that while SEE may not be a "perfect" representation of English, it comes very close, as illustrated in the language sample provided in Appendix A, in which a teacher of the deaf (TOD) speaks English and simultaneously signs SEE. This transcript is from a qualitative study in which TODs were filmed while teaching (M. Mayer, 2013). The purpose of that study was to identify the listening, speech, and English- grammar strategies used during lessons in the school where the filming was done (see Appendix B).

The basic similarities and differences between SEE, other invented sign systems, and ASL are provided by Nielsen et al. (2011), as are the findings of research, published predominantly in the 1990s, documenting that SEE can convey English on the hands when users are motivated and trained, set goals, and are supervised (Leigh, 1995; Luetke-Stahlman, 1989, 1991; M. Mayer & Lowenbraun, 1990), to a degree of accuracy that has been likened to that of English orthography codes for spoken English (Moores, 2000). Research published around this same time found that SEE functions as a primary method of communication (i.e. first language, home language) for many children in the United States (Luetke-Stahlman, 2000; Luetke-Stahlman & Moeller, 1990; C. Mayer & Akamatsu, 2000; Moeller & Luetke-Stahlman, 1990; Nielsen & Luetke-Stahlman, 2002; Schick & Moeller, 1992), and no newer studies could be found. In earlier research (Luetke-Stahlman, 1988a, 1998b), students who used SEE were found to score higher on standardized tests of English language and reading than students using oral English, MSS, SE, PSE, and ASL. More recent research involving SEE and language and/or literacy achievement is unavailable.

The rationale for the use of Standard English via simultaneous spoken English and SEE with students who are D/HH is that it is the national language of the United States and hearing students in this country are expected to learn to speak, understand, use, read, and write age-appropriate English. The relationship of proficient English to grade-level reading comprehension has been well documented for both hearing and deaf children. Fillmore and Snow (2002) stated that students learning English should be exposed to good language models. Therefore, it seems obvious that the teacher's ability to communicate using grammatically accurate Standard English is essential to students' linguistic and literacy growth. Beyond teaching children to read and write, teachers can "help children learn and use aspects of language associated with the academic discourse of the

various school participants" (Fillmore & Snow, 2002, p. 12).

Purpose of the Present Study

A review of the empirical literature shows that there is evidence of a relationship between a student's English-language abilities (e.g., MA and syntax) and reading achievement; that MA has been demonstrated to be an essential skill in the reading process; that some invented sign systems were designed to encode English morphemes; and that approximately half of students who are D/HH do not read as their hearing peers do and plateau at about the fourth-grade level when evaluated with standardized measures. The findings of this review support the QSH (Paul et al., 2013), suggesting that while MA has a role in the reading achievement of all students, QSH calls for "differentiated interventions" (Wang & Andrews, 2014, p. 321) based on the unique needs of students who are D/HH. We hypothesize that if students who are D/HH had access to and were expected to use grammatically accurate English, this access and expectation would support their language and reading development. Thus, the purpose of the present study was to investigate the English-language abilities and reading achievement of a sample of students who were D/HH and attended a school where staff and students communicated simultaneously in grammatically accurate Standard English via speech and SEE. Specifically, the following research questions were investigated:

1. Do the participants demonstrate Standard English morphology and syntax proficiency as measured by informal and formal tests?
2. Do the participants demonstrate reading achievement within the average range of their hearing peers?
3. Are there significant correlations between the participants' English-language and reading scores?
4. Do participants' scores on English-language measures predict reading achievement as measured on a standardized assessment of reading achievement?

Method

Setting

Simultaneous speech and grammatically accurate sign (i.e., SEE) is the communication method used at a school for the deaf located in the northwestern United States where annual evaluation using informal and formal English-language and reading tools guides lesson planning. It is a nonpublic school whose administrators adhere to the rules and regulations of a public school and contract with special education directors from approximately 20 school districts in the area (about a 2-hour radius from the school itself) to enroll a culturally and socioeconomically diverse student body. Students are ages 3 to 13 years (preschool through grade 8) and D/HH. They have been assessed to require specially designed instruction as determined by the individualized education program (IEP) process. Textbooks designed for hearing students enrolled in general education classes are used for all school subjects, including reading. For example, the reading selections in Houghton Mifflin Harcourt's *Collections* series (http://www.hmhco.com/shop/education-curriculum/literature-and-language-arts/literature/collections) require knowledge of morphemes, as demonstrated by Luetke (2013), who analyzed stories from the series, listing the affixes that are common in first- through fifth-grade selections. First-grade stories utilized words with 10 bound morphemes (dis-, -ed, -en, -ly, -ful, -ing, plural -s, possessive -s, third person -s, and -y) that are understood and used by hearing 6-year-olds who are prepared linguistically to read them (de Villiers & de Villiers, 1978). Luetke also found that 21 additional affixes were used in third-grade stories (-able, -an, -ant, -en, -er, -ible, -ic, -ice, in-, -ion, -ious, -its, -ity, -ment, mis-, -or, re-, -sion, -th, -tion, and -un), as well as 9 more in fifth-grade text. Students are expected to read the words that contain the morphemes introduced at their grade level.

With the exception of one child, all students at the school at the time of the present study could detect speech by means of assistive listening devices (hearing aids and CIs). Students at the school are expected to speak and sign grammatically accurate and authentic English (i.e., Standard English). When children speak and use Standard English, they are positively reinforced, and when they do not, a technique called the "Again" strategy is used (Appelman, Callahan, & Lowenbraun, 1980). The "Again" strategy is one of the strategies identified by M. Mayer (2013) that appear in Appendix B, and it affords students multiple exposures to bound morphemes, noted as necessary by Guo et al. (2013).

The philosophy and enforced policy of the school is that students wear their hearing aids or CIs throughout the day. These devices are checked twice daily to ensure that they are working, as are FM systems, which are used to facilitate listening, speech articulation acquisition, English-language development, and literacy attainment. A modification of the Slingerland (1996) approach to visually representing phonemes is taught and used in the preschool, kindergarten, and early primary classes to develop phonological awareness and knowledge of phonics. This method of phonics instruction includes demonstrations and repetition of the manual

handshape of a letter in addition to the formation of the letter drawn in the air to represent a "letter name," the handshape of the letter pulled to one side (usually the right) while one makes the letter sound to represent a "letter sound," and key words posted in the classroom to assist a child in recalling the sound and spelling associated with each letter (e.g., a picture of a ball displayed for the /b/ sound).

