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Differences in Parental Spoken Language Input, Gesture, and Emotional Sensitivity
Between Hearing Parents of Deaf Children and Hearing Parents of Hearing Children

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Differences in Parental Spoken Language Input, Gesture, and
Emotional Sensitivity Between Hearing Parents of Deaf Children
and Hearing Parents of Hearing Children

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Abstract

Deaf children of hearing parents have unique communication needs. Parental spoken language input, gesture use, and emotional sensitivity have been demonstrated to aid in the process of language development for these children. Twenty-two children (10 deaf, 12 hearing) participated in play sessions with a hearing parent. Parents' speech, gesture, and sensitivity were recorded and then assessed. Parents of hearing children spoke with greater mean length of utterances (MLU) compared with parents of deaf children. Parents of hearing children used marginally more word types/min as well. Additionally, several spoken language variables were positively correlated with parental sensitivity, including number of word types/min, word tokens/min, utterances/min, morphemes/min, and MLU. Parents who rated as highly sensitive spoke more and used more complex utterances. Parental gesture was positively correlated with tokens/min and marginally positively correlated with utterances/min and morphemes/min. Parent gesture was marginally correlated positively correlated with parental sensitivity. Additionally, assessing the individual dyad data allowed for deeper understanding of the parent's behavior during the play session. Parents of hearing and deaf children do not differ in their sensitivity or amount of gesture, but they do differ in the spoken language that they use with their children.

Introduction

There is increasing public awareness of the importance of the early language environment to a child's language learning outcome. A recent New York Times article reported that the American Academy of Pediatrics announced a new policy that pediatricians should tell parents to read aloud to their babies from birth, and repeat this advice at every visit (Rich, 2014). This recommendation will become be as routine as giving breastfeeding or immunization advice. This advice follows on the heels of a study demonstrating that by 18 months of age, the language gap between children in families with high socioeconomic status (SES) and low socioeconomic status is already apparent (Fernald, Marchman, & Weisleder, 2013). The study found that by 18 months of age, there were already significant differences in vocabulary and language processing efficiency, and by 24 months, there was a six-month gap between SES groups in language processing skills. These findings build on the groundbreaking work of Hart and Risley (1995), who found that the amount of language used by the child's family accounts for the child's vocabulary growth and related intellectual outcomes, that a child's expressive language practice is linked to his or her receptive language experience, and that a toddler's talkativeness stops growing when it reaches the parents' level of talkativeness. Collectively, these and related findings demonstrate that it is important for parents to speak as much as possible to their children, and that the early family experience and environment are important for a child's subsequent development. The current study represents an initial attempt to establish what, if any, differences exist in the early interactive environments experienced by deaf children of hearing parents relative to hearing children of hearing parents.

When children, whether hearing and deaf, receive consistent, structured, accessible input (spoken or sign), they generally follow similar language learning trajectories (Newport & Meier, 1985). However, approximately 90-95% of deaf children are born to hearing parents who are not likely to know even rudimentary sign language prior to their child's diagnosis (National Institute of Health, 2010; De Marco, Colle, & Bucciarelli, 2007; Vaccari & Marschark, 1997). These children typically do not receive the same kind of consistent language input that hearing children of hearing parents or deaf children of deaf parents do, creating a mismatch between the default modality for communication (spoken vs. sign). Regardless of whether parents decide that their child will get a cochlear implant or receive sign language training or both, there is a period of time during which parent-child communication is not comparable to the forms of input received by children who share a mode of communication with their parents.

A deaf child of hearing parents will almost always experience a period of language deprivation, which may impair his or her long term language outcome. Mayberry and colleagues found that in deaf people with little early language experience, syntactic processing is rudimentary and morphological and phonological skills are poor compared with deaf native signers (Mayberry, Lock, & Kazmi, 2002). In contrast, deaf children who used either sign language or speech reading from early infancy performed comparably with hearing bilingual children on a test of English proficiency, while late first language learners of sign language who didn't always have access to their caregivers' language did not perform as well (Mayberry and Lock, 2001). Despite the hardships faced during this initial period of language deprivation, there may be ways in which hearing parents can better communicate with their deaf children to establish early

communicative competence, whether they choose to learn sign language themselves or not.

