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## EFFECTS OF SES ON LITERACY DEVELOPMENT OF DEAF SIGNING BILINGUALS

**Author:** Twitchell, Paul; Morford, Jill P; Hauser, Peter C

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**Abstract:** Research on spoken language monolinguals and bilinguals has shown that socioeconomic status significantly affects literacy outcomes. One explanation for this effect is that children in higher-SES homes have better oral proficiency in the language of literacy instruction (Hoff, 2013; Zhang et al., 2013). American Sign Language-English deaf bilingual children exhibit a unique profile because they achieve L2 literacy without prior development of spoken L2 proficiency. This provides an opportunity to evaluate the role of SES in literacy development without the confounding effect of the influence of spoken language proficiency. The present study evaluated effects of SES and ASL proficiency on 135 deaf signing bilinguals' English reading proficiency. Although SES and ASL proficiency were not correlated in this sample, both factors were significant predictors of reading proficiency. The implications of these findings for educational reform in schools with deaf students are discussed.

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RESEARCH ON spoken-language monolinguals and bilinguals has shown that socioeconomic status significantly affects literacy outcomes. One explanation for this effect is that children in higher-SES homes have better oral proficiency in the language of literacy instruction (Hoff, 2013; Zhang et al., 2013). American Sign Language-English deaf bilingual children exhibit a unique profile because they achieve L2 literacy without prior development of spoken L2 proficiency. This provides an opportunity to evaluate the role of SES in literacy development without the confounding effect of the influence of spoken-language proficiency. The present study evaluated effects of SES and ASL proficiency on 135 deaf signing bilinguals' English reading proficiency. Although SES and ASL proficiency were not correlated in this sample, both factors were significant predictors of reading proficiency. The implications of these findings for educational reform in schools with deaf students are discussed.

**Keywords:** SES, literacy development, sign language, deaf, bilingual

Research on spoken-language monolinguals and bilinguals has repeatedly shown that socioeconomic status (SES) has a significant impact on literacy outcomes (Droop & Verhoeven, 2003; Ransdell, 2012; White, 1982). Two competing explanations for this relationship involve the direct versus indirect impacts of SES on literacy outcomes. SES may directly affect literacy outcomes through characteristics of the home literacy environment. Because higher-SES parents read more, they are strong role models for their children in regard to acquiring reading skills. They are also more likely to restrict their children's access to media that do not encourage literacy development, such as television and video games (Raag et al., 2011). Children from high-SES homes have more reading opportunities and more books, and their parents are highly skilled at gauging their children's literacy level and mediating literacy events. Thus, the home literacy environment and the amount of time children spend in literacy activities are one explanation for the impact of SES on literacy development (Korat, Arafat, Aram, & Klein, 2013). A second explanation proposes an indirect relationship because SES has been shown to influence first-language (L1) and second-language (L2) oral proficiency, which affects literacy development (Hoff, 2013; Zhang et al., 2013). Specifically, higher-SES parents speak to their children more (Hart & Risley, 1995) and use fewer directives in child-rearing (Murray, Fees, Crowe, Murphy, & Henriksen, 2006). These characteristics are associated with high-SES children's faster rate of spoken-language development, and higher levels of phonological and metalinguistic awareness. This second explanation

suggests that SES indirectly affects reading by promoting language skills that mediate reading success. Because SES and L1/L2 proficiency are confounded in research on spoken-language readers, it is difficult to discern the relationship among SES, L1/L2 proficiency, and reading. Signing bilingual readers can provide an opportunity to look more closely and more deeply at that relationship. American Sign Language-English deaf bilingual children exhibit a unique profile because they achieve L2 literacy without prior development of spoken L2 proficiency. (The term deaf is operationally defined in the present article as referring to a hearing loss of 85 dB or greater in the better ear.) Further, there is no widely used orthography for ASL that would make it possible for LI orthographic experience to have an impact on L2 literacy. In response to this unique configuration of proficiency in a signed language for face-to-face communication and in the written form of a spoken language for reading and writing, Morford, Kroll, Pifiar, and Wilkinson (2014) have coined a term to refer to this unique population of individuals who use both ASL and printed English: sign-print bilinguals. Sign-print bilingualism affords the unique opportunity to evaluate the role of SES without the confound of spoken-language proficiency influencing literacy development.

The present study investigated whether family SES influences reading comprehension of ASL-English deaf bilingual children (ASL-English bilinguals) while also considering LI proficiency in ASL. Despite the numerous previous studies on SES, LI proficiency, and literacy skills with both monolingual and bilingual populations, there have been no studies of the effect of SES on literacy skills of ASL-English bilinguals. Several early studies of literacy outcomes of deaf children found both effects and noneffects of parental hearing and communication choices, and pointed out that SES is not equivalent in these groups (Corson, 1973; Vernon & Koh, 1970). Indeed, Vernon and Koh (1970) were among the first investigators to provide solid evidence that "early manual communication produced better overall educational achievement, including superiority in reading skills and written language" (p. 535), compared to early oral communication. More recent studies have provided in-depth analyses of effects of ASL on reading development in deaf individuals (Chamberlain & Mayberry, 2008; Hoffmeister, 2000; Padden & Ramsey, 2000; Strong & Prinz, 1997). Evaluation of SES in greater detail, including consideration of its effects independently of parental hearing status, is long overdue in the research on reading development in deaf children.

