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Early exposure to both sign and spoken language for children who are deaf or hard of hearing: Might it help spoken language development?

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Early Exposure to Both Sign and Spoken Language for Children Who are Deaf or Hard of Hearing: Might it Help Spoken Language Development?

By

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Abstract: The literature on the benefits and deficits of bilingualism is reviewed with an emphasis on sign/spoken bilingualism and on the population of deaf or hard of hearing children. Since there are a limited number of reports on sign/spoken bilingualism for these children, a research plan is outlined for a large study whose results could have a significant impact on oral education policy and spoken language development in deaf or hard of hearing children.

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Abbreviations

CIs – cochlear implants

CODAs – children of deaf adults

D/HH – deaf or hard of hearing

EF – executive function

ToM – theory of mind

Introduction

As early as in utero, typically hearing children are exposed to ambient sounds, including spoken language, from the environment (Moon, Lagercrantz, & Kuhl, 2013). During the first twelve months of life, these typically hearing children show receptive and expressive advances in speech segmentation, vocabulary acquisition, syntax acquisition, and communication as a result of caregiver interactions (Levine, Strother-Garcia, Golinkoof, & Hirsh-Pasek, 2016). Children who are deaf and hard of hearing, on the other hand, miss these opportunities for spoken language advancement because they cannot hear that spoken language as effectively as typically hearing children. A child who is deaf or hard of hearing has poor access to sound and spoken language until he receives adequate amplification through devices such as hearing aids (HAs) or cochlear implants (CIs). Consequently, a child who is born deaf has a deficit of months, if not years, worth of time listening and learning to talk. When a deaf child eventually receives adequate devices or amplification, he is then starting from the beginning and, thus, is language-delayed compared to his typically hearing peers. For this reason, children who are deaf or hard of hearing have more difficulty acquiring the spoken language of a culture than do typically hearing children of that same culture (Soleymani, Mahmoodabadi, & Nouri, 2016) and need intensive therapy to do so adequately (Hayes, Geers, Treiman, & Moog, 2009). Access to spoken language is minimal to none at the critical time when their brains are primed, and ready to learn and use spoken language.

With this knowledge in mind, it is imperative to consider whether something more can be done as early as possible to better develop spoken language skills for children who are deaf or hard of hearing. For example, is it possible that introducing a sign language, a language that is completely accessible to a child who is deaf (i.e., a language conveyed via an intact visual

sensory system) would provide him with a general linguistic foundation needed to acquire a spoken language once he receives appropriate amplification? In particular, would this type of bilingualism, in which a child who is deaf has access to at least one language through an intact sensory system, provide him with a linguistic foundation that would improve his acquisition of a spoken language while appropriate amplification is provided?

This report covers a myriad of populations and language scenarios pertinent to this question. In the first section, there is a literature review on the positive and negative effects of: 1) spoken bilingualism – bilingualism in typically hearing children using 2 or more spoken languages, and 2) sign/spoken bilingualism – bilingualism in typically hearing and typically sighted children using at least 1 spoken and 1 sign language. Additionally in the first section, the lack of scientific literature on the positive and negative effects of 3) sign bilingualism – bilingualism in typically sighted children using 2 or more sign languages, is noted. In the second section, there is a review of the literature on the positive and negative effects of: 1) spoken bilingualism in children who are deaf or hard of hearing, and 2) sign/spoken bilingualism in children who are deaf or hard of hearing, but are typically sighted. Studies cited in this review exclusively represent children introduced to two or more languages from birth or nearly so (no later than two years old).

The Effects of Bilingualism in Typical Children

Bilingualism is defined as the regular input, and subsequent acquisition, of two or more languages during the critical period for language development (Kohnert, 2010). There have been many different views on the effects of bilingualism over the years. While some researchers have posited that bilingualism in typically hearing children can lead to language delays and confusion, there is now a substantial amount of evidence that instead suggests there are advantages to

childhood bilingualism (Kovács, 2015). Within the typically hearing bilingual population, this paper is interested in three sub-populations: 1) spoken bilinguals – those who use two or more spoken languages, 2) sign/spoken bilinguals – those who use both a spoken and a sign language, and 3) sign bilinguals – those who use two or more sign languages.