Students are placed in grade-level homerooms on the basis of chronological age, and a TOD and an assistant teacher are assigned to each class, which typically totals seven students. In addition to a daily literacy block, math, and other classes (e.g., science, art, music), students receive an individual tutoring session with a TOD for about 15 minutes on most days, and all students are mainstreamed into local area schools with hearing peers for a minimum of one subject. Skills in the areas of listening (the Developmental Approach to Successful Listening; Stout & Van Ert Windle, 1992), speech (Ling, 1978), unit vocabulary, and specific developmentally ordered sentence patterns (Appelman et al., 1980) are assessed and practiced during tutoring. Data taken daily in these four areas are used to inform instruction and are shared on report cards throughout the school year. In the qualitative study referred to previously, M. Mayer (2013) identified 23 listening, 23 spoken-English, and 16 English-grammar strategies that TODs infused into daily lessons to facilitate the development of students' grammatically accurate spoken and signed English. Readers are referred to Appelman et al. (1980) and Appelman, Callahan, M. Mayer, Luetke, and Stryker (2012) for additional information about school policies and curriculum, as well as above-average rates of college graduation and employment of graduates from the school.

Adults' Use of Signing Exact English

Teachers and teaching assistants are observed and monitored monthly by administrators to ensure grammatically accurate and consistent use of Standard English via speech and signs. SEE vocabulary is practiced at weekly staff meetings, and most staff attend annual intensive 3-day professional development sessions on SEE referred to as "Skillshops." The five TODs who taught the students involved in the present study, and one of two administrators who were employed during that time and who taught one literacy class daily, were filmed for the qualitative study of the listening, speech, and English-grammar strategies used during lessons (M. Mayer, 2013). These professionals had been working at the school an average of 13 years (range: 1–30 years) and had been signing SEE an average of 17 years (range: 4–38) at the time of data collection. Two of the TODs involved in the present analysis were certified SEE transliterators, having passed the Educational Sign Skills Evaluation (S.E.E. Center for the Advancement of Deaf Children, 1991) at Level 5, the highest level.

Language samples used in the study by M. Mayer (2013) were later transcribed, and sign-to-voice ratios were calculated (Luetke-Stahlman, 1998) for use in the present study (see Appendix A for an example). At the time of data collection, none of the TODs were aware that sign-to-voice ratios would be calculated as a measure of the degree to which they encoded Standard English in sign. It was found that the TODs signed an average of 94.4% of what they were saying while teaching (see Appendix C).

Participants

At the initiation of the present study, 45 students, ages 3–13 years (i.e., preschool to eighth grade), were enrolled in the school. Twenty-three students were identified by the school administration as having normal intelligence, no additional disabilities that interfered with cognitive development, and English-speaking parents. It was school policy to administer the CELF beginning in second grade, so children in grades 2–8 who met these criteria were potential participants. These 23 students had been enrolled in the school for at least 5 years, with the exception of the youngest child, who had attended for 3 years. Parents of 17 children (74%) granted permission for their child to participate. These children included 8 boys and 9 girls, ranging in age (and grade level) at the time of data collection from 7.6 years (second grade) to 13.9 years (eighth grade). Eleven of the 17 participants were Caucasian, 3 were Asian, and 3 were biracial.

In terms of hearing, all participants were identified as having a hearing loss at a young age: 7 between birth and age 1 year, 6 between ages 1 and 2 years, and the remaining 4 between 2 and 4 years of age. Of the 6 children identified between the ages of 1 and 2 years, 1 had been adopted internationally at 4 years of age, and his age of identification for deafness was reported in his adoption paperwork. Unaided hearing losses of the students ranged from moderate-to-severe to profound, with 13 of the 17 participants identified as profoundly deaf, 2 severely to profoundly, 1 severely, and 1 moderately to severely. Aided PTAs ranged from 10 to 83 dB, with a mean of 27.5 dB. All students used assistive listening devices. Six had received either hearing aids or CIs before their first birthday and another 3 before they were 2 years old. An additional 5 children had received their initial hearing aid or CI before they were 3 years old, 2 between the ages of 3 and 4 years, and 1 between the ages of 4 and

5 years. Eight of the 17 children (47%) had initially worn a hearing aid, but then had CI surgery as young children. At the time of data collection, 11 participants used a CI, and no child was bilaterally implanted. All the students wore amplification at home and school. All participants were monolingual speakers of Standard American English. They came from families where English was the language of the home; no family used ASL in the home. When the students were wearing their equipment (either hearing aids or CIs), 80% could detect sound in the mild hearing range, although research has shown that even a mild loss has educational ramifications (Bess, Dodd-Murphy, & Parker, 1998). See Table 1 for individual participant information.

Measures

In the fall and spring of each academic year, TODs and administrators assess students' English speech and language, as well as academic achievement, using informal and formal assessments. In the year the data for the present study were collected, those adults who were involved in the testing had an average of 13 years of experience giving the assessments described below. (Data for the study were collected in the spring.)

English Language

Both informal and formal measures were used to confirm that the participants used English. The assessments described below have been given by homeroom TODs at the school as a part of an annual IEP evaluation process since at least 2002. All assessments are administered and student responses given in simultaneous spoken and signed Standard English. Each student's speech and signed responses are transcribed so that the most grammatically inclusive utterance is captured. For example, if a student were to respond in speech, "The boys are walk to the car," and simultaneously sign "BOY WALK+ING TO CAR," the utterance "The boys are walking to the car" would be transcribed and credited.