Deaf parents are more likely to be sensitive to the communication needs of their deaf children than hearing parents of deaf children (Meadow-Orleans & Spencer, 1996). Additionally, hearing parents who have experience interacting with deaf people (such as with deaf family members) are more sensitive to their deaf child's communication needs (Swisher, 1992) than hearing parents without such experience. Nonetheless, in naturalistic settings, hearing mothers do appear to change their behavior to accommodate the needs of their deaf children. For example, during a free-play session, hearing mothers of deaf children used more vocal games (e.g. The Itsy Bitsy Spider) with exaggerated gestures than deaf mothers (Koester, Brooks, & Karkowski, 1998). Similarly, hearing mothers of deaf children tend to play with objects in the child's visual field more frequently than hearing mothers of hearing children (Waxman & Spencer, 1997). Collectively, these results demonstrate that hearing mothers of deaf children engage their children in unique ways that address a child's communicative needs.

In recent years, parental interaction with deaf children with and without cochlear implants has been the focus of research whose goal is identification of how different forms of parental behavior affect language development in this population. Here we will review forms of interaction between children and parents that have been shown to contribute to language development: the use of gesture together with spoken language, specifics of spoken language input, and parental sensitivity and responsiveness.

Gesture

Gesture is an obvious way for hearing parents to interact with their deaf children, even if they are not themselves learning a formal form of sign. One study found that deaf parents of two deaf children who were themselves English-only oral deaf (that is, deaf people whose primary communicative strategy is using spoken language) used extensive non-sign-language gestures along with spoken language to provide their children with more information about the content, structure, and nonverbal referents of their oral language (deVilliers, Bibeau, Ramos, & Gatty, 1993). The two profoundly deaf children in the deVilliers et al. study were videotaped every two months in an interaction with their profoundly deaf mothers. One child was filmed between the ages of 14 and 47 months, and the other between ages 22 and 58 months. The rates of gesture use by mothers in this study were compared to the rates of gesture use by hearing mothers of deaf children in a study conducted previously by Goldin Meadow (1991). The hearing mothers gestured an average of 2.8 times per minute, while the deaf mothers gestured an average of 16 times per minute, highlighting a substantial difference in gesture frequency across the dyad types. deVilliers and colleagues (1993) noted that the deaf children's gestures mirrored gestural input from their deaf mothers in form, use, and gestural type distribution. For example, these children showed the same pattern of types of gestures as their mothers used, with conventional gestures (nodding, shrugging, etc.) produced most often, and deictic (pointing, reference making) and iconic (representative) gestures constituting the second and third most frequently produced, respectively. deVilliers and colleagues conclude that deaf children will find ways to express their needs through gesture if the auditory modality is not fully accessible to them. This process appeared to

be aided by parents who provided their children with plenty of gestural input to complement their spoken input.

Not surprisingly, gesture appears to be more important for deaf children's communication than for that of hearing children. It has been found that in all children, gestures emerge at the same time or slightly before spoken words, but that hearing children quickly replace them with spoken words (Goldin Meadow & Morford, 1985). Moreover, Goldin Meadow and Morford (1985) found that maternal gesturing was less frequent for hearing children than for deaf children. Hearing children's gestures declined in complexity over time, while the gestures in the communication of deaf children increased in complexity over time. Finally, the deaf children created their own systems of gesture, similar in content and form to the early spoken language systems developed by hearing children.

Parental Language Input

Hearing parents' interactions with children who are deaf may differ in a variety of other ways, such as in how joint attention (i.e., the shared focus of two individuals on an object or event) is established. Successful joint attention occurs when two individuals look back and forth between each other and an object or event. A passive attention episode occurs when one individual joins the attention stream of another by looking at the same object, but the second person does not engage with the first person. Trautman and Rollins (2006) conducted a study with typically developing children and their mothers to examine the influence on language development of different types of parental conversational style during different types of joint attention. Conversational styles included child-centered input (caregiver contingent comments: communicative acts that

narrate an activity or discuss an object or event that is focused on by both child and parent), other child-centered acts (communicative acts that are within social routines, talking about feelings, talking about past events, etc.) and directive acts. Of these, caregiver contingent comments are indicative of the most responsive parenting style, as this type of input is contingent on what the child is doing and attending to.