Spoken Bilingualism in Typically Hearing Children. Most often, typically hearing children born into a bilingual household are born into ones in which the languages are spoken. Bilingualism has been studied for its effects, both positive and negative, on executive function (EF) skills (Poarch & Bialystok, 2015; Folke, Ouzia, Bright, De Martino, & Filippi, 2016), speech skills (Fennell, Byers-Heinlein, & Werker, 2007), and vocabulary skills (Kohnert, 2010). This section briefly summarizes these effects for typically hearing, spoken bilinguals. Most findings suggest that these bilinguals progress through typical early language milestones at the same rate as monolinguals do (Kovács, 2015; Petitto et al., 2001). Some findings, such as those of Folke et al. (2016), indicate a bilingual disadvantage in executive function (EF) skills and metacognitive performance. However, overall there is more evidence that bilingualism has a positive effect on the EF skills in typically hearing, spoken bilinguals.

EF is defined as a cognitive mechanism that controls attention when more than one system, in this case language system, is activated, allowing the bilingual in question to use whichever system is most suitable in a particular language environment (Poarch & Bialystok, 2015). Kovács, Mehler, and Carey (2009) report that typically, hearing bilingual infants develop better EF at an earlier age than monolinguals. They suggest that perceiving and processing utterances from two or more spoken languages at an early age, even before production begins, greatly improves a child's early cognitive development. Furthermore, some research indicates an advantage in cognitive function for bilinguals may benefit their performance in tasks other than

language ones like multitasking (Poarch & Bialystok, 2015). Bialystok (1999), for example, studied the difference in 30 English monolinguals' and 30 English-Chinese bilinguals' performance on a visual nonlinguistic task (a Dimensional Change Card Sort Task). Bialystok found that bilinguals perform better in tasks where distracting non-linguistic information makes finding a solution problematic. Thus, she concluded that speaking multiple languages affects a bilingual's performance in any task where more attention and problem-solving skills are required.

With regards to speech perception and production skills, there appears to be a negative effect for spoken bilinguals (Kovács, 2015). That is, many researchers believe there is a cost to bilingualism in this area. For example, Fennell, Byers-Heinlein, and Werker (2007) found that bilinguals use phonetic detail to guide word learning at 20 months of age while monolinguals do the same at the earlier age of 17 months. While this negative affect on speech skills has been found, there is no clear consensus among researchers as to its cause. Fennel, Byers-Heinlein, and Werker suggest that the added demands bilinguals face when acquiring new words cause them to take longer to differentiate receptively between phonetic units within each of their languages. Another explanation for this bilingual disadvantage in speech perception is related to a bilingual's vocabulary. At comparable ages, the size of a bilingual's vocabulary is greater. However, this number is divided among the bilingual's spoken languages. Thus, bilinguals have fewer examples of specific phonetic sounds in each language to develop their language-specific parameters (Kovács, 2015; Fennell et al., 2007). This could be an adaptive strategy which allows them to better acquire receptive and expressive knowledge of speech sounds in multiple languages at early ages (Kovács, 2015). Ianco-Worrall (1972) attempted to determine when these phonetic discriminations begin to provide meaning in a bilingual's vocabulary. She found that

between the ages of 4 and 6 years, bilingual children believed semantically similar words to be more like the reference word presented than phonetically similar words while monolinguals believed the latter. By 7 to 9 years of age, both groups believed semantically similar words were more like the standard word presented. Her findings suggest that bilingualism leads to greater metalinguistic awareness in children two to three years earlier than monolingualism typically allows.

