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Deaf Readers as Bilinguals: An Examination of Deaf Readers' Print Comprehension in Light of Current Advances in Bilingualism and Second Language Processing

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Abstract

Much work has examined whether deaf and hearing individuals' reading strategies are qualitatively different, under the assumption that such differences might account for discrepancies in levels of reading achievement (cf., Allen 1986; Gallaudet Research Institute 2005; Holt 1994; Karchmer and Mitchell 2003; Traxler 2000; Wauters et al. 2006). While generalizing over the performance of deaf readers is not trivial, the evidence seems to converge on the reader's quality of modality-independent language experience as the best predictor for reading abilities (Mayberry et al. 2011). In order to better understand the relationship between sign literacy and written literacy, more attention needs to be devoted to the fact that most deaf readers are bilingual in a signed and a written language and that, in most cases, the written language is, effectively, their second language. The growing body of research on bilingualism and L2 processing is rapidly advancing our understanding of the architecture of the bilingual brain and of the individual factors that might affect both production and comprehension in a second language. This body of research has great potential to illuminate aspects of deaf readers' behavior that have heretofore appeared vexing. In turn, including deaf literacy studies within the larger context of research on bilingualism will contribute to a richer picture of the bilingual experience.

1. Introduction

Reading comprehension studies involving deaf individuals have traditionally attempted to identify those variables that might distinguish hearing and deaf readers, such as use of a phonology-based decoding strategy, syntactic competence in the written language, and sentence processing strategies. A comprehensive account of the reading abilities of deaf individuals, however, remains elusive. Phonology-based models, for example, cannot easily account for the performance of congenitally deaf, highly proficient readers. As discussed below, there remains much debate over whether speech-based phonological coding underlies the reading development of deaf individuals and correlates with their reading comprehension (e.g., Mayberry et al. 2011). Similarly, while some studies point to gaps in syntactic knowledge as a possible cause for reading differences, others suggest that syntactic competence alone does not always predict reading skills and that more general differences in processing resources are at stake (e.g., Kelly 2003). Little is known, however, about the written sentence processing patterns of deaf readers. The few existing studies reveal both differences between hearing and deaf readers and between different

groups of deaf readers (e.g., Miller 2000, 2005), while the source of such processing differences is not fully understood.

It is important to understand that deaf individuals bring a wide range of experiences to the task of learning how to read. Onset of deafness, educational choices, and family background are key to language and literacy development. Crucially, only a small percentage of the deaf population grows up in signing families and is exposed to language from birth. More often, deaf children are not exposed to sign language in the earliest years of life. Additionally, limited access to auditory input makes spoken language development before the onset of reading unlikely. While most deaf individuals adopt a sign language as their primary mode of communication (Karchmer and Mitchell, 2003), with the written language often becoming, effectively, their second language (L2),¹ those acquiring a sign language early as their first language (L1) can arguably use their L1 skills to bootstrap L2 acquisition. This contrasts with individuals lacking a fully developed L1 when they are exposed to print. This difference has long-lasting consequences for literacy skill development (Mayberry 2007). Specifically, while deaf adults who learned a sign language as their L1 after the age of eight display pervasive phonological,² syntactic, and lexical processing deficits in sign language that set them apart from native and early signers (Boudreault and Mayberry 2006; Mayberry and Eichen 1991; Mayberry and Witcher 2006, respectively), a comparison of native and early signers to late language learners also indicates lower reading skills and lower grammaticality judgment scores among late learners (cf., Mayberry and Lock 2003). Other studies finding a relationship between signing and reading skills include Chamberlain and Mayberry (2008), Hoffmeister (2000), Kampfe and Turecheck (1987), Kuntze (2004), Mayberry (1989), Padden and Ramsey (2000), and Strong and Prinz (2000). Importantly, these studies bring to the forefront the bilingual nature of deaf readers' literacy. Yet, issues related to their reading comprehension have typically not been considered within the wider framework of current studies on bilingualism and L2 processing.

Recent work on bilingualism is rapidly advancing our understanding of the architecture of the bilingual brain and of the factors affecting both production and comprehension in an L2. We argue that this research has great potential to enhance our knowledge of deaf readers' written literacy. For example, discoveries in how the bilingual lexicon is organized and how L1–L2 connections modulate semantic access in the L2 can shed light on the well-documented, but still poorly understood, relationship between sign language proficiency and reading skills. Similarly, work on the multiple variables modulating L2 processing may potentially inform observed differences both among groups of deaf readers and between deaf L2 and hearing L1 readers. At the same time, issues that may be somewhat unique to deaf bilinguals, such as late versus early exposure to an L1, or learning the L2 through print, can provide insight into the intricate relationship between the L1 and L2 in the general bilingual population while also clarifying the effects of language modality on bilingualism.

We begin with an overview of traditional and current studies on deaf readers, focusing on word recognition, syntactic competence, and attention to different sentential cues. We then discuss how research in bilingualism can provide insights to deaf readers' path to literacy and provide new directions for re-examining their reading comprehension patterns.

2. Variables Potentially Affecting Deaf Readers' Written Comprehension

2.1. WORD RECOGNITION

Swift word recognition is critical for effective reading. Evidence that it plays an important role in deaf readers comes from Kelly (2003), who found that the word-reading rate for

adult deaf readers performing at college level was 367 ms in complex sentences – similar to that of hearing college readers (Just et al. 1982) – while for participants performing at the fifth grade level, the word-reading rate slowed to 503 ms.