These researchers also examined the role of multimodal input (the use of gesture or touch) between mothers and their children. Input modality was assessed using three categories: talk with gesture, talk without gesture, and gesture without talk. It was found that caregiver contingent comments had a strong positive correlation with talk with gesture, suggesting that this type of conversational style may be fundamentally multimodal. As found in other studies (e.g. Tomasello & Todd, 1983), the total time spent in joint attention was positively correlated with language proficiency at 30 months. Additionally, the rate of caregiver contingent comments during passive attention episodes was positively correlated with the language proficiency measure, while other child-centered acts were not. This indicates that multimodal caregiver contingent comments may be facilitative of later language outcomes. This may be because the use of caregiver contingent comments decreases the perceptual distance between the child's focus of attention and what the caregiver is talking about (reducing cognitive load), while gestures bring attention to the object and support the child's attention. This type of redundant information that enhances word – object relations may help promote language development (Gogate, Bahrick, & Watson 2000). Likewise, sensitive and responsive parents may often employ child-centered input styles of interaction with gesture, as they help the child connect the word with the referent.

Parental Sensitivity and Responsiveness

Parental sensitivity has been defined as the parent's ability to perceive the child's wants and needs accurately, and to respond to them quickly and appropriately (Ainsworth, Bell, & Stayton, 1974). Parental responsiveness is similar to sensitivity and is occasionally used by researchers as a proxy measure of sensitivity. However, the accepted definition of responsiveness depends only on the promptness or frequency of a parent's response, while appropriateness is generally not a factor (De Wolff & van Ijzendoorn, 1997). Parental responsiveness and sensitivity are important for many developmental facets, including social, cognitive, and linguistic development (e.g. Wakschlag & Hans, 1999; Tamis-Lemonda, Bornstein, & Baumwell, 2001).

Parental intrusiveness lies on the other side of the spectrum from responsiveness and sensitivity. Parents who behave intrusively have a tendency to take over tasks that the child is capable of doing independently, thus limiting the child's autonomy (Wood, 2006). Various studies have demonstrated that maternal intrusiveness predicts long term negative outcomes in the mother-child relationship (Ispa, Fine, Halgunseth, Harper, Robinson, Boyce, Brooks-Gunn, Brady-Smith, 2004; Park, Belsky, Putnam, & Crnic, 1997). In particular, Ispa and colleagues (2004) demonstrated that 10 months after the documentation of maternal intrusiveness in an observational study, there were increases in those children's negativity and decreases in their engagement with their mothers. It is likely that decreased engagement with parents would lead to less parental language input, and possibly less advanced language abilities. There is evidence that parental intrusiveness is related to detriments in vocabulary size, IQ, reading ability, and school

achievement in typically developing children (e.g. Hart & Risley, 1992; Walker, Greenwood, Hart, & Carta, 1994).

Warren, Brady, Sterling, Fleming, and Marquis (2010) propose a transactional model through which children and their parents co-create the environment in which the child develops. For example, a child at nine months of age may experience the onset of intentional communication. This change in the child creates a change in the social environment, such as increased linguistic mapping from the parent, which in turn supports further change and development for the child. It is believed that the real power of this model is the impact it has over time. If a parent frequently displays responsive behavior, these responsive events accrue over time. Conversely, if a child experiences cumulatively more negative or intrusive behavior from parents, this also has a significant impact. This evidence demonstrates that parent responsiveness does not function independently of the child's behavior. Instead, parent responsiveness interacts with a child's behavior in ways that have long term implications for a variety of behavioral and cognitive outcomes.