When looking at the vocabulary of these bilinguals, there are some conflicting findings. Most researchers agree that bilingual children tend to have a smaller vocabulary in each of their spoken languages than monolinguals, as well as slower reaction times when naming pictures and retrieving words (Poulin-Dubois, Bialystok, Blaye, Polonia, & Yott, 2013). Other researchers suggest there may be cross-linguistic interference between languages when fast mapping, or learning and producing new words for unfamiliar objects (Kan & Kohnert, 2005). Umbel, Pearson, Fernández, and Oller (1992) examined the receptive vocabulary skills of English and Spanish in 105 bilingual first graders. Whether the children spoke only Spanish in the home or both Spanish and English, they performed near the mean in Spanish receptive vocabulary. Those who spoke both languages in the home performed more than 1 standard deviation higher in English receptive vocabulary than those who only spoke Spanish. In this manner, Umbel, Pearson, Fernández, and Oller determined that, while previous experiments have shown bilingualism to be a risk factor in vocabulary development, a second spoken language may, in fact, have little or no negative effect on a speaker's home language development. Furthermore, their findings suggest that one's home language may actually help to better acquire a second language (Kohnert, 2010) at an early age. Finally, some researchers believe that experiments with typically hearing spoken bilinguals, such as Bialystok's, do not account and control for all

possible variables that could affect a bilingual's language abilities. Morton and Harper (2007), for example, believe that a bilinguals' better problem solving skills could actually be due to differences in ethnicity and socioeconomic status rather than greater cognitive functioning skills.

Sign/Spoken Bilingualism in Typically Hearing and Sighted Children. The acquisition of a sign language in monolinguals follows the same developmental milestones as that of a spoken language in monolinguals (Friedmann & Rusou, 2015; Brackenbury, Ryan, & Messenheimer, 2006). While bilingualism usually refers to the use of two spoken languages, there are instances when typically hearing children are exposed to both sign and spoken languages from birth. Here, these children are called "sign/spoken bilinguals"; they acquire two languages of two different modalities. Most commonly, sign/spoken bilinguals are children of deaf adults, or CODAs. They acquire a sign language from one or both parents, and a spoken language often from the community around them. This is not so different than children from immigrant families acquiring multiple languages. In cases such as these, do typically hearing sign/spoken bilinguals have speech, language, and vocabulary abilities that differ from those of typically hearing monolingual children who use a spoken language? It is noteworthy that while there are a good number of studies of CODAs' speech, sign, and language abilities, the populations in these studies are small. Thus, one must be careful when generalizing any findings.

Evidence suggests that sign/spoken bilingualism in typically hearing children can affect the organization of both linguistic and nonlinguistic areas of the brain (Emmorey & McCullough, 2009). Research on typically hearing spoken bilinguals shows that they have greater EF skills than their monolingual peers due to their need to inhibit one spoken language while activating a second (Olulade et al., 2015). In contrast, typically hearing sign/spoken bilinguals do not have as great a need as spoken bilinguals to inhibit the activation of one language while using the other

due to the use of different modalities when producing each language (Emmorey, Giezen, & Gollan, 2015). Olulade et al. (2015) examined grey matter volume (GMV) in the EF centers of the brain in typically hearing monolinguals of English, spoken bilinguals of English and Spanish, and sign/spoken bilinguals of English and American Sign Language (ASL). Olulade et al. interpret greater GMV in EF brain areas as indicating greater cognitive control and EF skills. Olulade et al. (2015) found that typically hearing spoken bilinguals have a greater GMV in EF brain centers in comparison to monolinguals, but they also found that sign/spoken bilinguals and monolinguals have similar GMV. These findings suggest that it is the management of two languages in the same modality (in this case the spoken modality), rather than a larger vocabulary, that causes the difference in GMV between typically hearing sign/spoken and spoken bilinguals. Emmorey, Giezen, & Gollan (2015) conclude that it is the articulatory competition between two languages within the same modality that causes these GMV effects.

While there appears to be a negative effect with regards to speech perception and production skills among typically hearing spoken bilinguals compared to their monolingual peers, these same negative effects do not seem to occur with typically hearing sign/spoken bilinguals. There is substantial research that shows that visual information is important for successful language and speech processing, particularly visual information received from facial expressions (Emmorey & McCullough, 2009) and from lip reading (Williams, Darcy, & Newman, 2016) during the use of a sign language. Consequently, the processing of two separate articulatory systems, manual and oral, allows for additional multisensory training for spoken language perception (Williams, Darcy & Newman, 2016). In this manner, learning to use visual information provided by the face and mouth when processing a sign language may positively impact spoken language audiovisual processing.