Investigating whether SES affects reading development in deaf signers can also help researchers address whether deaf readers' reading development is qualitatively different from that of hearing readers. LI proficiency and SES both predict reading achievement in hearing monolingual and bilingual readers, but, importantly, these two predictor variables are strongly correlated for these populations. If the same were true for deaf sign-print bilinguals, that would signal qualitative similarities in reading development across all groups, and the conundrum of SES effects would remain a mystery. A second possibility, however, is that only LI proficiency predicts reading outcomes for deaf readers. This would signal that the demographic context of learning to read differs for deaf and hearing children, but that the actual driver of reading achievement is primarily linguistic in nature, and not related to the home literacy environment. The reverse pattern, showing effects of SES but not of LI proficiency, is not anticipated given the wealth of data linking LI proficiency to reading achievement in both hearing populations (e.g., Dickinson & Snow, 1987) and those that are deaf (e.g., Chamberlain & Mayberry, 2008). A final and intriguing possibility is that both SES and LI proficiency can predict reading comprehension abilities in deaf signers even if they are not correlated with each other. This finding would again point to differences in the demographic context of learning to read for deaf signers relative to hearing readers, but would provide the first fully unambiguous evidence that SES and LI proficiency make unique contributions to reading outcomes. Before describing our own study, we first summarize a selection of the vast literature on SES effects in hearing monolingual and bilingual populations.

#### Monolinguals: Impact of SES on the Development of Language Skills

The role of SES is a complicated and dynamic factor that contributes to both language and literacy development. In order to understand how SES specifically affects the developmental stages of children's LI, it is

important to first define this construct. Family SES is a measure that includes multiple factors that may influence an individual child's growth. For example, the Hollingshead Four-Factor Index of SES includes marital status, retired/employed status, educational attainment, and occupational prestige (Hollingshead, 1975). The constellation of these four factors predicts a variety of behaviors, including the language use and child-rearing practices of parents, allowing us to explore the relationship of SES and LI proficiency in literacy outcomes. There is broad consensus that SES affects LI proficiency. Hoff (2003, 2006) has argued convincingly that these impacts are largely a factor of the quantity and complexity of maternal language input, even across different cultures. For example, Hoff (2003) compared toddlers from 33 high-SES families with 30 from mid-SES families who were just beginning to form twoword utterances. Mother-child naturalistic interaction was recorded at two points in time so that the children's rate of vocabulary learning could be compared to characteristics of maternal language across the two groups. Hoff found that the high-SES mothers produced more word types and tokens as well as more complex utterances as measured by mean length of utterance than the mid-SES mothers. Each of these measures was also a significant predictor of children's rate of vocabulary growth. Using multiple regression, Hoff then evaluated what proportion of variance in child vocabulary development could be attributed to SES once the variance associated with child vocabulary size at study onset and maternal language complexity had been removed. The results showed that the association between SES and child vocabulary disappeared once the mediating factor of maternal language was included in the model.

The proposal that SES effects on primary language development are mediated by maternal language input is supported by other findings that show variation in language development within a single SES level. Shimpi, Fedewa, and Hans (2012) studied African American low-SES families in which the mothers had only 11 years of education, on average, to see whether differences in the children's vocabulary development could be related to the mother's input. Shimpi et al. not only found that a correlation existed between the amount of maternal speech input and child language outcomes in these families, but that the consistency of input affected language outcomes as well. Hurtado, Marchman, and Fernald (2008) also specifically tested whether maternal input influenced vocabulary development in low-SES families. They recorded 27 children and their mothers interacting in Spanish when each child was 18 months old and again when each child was 24 months old. The amount of maternal utterances and each child's vocabulary size were coded and assessed. Hurtado et al. found that children who experienced more input from their mothers had larger vocabulary outputs at 24 months than children who had less maternal input. The overall results show that the quality and quantity of mothers' input predicts their children's language understanding and vocabulary growth within a low-SES environment. Hoff (2006) reviewed many studies investigating environmental effects on language development and concluded that variability in the rate and course of children's language development is clearly linked to variation in opportunities to have access to language in the environment. In sum, the findings that have been documented in multiple languages show that mother-to-child speech, including the amount of words and utterances as well as the grammatical complexity of language, has an impact on the rate of children's development of vocabulary and language overall. Oral language skills, in turn, are a primary predictor of literacy development (Dickinson & Snow, 1987).

#### Monolinguals: Impact of SES on the Development of Literacy Skills

In addition to assertions about the effects of SES on early language development, there are also claims in the literature that SES contributes more directly to literacy development. While the present study focuses on family SES, the literature on SES and literacy has included studies evaluating effects of family SES, as well as studies focused on school and peer SES.

Beals and De Temple (1993) evaluated a combination of home social and economic measures, family conversation measures, and child language measures to determine the best predictors of early literacy success in lowincome families. Beals and De Temple visited a total of 28 families, focusing on one parent (the mother) and the child, and excluding other adults in the home such as fathers, stepfathers, and grandparents.

Participants varied in cultural and economic background. Two home visits were made, one when the child was 3 years old and the second when the child was 4, in order to collect measures of the home literacy environment. During the home visit, recordings were made of the interaction while the mother and child read two books together. Mothers were also asked to record mealtime sessions with their child. Recordings of mother-child book sharing and the mealtime conversations were subsequently analyzed for both quantitative and qualitative measures of home language usage, such as the use of immediate versus displaced reference, content of child responses to questions, and frequency of narrative and explanatory talk. At the end of their kindergarten year, the children completed a series of standard tests of linguistic, cognitive, and reading comprehension skills. Beals and De Temple found that family SES and overall children's language production best predicted literacy success. They also concluded that a mother's ability to mediate her child's involvement in conversation at home during the literacy development stages affected the child's development by transferring the responsibility of conversation from the mother to the child.