That phonological knowledge plays an important role for word recognition among both hearing children (Cunningham et al. 2002) and adults (Berent and Perfetti 1995; Van Orden 1987; Van Orden et al. 1988) has triggered numerous studies of phonological coding abilities in deaf readers. However, the results remain inconclusive. Some studies report evidence of phonological awareness among young deaf readers (Colin et al. 2007; Harris and Moreno 2004) while others do not (Izzo 2002; Merrills et al. 1994). The strongest evidence for phonological coding among deaf readers comes from studies with deaf adolescents and adults testing phonological similarity in recall (Conrad 1979; Hauser 2000) or lexical decision tasks (Hanson and Fowler 1987; Kelly 1993, 2003) and tongue twister effects in semantic acceptability tasks (Hanson et al. 1991). Crucially, however, while some report correlations between phonological coding and reading skills (Conrad 1979), the overall evidence is tenuous at best. For example, Kelly (2003) found no relation between phonological coding and reading speed or accuracy at the sentence level in adults (see also Waters and Doehring 1990 for children, and Dyer et al. 2003 for adolescents). More recently, Dominguez and Alegria (2010) concluded that phonological representations of words underlie the reading and spelling mechanism of Spanish deaf adults, but found only marginal correlations between met-aphonological scores and reading.

An influential review of the literature completed in 2000 concluded that ‘deaf readers’ access to phonological representations may follow, rather than precede, initial word identification’ (Musselman 2000:14). More recently, a meta-analysis by Mayberry et al. (2011) found that phonological coding skills accounted for only 11% of the variance in reading proficiency among deaf participants and that, even in cases in which a positive correlation was found, a causal relation could not be established. Furthermore, a thought-provoking study by McQuarrie and Parrila (2009) casts doubts on results adducing evidence for phonological coding in tasks requiring a two-choice similarity judgment. They tested the ability of deaf students (ages 8–18) to make form similarity judgments of printed stimuli at the phonemic, syllabic, and rhyme levels and found that judgments were guided by visual and motoric rather than phonological cues. They noted that, although visual/tactile information might form part of the phonological characteristics of the input, such cues were insufficient to provide fine-grained contrastive distinctions between the sounds of words and led to confusions when in conflict with contrastive phonological cues. Despite an overall lack of sensitivity to spoken language phonology, their participants’ reading skills ranged from poor to very skilled. This supports the notion that spoken language-based phonological coding is neither necessary to attain good reading comprehension skills nor a discriminating factor between poor and strong deaf readers.

What might then be key to successful print decoding among skilled deaf readers? McQuarrie and Parrila suggest that knowledge of the sublexical structure of a signed language may subserve the development of lexical analytical skills in the written language. As the evidence for a phonology-based path to reading for deaf readers loses ground and evidence for a correlation between reading and signing skills mounts, it becomes imperative to further investigate the nature of the role that sign language may play in connecting print and meaning. We will return to this question in the last section.

2.2. SYNTACTIC COMPETENCE IN THE WRITTEN LANGUAGE

Prelingually deaf individuals often learn to read prior to mastering the grammar of the written language. That is, they acquire the written language grammar as they learn to read and not vice versa, as is the case for hearing readers. Some researchers have argued that this process of language acquisition, along with limited exposure to the spoken language, can constrain the ability to deduce and internalize its syntactic rules, which might, in turn, account for observed discrepancies between hearing and deaf readers (Quigley 1982; Webster 1986; Wilbur and Quigley 1975; Wood 1984).³ Quigley (1982) and Wood (1984), for example, claimed that some misinterpretations of English sentences by deaf readers suggest the imposition of a subject–verb–object order even on structures such as passives that do not follow a canonical thematic order. Similarly, other studies appeal to competence gaps in complex structures to account for comprehension difficulties when compared to syntactically less complex structures (Quigley et al. 1977; Robbins and Hatcher 1981). Furthermore, in a study of deaf adolescents from oral and signing programs, Kelly (1996) argued that limitations on English syntactic competence prevented readers from extracting full meaning from the sentential vocabulary and concluded that syntax both directly and indirectly affects sentence comprehension.

While syntactic competence might vary among deaf readers, evidence suggests that syntactic knowledge itself is not what ultimately predicts reading proficiency. Lillo-Martin et al. (1992) tested two groups of deaf high school students with different independently measured English reading comprehension levels on their knowledge of relative clauses (RC) in English, signed English,⁴ and American sign language (ASL). Despite differences in reading comprehension spanning four grades, both groups produced very few errors across RC sentence types and showed similar comprehension patterns in all three formats, suggesting that the difference in reading ability between the two groups was not due to a syntactic deficit. Instead, they hypothesized that a discrepancy in processing resources might explain the group differences.

Similarly, in Kelly (2003), two groups of deaf college students with different reading comprehension levels nevertheless showed the same on-line reading patterns for English RCs. Crucially, increased processing difficulty is predicted at the RC verb if the RC is appropriately parsed, since that is where the thematic roles of the sentence constituents are interpreted. Both groups slowed at the verb, but only the less skilled readers showed overall slower reading latencies and lower comprehension scores in RC sentences versus simpler control sentences. Kelly concluded that processing factors related to reading automaticity and cognitive resource allocation were driving the group differences in comprehension skills.

In sum, the available findings suggest that syntactic competence alone does not guarantee effective reading skills. Rather, other general processing issues might be involved, although there remains no consensus on the source(s) of the purported processing difference(s) between more and less skilled readers.

2.3. SENTENCE PROCESSING STRATEGIES

Research has also examined possible qualitative differences in the sentence parsing of deaf and hearing readers. Some researchers claim that deaf readers may rely on semantic and pragmatic information to compensate for syntactic knowledge gaps or processing limitations. For example, Gormley and Franzen (1978) suggested that deaf readers rely more on context and background information; Dalby and Letourneau (1991) reported deaf

readers' own intuition that they engage print as a primary linguistic system and derive meaning through pragmatic inferences and modality-independent linguistic knowledge (cf., Kuntze 2004:184), and De Villiers and Pomerantz (1992) proposed that deaf readers encountering unfamiliar syntactic structures rely on vocabulary to interpret written text. More recently, Dominguez and Alegria (2010) argued that Spanish deaf readers exploited the so-called keyword strategy to extract meaning from written text. Again, however, the extent to which deaf readers rely on lexical, semantic, and syntactic information to process sentences remains poorly understood.