Parents who are warm in response to their infants provide a strong foundation for their development (Ainsworth, Blehar, Waters, & Wall, 1978). When infants and young children receive parenting that is supportive of their limited skills, they are expected to have better and more successful learning experiences later (Bruner, 1975). Studies have even demonstrated that aspects of a parent's sensitivity can immediately influence something as basic as how a child allocates his or her attention. In hearing parent/hearing child (Hh) dyads, Tomasello and Todd (1983) found that when mothers initiated an interaction by joining the child's focus of attention (an example of sensitive behavior),

more object labels were learned. In addition, another study found that a mother-child dyad produces more utterances and has longer conversations when the mother initiates an interaction by joining the child's focus of attention (Tomasello & Farrar, 1986). This sensitive behavior on the part of the mother enables the child to avoid making errors when mapping an label to an object as the child does not need to determine the object of reference. This parental behavior may facilitate language development, as mapping errors are decreased and the child makes more correct direct inferences about the meaning of words (Tomasello & Farrar, 1986).

Optimum instances for language learning happen when adult speech is centered on the child's stream of attention (Bloom, 1993, 1998; Tomasello & Farrar, 1986; Tomasello & Todd, 1983). Parents who are responsive and sensitive to their child's attentional stream may specifically support language learning by giving labels for objects and events, which eases the task of word-referent mapping for the child (e.g. Tomasello & Farrar, 1986). Parents may differ in their responsiveness due to the fact that responsiveness is a multidimensional construct.

Tamis-LeMonda and colleagues (2001) investigated maternal responsiveness and child language outcomes in 40 typically developing hearing children from nine months of age to 13 months of age. The authors investigated which forms of maternal responsiveness predicted the timing of particular language milestones. It was found that mothers' responses to a child's exploratory behavior predicted the timing of the child's first imitation (when the child first repeated the phonetic approximation of an adult's vocalization), mothers' responses to a child's vocalizations predicted the timing of the child's first words and subsequent achievement of at least 50 words in their vocabulary.

Moreover, mothers' responses to children's play predicted the timing of combinatorial speech (when the child first used a combination of two or more words in one utterance), and mothers' responses to both child's vocalizations and child's play predicted the timing of children's ability to talk about the past. Overall, parental description, play prompts, and affirmations were the types of responsiveness that best predicted specific child language outcomes in this sample.

Typically developing hearing children benefit from responsive and sensitive parenting. How does this parenting style affect children who have a language and/or developmental delay? Children with developmental or language delays may be even more likely to have deficient environmental input because of their low rates of initiation and responsiveness. It has been proposed that parental sensitivity and responsiveness have an even larger effect on the language development of children with developmental and/or language delays; e.g., autism spectrum disorder (Siller & Sigman, 2002), Fragile X syndrome (Warren et al., 2010), infants with very low birth weight (Landry, Smith, Swank, Assel, & Vellet, 2001) and children who are deaf or hard of hearing (Pressman, Pipp-Siegel Yoshinaga-Itano, Deas, 1999; Quittner, Cruz, Barker, Tobey, Eisenberg, & Niparko, 2013; Spencer & Meadow-Orlans, 1996).

Parental responsiveness is a method for the mother and child to "share a way of looking at the world" (Snow, 1986). This creates a foundation from which the child can interpret and make sense of what the parent says in a parent-child interaction. Clearly, parental responsiveness and sensitivity are important in the dynamic of the parent-child relationship. If the parent can behave in these positive ways, he or she can give the child an advantage in language development. This may be particularly true for children who

have delays in language. However, many studies have not compared these delayed children to a control sample of typically developing children. Therefore, it is difficult to determine if language delayed children receive an extra 'boost' from parental sensitivity. Even though this has been speculated, few studies have demonstrated that language delayed children benefit even more than typically developing children.

Motivation for the current study

The current study examines the roles of parental sensitivity and gesture use, and how they are related with parental spoken language input. Although several previous studies have evaluated one or more of these parent behaviors in deaf children either with or without cochlear implants, to our knowledge, no other study has assessed the relationship of all three of these parent behaviors to one another.