While children may begin learning to read in the home, most make considerable gains in literacy development in school. Thus, in addition to evaluating the impact of family SES on reading, it is important to consider the possibility that school and country SES may also affect literacy. Chiu and McBride-Chang (2006) investigated whether different types of SES can have a crucial role in literacy development. The definition of SES that Chiu and McBride-Chang used considers not only individual families' SES, but also the SES of the children's environment at the level of the school and the country. Their study collected information from 43 countries, including measures of 193,841 fifteen-year-olds' gender, SES (country, school, peers' family, and child's family), number of books in the home, enjoyment of reading (as determined by survey), and reading achievement (as determined by test scores). Chiu and McBride-Chang modeled reading achievement using sequential sets of multilevel regressions to explain the variance of each set (gender, country SES, school SES, family SES, number of books at home, and reading enjoyment). Their findings showed that each factor was significantly associated with reading achievement. Combined SES effects at the country, school, and family levels accounted for 24% of the variance in reading achievement. However, variation in reading level was greater within countries than across countries, and within schools than across schools, a finding that indicated the importance of considering explanatory variables at all levels. Chiu and McBride-Chang concluded that, across nearly all countries, literacy achievement is influenced not only by personal family but by school SES and peers' SES within a school. They suggested that further research be done to address the specific mechanisms that explain why schools provide literacy success beyond the individual and family characteristics of the student. At the level of the family, number of books in the home mediated the SES effect, whereas at the level of the school, peers' family SES was a more influential factor. There is abundant evidence that SES, in general, plays an important role in a monolingual child's literacy development stages; however, there is a need to detect whether SES directly affects literacy success, or whether SES is merely a proxy for language proficiency. Researchers have taken different measures of SES for monolingual children and repeatedly found that SES has a significant impact on language and literacy development. However, language proficiency also affects literacy development (Dickinson & Snow, 1987; Oller & Eilers, 2002), and the majority of studies evaluating SES effects on literacy development do not control for this confound. There is a need to distinguish effects of SES and language proficiency on literacy outcomes to determine whether SES actually has unique impacts on literacy that are independent of language proficiency. Efforts to distinguish direct effects of SES and effects of language proficiency will contribute to understanding of the development of literacy skills.

#### Bilingual Children: Effects of SES and L1/L2 Proficiency on Literacy

One approach to disentangling the effects of SES on literacy achievement from the effects of SES on oral language proficiency is to look at child bilinguals. General research on bilingualism has shown that bilinguals are not like two monolinguals in one person. It proves a very difficult task to master each language at the same level attained by monolingual speakers of the respective languages (Negro & Genelot, 2012). Bilingualism

researchers have examined (a) how LI minority language proficiency affects majority L2 language and literacy; (b) the impact of different SES levels on children's acquisition of L2 majority language and literacy proficiency, and (c) the effects of bilingual education relative to monolingual approaches.

One of the biggest questions in bilingual education is What method of teaching language and literacy to bilinguals is most effective? The issue is more complex than in a monolingual environment, in which students are taught how to read and write in one language. Many other questions must be addressed: Should one language be taught first, and the other language later? Can children be taught two languages simultaneously? At what stage of development can bilingual literacy work effectively? One way of addressing this issue is to consider waiting until children achieve fluency in their LI before introducing the L2, both spoken and written. Gámez and Levine (2013) looked at Spanish-English bilingual children in educational settings to evaluate this approach. There were 12 participating classrooms, with 21 teachers and 101 kindergarten students from the midwestern United States. Gámez and Levine collected data that included specific linguistic features of teachers' quality of speech in Spanish and English and children's spoken-language assessment scores in Spanish as well as their English literacy scores. The researchers elicited data by using speech audio recordings; they transcribed the recordings and coded data from both the teachers and the students in the third and fourth quarters of the school year. On the basis of observations and recordings in the classroom setting, Gámez and Levine found that some teachers spoke only Spanish to students. Others used both Spanish and English. The teachers' choice of language was related to the students' test performance on words and sentences in spoken Spanish. The researchers found that the high quality of Spanish-only input from the teacher had a significant role in promoting LI Spanish proficiency. When teachers mixed languages, the children's LI Spanish proficiency was not as advanced. The students were also tested on their English literacy skills. Interestingly, Gámez and Levine found that children with higher LI Spanish oral skills outperformed those with lower LI Spanish oral skills. This suggests the need to have a strong LI foundation in order to transition to L2 literacy acquisition. The researchers concluded that it is important for teachers to promote and establish a strong language foundation for students in the early stages of LI development in order for them to have successful literacy outcomes in LI and L2. The study by Gámez and Levine is one of several indicating that L2 literacy skills in bilinguals are affected by proficiency in both the LI and the L2 (cf. Guglielmi, 2008; Lindholm-Leary, 2014).