Nevertheless, some insights emerge from early electromagnetic and event related potential (ERP) studies examining the neural systems underlying syntactic and semantic processing in hearing and deaf readers. Neville et al. (1992) compared ERP responses to closed-class English words, which convey syntactic information, and open-class English words, which refer to objects and events, in hearing native English speakers and congenitally deaf participants whose L1 was ASL. Both showed quantitatively and qualitatively similar ERP responses to open-class words. However, for the hearing readers closed-class words elicited negative peak responses distributed over left hemisphere areas assumed to be responsible for syntactic processing, whereas this effect was generally absent for the deaf readers. Interestingly, a sub-group of deaf participants with English proficiency scores comparable to the hearing participants' displayed the same pattern of responses to the closed-class words as the hearing readers, although the small size of this group prevented drawing statistically based conclusions. Neville et al. concluded that different neural systems mediate the processing of words carrying syntactic versus semantic information. Further, differences between hearing and deaf participants indicate that early language experience can alter the development of these distinct neural substrates. These results are complemented by studies of L1 syntactic processing in ASL versus English which demonstrate considerable overlap in neural systems despite differences in language modality (Bavelier et al. 1998; Neville et al. 1997). Thus, the different patterns of brain activity in Neville et al. (1992) likely reflected L1 versus L2 processing.

Behavioral studies of syntactic processing in deaf readers are consistent with the electrophysiological evidence. Hung et al. (1981) tested American deaf signing high school students in a sentence-picture verification task in English and ASL in which affirmative and negative statements accurately or inaccurately described spatial relationships in a target picture. For the ASL sentences, participants' response times fit a linearly increasing function revealing sensitivity to the syntactic complexity of the target sentence. By contrast, participants' performance did not fit this model for the English sentences. They concluded that this performance contrast indexed different levels of automaticity in low-level processing of ASL versus English that, in turn, conditioned whether sufficient resources were available in each language to compute syntactic operations.

In an off-line study of younger deaf readers, Miller (2005) compared comprehension across hearing, hard of hearing (HoH), and deaf students in semantically plausible and implausible sentences and found lower comprehension levels among the deaf and HoH participants only in the implausible condition, indicating general reliance on semantic cues (see also Miller 2000). Closer scrutiny of the deaf and HoH participants, however, revealed three performance groups: a small group exhibiting comprehension difficulties in both conditions, a group showing comprehension difficulties only for implausible sentences, and a group performing well in both conditions, revealing attention to syntactic cues. There was a balanced number of deaf and HoH participants in the second and third groups. Furthermore, in the group with the best syntactic processing abilities, the common variable was that their parents were also deaf or HoH and so the students were

more likely to have been exposed to sign language from birth. These results indicate that age of exposure to language, as opposed to auditory experience (i.e., HoH versus deaf), impacted the groups' ability to utilize syntactic cues. Along these lines, a recent on-line study by Traxler et al. (2010), using a moving window technique, tested adult deaf ASL-English bilinguals' parsing of English subject and object RCs, as well as active and passive structures. While attention to syntactic cues was not uniform, the key variable predicting sensitivity to the syntactic manipulations was onset of ASL acquisition. Native signers were more sensitive to syntactic cues than early signers, who were, in turn, more tuned to syntactic cues than late signers. These results again call attention to the importance of age of L1 exposure for reading development as well as to the bilingual relationship between ASL and reading skills in this population.

Finally, a recent eyetracking study by Piñar et al. (2010) found that highly proficient deaf ASL-English bilingual college students showed sensitivity to the increased syntactic complexity of object versus subject English RCs, in which the animacy of the relativized noun phrase was manipulated, much as hearing native English speakers do (Traxler et al. 2005). Participants with lower L2 proficiency, by contrast, experienced processing difficulty whenever the animacy properties of the relativized constituents conflicted with animacy expectations for thematic position (i.e., animate objects and inanimate subjects), thus showing reliance mainly on semantic cues. Possibly, as has been found for other bilinguals, greater L2 proficiency affords better availability of the cognitive resources needed for higher level computations in the L2.

Overall, these studies show that deaf and HoH individuals do not uniformly exploit syntactic information during reading comprehension and that those who do not use available syntactic cues might rely on other top-down strategies. Whether differences in attending to syntactic cues stem from syntactic competence or more general processing resources issues remains under investigation. What seems clear is the importance of carefully factoring in the language history variables and individual characteristics of deaf readers in order to draw nuanced conclusions about their processing strategies.

3. Future Directions: Deaf Readers in Light of Current Studies on Bilingualism and L2 Processing

Much work has examined whether deaf and hearing individuals' reading strategies are qualitatively different, under the assumption that such differences might account for discrepancies in levels of reading achievement (cf., Allen 1986; Gallaudet Research Institute 2005; Holt 1994; Karchmer and Mitchell 2003; Traxler 2000; Wauters et al. 2006). The emerging picture is complex. Generalizing over the performance of deaf readers is not trivial, but the evidence seems to converge on the reader's quality of modality-independent language experience as the best predictor for reading abilities (Mayberry et al. 2011). Many studies report a positive relationship between sign language and reading, with researchers such as McQuarrie and Parrila (2009) positing that sublexical mappings between signs and print might provide a better path to reading than spoken language phonology for deaf readers. Yet, the fact that a signed language and the spoken language represented by print are completely different languages, in different modalities, with little form overlap, raises questions about how exactly the mapping between sign and print might work. Under the assumption that the path to reading is unilingual and requires spoken phonology to be mapped onto its orthography, the issue might, indeed, seem vexing. By contrast, acknowledging a bilingual path from print to meaning among deaf readers might afford new insight into this question.

