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The Importance of Morphemic Awareness to Reading Achievement and the Potential of Signing Morphemes to Supporting Reading Development

Diane Corcoran Nielsen*[,1], Barbara Luetke[2], Deborah S. Stryker[3]

[1]University of Kansas

[2]Northwest School for Hearing-Impaired Children

[3]Bloomsburg University of Pennsylvania

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The ability to access and understand the meaning of multimorphemic words is essential for age-appropriate literacy growth as well as for achievement in other participants, such as science and social studies, which are so print-dependent. This paper provides a theoretical basis for focusing on the morphology of English when teaching students who are deaf or hard of hearing to read through a review of the literature on the role of morphology in reading for both hearing students and those with a hearing loss. In addition, the authors review the empirical literature on Signing Exact English (SEE), a system of signing English constructed in which the morphology of words is made visible to children who might not be able to hear them. The authors propose that students' use of SEE can provide a bridge to developing the morphemic awareness so necessary for age-appropriate reading development and achievement.

The Advantage of Signing Morphemes When Learning to Read

The process of learning to recognize words and to comprehend what one has read is the same for all students, hearing or deaf (Nielsen & Luetke-Stahlman, 2002; Paul, 1998a). Research suggests that there is a reciprocal relationship between vocabulary and comprehension (see Bauman, 2009, for a review). The larger the student's reading vocabulary, the better his or her comprehension, and the more one comprehends, the more one can learn new words (Stanovich, 1986). A clear thread in reading research findings is that as students move beyond primary-grade reading materials, the words they read get longer and the demands of vocabulary increase; such changes make comprehension more challenging (Carlisle, 2004; RAND Reading Study Group, 2002).

Vocabulary knowledge is not a simple construct. To know a word well, one not only must know the definition of the word but also its relationship to other words, including other morphological forms of the word (Nagy & Scott, 2000). Students with well-developed vocabularies understand how language works and thus are essentially metacognitive about words. Such understanding allows them to use grammatical clues to learn new words more readily (RAND Reading Study Group, 2002). Comprehending informational text (science, social studies, mathematics) is particularly important to school achievement, where the "academic" vocabulary is key to understanding the content. Given the number and variety of new words a student must learn to comprehend text on unfamiliar topics, knowing how to use the morphology of words is an essential skill (Carlisle, 2004).

Readers use the morphology of known words to unlock the meaning of unfamiliar multi-morphemic words while reading and thus expand their vocabulary and comprehension of text (Nagy & Anderson, 1984; Nagy, Berninger, Abbott, Vaughan, & Vermeulen, 2003; Nagy, Herman, & Anderson, 1985). Morphemes, the smallest

*Correspondence should be sent to Diane Corcoran Nielsen, University of Kansas, 446 JR Pearson Hall, 1122 West Campus Road, Lawrence, KS 66045-2340 (e-mail:dnielsen@ku.edu).

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units of meaning, are key elements in the reading process. Morphological awareness, essentially a student's understanding that words are made up of meaningful units, is operationalized when a student takes a complex word apart to make sense of it and to uncover the relationship between this word and others. Proficient readers do this automatically, which helps them learn more words and comprehend new information (Carlisle, 2004). Given this process, the purpose of this paper is twofold. First, we provide a theoretical basis for focusing on the morphology of English when teaching deaf students to read through a review of the literature on the role of morphology in reading for both hearing students and those who are deaf or hard of hearing. Our second purpose is to review the empirical literature on Signing Exact English (SEE; Gustason & Zawolkow, 1993) and to demonstrate its potential to represent the morphology of English on the hands as an aid to reading on grade level.

Morphology and Reading: Research on Hearing Students

Nagy, his colleagues (Nagy & Anderson, 1984; Nagy et al., 2003; Nagy et al., 1985), and others have conducted numerous empirical investigations to substantiate the relationship between morphemic knowledge, both derivational and inflectional, and reading. According to Verhoeven and Perfetti (2003), derivational morphology involves words formed from a base morpheme across different grammatical categories (e.g., *dark*, *darkness*, and *darken*), and inflectional morphology involves additions to a word's stem (e.g., *-s*, *ing*, *-ed*). Nagy, Berninger, and Abbott (2006) explained that within the English language over half of the words are morphologically complex and are more common in written language than in speech.

Researchers have found that even young readers demonstrate morphemic abilities when they read. Research by Nagy et al. (2003), as well as by Rubin (1988), found that for hearing second graders, morphemic knowledge made a significant unique contribution to reading achievement when phonological and orthographical abilities, as well as expressive vocabulary, were controlled. Similarly, a study by Deacon and Kirby (2004) revealed that second-grade morphemic abilities predicted fourth- and fifth-grade reading comprehension. A common conclusion in the studies reviewed by Apel and Swank (1999) and Carlisle (1995, 2004) was that morphology is routinely used by hearing children as a word-recognition strategy by third grade and that poor English morphological awareness contributes to poor decoding skills. The findings of Deacon and Kirby revealed that morphemic awareness made a significant unique contribution to decoding beyond that of the phonological for third, fourth, and fifth graders. This shift, from phonological to morphological word analysis, was also documented by Mahoney, Singson, and Mann (2000), who reported it for typical (hearing) fourth graders, an age when the reading achievement of deaf students is often reported to plateau (Traxler, 2000).