Turning to the question of how the SES of bilinguals influences their literacy outcomes, Oiler and Eilers (2002) looked at SES, the language of the home, and the method of instruction at school to see how these factors related to both Spanish and English language and literacy. They elicited data from 952 Spanish-English bilinguals and 248 monolinguals in Miami, FL. The Spanish-English bilinguals went to either a full English immersion school or a two-way bilingual school. Further, some participants only spoke Spanish at home, while others spoke both Spanish and English at home. Finally, participants were assigned to low- or high-SES groups on the basis of the parents' educational attainment, income, and occupation. Data were collected over a 4-year period. The study was designed carefully to avoid complications that occur when testing procedures developed for monolinguals are used to assess bilinguals' performance. The test included standardized assessments of spoken language and academic performance in both Spanish and English. The results revealed similar patterns between monolinguals and bilinguals, in that high-SES students consistently achieved better scores on the language assessments than the low-SES students. Effects of SES were particularly pronounced on spoken-language proficiency measures. Another key finding of the study was that when the high-SES bilingual children reached fifth grade, they had a level of proficiency in their English L2 reading that was equivalent to that of monolingual English readers. Oiler and Eilers concluded that both language exposure and SES have an impact on the development of spoken- and written-language proficiency, and importantly, that the two factors did not generate a significant interaction. However, whereas effects of language exposure are reduced over time, SES effects persist across development, so that only bilinguals from high-SES families maintain proficiency in their LI

in addition to developing 12 literacy skills that are indistinguishable from monolinguals' L1 literacy skills. Further, the high SES status of bilinguals' families was related to parents' use of the L2 in the home. These results are a reminder that language status is also an important factor in studies of bilingual children. In the United States, emphasis is placed on English-language proficiency as a means of achieving higher SES status. The minority language, Spanish within this context, is less likely to influence family SES, even though proficiency in a minority L1 language affects learning outcomes.

Students from minority-language bilingual homes can be assumed to have lower levels of proficiency in the majority language targeted for literacy at school. This implies that bilinguals may generally lag behind their monolingual peers in literacy development. However, recent studies have begun to evaluate how the experience of bilingualism may affect the learning of children from majority-language homes. What exactly are some advantages of being bilingual and attending bilingual schools? Kovelman, Baker, and Petitto (2008) evaluated whether the age of first bilingual exposure was a factor in the outcome of literacy skills. They studied 150 participants who were categorized into five different groups based on attendance at a Spanish-English bilingual school or an English monolingual school in grade 2 or 3. Kovelman et al. evaluated various language and literacy skills. Monolingual English speakers only completed English language and literacy tasks. The remaining participants were tested in both English and Spanish. The researchers considered three areas of language and literacy skills. First, they assessed children's ability to manipulate the sounds within their language. Second, they looked at the children's ability to read words and sentences. Third, they looked at the children's spoken-language production, competence, and proficiency. They demonstrated that children with the earliest exposure to both languages achieved reading levels in English comparable to those attained by English-dominant bilinguals and in Spanish comparable to those of Spanish-dominant bilinguals. They also found that students from monolingual English-speaking homes who attended Spanish-English bilingual schools outperformed monolingual English-speaking students who attended monolingual schools on a challenging English phonological awareness task. By virtue of learning two languages, the bilinguals could attain higher levels of metalinguistic awareness (i.e., the ability to reflect on language), a capacity that allowed them to outperform monolinguals on a task that did not directly involve L2 knowledge.

In sum, many studies provide evidence of effects of SES on both the L1 language proficiency and L1 literacy of monolinguals. Further, SES is related to language and literacy outcomes in both the L1 and the L2 for bilinguals. Within research on bilinguals, we see stronger effects of SES on the majority language than on the minority language. But L1 language proficiency contributes to L2 literacy even when the L1 is a minority language. Thus, the evidence strongly implicates both SES and L1 proficiency in predicting L2 literacy achievement, but these factors are also confounded since SES predicts L1 proficiency for most hearing students. Signing bilinguals can help to clarify if both factors, SES and L1 language proficiency, independently contribute to literacy development outcomes.

The Present Study ASL-English bilinguals have a unique profile because L2 literacy is achieved without prior development of spoken L2 proficiency. Although there have been several attempts to promote a standardized orthography for ASL, and deaf children have responded enthusiastically to opportunities to learn ASL writing systems (Cripps, 2008; Flood, 2002; Supalla & Cripps, 2004), there is no widely used orthography for ASL that would enable us to assess whether L1 orthographic experience could have an impact on L2 literacy in our sample. This absence of a common orthography, however, creates an opportunity for a novel investigation of the impact of SES and L1 language skills on L2 literacy achievement.

Before L2 learning is dealt with, it is important to address some factors influencing L1 learning in deaf signers. There is a great deal of variability of language skills in the deaf population. The process of acquiring ASL parallels the acquisition of other languages in the world if exposure to ASL begins at birth (Newport & Meier, 1985). Unfortunately, exposure to ASL at birth is not the experience of the majority of deaf children in the United States. The majority of deaf children have parents who are not aware of the importance of signing with their



child and who are not fluent in ASL. Some children become deaf while still in their language and literacy development stages. Hearing parents unfamiliar with deafness struggle to know how to mediate interactions involving their deaf child around language and literacy development. Indeed, Moeller (2000) found that the degree of parental involvement accounted for more variation in vocabulary size of deaf 5-year-olds who participated in early intervention than nonverbal IQ or age of enrollment in early intervention. Part of the challenge parents face is related to the different choices available to address deafness at a young age. Cochlear implants (CIs), hearing aids, and other technology are recommended to parents as means of improving their child's quality of hearing, but none of these technologies can ensure that deaf children will have access to language. Some deaf children attend speech therapy to support the development of spoken-English skills so that they might communicate with parents who only know English. Support for sign language exposure can be obtained through some state agencies providing early intervention, such as a deaf mentor who makes home visits or sign language classes for parents. However, in no case is the provision of speech therapy or sign language support equivalent to the continuous access to language that deaf children of deaf parents experience.