For sign/spoken bilinguals, vocabulary and language development are similar to each other (i.e., sign language development is about equal to spoken language development) and are both comparable to that of typically hearing monolinguals (Kanto, Huttunen, & Laakso, 2013). Any difference in the achievement of sign and spoken language milestones within bilinguals is attributable to environmental factors that impact language input (Petitto et al., 2001). There is no difference in typically hearing sign/spoken bilinguals' naming latencies, error rates, or frequency effects of their spoken language compared to those of monolingual users of a spoken language (Emmorey, Petrich, & Gollan, 2013). Typically hearing sign/spoken bilinguals can also differentiate between translational equivalents in their two separate languages from the time they start producing their first words (Petitto et al., 2001). Furthermore, sign/spoken bilingualism in typically hearing children appears to be dependent more on the amount of exposure to the sign language than to the spoken language. Hearing status of the child's parents and extended family also has an effect on the child's spoken language development (Kanto et al., 2013). Research by Pearson, Fernández, Lewedeg, and Oller (1997) and Brackenbury, Ryan, and Messenheimer (2006) suggests that the amount of exposure to the sign language necessary to acquire it at a typical rate may be much higher than what is necessary of the spoken language.

Sign Bilingualism in Typically Hearing and Sighted Children. A third population of bilinguals worth studying is that of sign bilinguals, i.e., those who use two or more sign languages. Studying such a population would allow further examination of the similarities and differences between the acquisition of sign and spoken languages. This population is likely very small and to the best of our knowledge has not yet been researched. Results on language development in such a population are purely speculative at this time. Research on the language, vocabulary, EF, sign, and cognitive processing skills of sign bilingual children would allow

direct comparison with: 1) spoken bilingual children and 2) monolingual children who use a sign language. Furthermore, if the language development and processing in sign bilinguals are comparable to those of spoken bilinguals, then one could infer that it is the integrity of the sensory system used for language acquisition, rather than the sensory system itself or the language modality, that affects the acquisition of a language. For example, one might expect larger GMV in sign bilinguals (like that of spoken bilinguals) compared to monolinguals or sign/spoken bilinguals if it interferes with a language modality to drive EF skill development.

The Effects of Bilingualism in Deaf or Hard of Hearing Children

The previous section of this review discussed how the acquisition of multiple languages, all-spoken or a mix of spoken and sign, affects the executive function, speech, and vocabulary skills of typically hearing and sighted children. Even with appropriate hearing devices, children who are deaf or hard of hearing (D/HH) exposed to only one spoken language often display deficits in EF skills (Beer et al., 2014), language and speech perception (Svirsky, Teoh, & Neuberger, 2004), and vocabulary (Donne & Briley, 2015). Some of these deficits may be due to inappropriate and inconsistent amplification and/or instruction (Fulcher, Purcell, Baker, & Munro, 2012). Niparko et al. (2010) examined spoken language comprehension and expression in 188 D/HH children who were implanted before 5 years of age and in 97 typically hearing peers. They found that, while gaps in spoken language growth between typically hearing and D/HH children were not eliminated in the first 3 years of CI use, after undergoing cochlear implantation, D/HH children's spoken language growth was greater than their predicted scores based on their pre-implantation hearing and language abilities. These findings suggest that cochlear implantation is correlated with better spoken language development in D/HH children

than would be expected of them pre-cochlear implantation. Based on the results of Niparko et al. (2010) and Hayes, Geers, Treiman, and Moog (2009)**,** we should speculate on the potential benefit, if any, of both spoken and sign/spoken bilingualism for spoken language development in D/HH children compared to their monolingual D/HH peers. It is important to note that, due to the low incidence of D/HH children and the even lower incidence of bilingual use in D/HH children, there is very little published research in this area. Within the deaf or hard of hearing bilingual population, this paper is interested in two sub-populations: 1) those who use two or more spoken languages, and 2) those who use both a spoken language and a sign language.

Spoken Bilingualism in Deaf or Hard of Hearing Children. Albeit infrequently, some children who are D/HH are born into spoken bilingual households. In such an environment and household, ideally children who are D/HH would learn to speak two separate spoken languages. How does their acquisition of two spoken languages compare to that of their monolingual D/HH counterparts?