A study using Hh (hearing parent, hearing child), Hd (hearing parent, deaf child), and Dd (deaf parent, deaf child) dyads found that Hh and Dd dyad mothers were more responsive to their children than Hd dyad mothers (Spencer, Bodner-Johnson, & Gutfreund, 1992). Hearing parents (who don't sign) of deaf children typically employ more directive behavior strategies to interact with their children than hearing parents of hearing children (Vaccari & Marschark, 1997). For example, a parent exhibiting directive behavior may grab a child's hands and make him or her clap, even while his attention is on another object. It is believed that these directive behaviors are not supportive of language development, as the parent is not following the child's lead (Gale & Schick, 2009).

Pressman, Pipp-Siegel, Yoshinaga-Itano, and Deas (1999) studied 24 deaf/hard of hearing children aged 21-30 months and followed up with them at age 33-41 months.

Mother and child were videorecorded during a free play session. Mothers completed the Minnesota Child Development Inventory (MCDI) at this assessment. Follow-up MCDIs were completed by the mothers approximately 11 months after the initial assessment. The Expressive Language scale of the MCDI was used at both time points as a measure of the child's language ability. The videorecordings of the initial assessment were coded for parental sensitivity using the Sensitivity subscale of the Emotional Availability scales. Parents' sensitivity predicted follow-up Expressive Language, over and above the initial Expressive Language score, as well as child and family characteristics such as mother's education, child's hearing loss, and mode of communication.

DesJardin and Eisenberg (2007) conducted a study testing 32 mother-child dyads in which all the children had bilateral sensorineural hearing loss and used multi-channel cochlear implants. Previous studies have demonstrated that children with cochlear implants experience significant gains in speech perception in the first year after implantation (Cohen, Waltzman, Roland, Staller, & Hoffman, 1999; Miyamoto, Kirk, Svirsky, & Sehgal, 1999). However, despite these findings, language ability varies greatly in children with cochlear implants, even after controlling for age and length of cochlear implant use. These findings may be attributable to differences in the child's ability to perceive speech, as well as mode of communication typically used (Kirk, Miyamoto, Ying, Perdew, & Zuganelis, 2002). Other factors that may contribute to these varying levels of communication include parental language input.

Mother's mean length of utterance (MLU) and word types were positively correlated with the child's receptive language score, while the use of open-ended questions was related to the child's expressive language score. Recasting as a language

technique (repeating the child's utterance in a question format) was also positively correlated with the child's MLU, number of word tokens, and word types. In the other direction, mothers' use of linguistic mapping (interpreting a child's intended message using context as a clue), labels (giving the word for an object), and directives were negatively associated with both the child's receptive and expressive language scores. Labels were also negatively correlated with child's number of word tokens and word types, while directives (an example of intrusive behavior) were negatively associated with child's word types. The authors conclude that the use of higher-level techniques (such as recast and open-ended questions) were positively associated with the child's language abilities, while lower-level techniques (linguistic mapping, labels, and directives) were negatively associated with the child's language abilities.

Quittner, Cruz, Barker, Tobey, Eisenberg, and Niparko (2013) studied the effects of maternal sensitivity, linguistic stimulation, and cognitive stimulation on the long-term spoken language outcomes of 188 children with cochlear implants aged 5 months to 5 years and 97 normally hearing children. The child's spoken language was assessed before implantation, and 6, 12, 24, 36, and 48 months after implantation. The assessments for child language included the MacArthur-Bates Communicative Development Inventories (CDI), Reynell Developmental Language Scales Verbal Comprehension and Expressive Language scales, and the Comprehensive Assessment of Spoken Language, depending on the age of the child.

Parent-child interactions were recorded and coded for maternal sensitivity, linguistic stimulation, and cognitive stimulation. Maternal sensitivity and cognitive stimulation were coded using the National Institute of Child Health and Human

Development's Early Childcare Study codes. The sensitivity scale ranged from one (very low sensitivity) to seven (very high sensitivity). The cognitive stimulation scale measures the degree to which the parent fosters the child's cognitive development. Linguistic stimulation was coded using a seven-point scale developed by a team of psychologists and speech-language pathologists at the University of Miami. This scale measures the amount and quality of stimulation that facilitates functional auditory and linguistic skill development for the child.