The Photo Articulation Test (PAT-3; Lippke, Dickey, Selmar, & Soder, 1997), a speech articulation inventory, is administered to each student individually in the spring of each school year by his or her homeroom TOD. Students are asked to describe a photo that has been shown reliably to prompt the use of a word with a target sound in the initial, medial, or final position. The test includes 93 items. Test norms were not used in scoring for the present study because the test was designed for children with normal hearing who were ages 3–8 years, and all but one of the study participants were older than 8. Instead, the number of correctly pronounced phonemes out of the to-

Table 1
Characteristics of the Study Participants

Student	Age (yrs.mos.)	Age of hearing loss[a]	Unaided hearing loss	Aided pure tone average (dB)	Equipment (years of use)	Ethnicity
1	7.6	2.0	Moderate to severe	43	Hearing aid (6)	Asian
2	8.11	@ birth	Severe to profound	83	Hearing aid (6)	Asian/White
3	9.5	3.0	Profound	10	Cochlear implant (9)	White
4	9.5	@ birth	Profound	20	Cochlear implant (6)	African American
5	9.11	2.4	Profound	20	Hearing aid (8)	Asian
6	10.7	1.1	Severe	20	Hearing aid (6)	White
7	10.8	4	Profound	20	Cochlear implant (5)[b]	White
8	10.9	1.1	Profound	13	Cochlear implant (8)[b]	White
9	10.11	1.0	Profound	75	Hearing aid (7)	Native American/White
10	11.2	5 mos.	Profound	20	Cochlear implant (10)	White
11	11.5	1.3	Profound	27	Cochlear implant (9)[b]	White
12	11.8	11.5 mos.	Profound	20	Cochlear implant (5)[b]	White
13	11.8	2 mos.	Profound	20	Cochlear implant (6)[b]	White
14	11.11	2.0	Profound	13	Cochlear implant (8)[b]	White
15	12.5	3.0	Profound	15	Cochlear implant (10)[b]	White
16	13.7	6 wks.	Profound	10	Cochlear implant (12)[b]	Asian
17	13.9	9 mos.	Severe to profound	40	Hearing aid (12)	White

Note. The students are sequenced on the basis of age at time of testing, youngest (7.6 years) to oldest (13.9 years).
[a] Years/months (unless otherwise indicated).
[b] Students with cochlear implants who were previously fitted with hearing aids.

tal possible articulation targets was calculated, yielding a raw score.

An expressive structured-language sample using the SPELT also is collected routinely. The questions and commands, provided in the test manual, are designed to elicit target morphological and syntactic English structures when approximately 50 photographs are presented.

An unstructured language sample of each student's use of English also is collected by homeroom TODs and reported on three report cards throughout the school year. The sample has two components. The first is a percentage of 20 utterances that were produced correctly by the student spontaneously while engaged in a routine lesson or classroom activity with classmates and another school professional. Examples of when the TODs collect these unstructured language samples include scenarios such as a science lesson taught by another professional, a whole-group activity facilitated by the teaching assistant, and times when the students were chatting in the lunchroom. In these situations, the TOD focused on and wrote the bimodal language of one student at a time. The second component of the unstructured language sample was the percentage correct of 30 sentences produced by a student (without prompts or modeling) as he or she looks at a book without words. Examples of picture books used in this task include, for first graders, *Frog Goes to Dinner* (M. Mayer, 2003), for fifth graders, *Sing, Pierrot, Sing* (dePaola, 1987), and for sixth graders, *The Snowman Storybook* (Briggs, 1978). The scores showed in Table 2 are percentages based on the number of grammatically correct sentences used by the students out of 50 sentences. A high score on the unstructured language sample is judged by school administrators to be harder to obtain than a structured language score because there is no photo cue or teacher remark to initiate the student's expressive use of English in the homeroom class. It is worth noting that during the time of this data collection, two of the six classroom teachers filmed their language sample collection and watched it to be certain that they had scored the students correctly.

Table 2
Students' English Language and Reading Assessment Scores

Student	PAT (speech articulation) % correct	SPELT (English morphology syntax % correct	Unstructured English-language sample % correct	CELF-4 Receptive Language (NCE)	CELF-4 Expressive Language (NCE)	CELF-4 Core Language (NCE)	Grade level and GMRT test level	GMRT Vocabulary (NCE)	GMRT Comprehension (NCE)	GMRT total (NCE)	MA % correct
1	95	34	30	86	77	78	2	29	32	28	30
2	96	34	30	73	55	54	3	34	34	33	90
3	100	52	32	76	71	64	3	48	55	52	78
4	100	30	18	83	61	62	3	29	35	32	45
5	100	96	86	116	110	112	4	72	75	75	100
6	99	78	48	96	96	97	4	51	42	46	95
7	85	84	62	102	96	96	4	54	55	55	90
8	96	68	52	79	77	72	4	42	51	46	85
9	99	78	62	90	101	94	5	58	68	62	93
10	69	82	64	90	99	98	5	77	81	80	93
11	100	84	42	67	53	62	5	32	25	26	80
12	54	68	60	96	89	91	5	67	68	67	98
13	99	56	44	79	57	64	5	36	27	31	95
14	84	30	38	76	61	58	6	24	52	38	85
15	97	66	56	85	63	69	6	50	38	43	88
16[a]	100	98	82	121	108	112	8	66	75	74	100
17[b]	100	94	82	107	110	118	8	71	77	80	100

Notes. CELF-4 = Clinical Assessment of Language Fundamentals. The mean normal curve equivalent (NCE) of the CELF–4 is 100 (SD = 15).
GMRT = Gates MacGinitie Reading Test: The mean NCE of the GMRT is 50 (SD = 21.06).
MA = morphemic awareness assessment. PAT = Photo Articulation Test. SPELT = Structured Photographic Expressive Language Test.
[a] The CELF was not collected for students 16 and 17 in the year of the present study because of the high scores in the previous year and the fact that they were transitioning to high school at another school. Their CELF data is from the individualized education program from the previous year.

Finally, students were administered the CELF-4, a standardized assessment of Standard English that yields three scores for each participant: Receptive, Expressive, and Core Language. Bennett et al. (2014) recently reviewed formal assessment of the English skills of students who are D/HH and concluded with a strong recommendation that the CELF-4 be used in research and practice. The CELF-4 subtests are Concepts and Following Directions, Word Structure, Recalling Sentences, Formulated Sentences, Word Classes, Sentence Structure, Expressive Vocabulary, Word Definitions, Understanding Spoken Paragraphs, Sentence Assembly, and Semantic Relationships. The majority of the subtests for each composite were the same for all age levels; however, only students age 13 years and older were given the Word Definitions subtest for computation of the Core Language score. One subtest directly assesses MA (Word Structure), while others require the child to *apply* morphemic understanding to be successful at the task. For example, in the Formulated Sentences subtest, the student formulates a sentence about visual stimuli using a targeted word or phrase, for example, "Tell me a sentence about the word I say. You must make your sentence about the picture and use the word I tell you in your sentence. 'Longest.'"

The CELF-4 was given as a part of the annual IEP process at the school, and TODs were unaware that the CELF data would be used for the present study. Approximately half the CELF tests were administered by TODs and the other half by two administrators. All assessors followed the guidelines for administration and scoring as presented in the manual. Accuracy of scoring and conversion of raw scores into standard scores by means of the charts in the manual were verified by four professionals, three of whom were the authors of the present study.