Parents also have several options for the education of their deaf child. Some deaf children attend a school where they are immersed in ASL with other deaf peers. Some attend private schools that focus on oral speech education. Others attend public schools that provide various forms of support so that they might have better access to communication: ASL interpreters, FM systems (for amplifying CIs and hearing aids in the classroom), realtime captioning devices, and note-taking resources. Some deaf children even attend public school with no support at all! Again, deaf children's exposure to ASL and English varies depending on the hearing loss, family, school, and other relevant factors.

One outcome of this variability in exposure to language in early life is that defining the "native language" or "first language" of a deaf signer is fraught with difficulties. For the present study, we refer to ASL as the first language if the study participant relied on signing as the primary form of communication. This characterization does not mean that parents used ASL regularly or fluently in the home. Nor does it rule out the possibility that the participant learned some English words prior to beginning to sign. The term first language in this study refers to our best effort to ascertain the participant's first fully functional language.

The majority of the U.S. population is monolingual, and resources at schools are based on monolingual education. Successful communication and employment rely to a large degree on English-language proficiency. Within this broader context, the traditional approach to reading in the deaf population has been to evaluate it within a monolingual framework. The present study departs from past work in two important ways. First, the question of reading proficiency and the factors related to it are considered within a bilingual framework. Instead of evaluating effects of SES on reading development alone, this study includes a measure of ASL proficiency as well. Hauser, Paludneviciene, Supalla, and Bavalier (2008) devised one of the first ASL tests that can be given to ASL-English bilingual children to directly assess their ASL proficiency. By including measures of both ASL and English proficiency, the present study considers all the language skills of the bilingual participants. Second, past studies have only included native signers (deaf children with deaf parents) because of the lack of ASL assessment tools, which severely limited sample size and the generalizability of the results to the broader deaf population. We use direct assessment of ASL skill, which allows us to include deaf individuals from both hearing and deaf families; it also allows us to distinguish between different levels of language proficiency within populations of deaf individuals who are all native signers, just as variability in language proficiency can be distinguished in any population of hearing native speakers of a language. The importance of this change in methods cannot be understated. As the results of the present study will demonstrate, categorical distinctions in ASL proficiency cannot be made on the basis of whether a deaf individual has deaf or hearing parents. By excluding deaf individuals with hearing parents from most studies, the literature has provided a piecemeal view of linguistic and cognitive skills in the deaf population.

Previous studies of ASL-English bilinguals have shown that L1 language proficiency in ASL is related to L2 literacy skills, even when signing bilinguals do not use a writing system with their L1 (Chamberlain & Mayberry, 2008; Hoffmeister, 2000). Despite the numerous previous studies on SES, L1 proficiency, and literacy skills of hearing monolinguals and bilinguals, there is a dearth of research on SES and how it affects language development in ASL-English bilinguals. Thus, the goal of the present study was to investigate this relationship in deaf ASL-English bilinguals for the first time. The research questions were:

- \* Does SES predict L2 reading ability in signing bilingual readers?
- \* Does L1 proficiency predict L2 reading ability in signing bilingual readers?
- \* If both factors affect L2 reading ability, are they correlated with each other? Can L2 reading ability in signing bilingual readers be modeled with both factors?

#### Methodology and Data

To investigate the possibilities raised by our research questions, we assessed family SES, L1 ASL language proficiency, and L2 English reading proficiency in a large population of ASL-English bilinguals. We used mixed-effects linear modeling to explore the relationships among these three variables.

#### Participants

The data for the present study were collected nationally at universities, schools, and summer camps for the deaf. A total of 212 deaf children and adults ranging in age from 6 to 26 years with a hearing loss of 85 dB or greater in the better ear were recruited. Individuals with known learning disabilities, neurological disorders, or uncorrected vision difficulties were excluded from the sample, as was any participant who did not complete the entire protocol. Consequently, 135 participants were included in the analysis.

#### Materials

Parents of the participants filled out a background questionnaire regarding their marital status, occupation, and educational experience, which was used to assign participants a score on the Hollingshead (1975) SES scale. Participants' age was also recorded.

The ASL-Sentence Reproduction Test (ASL-SRT; Hauser, Paludneviciene, et al., 2008) was the instrument used to assess ASL proficiency. The ASL-SRT requires test takers to view 20 sentences of increasing complexity. After each stimulus sentence, they are asked to repeat the sentence verbatim (cf. the Test of Adult and Adolescent Language; Hammill, Brown, Larsen, & Weiderholt, 1994). The ASL-SRT has not yet been normed for different ages. In order to compare performance across participants of different ages, we modified the ASL-SRT scores into age-normed standard scores by calculating the mean and standard deviation of ASL-SRT scores for three age groups: 79-120 months, 121-160 months, and 161 months or older. We subsequently generated standard scores for participants on the basis of their age group.

Scores from the reading comprehension portion of the Peabody Individual Achievement Test-Revised (PIAT-R; Markwardt, 1989) were used to assess English literacy skills. For each PIAT-R item, participants read a sentence, then picked the picture that matched the sentence from four choices.