Abundant evidence in bilingualism research indicates that bilinguals jointly activate both languages when presented with stimuli in one of their languages. Much of this evidence comes from studies involving languages with phonological and orthographic overlap in which target words with cognates in the non-target language are recognized faster than controls, arguably due to the activation of sub-lexical form-meaning connections in both languages (e.g., Beauvillain and Grainger 1987; Dijkstra 2005; Kroll and de Groot 1997; Marian and Spivey 2003). Predictably, cross-language homophones and homographs, which share form but not meaning, inhibit word recognition (e.g., Dijkstra et al. 1999). Evidence of cross-language activation has also been found for languages without orthographic overlap (Thierry and Wu 2007) and for hearing bimodal bilinguals (Emmorey et al. 2008a).

Recently, Morford et al. (2011) examined whether adult deaf ASL-English bilinguals activated the ASL equivalents of English word pairs in a semantic relatedness task in which the stimuli were presented exclusively in print. They found that these bilinguals accepted semantically related English pairs faster when their ASL translations were form-related (i.e., overlapped in two or more sublexical parameters, such as handshape, location, and movement) than when the translations were not form-related. Conversely, underlying form-related ASL translations inhibited responses to semantically unrelated English pairs. This study provides some of the first evidence that deaf bilinguals activate sublexical aspects of signs when making semantic decisions about printed words. While still incipient, this line of research has the potential to provide groundbreaking insights into how sign and print connect in reading. For instance, a long-standing model of bilingual lexical architecture, the Revised Hierarchical model (RHM; Kroll and Stewart 1994), predicts that less proficient bilinguals rely on the L1 to retrieve meaning in L2, thus activating a path from L2 to L1 form when accessing conceptual meaning. As proficiency increases, direct L2 form and meaning connections strengthen, although L1 forms are still activated (Sunderman and Kroll 2006). While the bilinguals in Morford et al.'s study were highly proficient in both languages and thus might not have activated the ASL signs prior to retrieving meaning, the evidence that deaf bilinguals activate signs while reading words regardless of modality or form overlap brings us closer to understanding the much-debated issue of sign-to-print mapping.

In fact, given Morford et al.'s results showing that deaf sign-print bilinguals exhibit patterns of co-activation similar to those of other bilinguals, the RHM would predict that deaf bilinguals with weaker or developing proficiency in the written language will rely on sign forms to access meaning in print. Interestingly, Hermans et al. (2008) found a strong positive correlation between deaf children's scores in Sign Language of the Netherlands vocabulary and Dutch reading vocabulary and argued that children dominant in a sign language understand written vocabulary through associations with preexisting sign language vocabulary knowledge. More recent evidence from Ormel et al. (forthcoming), showing that deaf Dutch children activated phonological and iconic features of sign equivalents in an on-line print-picture matching task, indicates that print-sign co-activation does occur in developing deaf bilinguals and might constitute a key step in the development of direct links between orthography and meaning. Studies examining the timing of sign activation in more and less proficient deaf bilinguals are needed to investigate whether signs are activated prior to accessing the meaning of print, particularly in less proficient and developing readers. Answers to these questions will provide a better understanding of the role of sign competence in reading, in particular of the role of sign-print connections as an alternative path in reading development. If signs do provide a link to meaning at developing proficiency stages, we might speculate that early exposure to

both sign and print will facilitate the establishment of direct links between print and conceptual meaning, whereas delayed exposure might compromise the process by which print-meaning associations become automatic, which might in turn affect processing at higher levels.

Similarly, research on sentence parsing in deaf readers can benefit from explicit comparison to other bilinguals reading in their L2. In view of the evidence that additional cognitive costs are involved in processing an L2 as compared to the L1 (Michael and Gollan 2005), it is somewhat surprising that deaf readers' comprehension patterns have, for years, been gauged only against those of hearing individuals reading in L1. Admittedly, many factors might affect deaf readers' written sentence comprehension. As we have discussed, deaf individuals vary regarding onset of L1 acquisition, and delay in L1 acquisition leads to deficits in both L1 and L2 processing (Mayberry 2007), and can even have cognitive consequences in other domains (cf., Courtin 2000 regarding late language exposure and theory of mind). Learning the L2 through print might also affect the representations of the L2 of deaf as compared to hearing bilinguals.⁵ Yet, a thorough examination of deaf readers' sentence processing within the context of L2 processing research should help tease apart those aspects of deaf bilinguals' sentence parsing that might be the result of the cognitive constraints imposed by reading in an L2 from those that might stem from their specific language development or primary sensory-motor modality.

To our knowledge, research by Mayberry and Lock (2003) constitutes an exception in that they compared English language abilities in deaf ASL-English bilinguals and hearing English-L2 bilinguals to those of hearing English monolinguals. They found that when the age of acquisition (AoA) of the L1 and L2 were controlled, deaf and hearing English-L2 learners did not differ on sentence comprehension or grammaticality judgments of English structures ranging in complexity. Deaf English-L2 readers who acquired an L1 early and hearing English-L2 readers performed below the English monolingual group, but significantly above the deaf late-L1 group, thus isolating L1 AoA as a key variable for L2 acquisition as opposed to L1 sensory-motor modality. At minimum, this result indicates that grouping deaf readers without attention to their individual variables and comparing deaf bilingual readers only to hearing monolinguals can miss important generalizations affecting both hearing and deaf L2 readers.