Reading

The fourth edition of the GMRT was selected for the present study because its validity has been researched extensively, it is commonly administered in reading research, and it is useful for comparing scores of children who are D/HH with those of a representative sample of hearing children of the same age and grade. The GMRT yields three scores for each student: Vocabulary, Comprehension, and a total score. The Vocabulary subtest requires the student to read a word that is presented in the context of just a few other words. The student's task is to select the word or phrase that represents the meaning of the target word. The Comprehension subtest is designed to measure a student's ability to demonstrate understanding (e.g., know literal meanings, make inferences, draw conclusions) of expository and narrative texts. The second author administered the GMRT to most participants in small groups by grade level. One group of students took the test in their homeroom, supervised by the third author, a classroom TOD. Accuracy of scoring and conversion of raw scores into standard scores as directed in the charts in the manual was verified by four professionals, three of whom were the authors of the present study.

Demonstration of morphological awareness was assessed not only in the English-language tasks of the SPELT and CELF, but also during reading. A researcher-created assessment, referred to the present article as the Morphological Awareness (MA) task, was designed specifically to assess students' ability to apply their knowledge of the bound morphemes of English to identify the word that would correctly complete a sentence while reading. Forty simple sentences were provided on a work sheet, each with a missing word. This was essentially a cloze procedure, a form of reading assessment (Read, 2000), with choices provided for the reader. Test items were inflectional and derivational morphemes that were developmentally ordered and based on linguistic information from the Developmental Language Curriculum (Cheney, Compton, & Harder, 1988). Examples include "The cat _____ with me yesterday (play, plays, played, playing)" and "That silly behavior is _____ (remature, premature, postmature, immature)." After two practice items were completed in small groups with a TOD, the students completed the MA reading assessment independently by reading each sentence and circling the word that seemed the best fit. This researcher-created reading assessment provided a reading task that focused on students' application of their knowledge of morphology. (A copy of this researcher-created measure is at Appendix D.)

Data Analysis and Results

In the spring of the academic year, the subject background information and assessment data were collected by the second and third authors, an administrator and a TOD at the school. The researchers were recorded and compiled data on an Excel spreadsheet for analysis. Because the students were of different ages and grades, they recorded raw scores for nonstandardized assessments, and identified the standard scores and normal curve equivalents (NCEs) using the test manuals for the standardized measures. Normative tables were based on national samples of hearing children from geographical areas specified by the U.S. Census Bureau.

Research Question 1

To determine whether the participants in the present study demonstrated Standard English morphology and syn-

tax proficiency, both informal and formal tests of English were used. Speech articulation in English, as measured by the PAT, was clearly a strength for most students in the cohort, as may be noted by examining individual percentage-correct scores presented in Table 2 and scores by grade-level groupings (primary and intermediate) in Table 3. While students scored from 54% to 100% correct on the items, the group average (N =17) was 93%. All but 4 students had scores of 95% or higher. There was no developmental pattern within the scores; nor was there a significant relationship between aided hearing and speech as measured by the PAT (correlation = .154, p = .555), or between speech and any of the other language measures.

On both the SPELT structured language sample and the unstructured language sample, older students scored considerably higher as a group than the younger students. (See Table 2 for individual scores and Table 3 for group scores on the SPELT, unstructured language sample, and CELF.) The standardized CELF-4 assessment suggested an overall strength in students' *understanding* of English (receptive) relative to hearing peers. There was wider variability in individuals' expressive English, with a range of scores from more than two standard deviations below the mean to scores above the mean. There was also a developmental pattern evidenced by CELF-4 scores, showing that, overall, older students had much higher standard scores than younger students. As a group, the primary-grade children scored below the average range on the CELF-4. There was wide variability across the students who were enrolled in grades 4–6, although as a group they achieved within the average range. Thus, as a group, students in grades 4 and above demonstrated Standard English proficiency commensurate with that of their hearing peers, but students in the primary grades did not.

Research Question 2

To determine if the participants' reading achievement was within the average range in relation to that of their hearing peers, standard scores (NCEs)

Table 3
English-Language Scores and Reading Achievement Within Grade Level Bands and Whole Group Averages

	Grades 2–3 (n = 4)	*Grades 4–8 (n = 13)*	*All participants*
PAT (speech articulation)	98% correct	91% correct	93% correct
SPELT (structured sample)	38% correct	76% correct	67% correct
Unstructured sample	28% correct	60% correct	52% correct
CELF-4 receptive			
Mean NCE *(SD)*	79.5 (6.0)	92.6 (16)	89.5 (15.1)
Range	73–86	67–121	67–121
CELF-4 Expressive			
Mean NCE *(SD)*	66.0 (9.9)	86.1 (21.2)	81.4 (20.8)
Range	55–77	53–110	53–110
CELF-4 Core			
Mean NCE *(SD)*	64.5 (10.0)	87.9 (20.6)	82.4 (21.0)
Range	54–78	58–118	54–118
GMRT Vocabulary			
Mean NCE *(SD)*	35.0 (9.0)	53.8 (16.7)	49.4 (17.1)
Range	29–48	24–77	24–77
GMRT Comprehension			
M (SD)	39.0 (10.7)	56.5 (19.2)	52.4 (18.9)
Range	32–55	27–77	27–77
GMRT total			
M (SD)	36.3 (10.7)	55.6 (18.7)	51.1 (18.9)
Range	28–52	26–80	26–80
Morphology assessment	60% correct	93% correct	85% correct

Notes. CELF-4 = Clinical Assessment of Language Fundamentals: The mean normal curve equivalent (NCE) of the CELF-4 is 100 (SD = 15). GMRT = Gates-MacGinitie Reading Test. The mean NCE of the GMRT is 50 (SD = 21.06). PAT = Photo Articulation Test. SPELT = Structured Photographic Expressive Language Test.

on the GMRT were compared to national norms. Just as with the CELF, since the students were at various grade levels, NCEs were used to compute group mean scores. The mean NCE for the GMRT was 50 and the standard deviation was 21.06. Thus, students with NCEs between 29 and 71 were considered within the *average range for their grade level* when compared to hearing peers. There were two components to the GMRT, Vocabulary and Comprehension, and a total score, which reflected both components. As a group, the participants' total mean score was 51.1, essentially at the mean. Individual reading scores are presented in Table 2 and group scores in Table 3. On the Vocabulary subtest, 1 student was in the below-average range and 16 (94%) scored within (14 students) or above (2 students) the average range. On both the Comprehension subtest and the total score, 2 students were in the below-average range, and the other 15 (88%) scored within (11 students) or above (4 students) the average range when compared to hearing peers.