There is limited research on the effects of spoken language on speech skills in D/HH spoken bilingual children. Results from a handful of studies suggest that children with cochlear implants who are raised in a spoken bilingual home develop speech comparable to their monolingual peers with CIs (Guiberson, 2014; McConkey Robbins, Green, & Waltzman, 2004). In a study to the contrary, Teschendorf, Arweiler-Harbeck, and Bagus (2010) studied the speech and language development of 56 bilinguals (first language = German; second language = a variety of languages) with profound hearing loss who were all implanted before the age of 6. They found that these bilinguals with profound hearing loss performed worse in both receptive and expressive speech skills than monolingual CI users. Eventually, however, their receptive and expressive speech skills matched those of their monolingual D/HH peers. Research by Looi, Teo,

and Loo (2016) suggests that this pattern of speech development in D/HH bilinguals where their receptive and expressive speech skills eventually match their monolingual D/HH peers may not hold true for those who acquire a tonal language such as Mandarin. They found that while hearing aid users do not struggle quite as much as cochlear implant users, bilingual children of Mandarin and English households who have a hearing loss struggle with pitch and tone perception. Together, these findings suggest that while speech production may develop somewhat typically for children who are D/HH raised in spoken bilingual households, development may be affected by the specific languages that are being acquired.

While there is little research on the speech skills of bilingual children who are D/HH, there is some evidence that bilingual children who are D/HH not only match, but surpass their monolingual D/HH peers in language skills (Bunta & Douglas, 2013). In their study, Bunta and Douglas (2013) looked at the language skills of 40 children who are D/HH, 20 of which were English monolinguals and 20 of which were English and Spanish bilinguals. The authors found that not only do bilingual children who are D/HH display equivalent language skills to their monolingual D/HH peers, but they do so in both of their languages, suggesting that these children can adequately acquire more than one spoken language. Findings by McConkey Robbins, Green, and Waltzman (2004) in 12 D/HH spoken bilingual children of differing languages suggest that second language acquisition milestones in children who are deaf or hard of hearing mimic those in their typically hearing peers and the factors that affect these milestones are the amount and intensity of language exposure, as well as the children's age at implantation. Research by Deriaz, Pelizzone, and Fornos (2014) suggests that spoken bilingual children who are deaf or hard of hearing have worse oral language performance than their monolingual D/HH peers because of the quantity and quality of language input they receive. In this case, it is

noteworthy that the parents of the bilingual children from Deriaz, Pelizzone, and Fornos' study come from a poor socioeconomic background, which has been shown to affect quality and quantity of language input and, thus, vocabulary growth of children (Hart & Risley, 2003).

Sign/Spoken Bilingualism in Deaf or Hard of Hearing Children. For a D/HH child who does not have access to adequate and consistent spoken language until he receives properly fitted hearing aids or cochlear implants, it is worth considering other means of early language input, in this case, early sign language input. For all of the populations discussed in previous sections of this literature review, the effects of bilingualism have been assessed in terms of EF, speech, and language, in this section. However, for this population, in addition to EF, Theory of Mind (ToM) skills will be discussed and there will be no discussion of speech because there are no published articles on this topic for this population.

Regarding EF skills, it has been shown that spoken bilingualism has positive effects on EF skills in linguistic and nonlinguistic domains in typically hearing children (Poarch & Bialystok, 2015; Bialystok, 1999). Emmorey, Luk, Pyers, and Bialystok (2008) looked at cognitive flexibility in 48 deaf or hard of hearing sign/spoken bilinguals grouped by their proficiency in both English and ASL. The participants were either balanced (they were equally proficient in both languages) or unbalanced (they were more proficient in one language than the other) in language proficiency. Emmorey, Luk, Pyers, and Bialystok found that balanced D/HH sign/spoken bilinguals outperformed their unbalanced peers in attention switching tasks. Thus, the amount to which a D/HH sign/spoken bilingual is proficient in both languages still positively affects EF, though maybe not to the same extent as it does in purely spoken bilinguals. The anatomical GMV results of Olulade et al. (2015) are somewhat similar to those of Emmorey, Luk, Pyers, and Bialystok (2008). Olulade et al. (2015) inferred that there is no EF benefit for

both typically hearing and D/HH sign/spoken bilinguals based on GMV. They attributed this lack of EF benefit to the differing modalities of the sign/spoken language modalities of these bilinguals. Furthermore, this research suggests it is not necessarily the age of second language acquisition, but rather the level of proficiency in both languages that affect attention switching and, consequently, EF skills (Kushalnagar, Hannay, & Hernandez, 2010).