Research on L2 sentence processing has identified differences between native speakers versus L2 learners, as well as variables modulating those differences, that might be relevant when examining the parsing strategies of deaf bilinguals. For example, an influential proposal by Clahsen and Felser (2006) claims that the syntactic representations that L2 learners build are less detailed than those computed by adult L1 speakers. They posit that whereas L1 speakers prioritize structure-driven strategies and syntactic information, L2 speakers favor lexical-semantic and pragmatic information. However, a number of studies highlight the critical role of proficiency during L2 reading (Gillon Dowens et al. 2009; Kotz et al. 2008), suggesting that at high levels of proficiency L2 speakers are able to recruit syntactic processes hypothesized to be partly automatic (Pakulak and Neville 2010). Working memory span (Dussias and Piñar 2010), and experienced-based factors such as immersion (Dussias 2003; Dussias and Sagarra 2007) also modulate whether sufficient resources are available to attend to different types of sentential cues, with L2 AoA (as reported in Neville and Bavelier 2000) even affecting the neural substrates involved in syntactic processing. As a suggestion for future directions, studies comparing deaf bilingual readers to both monolinguals and to other bilinguals functioning in their L2 that carefully control for the learners' individual variables can provide a more complete characterization of deaf readers' print processing abilities than has been achieved thus far.

Given the reported relationship between signing and English skills in deaf bilinguals, a multi-level approach to measuring proficiency in both the signed and the written language will be crucial for understanding how knowledge and use of the two languages modulate reading processes.⁶ Future studies need to investigate language processing at various stages of L1 and L2 development in deaf individuals to better understand the developmental trajectory of reading processes as a function of gradually increasing proficiency in both the signed and written languages. Future research also needs to explore the use of different online measures that are closely time-locked to the input so that short-lived input-driven processes are not missed. L2 speakers display behaviors that suggest insensitivity to certain syntactic properties of the L2, but show sensitivity to those same properties when measures that are time-locked to the input are employed (Tokowicz and MacWhinney 2005). Relying on multiple response measures for our theorizing has the advantage that the weaknesses of one method can be compensated by the strengths of others.

4. Conclusion

Bilingualism plays a central role in the lives of deaf individuals, and mounting evidence indicates that signing and reading skills are related. This calls for a shift in how we look at deaf readers' comprehension patterns toward a bilingual perspective that examines how knowledge of a signed language interacts with the processing of print, one that considers similarities between deaf bilinguals and other bilingual readers. This approach is already revealing a richer portrait of the lexical representations of deaf bilinguals and bringing us closer to understanding the role that sign plays in the development of reading. At the same time, given that deaf individuals bring a wide variety of previous linguistic experiences to the task of learning how to read, it will be important to attend carefully to individual differences in pursuing a nuanced characterization of sign-print bilingualism.

On the other hand, attention to differences between deaf and hearing bilinguals will enrich current models of bilingualism and contribute to our knowledge of how bilingualism affects cognition. For example, research shows that a lifetime of dealing with competing alternatives created by the parallel activation of two languages yields long-term cognitive benefits in executive function that extend to non-linguistic tasks (Bialystok et al. 2005, 2009). Emmorey et al. (2008b), however, found that hearing speech-sign bilinguals appear not to display the same inhibitory control benefits as unimodal bilinguals, arguably because there is less need to inhibit the non-target language (at least lexically) when it is in a different modality. Given that deaf readers' lexical representations of the spoken language might be more visually based than those of hearing bimodal bilinguals, the question arises as to whether sign-print bilinguals need to exert more inhibitory control than speech-sign bilinguals – even though they may know the same languages – and whether they reap the same cognitive benefits in inhibitory control tasks as speech-speech bilinguals. In sum, research on deaf readers has much to benefit from the growing body of research on bilingualism and L2 processing, while studies of deaf bilinguals are already contributing to a more complete characterization of what it means to be bilingual.

Short Biographies

Pilar Piñar received her PhD in Linguistics from the University of Arizona in 1996. She joined the department of Foreign Languages at Gallaudet University in 1997 and is currently Associate Professor. Her experience teaching deaf students at Gallaudet motivated

her main current research interest on language processing and literacy among deaf learners. In particular, she is interested in an approach that looks at this long-debated area of research through collaborative work within the growing field of studies on bilingualism. She has also published work in the interface area of gesture and sign language research. She is an affiliated researcher with the Science of Learning Center on Visual Language and Visual Learning (VL2) at Gallaudet University (<http://vl2.gallaudet.edu/>). Her work has appeared in *Gesture, Second Language Research, and Cognition* as well as in edited volumes.

Paola E. Dussias is an Associate Professor of Spanish, linguistics and psychology at Penn State University. Her research program takes a cross-disciplinary approach to bilingual language processing using converging methodological tools from linguistics, experimental psycholinguistics, and second language acquisition. The primary focus of her research concerns bilingual sentence processing. Together with her students, she examines whether language-specific information is largely kept independent when bilinguals compute or *parse* an initial syntactic structure for the sentences they read, or whether information from one language influences parsing decisions in the other language. In addition, because of her interest in cognitive aspects of bilingualism and in language contact phenomena, she has conducted a series of studies on code-switching. She uses eye-tracking methods to examine reading and spoken-language processing during code-switched sentences. Her work has appeared in journals such as *Bilingualism, Language and Cognition, The International Journal of Bilingualism, Studies in Second Language Acquisition* and *Second Language Research*, as well as in a number of edited volumes. Currently, she is a co-director of the Center for Language Science (<http://cls.psu.edu/>) at Penn State University.

Jill P. Morford investigates language acquisition and processing in the visual modality, including both signed languages and Augmentative and Alternative Communication systems. Recently she has turned her attention to the reading patterns of deaf sign-print bilinguals. She is Professor of Linguistics at the University of New Mexico and a member of the Executive Team of the NSF Science of Learning Center on Visual Language and Visual Learning (VL2) based at Gallaudet University.