Reading scores of students in the primary grades (2–3) were compared to those in the intermediate/middle grades and higher (4–8). (See the NCE means within grade-level bands presented in Table 3.) As groups, both the primary-grade and intermediate-and-higher-grade students' achievement was within the average range for their grade level when compared to the performance of hearing peers. Proficiency generally improved as students advanced in grade level. Of the 13 students in grades 4–8, one was in the below-average range and the rest (92%) were in the average (8 students) or above-average range (4 students), as determined from the GMRT total score. Thus, the reading achievement of this group of students did not plateau.

Table 4
Correlations Between English-Language Measures and Reading Achievement ($N = 17$)

	GMRT Vocabulary	*GMRT Comprehension*	*GMRT total*
PAT (speech)	–.316	–.354	–.312
SPELT (structured sample)	.796**	.604*	.718**
Unstructured sample	.860**	.784**	.854**
CELF-4 Receptive	.754**	.709*	.771**
CELF-4 Expressive	.855**	.849**	.882**
CELF-4 Core	.861**	.789**	.859**

Notes. CELF-4 = Clinical Evaluation of Language Fundamentals–4. GMRT = Gates-MacGinitie Reading Tests. PAT = Photo Articulation Test. SPELT = Structured Photographic Expressive Language Test.
*$p < .05$. **$p < .01$.

While the MA assessment was not used to directly answer the research question about comparing participants' achievement to that of hearing peers, as was possible with the standardized GMRT, it does provide additional reading achievement information on the participants. The individual scores (Table 2) and grade-level band group achievement (Table 3), as well as significant correlations between achievement on the MA assessment and the GMRT Vocabulary (.622, $p = .008$) and Comprehension (.523, $p = .031$) subtests and the total score (.593, $p = .012$), suggest that the students used their knowledge of morphology to select the appropriate word on this cloze-style reading measure and that ability was highly related to their achievement on a standardized reading measure, the GMRT.

Research Question 3

To determine if there were significant correlations between the participants' English-language proficiency and reading achievement, a correlational analysis was run using the raw scores on the informal measures of English (PAT, SPELT, unstructured language sample) and the standard scores (NCEs) on the CELF-4 compared to the NCEs on the GMRT. The results, as presented in Table 4, indicate that while speech scores (PAT) were not significantly correlated to reading scores, proficiency on measures of English language were significantly correlated to reading achievement.

Research Question 4

A multiple-regression analysis was used to evaluate if students' competency in English predicted their reading achievement as measured on a standardized assessment of reading achievement. Since the subtests of the GMRT (Vocabulary and Comprehension) were significantly correlated with the total score ($r = .956$ and $r = .971$, both $p < .001$), and as the total score reflected both the Vocabulary and Comprehension components of the GMRT, the GMRT total score was used as the dependent variable in the analysis. The standard scores of the Receptive and Expressive components of the CELF-4 were treated as the predictor variables. The results of the regression analysis revealed that the two predictor variables, when studied simultaneously, explained 78% of the variance in reading achievement scores ($R^2 = .778$, $p < .001$).

Discussion and Directions for Future Research

The present study examined the English-language (i.e., morphology and syntax) and reading abilities of a cohort of students at a school where Standard

American English was used in simultaneously spoken and signed communication. Students were expected to use grammatically correct English, and their progress was systematically documented. The children had worn hearing aids and/or CIs from a young age, were monolingual speakers of English, and had been administered informal and formal measures of English speech, language, and reading.

While most students had high scores on the PAT-3, speech articulation ability did not correlate significantly with language or reading ability. Instead, the consistent variable that was associated with reading proficiency was access to grammatically accurate English morphology and syntax, which was available to the students at this school via SEE. Perhaps unique to the field of deaf education, speech-articulation ability often does not reflect age-appropriate language ability. As Appelman et al. (2012) advised, educators can do much to assist students who are D/HH to obtain the same age-appropriate English that is acquired by their hearing peers and required for academic advancement and employment. Adults can model grammatically correct English, just as they would if they were instructing hearing children; there is no research to suggest otherwise. They can be aware of the research that documents how difficult it is to hear pronouns, articles, and bound morphemes, and, when words or word parts are inaudible to a student, pair sign with their speech. If children who are D/HH cannot hear the quick, quiet morphemes of English, they do not use them; if they do not express them, they do not read them well.

In the present study, a developmental trend was documented across the results of the informal and formal tests of the English language (morphology and syntax), with the older students speaking, understanding, and using more grammatically correct English than the younger children. This trend is supportive of the CALP theory (Cummins 1980, 1984) stating that while many children develop basic, routinized language within 2 years of immersion in the target language (or system), it takes 5–7 years for a child to develop the decontextualized academic language necessary for academic achievement. While as a group the primary-grade students were in the below-average range on standardized measures in comparison to their hearing peers, the intermediate middle-grades group demonstrated receptive and expressive Standard English proficiency within the average range. This finding is similar to that in the case study of a child who used SEE (Nielsen & Luetke-Stahlman, 2002) in which the child had low CELF scores in the primary grades, but scored in the average range by grade 5. In addition, the language findings of the present study differ from the results of previous research that did not find the language development of this population within the average range (e.g., Johnson & Goswami, 2010) or that found that children who received CIs at an early age achieved within the average range only on some measures (e.g., narrative ability and receptive vocabulary) but not on syntax-related measures (e.g., Geers, Nicholas, & Sedey, 2003). Cannon and Kirby (2013) found that students who are D/HH struggle with many morphosyntactic structures of English. The results of the present study suggest that the modeling and expectation of grammatically correct morphology and syntax require attention if students who are D/HH are to acquire CALP and reading proficiency, particularly as they read and discuss more challenging content-area text.

Since student morphology and syntax abilities were the focus of the present study, it is important to note that only four previous studies regarding reading and deafness have used a standardized English-language measure *in addition to* a standardized reading measure in the same investigation, a practice that allows a comparison to hearing norms and a more realistic impression of a D/HH student's abilities compared to those of hearing peers. That is, the CELF-4, commonly used and respected (Bennett et al, 2014), measured the ability of children in this cohort to analyze, understand, and express the morphemes of English with little pictorial support, repetition, or example, as required in the academic arena (Nagy et. al, 2014).