In a very recent study, Berninger, Abbott, Nagy, and Carlisle (2010) investigated the growth of phonological, orthographic, and morphological awareness from Grades 1–6. Using growth curve analysis, the authors found

> that (a) word-level phonological and orthographic awareness show greatest growth during the primary grades but some additional growth thereafter, and (b) three kinds of morphological awareness show greatest growth in the first three or four grades but one—derivation—continues to show substantial growth after fourth grade (p. 141).

These findings reinforce the importance of attention to morphemic awareness, even with young readers. Researchers emphasized that their findings point to the value of attention, even with beginning readers, to more than the phonological aspects of words. Among the authors' recommendations was to convey the importance of morphological awareness with practitioners and to provide them with suggestions for instruction that support its development, reminding teachers that their students' reading achievement will be optimized as a result.

Anglin (1993) studied the relationship between students' use of morphology and lexical development in first, third, and fifth grades. He found that students' knowledge of derived words increased sharply between first and fifth grades. Anglin noted that this finding supports the idea that lexical development is characterized by increasing morphological complexity. He found evidence, for example, that as children increased in age, so

too did their use of morphemic analysis to figure out more complex words. His analysis revealed that the middle-grade students learned an average of 8–10 multi-morphemic words per day, potentially "thousands" per year. Thus, as Gaustad and Kelly (2004) suggested, "morphologically based vocabulary growth, rather than being linear, is more likely to be exponential" (p. 272).

Nagy et al. (2006), who studied the contribution of the morphological awareness of students in fourth/fifth, sixth/seventh, and eighth/ninth grades with regard to aspects of reading (vocabulary, comprehension, and rate of spelling and decoding morphologically complex words), empirically verified the importance of morphological awareness. They found that morphological awareness made significant and unique contributions to vocabulary, reading comprehension, and spelling for all groups, as well as to the decoding rate of the eighth/ninth graders. In addition, their analysis revealed that for all three groups, morphological awareness significantly affected reading comprehension, even "above and beyond that of reading vocabulary" (p. 134). Because reading comprehension is the ultimate goal for all readers, these findings are not only statistically significant but also of paramount importance with regard to practical application.

Whereas most research on reading has been done with native English speakers, there is a growing body of knowledge focused on the reading development and achievement of English language learners (ELLs). The recently published findings of the *National Literacy Panel on Language Minority Children and Youth* (August & Shanahan, 2006) reported that some of the same elements of reading (e.g., phonological awareness) that affect native speakers' reading achievement also affect the reading achievement of ELLs. Whereas most of the research with ELLs has focused on vocabulary knowledge in general, recent studies have focused on the role of morphology. For example, Kieffer and Lesaux (2008) investigated the relationship between (derivational) morphological awareness and reading comprehension in English of a group of ELLs whose first language was Spanish. The researchers followed the students for 2 years (fourth through fifth grade) and found that during this time, the relationship between morphology and comprehension increased. In addition, the students' morphological awareness was a significant predictor of their reading comprehension in fifth grade.

Carlo et al. (2004) studied the effect of a vocabulary-focused intervention on fifth-grade participants' knowledge of taught words, depth of vocabulary knowledge, understanding of multiple meanings, and reading comprehension. The intervention included explicit instruction of selected academic vocabulary as well as strategies (use of cognates, context, and morphology) to learn new words. They found that the effects of the intervention "were as large for the English-language learners (ELLs) as for the English-only speakers (EOs), though the ELLs scored lower on all pre-and posttest measures" (p. 189). In a similar study with 346 sixth-grade ELLs and 130 English-only peers, Lesaux, Kieffer, Faller, and Kelley (2010) found that an academic vocabulary intervention resulted in significant effects on several aspects of vocabulary knowledge, including morphological awareness ($p = .0003$). Effects for ELLs were comparable to their English-only peers.

Morphology, Reading, and Deafness

In a study by White, Power, and White (1989), the authors also found that morphology plays an important role in students' reading development. They explained that in the mature reader, processing the morphology of print is a key to decoding speed and efficiency in that the proficient reader is able to delete affixes to discern a root form of a word, check that word for its meaning, and then add the meaning of the root word to the meaning of each of the affixed morphemes to uncover the meaning of the whole word. They noted that morphology accounts for the rapid growth in students' vocabulary knowledge in the elementary grades. When the reader is deaf and not able to hear the various morphemes of spoken words or hear them well, visual experiences with affixes and roots are necessary.

Gaustad and Kelly (2004) agreed with Moats (1998) that English is a "deeply alphabetic" system, such that

> printed forms of words reflect not only phonemic content but syllabic, morphemic, and orthographic regularities as well … . In English the compilation of meaning within words and discrimination among

> the meanings for different words is accomplished principally through affixing, by rule-governed sequencing of affixed morphemes in complex multimorpheme English words (p. 270).