There is limited research on the EF skills of D/HH sign/spoken bilinguals, but there are reports on another skill, Theory of Mind (ToM), which is related to EF (Meristo & Hjelmquist, 2009). ToM is the understanding that people can have beliefs that differ from one another. False-belief tasks are used to assess the development of ToM. Good performance on false-belief tasks are indicators of well-developed language and social skills (Stanzione & Schick, 2014). Research on ToM and false-belief tasks in the monolingual D/HH population consistently shows that children who are D/HH born to deaf signing parents develop false-belief at the same age as their typically hearing peers. In contrast, D/HH children born to hearing parents who use a spoken language do not develop false-belief until significantly older ages, presumably due to a lack of an accessible language-rich environment (Stanzione & Schick, 2014). These findings suggest that while the acquisition of two spoken languages may build better EF or ToM skills in typically hearing children, children who are prelingually D/HH have weakened EF skills due to their poor spoken language skills (Kronenberger, Pisoni, Henning, & Colson, 2013). They may not gain those EF or ToM skills if they are not exposed to a language-rich environment where they have complete access to a language, such as a sign language.

While there is little research on sign/spoken bilingualism in the D/HH population, there is a growing sentiment suggesting that, because a sign language is always fully accessible to children who are D/HH from birth regardless of hearing device use, a D/HH child who is

exposed to sign language from birth is better able to acquire a spoken language (Grosjean, 2010; Klaudia, 2013; Woll & MacSweeney, 2015). Language processing skills and cognitive development may be independent of language modality (Klaudia, 2013). Davidson, Lillo-Martin, and Pichler (2014) examined spoken English language skills of 5 D/HH sign/spoken bilingual children born to D/HH parents in comparison to those of 20 typically hearing sign/spoken bilingual peers. On a myriad of expressive and receptive speech, vocabulary, and language tests, they found that the scores of the D/HH group were comparable to those of their typically hearing peers. Hassanzadeh (2012) examined the relationship between the hearing status of 7 sets of parents and the speech perception, speech production, and language development of their D/HH children with cochlear implants. Two sets of 7 families and D/HH children were matched on their development stage and differed only in their sign environment at home. The 7 D/HH participants with D/HH parents were exposed to both Persian and Persian Sign Language, while their peers with typically hearing parents were exposed only to spoken Persian. The second-generation D/HH children's cochlear implant outcomes surpassed those of their first-generation D/HH peers. These findings by Davidson, Lillo-Martin, and Pichler (2014) and Hassanzadeh (2012) suggest that, for D/HH children, early exposure to sign language is associated with the development of age-appropriate spoken language skills.

Discussion

It has been well documented that children who are deaf or hard of hearing have difficulty acquiring a first spoken language due to a lack of spoken language input. Explicit and intense instruction is necessary to help teach them spoken language once they receive adequate hearing devices. This literature review discusses the possible positive and negative effects of introducing a sign language for such children, i.e., a language that is completely accessible. That is, would the introduction of sign language, once a diagnosis of hearing loss has been made, have a net benefit for the acquisition of a spoken language for children who are D/HH?

This literature review examined both typically hearing and D/HH pediatric populations. For those spoken bilingual children who are typically hearing, acquiring two spoken languages from an early age is associated with, before adulthood: better development of EF skills than found in monolinguals, poorer speech skills, smaller individual language vocabularies, and slower reaction times when naming pictures and retrieving words from memory. However, typically hearing spoken bilinguals appear to progress through typical early language milestones at the same rate as their typically hearing monolingual peers. For those children acquiring a sign and a spoken language, research suggests that, due to a lack of articulatory competition between their two languages, they do not possess the same larger GMV found in spoken bilinguals. Explanations of such findings suggest that sign/spoken bilingualism may positively impact audiovisual processing in spoken language. Still, differences across studies indicate that it is the amount and quality of the exposure to each language that allows a child to truly become fluent in them both, assuming there is good access to language through sensory systems. Last, while there is no research on typically hearing children acquiring two sign languages, such research could

help determine whether two sign languages through the same visual sensory modality yield the same types of benefits seen for two spoken languages.