Findings about deafness and the acquisition of English syntax and morphology in the present study might add to the body of research in deaf education because, as Gaustad and Kelly (2004) suggested, deaf students require excellent models of and exposure to morphological aspects of English in order to continue to progress in language and literacy. It is possible that the children in the present study benefited from more exposure to a wider variety of English morphology in conversation, as was also recommended by C. Mayer (2007), which perhaps was an improvement on the "insufficient morphographic skills" demonstrated by the deaf students in previous investigations lead by Gaustad (Gaustad & Kelly, 2004; Gaustad et al., 2002) and summarized in the review of the literature. Because English-based signing has been suggested as necessary to increase age-appropriate English literacy in deaf education (C. Mayer, 2007; C. Mayer & Akamatsu, 2000), and the SEE signing used at the school in the present study is not used in most places in the country, the results of the study might be of interest to others working in the field of deaf education. It might be

advantageous to study the English-language and reading abilities of other groups of students who are using particular invented sign systems and compare the results to those reported here.

That the students in the present study used English via simultaneous spoken English and SEE was evidenced in the language sampling that was transcribed for the SPELT (structured) and unstructured language samples, as well as in CELF subtest scores. More extensive sign-to-voice ratios and longer language samples for teachers and students would improve future investigations. In addition, the expectation at the school in this study was that Standard English be used as it would be in any other classroom in the country (Fillmore & Snow, 2002) by teachers and students alike. The study might be a contribution to the field because such effort was taken in the program to use and have the students use English (simultaneously spoken and SEE) and because the opportunity to do research on such a program is not easily afforded to other researchers. The characteristics found in previous research (Appelman et al., 2012; Leigh, 1995; Luetke-Stahlman, 1989, 1991; M. Mayer & Lowenbraun, 1990) to result in the most accurate representation of Standard English grammar via sign (i.e., attitude, training, goal setting, and monthly supervision) were components of the program in which the students in the present study were enrolled. Even so, more specific study is needed to determine if SEE assists students in understanding and using English signs for pronouns, conjunctions, articles, and bound morphemes that are not signed in many sign systems (e.g., Pidgin Signed English), but are required to obtain a high score on the SPELT and CELF. The present study adds to the research literature because it is a newer study in which an invented sign system (SEE) used in conjunction with simultaneous speech was found to function as a first or primary language for a group of children who were D/HH (Luetke-Stahlman, 2000; Luetke-Stahlman & Moeller, 1990; C. Mayer & Akamatsu, 2000; Moeller & Luetke-Stahlman, 1990; Nielsen & Luetke-Stahlman, 2002; Schick & Moeller, 1992).

Just as with the language-assessment findings, the findings on reading achievement differed for the two groups of students in the present study. The younger students (second and third graders) did not read within the average range when compared to hearing peers. One possible explanation is that they were in the process of developing their English-language skills, as reflected in their CELF scores, and as is explained by the Cummins model of CALP mentioned above (Cummins, 1980, 1984). The result of the present study was that as a group, the older students (in grades 4–8) read within the average range on the standardized reading test that assessed both reading vocabulary and comprehension. For them as a group, reading achievement did not plateau at grade 4 (Spencer & Marschark, 2010; Traxler, 2000), a finding that contrasts with those of previous research, which did not include students exposed to and using SEE (e.g., Cannon & Kirby, 2013; Geers, Tobey, Moog, & Brenner, 2008; Harris & Terlektsi, 2011; Kyle & Harris, 2010).

While we acknowledge that not all of the older students in the present study were reading at grade level, an explanation for the achievement of those reading at or above grade level may be found in an examination of individual English-language scores as measured on the CELF and the GMRT reading achievement scores. They illustrate the well-documented relationship between English-language abilities and reading achievement that was presented in the review of the literature and found in the correlational analyses of the present study. The stronger the English-language skills of a learner, the more access that learner has to the academic content of the classroom, both presented by the teacher and read. As Marschark, Rhoten, and Fabich (2007) pointed out, children who are D/HH, even with CIs, probably are missing out on some information in their classes. If SEE can support greater access to the language of academic content, then students will have a better chance of making progress both linguistically and in their studies. Wang and Andrews (2014), who provided an overview of the QSH, discussed at the beginning of the present article, noted that "while suggesting qualitative similarities in language and reading components that are the same for anyone engaged in learning English" (p. 321), the allowance of individual differences in the model is particularly relevant in understanding why some students do not achieve at or above grade level.

Explanations for reading achievement, or the lack thereof, are complex. While explicit attention to grammatically accurate Standard English is essential and needs to be further investigated, it is important that members of the research community study other reading-related variables as well. For example, Geers et al. (2008) called for research that would examine multiple student-background variables in relation to reading achievement to help further explain student outcomes. Such information might help researchers identify factors to include in their investigations. While not within the scope of the present article to present, information on other variables (e.g., age of access to English language, parental signing ability, and parental engagement in school activities) was

collected at the same time as the present study, and examined in an effort to further understand individuals' progress, or lack thereof. Case studies are available (McLean, Nielsen, Stryker, & Luetke, 2014) of four intermediate-grade students who had many of the same characteristics (intelligence, ethnicity, closeness in age at the time of identification of hearing loss) but developed age-appropriate English-language proficiency and reading achievement to different degrees.

A standardized measure that focuses on students' ability to apply knowledge of inflectional and derivational morphology when reading is not available. For the present study, as in the few studies that included a MA assessment (e.g., Gaustad & Kelly, 2004; Gaustad et al., 2002; Moores & Sweet, 1990), a researcher-created assessment was used. It was found that all comparisons between MA scores and the scores on the CELF and GMRT subtests showed significant correlations—with correlations that compared MA scores with GMRT Vocabulary subtest scores being the highest. These results are reported with caution because the MA tool was not subjected to reliability or validity measures, but the associative nature of the findings of the present study might motivate future researchers to develop a more stringent test. The recent work of Cannon and Kirby (2013) on the grammatical structures that are the most challenging to students who are D/HH may be important to consider in the development of such an assessment.

There are additional ways in which the findings of the present investigation might add to the research in deaf education. Information on aided hearing acuity, as well as the commonly included unaided hearing data, was included on each participant. The students in the present study were elementary and middle-grade students who were D/HH, not beginning readers or college students, as has been the case in much of the past research regarding reading and deafness. When standardized tests of English language and reading normed on hearing children have been used in previous research in deaf education, only group averages have been reported, not also individual scores as in the present study. When only averaged scores are reported, it is difficult to examine the interrelationships of variables that might inform the understanding of the factors that affect English-language and reading achievement when D/HH children are in the elementary and middle-school grades and are thus expected to be reading beyond the emergent and beginning reading levels.