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Notes

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- ¹ For deaf individuals for whom sign language exposure is delayed, it might be inaccurate to refer to sign language as the first language. One additional caveat is that we are using the terms L1 and L2 interchangeably with the notions of more and less dominant language.
- ² Phonology here refers to the sublexical structure of signs, based on contrastive parameters such as handshape, location, movement, and palm orientation (cf., Battison 1978; Stokoe 1960).
- ³ Note that at the time these studies were done, generally no heed was paid to whether the readers had a fully developed L1 on which to rely through this process or not.
- ⁴ Signed English is a form of sign communication that approximates the grammar and word order of spoken English.
- ⁵ We thank two anonymous reviewers for stressing this point.
- ⁶ As an anonymous reviewer points out, one challenge is to come up with English proficiency measures for deaf readers that are not solely based on reading.

Works Cited

- Allen, T. 1986. Patterns of academic achievement among hearing impaired students: 1974 and 1973. Deaf children in America, ed. by A. N. Schildroth and M. A. Karchmer, 161–206. San Diego, CA: College-Hill Press.
- Battison, R. 1978. *Lexical borrowing in American Sign Language*. Silver Spring, MD: Linstok Press.
- Bavelier, D., D. Corina, J. Rauschecker, A. Karni, A. Lalwani, A. Braun, V. Clark, P. Jezzard, and R. Turner. 1998. Cerebral organization for language in deaf and hearing subjects: biological constraints and effects of experience. *Proceedings of the National Academy of Sciences* 95. 922–9.
- Beauvillain, C., and J. Grainger. 1987. Accessing interlexical homographs: some limitations of a language-selective access. *Journal of Memory and Language* 26. 658–72.
- Berent, I., and C. Perfetti. 1995. A rose is a REEZ: the two-cycles model of phonology assembly in reading English. *Psychological Review* 102(1). 146–84.
- Bialystok, E., F. I. M. Craik, C. Grady, W. Chau, R. Ishii, A. Gunji, and C. Pantev. 2005. Effects of bilingualism on cognitive control in the Simon task: evidence from MEG. *Neuroimage* 24. 40–9.
- , ———, D. W. Green, and T. H. Gollan. 2009. Bilingual minds. *Psychological Science* 10(3). 89–129.
- Boudreault, P., and R. I. Mayberry. 2006. Grammatical processing in American Sign Language: age of first-language acquisition effects in relation to syntactic structure. *Language and Cognitive Processes* 21. 608–35.
- Chamberlain, C., and R. I. Mayberry. 2008. ASL syntactic and narrative comprehension in skilled and less skilled adults readers: bilingual-bimodal evidence for the linguistic basis of reading. *Applied Psycholinguistics* 28. 537–49.
- Clahsen, H., and C. Felser. 2006. Grammatical processing in language learners. *Applied Psycholinguistics* 27. 3–42.
- Colin, S., A. Magnan, J. Ecalle, and J. Leybaert. 2007. Relation between deaf children's phonological skills in kindergarten and word recognition performance in first grade. *Journal of Child Psychology and Psychiatry* 48. 139–46.
- Conrad, R. 1979. *The deaf schoolchild*. London: Harper and Row.
- Cunningham, A., K. Perry, K. Stanovich, and D. Share. 2002. Orthographic learning during reading: examining the role of self-teaching. *Journal of Experimental Child Psychology* 82(3). 185–99.
- Courtin, C. 2000. The impact of sign language on the cognitive development of deaf children: the case of theories of mind. *Journal of Deaf Studies and Deaf Education* 5. 266–76.
- Dalby, K., and C. Letourneau. 1991. Survey of communication history of deaf adults. Paper presented at the Biennial Meeting of the Association of Canadian Educators of the Hearing Impaired, Calgary, AB.
- De Villiers, P., and S. Pomerantz. 1992. Hearing impaired students learning new words from written context. *Applied Psycholinguistics* 13. 409–31.
- Dijkstra, T. 2005. Bilingual visual word recognition and lexical access. *Handbook of bilingualism: psycholinguistic approaches*, ed. by J. F. Kroll and A. M. B. de Groot, 179–201. New York: Oxford University Press.
- , J. Grainger, and W. J. B. van Heuven. 1999. Recognition of cognates and interlingual homographs: the neglected role of phonology. *Journal of Memory and Language* 41. 496–518.
- Dominguez, A. B., and J. Alegria. 2010. Reading mechanism in orally educated deaf adults. *Journal of Deaf Studies and Deaf Education* 15(2). 136–48.
- Dussias, P. E. 2003. Syntactic ambiguity resolution in L2 learners. *Studies in Second Language Acquisition* 25. 529–57.
- , and N. Sagarra. 2007. The effect of exposure on syntactic parsing in Spanish-English L2 speakers. *Bilingualism: Language and Cognition* 10. 101–16.
- , and P. Piñar. 2010. Effects of reading span and plausibility in the reanalysis of wh-gaps by Chinese-English L2 speakers. *Second Language Research* 26(4). 443–72.
- Dyer, A., M. MacSweeney, M. Szczerbinski, and R. Campbell. 2003. Predictors of reading delay in deaf adolescents: the relative contributions of rapid automatized naming speed and phonemic awareness and decoding. *Journal of Deaf Studies and Deaf Education* 8. 215–29.