While there has been a substantial amount of research on both typically hearing spoken and sign/spoken bilinguals, there is much less on their D/HH counterparts. Although it's limited, the research suggests that spoken bilingualism is possible for D/HH children. For those D/HH children acquiring a sign and a spoken language, emerging research suggests: 1) their proficiency in both languages may positively affect EF (Emmorey et al., 2008; Kushalnagar, Hannay, & Hernandez, 2010), 2) that language processing and cognitive development are independent of language modality (Olulade et al;, 2015), and 3) that early sign language exposure, especially prior to cochlear implantation, may facilitate age-appropriate spoken language development (Hassanzadeh, 2012; Davidson, Lillo-Martin, & Pichler, 2014). Furthermore, knowledge of ToM suggests that exposure to an accessible language-rich environment may help them to better acquire the EF skills that their D/HH monolingual peers lack.

Despite the extremely limited number of research studies on this topic, opinions and speculations are abundant. Many recent articles on sign/spoken D/HH children are speculative based on findings of other populations. The information needed to determine the efficacy of sign/spoken language instruction for children who are D/HH is still unknown. A well-designed study of this population is critically needed. The goal of such a study would be to determine whether sign/spoken bilingualism from birth for D/HH children would improve spoken language outcomes compared to those of D/HH spoken monolinguals.

An example research study is outlined below. The study would be longitudinal in design, and would examine D/HH children from birth to five years of age. There would be a total of about 30 typically developing participants in each population who were identified at birth with

profound sensorineural hearing loss and who would each be fitted with appropriate listening devices as early as possible. Half of the participants would be randomly selected to partake in intensive oral language instruction from birth to five years of age. Until age 3, the child participants and their families would receive early intervention therapy at least once a week from a teacher of the deaf. Between the ages of 18 months and 3 years, the children would also attend school with intensive oral language instruction at least 3 days a week. Between the ages of 3 and 5, they would attend all-day pre-kindergarten in the same program. Throughout their five years in the study, the participants' cognition, language, speech, and vocabulary skills would be monitored and assessed frequently.

The other half of the participants in this study, from random selection, would partake in intensive sign/spoken language instruction from birth to five years of age. They would spend the same amount of time in school as those children placed in the oral program, but their time would be split equally among sign and spoken language exposure. That is, two early intervention therapy sessions a month until age 3 would be taught by typically hearing sign/spoken bilingual adults (CODAs or similar qualified teachers) in sign language alone, at least 2 of 3 days a week spent at school between the ages of 18 months and 3 years would be in a classroom run by the same typically hearing sign/spoken bilinguals, and between the ages of 3 and 5 at pre-kindergarten, half of every day would be spent with sign language instruction while the other half would be spent with spoken language instruction, switching between the two at hour-long intervals. At lunch and recess, both languages would be used. Throughout their five years in the study, the participants' cognition, language, speech, and vocabulary skills would be monitored and assessed frequently in both languages. Their scores in spoken language would then be compared to those of the participants placed in the intensive oral (monolingual) instruction

program. One proposal would be to expose D/HH children in this manner to spoken and sign language as equally as possible, but based on findings by Pearson, Fernández, Lewedeg, and Oller (1997) and Brackenbury, Ryan, and Messenheimer (2006), putting a greater emphasis on sign language may yield better results as sign language cannot be overheard to the same extent that one could overhear spoken language. Thus, other possible designs for this study would be to restructure the hours of sign language, providing more to the children, or to have a third group of children in a monolingual sign language instruction program comparable to the oral instruction program described in detail above.

While the results of the proposed study are unknown, benefits and/or deficits due to sign/spoken bilingualism, for children who are D/HH, would be observed. If large benefits were observed for those participants in a sign/spoken bilingual program while at school, it could be argued that those in the field of deaf education should consider implementing similar forms of language instruction in the future. If no benefits, or large deficits, were observed, then there would be no justification for the introduction of sign language simultaneous with oral education to infants diagnosed with severe to profound hearing loss.

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