Both cognitive stimulation and maternal sensitivity predicted increases in language growth, while linguistic stimulation only predicted language growth in the context of high maternal sensitivity (an interaction between maternal sensitivity and linguistic stimulation was found). At 48 months post-implantation, children with parents who demonstrated high maternal sensitivity and linguistic stimulation had 1.52 years less delay than children with either low maternal sensitivity or low linguistic stimulation. Both maternal sensitivity and linguistic stimulation are needed to maximize language outcomes with the use of a cochlear implant.

The current study

Based on previous findings, the current study aims to understand how hearing parents interact with their deaf children. Specifically, we assessed language development and how it relates to sensitive and responsive parenting, and gesture is a part of sensitive/responsive parenting. This study asks the following questions:

- Do parents of hearing and deaf children differ in oral language use with the child (MLU, word types, and word tokens)? It is expected that parents of hearing children will use more oral language with their children.

- Do parents of hearing and deaf children differ in their sensitivity toward the child? It is expected that parents of deaf children will be more sensitive, as their children have special communicative needs.
- Does parental sensitivity correlate with gesturing?
- Does parental sensitivity correlate with parental oral language use?

Methods

Participants:

Ten severely to profoundly deaf children ($n = 4$ males) ages (7.2 – 39.0 months, $M = 17.68$, $SD = 11.07$) and their hearing parents ($n = 1$ male) (i.e., dH dyads) participated in the study. Additionally, ten age-matched hearing children ($n = 6$ males) ages (7.0 – 36.6 months, $M = 17.67$, $SD = 11.83$) and their hearing parents ($n = 2$ males) took part in the study. These hearing children/hearing parent dyads (i.e., hH dyads) were recruited through the National Institutes of Health website or local recruitment. Eighteen percent of parents had a high school education and 73% had a college education or higher. The rest of the parents did not report their education levels. The parents of the hearing children had slightly higher education levels than the parents of the deaf children. All of the parents of the hearing children had at least some college education, while four parents of deaf children did not attend any college. None of the children had any known developmental delays.

Materials:

Age-appropriate toys (play tableware, toy cars, a set of large blocks, a set of stacking cups, a ball, and a tower of stacking rings) were used during a free-play session with one parent and the child that lasted approximately 10 minutes ($M = 9.34$, $SD = 2.32$). This

was part of a visit with a speech language pathologist (for the deaf children) or during a visit to the Husky Pup Language Lab at the University of Connecticut (for the hearing children). Parents in both types of dyad were instructed to play with their child as they would at home. These play sessions were videorecorded. Clinical videos were transferred from researchers at Stanford University School of Medicine to researchers at University of Connecticut using the REDCap (Research Electronic Data Capture) electronic data capture tools hosted at Stanford University (Harris et al., 2009). For the hH dyads, parents gave informed consent and completed demographics questionnaires prior to the play session.

Measures

Demographics questionnaires included information about the parents' education levels, languages spoken at home, and family members who live with the child.

The Preschool Language Scale – 5th edition (PLS-5) was administered before the play session to assess the child's language abilities. A trained graduate student performed the PLS-5 assessment with the parent and child. The Stark scale was used as a measure of early vocal development. This scale was rated while trained graduate students watched the videotaped play sessions.

The videorecordings of the play sessions were coded using ELAN software (Wittenburg et al., 2006). ELAN is a language annotation software designed at the Max Planck Institute for Psycholinguistics (The Language Archive, Nijmegen, The Netherlands). It is free of charge and allows for the temporal coding of multimodal interactions. Trained undergraduate and graduate research assistants transcribed the language spoken during the PCI, as well as the parents' use of gesture. Trained

undergraduate research assistants also used the videorecordings in ELAN to code for parent gesture use.

Transcripts from ELAN were exported into a format compatible with the conventions of the Child Language Data Exchange System (CHILDES). CHILDES provides a software package for the automatic analysis of language transcripts called CLAN (Child Language ANalysis; MacWhinney, 2000). CLAN allows for the calculation of mean length of utterance (MLU) as well as frequency counts (type and token).