- Emmorey, K., H. B. Borinstein, R. L. Thompson, and T. H. Gollan. 2008a. Bimodal bilingualism. *Bilingualism: Language and Cognition* 11. 43–61.
- , G. Luk, J. E. Pyers, and E. Bialystok. 2008b. The source of enhanced cognitive control in bilinguals. *Psychological Science* 19. 1201–6.
- Gallaudet Research Institute. 2005. Regional and national summary report of data from the 2003–2004 annual survey of deaf and hard of hearing children and youth. Washington, DC: GRI.
- Gillon Dowens, M., H. Barber, M. Vergara, and M. Carreiras. 2009. Morpho-syntactic processing in late L2 learners. *Journal of Cognitive Neuroscience* 22. 1870–87.
- Gormley, K. A., and A. M. Franzen. 1978. Why can't the deaf read? Comments on asking the wrong question. *American Annals of the Deaf* 123. 542–7.
- Hanson, V. L., and C. Fowler. 1987. Phonological coding in word reading: evidence from hearing and deaf readers. *Memory and Cognition* 15(3). 199–207.
- , E. W. Goodell, and C. A. Perfetti. 1991. Tongue-twister effects in the silent reading of hearing and deaf college students. *Journal of Memory and Language* 30. 319–30.
- Harris, M., and C. Moreno. 2004. Deaf children's use of phonological coding: evidence from reading, spelling, and working memory. *Journal of Deaf Studies and Deaf Education* 9. 253–68.
- Hauser, P. C. 2000. Deaf readers' phonological encoding: an electromyogram study of covert reading behavior. Unpublished PhD dissertation, Washington DC: Gallaudet University.
- Hermans, D., H. Knoors, E. Ormel, and L. Verhoeven. 2008. The relationship between the reading and signing skills of deaf children in bilingual education programs. *Journal of Deaf Studies and Deaf Education* 13. 518–30.
- Hoffmeister, R. J. 2000. A piece of the puzzle: ASL and reading comprehension in deaf children. *Language acquisition by eye*, ed. by C. Chamberlain, J. P. Morford and R. I. Mayberry, 221–59. Mahwah, NJ: Erlbaum.
- Holt, J. A. 1994. Classroom attributes and achievement test scores for deaf and hard of hearing students. *American Annals of the Deaf* 139. 430–7.
- Hung, D. L., O. J. L. Tzeng, and D. H. Warren. 1981. A chronometric study of sentence processing in deaf children. *Cognitive Psychology* 13. 583–610.
- Izzo, A. 2002. Phonemic awareness and reading ability: an investigation with young readers who are deaf. *American Annals of the Deaf* 147(4). 18–28.
- Just, M., P. Carpenter, and M. Mason. 1982. What eye fixations tell us about speed reading and skimming. Technical Report. Pittsburgh, PA: Carnegie Mellon University.
- Kampfe, C. M., and A. G. Turecheck. 1987. Reading achievement of prelingually deaf students and its relationship to parental method of communication: a review of the literature. *American Annals of the Deaf* 132. 11–5.
- Karchmer, M. A., and R. E. Mitchell. 2003. Demographic and achievement characteristics of deaf and hard-of-hearing students. *Oxford handbook of deaf studies, language, and education*, ed. by M. Marschark and P. E. Spencer, 21–37. New York: Oxford University Press.
- Kelly, L. 1993. Recall of English function words and inflections by skilled and average deaf readers. *American Annals of the Deaf* 138(3). 288–96.
- . 1996. The interaction of syntactic competence and vocabulary during reading by deaf students. *Journal of Deaf Studies and Deaf Education* 1(1). 75–90.
- . 2003. The importance of processing automaticity and temporary storage capacity to the differences in comprehension between skilled and less skilled college-age deaf readers. *Journal of Deaf Studies and Deaf Education* 8(3). 230–49.
- Kotz, S. A., P. J. Holcomb, and L. Osterhout. 2008. ERPs reveal comparable syntactic sentence processing in early bilinguals and monolinguals. *Acta Psychologica* 128. 514–27.
- Kroll, J. F., and A. M. B. de Groot. 1997. Lexical and conceptual memory in the bilingual: mapping form to meaning in two languages. *Tutorials in bilingualism*, ed. by A. M. B. de Groot and J. F. Kroll, 169–99. Mahwah, NJ: Erlbaum.
- , and E. Stewart. 1994. Category interference in translation and picture naming: evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language* 33. 49–174.
- Kuntze, M. 2004. Literacy acquisition and deaf children: a study of the interaction between ASL and written English. Unpublished doctoral dissertation, Stanford, CA: Stanford University.
- Lillo-Martin, D. C., V. L. Hanson, and S. T. Smith. 1992. Deaf readers' comprehension of relative clause structures. *Applied Psycholinguistics* 13. 13–30.
- Marian, V., and M. J. Spivey. 2003. Competing activation in bilingual language processing: within-and between-language competition. *Bilingualism: Language and Cognition* 6. 97–115.
- Mayberry, R. I. 1989. Deaf children's reading comprehension in relation to sign language structure and input. Paper presented at the Society for Research in Child Development, Kansas City.
- . 2007. When timing is everything: age of first-language acquisition effects on second-language learning. *Applied Psycholinguistics* 28. 537–49.
- , A. A. del Giudice, and A. Lieberman. 2011. Reading achievement in relation to phonological coding and awareness: a meta-analysis. *Journal of Deaf Studies and Deaf Education*, 16(2). 164–88.