Limitations of the Study

One limitations of the present study was that the sample was small (N =17), although it was similar in size to samples in other studies reviewed above. Also, the sample consisted of a group of students from only one school. While the sample was diverse in terms of ethnicity and family background, it did not allow for generalization or analysis beyond itself.

Second, while the MA assessment, designed to measure application of morphological knowledge in a reading task, was found to be significantly correlated to the vocabulary component of the standardized GMRT (.622, p =. 008), it was not subjected to measures of reliability and validity, and older students reached a score ceiling on it. Therefore, the findings are reported with caution. A future version of this assessment tool should include additional items of more difficulty and should be subjected to reliability and validity testing.

Third, the sign-to-voice ratios of the teachers at the school were calculated from short segments. Thus, it cannot be reported with complete certainty that these adults consistently used grammatically accurate English; research to replicate these ratios should be conducted.

Fourth, because student language samples for unstructured and structured language and some CELF tests were collected by homeroom TODs as a part of the IEP process and not judged by a second rater, student use of Standard English is reported with caution. If the present study is replicated, interjudge reliability measures should be employed. For example, testing should be administrated by an uninvolved third party and interjudge reliability reported.

Conclusion

Research continues to suggest that the gap between the reading achievement of students who are D/HH and that of their hearing peers widens as students move beyond the primary grades (e.g., Geers et al., 2008; Harris & Terlektsi, 2011). However, as presented in detail by Paul et al. (2013) in their book on the QSH, whether students are hearing native English speakers, English-language learners, or students who are D/HH, their learning and development of the English language and reading are similar, even if the rate of learning is different.

Researchers in varied disciplines need to collaborate and study the various aspects of English-language and reading development and identify "evidence- and reason-based instructional strategies" (Paul et al., 2013, p. 151) in order to support students who are D/HH. The purpose of the present study was to investigate two such aspects: the role of access to the morphology and syntax of English-language development and reading achievement. The participants were D/HH and enrolled in the same school

program, where simultaneous speech and a specific system of grammatically accurate SEE was modeled and expected. This system gave these students access to the audibly insalient components of English, such as pronouns, articles, conjunctions, and bound morphemes, critical for gaining access to the vocabulary and grammar common in reading materials beyond the third grade. We hypothesized that such access would allow the study participants to achieve within the average range on standardized measures of language and reading when compared to hearing peers. It was found that there was a developmental trend (and no plateau) in the English-language and reading achievement of the students, with the older ones scoring generally higher than the younger ones; more than half of the participants demonstrated average or above-average command of morphology and syntax, an integral CALP component (Cummins, 1980, 1984). MA was necessary to receive a high test score, and speech was not significantly correlated with language skills or reading achievement. In addition, students with higher English-language ability scored higher in general on tests of reading vocabulary and comprehension; as a group, the students read within the average range when compared to hearing peers on a standardized measure of reading achievement; all but one of the students in grades 4–8 read within the average range. Thus, achievement did not plateau for this group. Finally, language proficiency, as measured on the standardized CELF-4, predicted reading achievement.

The present study is a contribution to the field of deaf education because it underscores the need for access to the morphology of English when students are D/HH—essential to unlocking the words of more challenging text—through a specific invented sign system. It is critical that ways to provide more access to English morphology be identified as one means of supporting students who are D/HH so that they can continue to progress and reach their literacy and academic potential.

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Appendix A

Language Sample of a Teacher of the Deaf (TOD) at a School Using Simultaneous Spoken English and Signing Exact English (SEE)

The following transcription uses the convention of lowercase letters to represent spoken-English words and underlining to represent signed morphemes. For example, the words for "DO YOU THINK THOSE ARE COCONUT+S marker" are underlined in the first utterance to show that TOD 1 paired seven signs with speech when talking to a kindergarten child during tutoring.

	Signed
Oh, do you think those are apples?	(7)
Oh, you know what?	(3)
Those are coconuts.	(4)
Yeah, with an /s/ on the end.	(5)
Because I see 1, 2, 3, 4, 5, 6.	(9)
Six coconuts—yeah (Reinforcing listening).	
Can you tell me the /s/ on the end of coconuts?	(12)
Good /s/ sound.	(3)
Very nice.	(2)
You love coconuts?	(4)
Oh, you are asking for the squirrel.	(7)
May I have the squirrel?	(5)
Ah, again.	(1)
OK, listen again for the word "the."	(6)
Listen.	(1)
(Said behind a speech hoop) May I have the squirrel?	
Oh, you are so close!	(4)
Good job.	(2)
Listen again for "may I."	(5)
(Said behind a speech hoop) May I have the squirrel?	
(Routine reinforcement) Good job.	
You may have the squirrel after we are finished with vocabulary.	(11)
OK?	(1)
You say "OK."	(3)
OK.	(1)
Listen again.	(2)
You may have the squirrel after we finish with vocabulary.	(10)
(Said behind a speech hoop) OK.	
Better /k/ sound.	(3)
Good job.	(2)

Notes. Sign-to-voice ratio = 113 of 119, or 95%. Sign-to-voice ratio if the word "oh" is counted = 94%.

Appendix B

Communication Strategies Used at the School in Conjunction With Signing Exact English (SEE)

LISTENING

1. Audiological management of assistive listening devices that are state of the art, worn daily, working, and safe.
   a. Equipment checked twice daily, including the Ling Six Sound Test.
   b. Children begin to learn to manage and maintain their equipment beginning at 3 years of age.
2. Listening skills are assessed both formally and informally, with instruction guided by daily record keeping.
3. Listening instruction, reinforcement, and practice are embedded in all lessons throughout the day so that automatic listening skills are developed (Appelman et al., 1980).
4. Daily, individualized, direct instruction based on each student's needs is provided by a trained teacher of the deaf.
5. Modeling, reinforcement, and repetition are used to encourage listening.
6. Request students to listen/audition only, using a speech/listening hoop, standing behind or to the side of the child or turning away, asking students to close their eyes or put their heads down, etc.
7. "Verbal highlighting" is used with and without the speech hoop.
8. Students are requested to listen for a particular phoneme, morpheme, phrase, or utterance.
9. Use of "Auditory Sandwich" [e.g., "Touch the /–s/ (auditory); touch the /–s/ (auditory and sign); touch the /–s/ (auditory only)].
10. Speaking and using the speech hoop while counting syllables via sign.