When students who are deaf and hard of hearing are below the norm in development of their comprehension and use of "though the air" conversational use of morphology, instruction can make a difference. For example, one purpose of a study by Bow, Blamey, Paatsch, and Sarant (2004) was to investigate the effect of 9 weeks of morphological training, focusing on inflectional morphemes, on the grammatical judgments of 17 deaf and hard-of-hearing primary-school students (aged 5–11 years). To be considered for the study, all participants struggled with basic morphological structures as indicated on results of the Word Structure subtests of the *Clinical Evaluation of Language Fundamentals* (Semel, Wiig, & Secord, 1995) and their most recent (annual) conversational assessment. The researchers provided information on participants' unaided hearing loss and the length of time the 10 students with cochlear implants had been using their implants. Results of a statistical analysis showed that the students made significant improvement in correct English morphology comprehension and use following the training.

Much of the research on morphology and deaf students has been conducted with students older than those in the study of Bow et al. (2004). For example, Moores and Sweet (2008) studied the relationships between English grammar and communicative fluency and the reading achievement of congenitally deaf students aged 16–18 years. One group ($n = 65$) was deaf children of deaf parents, and the other group ($n = 65$) had hearing parents. Information on level of hearing loss and type of school program was provided. Reading was measured with multiple assessments of reading comprehension, mostly norm-referenced. Two tasks tapped grammar: the Test of Syntactic Abilities (a paper-and-pencil task normed on deaf students) and the Signed English Morphology Tests (focused on inflectional morphology and collected by the students signing what is seen on a videotape). The researchers found high correlations between reading and knowledge of grammar for both groups. They concluded that knowledge of grammar is highly predictive of reading achievement. However, American Sign Language (ASL) proficiency was not well correlated with reading (.06 for deaf children of deaf parents and .04 for deaf students of hearing parents).

Gaustad, Kelly, Payne, and Lylak (2002) studied the morphemic abilities of deaf middle- and high-school students. Their participants included 43 deaf and 33 hearing college students, as well as 27 deaf and 25 hearing deaf middle-school students. No information was given regarding level of hearing ability, use of assistive listening devices, social economic status, or use of a sign system or ASL. Participants were given two paper-and-pencil assessments: one designed to assess participant skill of segmenting words into their morphological parts and the second to measure students' knowledge of morphological meanings. These morphemic analysis abilities were then examined in relationship to their achievement in reading comprehension. Multivariate analysis of variance revealed that the hearing students outperformed the deaf students and that all groups did best on the inflectional-morpheme content rather than the derivational task. The deaf college students demonstrated essentially the same level of reading achievement as the hearing middle-school students. The authors emphasized that the findings of their study revealed "serious deficiencies" (p. 14) in both older and younger deaf students' underlying knowledge of and ability to quickly analyze the morphological aspects of words "with attainment levels so low as to negatively affect text processing and comprehension" (p. 14). The authors concluded their paper with the implications of such findings on not only reading instruction but also content area (e.g., social studies and science) reading because students are called upon to read morphemically complex words and gain much of the knowledge in content areas through extensive reading.

Kelly and Gaustad (2007) continued their study of deaf college students with a focus on the relationship between their performance on mathematics assessments (the ACT mathematics subtest and the placement test given at the National Technical Institute for the Deaf) and their morphological knowledge, reading achievement, and language proficiency. The researchers found significant correlations between mathematics

assessments and students' reading achievement and language proficiency. Particularly relevant to this paper is the finding that the students' morphological knowledge regarding word segmentation and meaning was significantly related to their achievement on the mathematics assessments. Thus, morphological knowledge is important to achievement in not only reading but also mathematics.

Although there are few studies investigating the role of morphology and achievement of students who are deaf or hard of hearing, what is available clearly suggests the importance of the knowledge of morphology to deaf students' academic achievement, particularly reading, the skill used to access the content areas of science, social studies, and mathematics. Gaustad and Kelly (2004) suggested three strategies to improve the morphemic awareness of deaf students: "conversation, reading, and direct instruction" (p. 283). The conversation that they suggested often must be signed if a profoundly deaf student is to comprehend it. In the 2002 study by Gaustad et al. (2002) reviewed previously, they suggested ways to improve the "insufficient morphographic skills of deaf students" (p. 17): cued speech, use of SEE, and direct morphographic analysis instruction. In recommending SEE, and advising that it needed to be used correctly, the authors stated "this system has the advantage of being visual without the problems engendered by homophonous forms as encountered with cuing systems" (p. 17).

Potential of SEE to Reading

The review of the research literature on SEE (Gustason, Pfetzing, & Zawolkow, 1973; Gustason & Zawolkow, 1993) that follows was conducted in part because Kelly (2003) advised, after reporting on morphological awareness in deaf college students, that "given the prevalence of reading comprehension problems," no opportunity "should be discarded without careful scrutiny" (p. 184). After all, concluded Mayer (2007) as she discussed the literacy abilities of deaf children, "it is not the presence of ASL but the absence of some form of face-to-face English that is at issue and the challenge for educators" (p. 416). Given this point, it is important to substantiate the potential of SEE as a bridge to developing morphemic awareness found to be important for reading achievement as presented in the research reviewed previously. We will begin this discussion with an overview of SEE and a comparison of the structures of SEE to other systems, particularly in terms of their ability to represent the morphology of English.