- , and E. B. Eichen. 1991. The long-lasting advantage of learning sign language in childhood: another look at the critical period for language acquisition. *Journal of Memory and Language* 30. 486–512.
- , and E. Lock. 2003. Age constraints on first versus second language acquisition: evidence for linguistic plasticity and epigenesis. *Brain and Language* 87. 369–83.
- , and P. Witcher. 2006. What age of acquisition effects reveal about the nature of phonological processing. Technical Report No. 17.3. San Diego, CA: University of California San Diego, Center for Research in Language.
- McQuarrie, L., and R. Parrila. 2009. Phonological representations in deaf children: rethinking the “functional equivalence” hypothesis. *Journal of Deaf Studies and Deaf Education* 14(2). 137–54.
- Merrills, J., G. Underwood, and D. Wood. 1994. The word recognition skills of profoundly, prelingually deaf children. *British Journal of Developmental Psychology* 12(3). 365–84.
- Michael, E. B., and T. H. Gollan. 2005. Being and becoming bilingual: individual differences and consequences for language production. *Handbook of bilingualism: psycholinguistic approaches*, ed. by J. F. Kroll and A. M. B. De Groot, 389–410. Oxford, UK: Oxford University Press.
- Miller, P. F. 2000. Syntactic and semantic processing in Hebrew readers with prelingual deafness. *American Annals of the Deaf* 145(5). 436–48.
- . 2005. Reading comprehension and its relation to the quality of functional hearing: evidence from readers with different functional hearing abilities. *American Annals of the Deaf* 150(3). 305–22.
- Morford, J. P., E. Wilkinson, A. Villwock, P. Piñar, and J. F. Kroll. 2011. When deaf signers read English: do written words activate their sign translations? *Cognition* 118. 286–92.
- Musselman, C. 2000. How do children who can't hear learn to read an alphabetic script? A review of the literature on reading and deafness. *Journal of Deaf Studies and Deaf Education* 5. 11–31.
- Neville, H. J., and D. Bavelier. 2000. Specificity and plasticity in neurocognitive development in humans. *New cognitive neurosciences*, 2nd edn, ed. by M. S. Gazzaniga, 83–98. Cambridge, MA: MIT Press.
- , D. L. Mills, and D. S. Lawson. 1992. Fractionating language: different neural subsystems with different sensitive periods. *Cerebral Cortex* 2. 244–58.
- , S. A. Coffey, D. S. Lawson, A. Fischer, K. Emmorey, and U. Bellugi. 1997. Neural systems mediating American Sign Language: effects of sensory experience and age of acquisition. *Brain and Language* 57. 285–308.
- Ormel, E., D. Hermans, H. Knoors, and L. Verhoeven. forthcoming. Cross-language effects in visual word recognition: the case of bilingual deaf children. *Bilingualism: Language and Cognition*.
- Padden, C., and C. Ramsey. 2000. American Sign Language and reading ability in deaf children. *Language acquisition by eye*, ed. by C. Chamberlain, J. P. Morford and R. I. Mayberry, 165–89. Mahwah, NJ: Erlbaum.
- Pakulak, E., and H. J. Neville. 2010. Proficiency differences in syntactic processing of monolingual native speakers indexed by event-related potentials. *Journal of Cognitive Neuroscience* 22. 2728–44.
- Piñar, P., P. E. Dussias, and J. P. Morford. 2010. Processing subject and object relative clauses in ASL-English bilinguals. Poster presented at the 23rd Annual CUNY Conference on Sentence Processing, March 18–21, New York, NY.
- Quigley, S. 1982. Reading achievement and special reading materials. *Volta Review* 84(5). 95–106.
- , D. Power, and M. Steinkamp. 1977. The language structure of deaf children. *Volta Review* 79(2). 73–83.
- Robbins, N. L., and C. W. Hatcher. 1981. The effects of syntax on the reading comprehension of hearing-impaired children. *Volta Review* 83. 105–15.
- Stokoe, W. C. 1960. Sign language structure (Studies in Linguistics: Occasional Paper No. 8). Buffalo, NY: University of Buffalo.
- Strong, M., and P. Prinz. 2000. Is American Sign Language skill related to English literacy? Language acquisition by eye, ed. by C. Chamberlain, J. P. Morford and R. I. Mayberry, 221–59. Mahwah, NJ: Erlbaum.
- Sunderman, G., and J. F. Kroll. 2006. First language activation during second language lexical processing: an investigation of lexical form meaning and grammatical class. *Studies in Second Language Acquisition* 28. 387–422.
- Thierry, G., and Y. J. Wu. 2007. Brain potentials reveal unconscious translation during foreign language comprehension. *Proceeding of National Academy of Sciences* 104(30). 12530–5.
- Tokowicz, N., and B. MacWhinney. 2005. Implicit and explicit measures of sensitivity to violations in second language grammar: an event-related potential investigation. *Studies in Second Language Acquisition* 27. 173–204.
- Traxler, C. B. 2000. The Stanford Achievement Test, 9th Edition: national norming and performance standards for deaf and hard-of-hearing students. *Journal of Deaf Studies and Deaf Education* 5. 337–48.
- Traxler, M. J., J. P. Morford, and D. Corina. 2010. Deaf signers reading written English sentences: syntax and age-of-acquisition. Poster presented at the 23rd Annual CUNY Conference on Sentence Processing, March 18–21, New York, NY.
- , R. S. Williams, S. A. Blozis, and R. K. Morris. 2005. Working memory, animacy, and verb class in the processing of relative clauses. *Journal of Memory and Language* 53. 204–24.
- Van Orden, G. 1987. A ROWS is a ROSE: spelling, sound, and reading. *Memory and Cognition* 15(3). 181–98.
- , J. Johnston, and B. Hale. 1988. Word identification in reading proceeds from spelling to sound to meaning. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 14(3). 371–86.

- Waters, G. S., and D. G. Doehring. 1990. Reading acquisition in congenitally deaf children who communicate orally: insights from an analysis of component reading, language, and memory skills. *Reading and its development: component skills approaches*, ed. by T. H. Carr and B. A. Levy, 323–73. San Diego, CA: Academic.
- Wauters, L. N., W. van Bon, and A. Tellings. 2006. Reading comprehension of Dutch deaf children. *Reading and Writing* 19(1). 49–76.
- Webster, A. 1986. *Deafness, development and literacy*. London: Methuen.
- Wilbur, R. B., and S. P. Quigley. 1975. Syntactic structures in the written language of deaf children. *Volta Review* 77(3). 194–203.
- Wood, D. 1984. The assessment of linguistic and intellectual abilities of hearing impaired school children. *Association of Educational Psychologists Journal* 6(5). 31–9.

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