#### Procedure

Participants were tested individually by examiners fluent in ASL. From the total sample of participants, we selected a subsample using the following criteria: completion of the reading assessment (PIAT-R) and intelligible writing or signing to allow accurate scoring. A total of 97 DoD (deaf children of deaf parents) and 38 DoH (deaf children of hearing parents) were identified for inclusion in the study. Traditionally, DoD and DoH have been analyzed separately because there have not been tools available to directly assess ASL proficiency. The assumption has been that DoD will always have better ASL proficiency than DoH. Further, many studies do not include DoH at all since their ASL proficiency is less predictable. DoD account for roughly 5% of the deaf population in the United States, with DoH representing the other 95% (Mitchell & Karchmer, 2002). Although DoH as a group typically attain lower proficiency levels in ASL than DoD, there is a need to include data that represent the majority of the deaf population. In the present study, we were able to include both groups because

we directly assessed ASL proficiency. While the DoD participants had a higher mean ASL score (8.68) than the DoH participants (5-08), the ranges of scores for the two groups were highly similar-DoD 0 to 18, DoH 0 to 15-differing primarily in the range's upper boundary. Further, as estimated by the mean-median differential, variability in ASL fluency was comparable-a value less than 1.00 for both groups (DoD .32, DoH .58). The opportunity to include all 135 subjects, regardless of parental hearing status, enabled a fuller representation of the target population. Demographics characteristics and language assessment values for the sample are listed in Table 1.

We analyzed the data with mixedeffects regression using the lme4 package (Bates, Maechler & Bolker, 2012) in R (R Core Team, 2014). SES and ASLSRT scores were treated as fixed factors and participant was the random factor; the dependent measure was reading comprehension as measured by the PIAT-R.

## Results

We first evaluated whether SES and ASL were correlated in the sample. The correlation was not significant ( $R^2 = .020$ ; adjusted  $R^2 = .013$ ;  $N = 135$ ;  $p = .097$ , n.s.). This is an important finding. SES is highly correlated with English proficiency in hearing children, in that hearing children who experience home literacy environments that are the most conducive to learning to read typically also have the strongest oral language skills. A failure to detect a similar pattern between SES and ASL proficiency in deaf children is the first indicator that ASL proficiency is distributed in the deaf population differently from English proficiency in the hearing population. Deaf children living in high-SES homes do not necessarily have the greatest LI proficiency. This may be an indication that ASL is comparable to a minority language in the English majority language environment in the United States. Parents of deaf children who have well-developed signing skills are not necessarily the parents with the highest education levels and incomes.

Having established the independence of SES and ASL as factors that could influence reading comprehension, we next carried out the mixedeffects regression including SES and ASL. Both SES ( $p < .01$ ) and ASL ( $p < .01$ ) were significant factors in the model. How can SES and ASL both predict better reading scores, even though they are not correlated? To help explain the complex relationship between these factors, we present the data in a panel graph in Figure 1. Unlike most figures that display regression data, Figure 1 does not show the dependent variable on the y-axis. This figure separates the data into four separate but overlapping groups with respect to the dependent variable: PIAT-low, PIAT-midlow, PIAT-midhigh, and PIAT-high. The separation of the PIAT scores into four overlapping groups provides a chance to look more closely at the relationship between SES and ASL at each level of reading proficiency. In the leftmost panel of the figure, one can see that there is a slightly negative correlation of SES and ASL for poor readers. By contrast, in the rightmost panel, one can see that SES and ASL are positively correlated for good readers. For the two middle groups, the regression line is flatter than for the best readers, but the regression line nevertheless indicates a positive correlation. The results suggest that for the poorest readers, home SES and ASL proficiency are competing factors. By contrast, deaf signers have the greatest success in literacy when SES and ASL are cooperating factors providing mutual support for development.

## Discussion

The question, from the start, was whether SES has an impact on literacy development of ASL-English bilinguals. The results extend the finding of prior studies of SES effects on monolingual and bilingual hearing children's reading outcomes and document for the first time that ASL-English bilinguals' reading proficiency also benefits from higher levels of home SES. There are several reasons why high-SES parents of hearing children are better at promoting literacy. They provide more reading opportunities; they exhibit strong portrayals of reading enjoyment; they use more mediation strategies, and their mediation strategies are more closely aligned with the reading level of their children than is the case for low-SES parents (Korat & Haglili, 2007). Some examples of mediation strategies include talking with children about issues that go beyond the text in the book. The quality of encouragement high-SES parents give their children to participate actively in reading activities is

also greater. The style of talk of high-SES parents creates a connection between the text's meaning and the child's own experience. While it is not surprising that these behaviors would be beneficial to deaf children, the present study is the first to demonstrate that despite the unique factors influencing relationships between deaf children and their deaf or hearing parents, the association between SES and literacy nevertheless holds. What we cannot conclude from this type of study is whether the relationship between SES and reading achievement in deaf children reflects the same set of behaviors, or different behaviors, on the part of high-SES versus low-SES parents of deaf children.

Many of the characteristics of high-SES home literacy environments in monolingual households could easily be transferred to the context of communicating in ASL about English print. For example, mothers from all SES levels overestimate their child's literacy skills (Korat & Haglilii, 2007). High-SES mothers overestimate less and are more aware of the importance of using different mediation strategies to facilitate their child's literacy development. In other words, the focus of educating a signing bilingual child needs to be on the relationship between the parent (s) and child, even if a parent is learning to sign with the child. This may be particularly critical in the case of deaf children who are approaching literacy without full mastery of the language represented by print. Deaf children vary widely in literacy outcomes. The ability of parents to realistically assess their child's literacy performance allows them to then respond in appropriate ways to their child's literacy needs. The topic of literacy is prioritized in the educational environment for teachers and educators of deaf students. However, if a child is to obtain good literacy skills at school, the role and responsibility of the parent (s) should be acknowledged and cultivated as well.