Rationale for and Comparison of SEE to Other Systems

Prior to the early 1970s, educational programs for children with a hearing loss were "oral-only" (i.e., adults did not sign when speaking to students with hearing loss; Stedt & Moores, 1990) and teachers of the deaf (TODs) did not sign at school. About that time, sign slowly seeped into use as an educational tool in "total communication" classrooms. ASL was beginning to be offered at the college level for credit, and the concept of "educational interpreter" had not been developed as yet. In most programs, the sign used was not specifically delineated as a particular language or system as ASL had only recently been recognized as a language and forms of manually coded English had just been invented (Gustason, 1990).

As an outgrowth of "the continuing concern about low levels of literacy and other academic skills attained by most deaf students" and "an attempt to teach deaf children the language that would be used in schools" (Marschark, Schick, & Spencer, 2006, p. 9), manually coded invented sign systems were developed. SEE (Gustason et al., 1973), the sign system of focus in this paper, is one such system. The first manual English system, Seeing Essential English or SEE 1 (referred to today as Morphemic Sign Systems or MSS) was designed by David Anthony, a deaf teacher, with input from a team of deaf educators and the parents of deaf children (Gustason, 1990). The other members of the team viewed SEE 1 (MSS) as inadequate. As a result, Gerilee Gustason, a deaf woman and educator, and other members of the original SEE 1 (MSS) team developed Signing Exact English (Gustason et al., 1973), initially referred to as SEE 2, but now simply as SEE. Gustason (1990) delineated the rationale for the invention of SEE as not only due to dissatisfaction with the educational achievement of children with a hearing loss and a desire to use the English language in education but also due to the increasing knowledge

of English language development of hearing children and research as to the inability of speech reading to access the grammar of spoken English. At the time of the creation of SEE, research documented that deaf children acquired a smaller vocabulary than their hearing peers. In addition, deaf students' understanding of the morphological and syntactical rules of English was weak when compared to the understanding and clear pattern of development of their hearing peers. Gustason explained that "many word endings are not visible (e.g., *interest*, *interesting*, *interests*, and *interested* are nearly impossible to distinguish) and … some involve hard-to-hear sounds" (p. 109). This is an issue that cannot be resolved through speech reading because according to the research she reviewed, only 5% of what was said through speech reading was understood by "otherwise capable deaf children" (p. 109). To address the need to visually represent words fully and accurately, SEE was designed to correspond with the number of morphemes of English (Luetke-Stahlman, 1998). Signs are provided for root words and affix markers (e.g., re-, un-, -ing, -ity, -ness). Different signs exist for different words, so that it is possible to sign *electric*, *electrical*, *electrician*, *electricity*, and *non-electrical*. Both the root word and all affixes are made visually obvious. The hope for this system was that signing English would increase the language, reading, and writing abilities of children who were deaf or hard of hearing (Luetke-Stahlman, 1990). The same author expanded on this concept in the forward of the revised SEE dictionary (Gustason & Zawolkow, 1993) explaining that SEE 2 visually displays figurative, authentic, exact English, which Pidgin Signed English (PSE) cannot.

The basic similarities and differences between SEE and other invented sign systems and ASL are outlined in Table 1. MSS, SEE, and the third manually coded system, Signed English (SE) (Bornstein, 1974, 1990), are both similar and dissimilar in ways that warrant clarification. Users of all three systems speak while they sign. They also represent English semantics and syntax via signs but to different degrees. MSS users attempt to sign almost every syllable of every word that they say. For example, a word such as *motorcycle* has four sign parts in MSS. Users of the SE system can sign some of the morphology of English, but to a limited degree, because SE represents only 14 signed morphological markers. For example, to say and sign the word *unworkable*, the user is constrained in SE and can only sign "not work" because SE does not have a sign for the morpheme *un*. In contrast, users of SEE can choose among 94 morphological markers to make English morphology visual to a deaf student. Because SEE users base the signed component of their utterances on the number of morphemes of a word, an SEE user would manually use three signs for *unworkable*, one for each morpheme: *un*, *work*, and *able*. As Schick and Moeller (1992) explained, SEE "attempts to represent English literally, and it purports to follow a strict criterion of one sign for one English free morpheme or 'word'" (pp. 318–319). They went on to note that SEE

> follows English semantics and does not borrow from ASL semantics, unlike some other MCE [manually-coded English] systems. For example, the English word *run* would appear as the same sign in the following phrases even through a different sign would be used in ASL for each one: "*a home run*"; "*a runny nose*"; "*run for office*"; and "*a run on the ban*" (p. 319).

Both MSS and SEE are based on a "two out of three" rule: If a word is spelled with the same letters and sounds the same, it is signed in the same way, even if the meaning of the two words differs. Thus, the word *run* is signed consistently in SEE no matter the meaning. SEE uses the manual features common to all sign languages and systems as was first explained by the authors in the first edition of the SEE dictionary (Gustasonet al., 1973). The "two out of three" rule is not utilized in SE or PSE. Instead, when English words have different meanings, they are usually signed in different ways. For more detailed information as to the commonalities and differences of signed language and systems, see Stewart and Luetke-Stahlman (1998).