SPEECH ARTICULATION

11. Speech skills are assessed both formally and informally, with instruction guided by daily record keeping.
12. The "Again" strategy: Speech instruction, reinforcement, and practice are embedded in all lessons throughout the school day, so that automatic speech skills are developed (Appelman et al., 1980).
13. Modeling, specific reinforcement, and repetition are used to encourage speech production (e.g., "You said a better /k/ sound! Good job! /k/, /k/. Good").
14. Daily, individualized, direct instruction based on each student's needs is provided by the trained teacher of the deaf.
15. Highlighting of phonemes, syllables, and morphemes, in speech and signs, is used.
16. Direct instruction is used (e.g., "You are saying a /d/ sound; I want it to come from the back of your throat").
17. Physical prompts are used to aid production.
18. Words are broken up into familiar parts of speech so that the child can produce each syllable (e.g., "cat er pill ar").
19. The handshape is used at the beginning of a sign to cue the word the teacher predicts the child might omit as he or she is speaking.
20. The student is requested to say a specific phoneme, morpheme, word, or phrase.

ENGLISH GRAMMAR

21. Grammar skills are assessed formally and informally, with instruction guided by daily record keeping.
22. The "Again" strategy: Grammar instruction, reinforcement, and practice are embedded in all lesson throughout the day so that automatic grammar skills are developed (Appelman et al., 1980).

23. Modeling, reinforcement, and repetition of grammatically accurate, authentic Standard English in simultaneous spoken English and SEE are used.
24. Receptive and expressive skills are assessed both formally and informally, with language instruction guided by daily record keeping.
25. Strategies for using correct vocabulary and grammar are embedded in all lessons throughout the day so that automatic grammar skills are developed (Appelman et al., 1980).
26. Daily individual direct instruction based on each student's needs is provided by the teacher of the deaf.
27. Highlighting of phonemes, syllables, and morphemes in speech and signs is used.
28. Direct instruction is used (e.g., "Can you put the word "an" in that sentence?").
29. Respond to child-led topic, expand utterance, paraphrase, etc. (Luetke-Stahlman, 1998).
30. Manually modeling, correcting, or manipulating fingers and hands is used to promote correct articulation of signed morphemes.

Appendix C

Grammatical Signing While Speaking, Calculated for Language Samples in M. Mayer (2013)

Teachers	Omissions	Student age, number of samples	Sign-to-voice ratio
TOD 1	1 one-word comment; 1 five-word utterance; 3 uses of "ah" or "oh"; 1 use of "OK."	1 sample, kindergartener	95%, 26 utterances (see Appendix A).
TOD 2, reading discussion	–1 "yes/yeah" at the beginning of utterances; –1 word ("but") at beginning of utterance.	3 samples; fourth graders	97%, 20 sentences
TOD 3, math discussion	–1 third-person "s"; the word "so" at the beginning of an utterance; –1 contracted "s"	7th–8th grade math	98%, 20 sentences
TOD 4, math with speech correction work	2– plural "s" 3–yeah/yup and 1 OK at the beginning of utterances; 3–word "6" and "60" during speech work; 5 morphemes at the beginning of two different sentences.	2 sessions with 7th–8th graders	90% with speech work, 92% without speech work; 20 sentences
TOD 5	"OK" and "oops" omitted at the beginning of two utterances; 1 five-word utterance	Fourth graders; speech and listening work during vocabulary review	92%, 16 utterances

Appendix D

Morphemic Awareness (MA) Assessment

Item	Sentence starter	Circle the answer
1	The cat was _____ with me.	play plays played playing
2	The boy _____ loudly, doesn't he?	talk talks talking talked
3	Dad ____ the steps yesterday.	clean cleans cleaned cleaning
4	I see many _____ at the school.	buses bus busing busly
5	The girl ____ well.	readly reading reads readed
6	Dad _____ the house last week.	paint paints painting painted
7	The bee _____ noisily.	buzz buzzes buzzly buzzment
8	The dog is _____ with the boy.	running runs ran run
9	She makes me laugh. She is so _____.	funny funniness funnying funniest
10	He ____ the race last year.	win won winning winded

11	Her mother looks _____.	love loves loveful lovely
12	His hands are so ____!	dirtiness dirted dirty dirt
13	That's the ____ food.	cat cat's cats catful
14	She acted ____.	bravely braved braving braves
15	The boy ____down yesterday.	fall falls fells fell
16	That is the _____ toy.	dog dogs dog's dogful
17.	OK, good, we are in _____.	agreement agree agrees agreeing
18	That baby is the _____ kid in the world!	happy happiest happier happily
19	I am _____ the toy can be fixed.	hope hoped hopefully hopeful
20	The green book is the _____ one of all.	new newer newest news

21	Wow, that tool is really _____.	use useful using usement
22	The nozzle is broken. There is no ____.	movement move moves moved
23	I don't want any of that food because it's ____.	taste tastes tasting tasteless
24	You showed _____ when you helped her.	kind kindly kindness kindful
25	Please ___ your hair because I like it better when it's long.	reclip unclip misclip preclip
26	The green wagon is _____ than the red wagon.	longest long longing longer
27	Put your dirty clothes in the laundry basket after you ___.	disdress predress undress imdress
28	Did you _____ while I was gone today?	misbehave unbehave prebehave rebehave
29	Watch out! You are being _____.	careless carely careful caring
30	Don't _____ the words on your spelling test.	unspell disspell respell misspell

31	The blue truck is _____ than the green car.	big biggest bigger bigging
32	I didn't hear you. Will you _____ what you said?	dispeat repeat mispeat unpeat
33	Mom _____ with me and said I was wrong.	reagreed misagreed unagreed disagreed
34	Before starting to bake the cookies, ___ the oven.	preheat disheat reheat unheat
35	I feel such _____.	happy happiness happily happyful
36	Please _____ that messy paper.	diswrite unwrite rewrite prewrite
37	The car didn't move. It was _____.	mismobile premobile immobile remobile
38	I think you were ____ when you said you said you didn't cheat.	mishonest dishonest rehonest unhonest
39	I will give you a _____ to see which words you already know how to spell.	pretest untest retest mistest
40	That silly behavior is _____.	remature premature postmature immature