The next step is to consider whether the behaviors of high-SES parents documented in previous studies can be expected in families with deaf children. Do higher-SES parents who have ASL-English bilingual children accommodate their need for literacy success? The reason to take this into consideration is the fact that communication from parent to child is different when the parent is learning to sign and the child is not fluent in the parent's language. The results ultimately support the idea that even when communication skills between parents and signing bilingual children are not similar to those of other monolingual and bilingual families, high-SES parents nevertheless find ways to promote literacy. The majority of signing bilingual children have parents who are learning ASL as a second language or are not signing bilinguals; thus, it is highly informative to discover that despite potential communication barriers, SES is still predictive of stronger literacy skills. There has been an attempt to evaluate the language behaviors of hearing parents of deaf children (Harris & Mohay, 1997; Loots, Devise, & Jacquet, 2005; Spencer & Harris, 2006), but there has been no investigation of the role of SES as a factor. The results of the present study demonstrate the need to take SES into account as a potential factor influencing parent-child behaviors in designing studies of parental mediation of literacy interactions in the future.

For deaf parents, whose children are fluent in their language, the relationship between SES and literacy may have a different explanation (Beck, McKeown, & Kucan, 2013). Deaf families face barriers to higher SES levels. For instance, Schembri et al. (2009) collected and categorized different SES levels of deaf individuals from Australia and New Zealand. Despite some methodological concerns related to sampling from a sparse population, Schembri et al. concluded that deaf individuals' and families' SES levels are not distributed similarly to those of the general monolingual population. The researchers proposed that deaf individuals face a barrier to higher SES because of restricted fluency in the majority language. This account is similar to ones describing other bilingual situations (Oller & Eilers, 2002). Sign languages are essentially minority languages and are not as socially esteemed as majority spoken languages. Thus most DoD families are classified as having working and middle-class SES; by contrast, DoH families can be found at all SES levels. Yet it is not impossible for DoD families to have high SES levels; it is just less typical. One type of societal change that might be necessary so that more deaf families can attain a higher SES level is the recognition of bilingualism as socially valuable, and the recognition of deaf individuals who use a signed language and a spoken language as bilinguals. There is no

reason to focus solely on English to the detriment of ASL. Language attitudes influence access to educational and professional opportunities that allow children of lower-SES families to attain a higher level of SES in adulthood. When the advantages of bilingualism are widely recognized by the general public, not only deaf families, but all bilingual families, will benefit from this change in societal attitudes.

The few attempts to document parental mediation of literacy activities in deaf families demonstrate that when the home language is shared between deaf children and their signing deaf parents, parents scaffold early literacy experiences in such a way that their children are socialized into literate behaviors and become increasingly independent participants in literacy events (Bañes, C. N. Erting, L. C. Erting, & Thumann-Prezioso, 2009; Berke, 2013). Deaf parents capitalize on visual features of signed languages to draw their children's attention to features of print—for example, holding a handshape next to a word in a book or signing different meanings associated with an English word while pointing at the print. Chaining is a strategy first documented among teachers of the deaf (Humphries & MacDougall, 2000), but it is also observed in the behaviors of deaf parents (Berke, 2013). Deaf parents are also sensitive to the visual needs of their children; the parents will choose how to position themselves and a book relative to their child in a way that enables the child to view the book and the parents' signing simultaneously. While there is interest in the possibility of teaching hearing parents these mediation strategies (see, e.g., Schleper, 1997), there have not been attempts to investigate how parental mediation of literacy activities might differ across SES levels of deaf parents.

In addition to showing effects of SES on reading comprehension, the results of the present study replicate and extend those of prior studies showing that ASL proficiency predicts English literacy outcomes in both children (Hoffmeister, 2000; Vernon & Koh, 1970) and adults (Chamberlain & Mayberry, 2008; Freil et al., 2011). Chamberlain and Mayberry (2008), for example, assessed the proficiency in ASL, Manually Coded English (MCE), and English reading of 31 deaf adults by means of a range of assessment tasks. Participants were separated into two groups on the basis of their performance on the Stanford Reading Test: those reading below the grade 8 level, and those reading at grade 8 or above. Deaf signers with better reading abilities differed significantly from the less proficient readers on an ASL grammaticality judgment task, as well as on ASL and MCE narrative comprehension tasks. Chamberlain and Mayberry argue that there is a linguistic basis to reading that is independent of the specific language represented by print; thus, sign language can provide a general linguistic advantage to reading development, even though it does not share phonological, lexical, or grammatical features with spoken languages. The results of the present study are consistent with Chamberlain and Mayberry's findings, and add to those findings by showing that this relationship holds at an earlier phase of development. Chamberlain and Mayberry recruited adults for their study (ages 17-53 years). The present study demonstrates that this relationship between ASL and English literacy skills is already apparent in a much younger population.

Vernon and Koh (1970), who documented better literacy outcomes in deaf children with deaf parents than in deaf children with hearing parents, carried out their research at a time when there was less recognition of the linguistic status of ASL. They discussed their results as they related to "early manual communication" (p. 527), thus emphasizing the accessibility of the communication form to children rather than its linguistic status. Interestingly, they pointed out that their results held despite the fact that 88% of the deaf parents they studied had not attended school past the eighth grade, while 30% of the hearing parents had attended college. Vernon and Koh interpreted this inverse relationship between parent education and child success as evidence that parent-child communication is essential for developing basic language competence. Their results may on first reflection seem to contradict ours, but it should be noted that none of the deaf children of hearing parents in their study had access to ASL. In our population of deaf children, all participants had access to ASL at some point regardless of the hearing status of their parents. Our study has thus allowed us to discover that both accessible language and the home literacy environment associated with high-SES families are beneficial to the development of literacy skills for deaf children.