SEE Can Convey English on the Hands

Marmor and Petitto (1979) analyzed language samples from two Pidgin Sign English-using, middle-school, residential school TODs and found that only 10% of the grammar of their spoken English in spontaneous

Table 1 Basic similarities and differences between Signed Exact English (SEE), other created sign systems, and American Sign Language (ASL)

Language or system	Signed in conjunction with spoken English	Grammar base	Sign decision base	Signing figurative English; words with multiple meanings	Naturally evolving language or invented
Morphemic Sign System	Yes	English	"Pivots" (similar to syllables)	Signed literally	Invented
SEE	Yes	English	Morphemes	Signed literally	Invented
Signed English	Yes	English	Some English words and some invented markers	Sometimes signed literally, sometimes based on meaning	Invented
Pidgin Signed English	Sometimes	English and ASL	Meaning (primarily using ASL signs in English word order, no invented markers)	Usually based on meaning	Natural evolving pidgin
ASL	No	ASL	ASL grammar	Based on meaning	Natural evolving language

language samples was signed. For those who understand how PSE is signed, this result is not unexpected. Yet the results of the study were quoted by many as evidence that English could not be signed. Since the late 1980s, many studies have demonstrated that adults can be taught to sign grammatically correct English.

To investigate the ability for English to be signed and focusing on adults who signed in SEE, Luetke-Stahlman (1988b) examined the abilities of four TODs working in two different educational facilities and of three hearing parents of deaf children. The methods of Marmor and Petitto (1979) were replicated and expanded. That is, language samples were collected, transcribed, and coded for grammar and meaning features (inter-rater reliability: 89%); mean length utterance (MLU) per participant was also calculated. Results were that the participants (SEE users) encoded 80–100% of their WH-questions, 76–100% of the words in their relative clauses, 97–100% of their personal pronouns, and 50–100% of the words in their verb tenses. Following an analysis of the data, the author concluded that SEE-2 users can accurately code many forms of English: question forms, declarative sentences, relative clauses, personal pronouns, and verb tenses. Even when their SEE-2 was not "precise," the meaning of most of their utterances was present.

Luetke-Stahlman (1989) replicated her 1988 study with 12 TODs who used either SE or SEE, coding the language samples with regard to meaning and form. She found that some teachers were proficient at using their current sign system during instruction to encode semantic information accurately when signing. Five of the seven SEE users and one of the SE users conveyed "spoken meaning 86 percent or more of the time via the signed portion of their utterances. These signers had almost no difficulty in expressing the range of semantic intentions" (p. 234). The author also created a tool called the sign-to-voice ratio and suggested that professionals and researchers sample and analyze the samples to see how accurately an adult signs. The author proposed that one should expect an 80% or better voice-to-sign ratio to suggest that one is signing accurately.

Whereas much of the research has been conducted with teachers, Moeller and Luetke-Stahlman (1990) described how a group ($n = 5$) of SEE-using hearing parents of deaf children signed. They were all intermediate-level signers. An analysis of the codings of transcripts of the parents speaking and signing found that while their MLU was lower than those of their children and their lexical range was narrow, "their sign utterances were syntactically intact" (p. 327). This same group of parents, motivated to improve their use of SEE, participated in a 12-month intervention study to see if feedback on specific characteristics of their communication in SEE could improve their form, content, and use of SEE (Luetke-Stahlman & Moeller, 1990). The parents were videotaped five

times (two baseline sessions, two intervention sessions, and a retention session). Following each taping, one of the authors provided the parent with specific feedback on characteristics of his/her communication that needed improvement. Sources of information to guide the feedback and determine goals for improvement were video transcripts, graphs, and individual educational plans. All parents improved in at least one aspect of communication in SEE, some showed a marked change in their ability to sign the grammar of English more accurately.

Mayer and Lowenbraun (1990) also documented that the grammar of English can be represented on the hands and that feedback and coaching can improve one's ability to accurately sign English. The researchers videotaped seven TODs working in four schools in the northwestern part of United States, then transcribed and coded classroom samples with regard to morphemes spoken and signed. Results were that the teachers provided a grammatical representation of their spoken English "with sign consistency ratings similar to Luetke-Stahlman (1989)" (p. 260). Teachers who set sign goals and who were provided with monthly feedback exhibited the most accurate SEE use.

To further investigate teachers' and interpreters' sign consistency across three invented sign systems (MSS, SEE, and SE), Luetke-Stahlman (1991) asked 25 adults working in educational settings to interpret a carefully designed set of stimuli consisting of complete sentences which contained "varying verb tenses and pronouns, novel vocabulary, figurative English, and phases that could use manual features of sign language easily" (p. 1294). Participants listened to an audiotape of each sentence read twice, then paused the tape recorder, signed, and spoke. Their performance was videotaped for later bimodal transcription, coding, and analysis. The findings indicated that the SEE participants ($n = 7$) followed the rules of the system for a significantly greater percentage of the time than users of either of the other two systems ($p = .001$). They also were able to encode the meaning in sign of what they were saying an average of 86% of the time—significantly higher ($p = .05$) than users of SE.

To address the importance of distinguishing between instructional inputs when studying reading comprehension and deaf children, Luetke-Stahlman (1993) involved adults (teachers and interpreters working in deaf education) who used one of three different languages or systems (PSE, SE, or SEE) and investigated their ability to write what they themselves had signed. The participants' average number of years signing was as follows: 7.1 (PSE users), 9.6 (SE users), and 7.4 (SEE users). Using a set of 25 stimuli from a previous study (Luetke-Stahlman, 1991) for which the audio was erased, participants ($n = 22$) watched a videotape of themselves signing and wrote what they saw themselves signing (e.g., *The cars in the lot are lined up in rows. Time is fleeting.*). Significant differences were found in the ability of users of different systems to transcribe both the form and the meaning of what they themselves had signed previously. SEE users transcribed the meaning, figurative language, and grammar of the original sentences with significantly greater accuracy (95% accuracy) than the non-SEE users. SE users transcribed the utterances with 71% accuracy and PSE users with 23% accuracy.

Using Australian Signed English, Leigh (1995) studied Australian TODs using methods that were very similar to those of Luetke-Stahlman (1989) and Mayer and Lowenbraun (1990), as described above. Results were that participants produced simultaneous communication in English speech and sign with high rates of accuracy, as did Hyde and Power (1991) in their study (89% voice-to-sign accuracy), although the prosody of speech sometimes suffered. Like Mayer and Lowenbraun, Leigh advocated that positive steps be taken in deaf education programs to ensure consistent and accurate English input via sign, including

> a) adequate training and experience in the use of the system, as exemplified by appropriate assessment; b) a positive attitude toward the use of the system; c) accurate knowledge of the encoding principles and specific rules of the sign system; d) commitment to using the system within the rules and guidelines defined by the sign system; and e) monitoring (p. 270).

English Language Abilities of SEE Users

SEE, a monolingual, bimodal option for communication in English, has been documented empirically as

the first language of many deaf children in such studies as those of Luetke-Stahlman and her colleagues (e.g., Luetke-Stahlman & Moeller, 1990; Luetke-Stahlman & Nielsen, 2004), as well as others (Schick & Moeller, 1992). In addition, after completing a literacy-focused investigation, Mayer and Akamatsu (2000) concluded that a first language can be developed using an English-based sign system. The creators of SEE and proponents of the system (Gustason & Zawolkow, 1993) believe that if family members, TODs, and speech–language pathologists (SLPs) sign grammatically accurate English, deaf children will have access to authentic English, which will allow them access to acquiring it. With such visual access, children have an opportunity to develop age-appropriate receptive and expressive English, which in turn supports their reading achievement in English.

Luetke-Stahlman (1988a) conducted a study to ascertain the English language and reading abilities of deaf children exposed to seven different instructional inputs (oral English, cued speech, MSS, SEE, SE, PSE, and ASL). The researcher compared participants in Group A ($n = 109$), children who were educated in programs that exposed them to grammatically complete inputs (oral-only, cued speech, MSS, SEE, ASL), to participants in Group B ($n = 74$) who were educated in programs that exposed them to grammatically incomplete inputs (SE and PSE). The participants, aged 5–12 years, were of normal intelligence, attended their school program (public, private, or residential) for at least 3 years, and did not have a condition that would have interfered with learning other than impaired hearing. Demographic variables (gender, economic, and minority status) and other variables (home environment survey data, degree of teacher grammatical completeness in sign, unaided and aided hearing acuity, speech intelligibility) were reported. In terms of facilitation of language in each program, the author noted, "Curriculum comparisons revealed a high degree of similarity among programs. All programs were taught using an interdisciplinary approach whereby the SLP attempted to work with teachers and parents to facilitate optimal articulation and English language development" (p. 359). Teachers' use of sign or cueing was verified by analysis of videotaped spontaneous classroom language samples that were transcribed, coded, and analyzed to verify the type of language or system used and the degree to which the rules of that language or system were followed. This process was reported with detail in Moeller and Luetke-Stahlman (1990). Assessments of English language and reading abilities, standardized on hearing children, were administered to the participants. The standardized English language tests were the *Northwest Syntax Screening Tool (NSST)* (Lee, 1969) and the *Woodcock-Johnson Psychoeducational Battery (W-J)* (Woodcock & Johnson, 1977) (relevant subtests: Antonyms, Synonyms, Picture Vocabulary). All testing was conducted in the language or system of the students' school program. The various language and system inputs, as noted above, served as the independent variables, and the language and literacy assessments were the dependent variables. Planned orthogonal comparisons of all possible comparisons were analyzed. Age and hearing acuity served as covariates in the statistical analyses. Data were analyzed to determine the effect of age on achievement, and Group A was compared to Group B, controlling for unaided pure tone average (PTA). Significant differences favored Group A in the 4- to 6-year-old group for Antonyms ($p = .001$), Synonyms ($p = .01$), and NSST ($p = .001$). The NSST was also significant ($p = .04$) for Group A 7- to 9-year-olds. In addition, when the test scores of participants representing Group A inputs were compared (with age and aided acuity controlled), profoundly deaf students representing SEE programs acquired significantly more (.05) English vocabulary and grammar than those enrolled in programs using oral English, cued speech, MSS, SE, PSE, or ASL. Reading results are described in the next section of this paper.