How can knowledge of a sign language promote literacy development? Kubus, Villwock, Morford, and Rathmann (2014) found that deaf German bilinguals activate signs in DGS (German Sign Language) while processing written German words in a semantic similarity judgment task (cf. Morford, Wilkinson, Villwock, Pifiar, & Kroll, 2011, for ASL-English bilinguals). To provide a potential explanation of their findings, Kubus et al. proposed not only that knowledge of a signed language supports written-word recognition by providing a general linguistic advantage, but that there may be language-specific benefits of learning a signed language as well. Kubus et al. explained that during the course of LI acquisition, signers develop extensive semantic networks. Deaf readers can map orthographic forms to signed phonological forms and the meaning representations associated with those signs instead of creating new meaning and forming representations every time they encounter a written word they have never seen before. In other words, signed language proficiency may allow signing bilinguals to associate meaning with written-word forms more rapidly, even though the print represents words from a different language.

All parents of deaf children can promote their child's sign language proficiency, whether or not it is the parent's LI. Developing strong signing skills in themselves and in their child gives parents a basis for being involved in literacy events, and for empowering their children to become proficient bilinguals. The fact that ASL skills and SES are positively correlated in the most proficient readers in our study sample suggests that these two factors can be mutually beneficial. Increasingly, studies of bilinguals are showing that bilingualism has benefits for cognitive function, even beyond the domain of language processing. Hauser, Lukomski, and Hillman (2008) focused on executive function (EF), which is a selfregulatory system that has significant implications for both social and academic development. These researchers provided an overview of the ways the environment can affect the development of EF. Overall, they found better EF task outcomes for bilinguals compared to monolinguals, and suggested that the evidence provides necessary insights for parents and educators about the consequences of sign-print bilingualism for other cognitive functions.

Indeed, parents and educators may already have tacit knowledge of the potential benefits of bilingualism in ASL and English. Pucci, Harmon, and Mouny (2012) interviewed 12 parents and teachers who worked with deaf signers to probe their emic perspectives on the relationship between ASL and English proficiency in their children and students. Interviewees expressed the conviction that a bidirectionality of influence exists between these languages. As the development of one language increases, it supports and facilitates development of the other language. Much of the prior literature has addressed how ASL influences English, since many deaf individuals become fluent signers before becoming proficient readers. Pucci et al. found that respondents were sensitive to influences in the opposite direction as well, noting that as English vocabulary increases, signers show more sensitivity to genre and lexical choice in ASL. The unique insights into the language development of deaf bilinguals from this group of stakeholders provide additional support for the conclusions reached on the basis of performance-based measures of ASL and English proficiency of deaf signing bilinguals.

The results of the present study can also be brought to bear on the question of whether reading development is qualitatively similar for deaf and hearing children. On the one hand, the study shows that two factors that influence the reading achievement of hearing children also influence deaf children's reading achievement. One of these factors, LI proficiency, is cognitive, and reflects on the importance of prior language knowledge in the development of reading skills (Chamberlain & Mayberry, 2008; Dickinson & Snow, 1987). The second factor, SES, is social, and reflects on the influence of parents in shaping opportunities for learning to read (Bailes et al., 2009; Berke, 2013; Korat et al., 2013). These two factors often co-occur for hearing children; deaf children are much less likely to benefit from both factors. These results do not provide a basis either to propose or reject the presence of qualitative differences in the cognitive process of reading for deaf and hearing children. However, they do suggest important differences in the topography of learning experiences for deaf and hearing children. Deaf children may be surrounded by books but not have sufficient language to benefit from the stories the books hold. They may have rich and engaging conversations with their parents in ASL, but rarely receive

encouragement to put their stories into writing. When both factors come together to support the developing deaf learner, successful literacy achievement is a likely outcome.

To conclude, this initial study of the effect of SES on the literacy skills of ASL-English bilinguals has shown for the first time that SES has a direct impact on ASL-English bilinguals' L2 literacy success, and that this effect is independent of and additional to the benefits of LI proficiency in ASL. Since SES and ASL proficiency are not correlated for deaf signing bilinguals, it is critical to explore a range of sensitive, complex linguistic and social interactions that can account for the way these factors contribute to the process of acquiring language and literacy during childhood bilingualism. Future research should investigate the impact of different types of literacy mediation between monolingual and bilingual parents and their deaf children. Also, research should explore the different roles possibly played by SES in ASLEnglish bilingual children's language and literacy outcomes.

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**Author Affiliation**

PAUL TWITCHELL, JILL P. MORFORD, AND PETER C. HAUSER  
TWITCHELL IS A GRADUATE INTERN AT DR. LAURA-ANN PETITTO'S BRAIN AND LANGUAGE LABORATORY FOR NEUROIMAGING (BL2) IN THE NSF SCIENCE OF LEARNING CENTER ON VISUAL LANGUAGE AND VISUAL LEARNING (VL2), AND A PHD STUDENT, PROGRAM IN EDUCATIONAL NEUROSCIENCE, GALLAUDET UNIVERSITY, WASHINGTON, DC. MORFORD IS PROFESSOR, DEPARTMENT OF LINGUISTICS, UNIVERSITY OF NEW MEXICO, ALBUQUERQUE, AND AN AFFILIATED RESEARCHER, VL2. HAUSER IS A SCIENCE MENTORSHIP LEADER, VL2, AND PROFESSOR, NATIONAL TECHNICAL INSTITUTE FOR THE DEAF, ROCHESTER INSTITUTE OF TECHNOLOGY, ROCHESTER, NY.

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