Nielsen and Luetke-Stahlman (2002) published a case study, which included analyses of 9 years of language and literacy data from a deaf child who used SEE at both home and school. The child, Marcy, had no language or literacy-related experiences until she was 4 years old, at which time she was adopted from an orphanage in Bulgaria. As documented by tests of English using hearing norms, Marcy's English was below average in preschool and kindergarten but within the low-average range in first through fifth grade. During fifth grade, 8 years after beginning school in the United States, Marcy improved from the 37th to the 50th percentile on the Word Classes

subtest of the *CELF* (Semel et al., 1995) and her total score in the high-average range (56th percentile) on the *Language Processing Test* (Richard & Hanner, 1990), a measure of decontextualized language skills associated with reading and academic achievement (Porche, Tabors, Harris, Snow, 2007; Snow, Barnes, Chandler, Goodman, & Hempill, 1991). Marcy's reading abilities were low average in first through third grade and between low and high average in fourth through sixth grade as assessed by both the *Gates-MacGinitie* (MacGinitie & MacGinitie, 1989) and the *Woodcock Reading Mastery Tests-Revised* (Woodcock, 1998), standardized on hearing children. These findings echo the work of Cummins (1984, 2000) who found, after extensively reviewing second-language acquisition research regarding hearing students, that although it takes a student only about 2 years to acquire conversational skills, it takes approximately 5–7 years to develop academic language and reading proficiency. The main issue in academic language is the ability to analyze and understand multi-morphemic words (Kieffer & Lesaux, 2008). By the end of data collection, Marcy was making a "year's progress in a year's time" (p. 176). She went on to graduate from public high school, tested out of freshman English, and is currently a sophomore in college. As explained in the case study and other publications (Luetke-Stahlman, 1996a, 1996b), Marcy as well as her older deaf sister, Mary Pat, used SEE both at home and through a school program where administration, TODs, SLPs, interpreters, and family members were committed to signing grammatically accurate English. Mary Pat also has been successful in school, as is evident in the fact that she took advanced courses in high school, was accepted into college after her junior year of high school, graduated from college with honors in the spring of 2010, and is employed (M.P. Clark, personal communication, May 2010).

Reading and Writing Abilities of SEE Users

Marschark (1993) reviewed work about deafness and reading and stated that "although it is tempting to assume that early exposure to language would provide a linguistic advantage in reading development for deaf children, this advantage may be offset by the fact that the ASL vocabulary and syntax do not parallel those of printed English" (p. 207). He suggested that if deaf children had training at a young age with a manual form of English, then such early exposure to English would benefit their development as readers. As indicated by the studies discussed previously, it is not just competence with English via the hands in general that is important if age-appropriate reading proficiency is the goal but acquisition of English grammar.

Paul (1998b) may have been the first researcher in deaf education to focus on reading and the morphological aspects of English. He wrote that "all readers of English as a second language need to obtain a high level of proficiency in the alphabet system, the system upon which the English written language is based. This knowledge entails phonological and morphological components" (p. 177). In the past decade, English-based signing has been suggested as necessary if English literacy is a goal (Mayer, 2007; Mayer & Akamatsu, 2000). These researchers did not mention English grammar or morphology specifically nor did they name SEE per se. Yet, in the conclusion of a study of writing with deaf children, Mayer and Akamatsu (2000) stated that

> If English-based sign can be used to communicate readily and effectively, and if some internal model of English is necessary to engage successfully in the composing process [of writing], then … . English-based sign would be an appropriate choice for developing an L1 [or first language]. (p. 400)

Careful to note that "the key function of this signed form of English would be to serve as a model for English text, rather than as the primary language for face-to-face communication," Mayer and Akamatsu stated further that "this 'through the air' English might provide a basis for developing a form of inner speech that would support the development of higher levels of English literacy" (p. 395).

As reviewed previously, Luetke-Stahlman (1988a) compared the English language and literacy abilities of deaf students who used SEE with those of other groups of deaf children exposed to six different instructional inputs. In addition to the data collected on how language instruction was addressed in each school program, information on the reading curriculum was collected from the teachers through a survey, including responses to questions on the following reading

instruction-related topics: materials used for reading instruction, how new vocabulary was taught, and procedures used to collect data on story comprehension. The author noted "a high-degree of similarity in reading curriculum across programs" (p. 359) and provided examples of the similarities (e.g., all used basal readers). Student achievement on the Passage Comprehension subtest of the W-J (Woodcock & Johnson, 1977) served as the dependent variable for reading in this study. Results were that participants in programs representing grammatically complete input (Group A) were significantly better readers ($p < .001$) than those who represented inputs for which the grammar was incomplete (Group B). In addition, SEE participants ($n = 26$) significantly outscored all other groups on passage comprehension.

Schick and Moeller (1992) found that 13 deaf students (aged 7–14 years) using SEE since age 3 acquired and internalized some of the most complex rules of the syntactic structures in English and that that knowledge supported their reading development. Participants were profoundly deaf based on the unaided reported PTA and had no additional handicapping conditions. The researchers stated that SEE served as an input for the native language learning of English for these students. Several standardized English language and reading tests were administered to the participants. Results were that, "In comparison with their hearing peers in both vocabulary and reading, these students scored within normal limits" (p. 324). The authors continued, "From a functional perspective, the performance on standardized reading tests reveals that these participants appeared to have sufficient English skills to serve as a foundation for the acquisition of reading" (p. 332).

Based on a search of the research literature, the most recent study published focused on SEE users and their literacy achievement was Luetke-Stahlman and Nielsen (2003). The participants were 31 unaided profoundly deaf students aged 7–17 years, participating in three school programs committed to the use of SEE. The students had normal intelligence and no additional handicapping conditions; none used cochlear implants. The researchers collected information regarding the TODs' ability to sign SEE, as well as background information (i.e., gender, ethnicity, SES, parent ability to sign, and speech intelligibility). Standardized English language and reading measures, normed on hearing children, were administered. Passage comprehension results were analyzed by Pearson correlations, and Marasciulo categories for examining strength of correlations were applied. Statistical analysis found that deaf students who had been enrolled in an SEE program 5 or more years (the "Longer Exposure" to SEE group) read at significantly higher grade levels than the deaf students exposed to SEE for 2 years or less (the Shorter Exposure Group). The Longer Exposure to SEE group could manipulate phonemes (segmenting, blending, deleting, and substituting them); provide synonyms, antonyms, and analogies of read words and phrases; and read more words on the word lists than the Shorter Exposure Group. Morphological aspects of English were not specifically assessed or analyzed.

Conclusion and Future Directions

The research demonstrating that the greater a students' knowledge of morphology, the more able they are to understand new words and comprehend academic text presents a strong argument for providing morphology instruction, beginning in the primary grades (Carlisle, 2004). In 2004, Gaustad and Kelly published a study involving deaf college students and hearing middle-school students, extending their earlier work regarding morphological knowledge and word segmentation. The authors suggested "that deficiencies in morphological aspects of conversational language acquisition play a critical role in deaf students' morphographic awareness and growth" and further stated 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). Yet neither these nor other authors (e.g., Mayer & Akamatsu, 2000; Paul, 1998b) suggested SEE, or even the fingerspelling of inflectional or derivational word parts, as a route to this required competence when reading proficiency in English is the desired outcome. However, in a study published in 2002, Gaustad et al. (2002) did suggest SEE as a way to improve the "insufficient morphographic skills of deaf students" (p. 17). Using SEE or fingerspelling, the derivational and inflectional parts of words do seem to have merit if

the goal is reading proficiency such that students who are deaf or hard of hearing read as their same age hearing peers. After all, SEE was designed to make the morphology of English salient so that adults and children could use different signs to differentiate similar words. In SEE, root words and the morphemes of English are marked (and made obvious) in face-to-face conversations and no one single sign represents more than one English word. Age-appropriate literacy growth is possible if access to English, as described in the extant research studies provided in this review of literature, along with exposure to SEE for at least 5 years (Luetke-Stahlman & Nielsen, 2003) and exposure to English by adults who attempt to follow the rules of the system and incorporate phonological and morphological awareness directly into their reading and writing instruction is provided. As did Gaustad and Kelly (2004), we call for research "to ascertain the optimum structure and presentation of such a program with various populations" (p. 283). Such research should include information on the input provided.

Mitchell (1982) stated that "there is no logically implicit reason why contrived systems of communication should be considered less functional than 'natural' languages" (p. 332). He also noted that if students are exposed to a simplified or weak form of manually coded English, the child would develop at best an impoverished understanding of English. That said, it is important that future research focuses on ways to support teachers and interpreters so that they provide models of grammatically accurate English. Given the research reviewed earlier in this paper on the role of morphology to reading achievement, starting at the early stages of reading and becoming progressively more important to reading achievement, we propose that the use of SEE be explored as a vehicle for giving students who are deaf or hard of hearing access to the English that they will read. A number of questions could be investigated in future research such as how do we best prepare teachers and interpreters to accurately sign SEE so that the morphology of English is visibly available to students? How do we teach students to use what they know about the morphology of English to improve aspects of reading (decoding, vocabulary, fluency, and comprehension)? The relationship between morphology and these reading components has been studied with hearing monolingual and bilingual students and should be studied with deaf students for us to better understand how to support their development as proficient readers.

We agree with Marschark, Rhoten, and Fabich (2007), who reported that within a noisy, cognitively demanding academic setting, the use of sign can serve as a bridge between through-the-air communication and print. Although we acknowledge that the body of knowledge on SEE is limited, we also believe that the extant research suggests the potential of SEE in supporting the English and reading development of deaf students. The creators of SEE and proponents of the system (Gustason & Zawolkow, 1993) believe that if family members, TODs, and SLPs sign grammatically accurate English, deaf children will have access to authentic English, which allows them access to acquiring it. Without such visual access, it seems logical that deaf children may not develop age-appropriate receptive and expressive English. If students are provided grammatically correct input in English via SEE coupled with reading instruction in elementary school that gives explicit attention to morphology, we believe that students who are deaf or hard of hearing can develop reading proficiency to the same level as their hearing peers. There is clearly a need for more research on this topic.

Conflicts of Interest

No conflicts of interest were reported.

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