The Sensitivity subscale of Emotional Availability (EA) Scales - infancy to early childhood version - (Biringen & Robinson, 1991) was used as a measure of parental sensitivity. The scales define sensitivity as the parent's ability to read the child's cues and respond appropriately, to resolve conflict or misunderstanding between the parent and child, and to manage a wide range of affect while keeping interactions mostly positive. These abilities are assessed using a scale from one (highly insensitive) to seven (highly sensitive). This score is called the 'direct score.' There are also several categories that make up a 'total score' from 1-29: Affect, Clarity of Perceptions, Timing, Flexibility, Acceptance, Amount of Interaction, and Conflict. One graduate student and one undergraduate research assistant were trained using the online training available at www.emotionalavailability.com. Each coder watched the videorecordings of the parent-child interaction and created both direct and total scores for the parental sensitivity demonstrated during the session.

Procedure:

Video processing. Videos were reviewed for clarity and completeness; and then they were cut to the start and end of the play session using Adobe Premiere Pro. The play

session began when the SLP or experimenter left the room and the door shut. The first frame in which the door was shut was the start time of the play session. The play session ended when the SLP or experimenter re-entered the room. The first frame in which the door was seen opening was the end time of the play session. The total length of the play session was determined using these start and end times.

Coding criteria: Language. Language was transcribed by trained graduate and undergraduate students. The transcribers coded the beginning of an utterance as the frame during which speech was first heard. Similarly, the transcribers coded the end of an utterance as the frame during which speech was last heard. The length of an utterance was then coded with the spoken language used during that time. Two coders transcribed the interactions, and their transcripts were compared. A trained graduate student settled any discrepancies in transcription.

Gesture. Gestures were coded by trained graduate and undergraduate students. The videorecordings were broken up into thirty-second bins using ELAN. Coders then coded a “yes” if the parent gestured during that thirty-second period, or “no” if the parent did not gesture during that thirty-second period. Gestures counted as “yes” even if the child was not watching. Gestures included any intentional gesturing towards the child. Pointing, demonstrating how a toy is used, and sign language words all counted as gestures. The same procedure as previously noted was used for gesture reliability: two people coded and a third person made final decisions on any discrepancies.

Sensitivity. Parental sensitivity was coded for using the entire video of the play session, according to the Emotional Availability training that coders received. Fifty-nine percent of the videos received the same direct score, while 27% of the videos received direct

scores within one point of one another. Scores within one point of one another are considered reliable, according to the EA scoring system. This means that 86% of the sensitivity scores were reliable. Discrepancies between the two coders were settled by the graduate student. **Analyses**

Mean length of utterance (MLU) was calculated using CLAN. However, language production frequency counts (type and token) needed additional analysis. The length of the play sessions varied, so the rate of word types per minute was calculated by dividing the number of word types by the total length of the play session. Similarly, the number of tokens per minute was calculated by dividing the number of tokens by the total length of the play session. Finally, a type-to-token ratio was calculated by dividing the number of word types by the number of word tokens in each play session.

The proportion of thirty-second periods in which the parent gestured was calculated by dividing the number of periods in which the code was “yes” by the total number of periods.

Results and Discussion

The Stark scale and the PLS-5 measures were not used in the analyses, as there were ceiling effects found for each of these in the normally hearing children. Each of the normally hearing children scored at the top on each of these measures, while the deaf children had quite a bit of variance in their scores. Because of this dichotomy, we decided not to use these measures in our analyses.

Group Differences

T-tests were run on each variable to determine whether there were any group differences between the hH dyads and the dH dyads. A significant difference was found

between the dH and hH dyads in parent spoken MLU ($p=.004$). dH dyads had a mean of 2.91 morphemes/utterances, while hH dyads had a mean of 4.21 morphemes/utterance. Additionally, the group differences in Types/Min was approaching significance ($p=.055$). dH dyads had a mean of 10.67 types/min, while hH dyads had a mean of 15.19 types/min. Table 1 shows the means and standard deviations of all the variables assessed in this study.

Measure	dH Mean	dH SD	hH Mean	hH SD	Total Mean	Total SD
Types/Min	10.67	5.25	14.44	4.98	12.56	5.34
Tokens/Min	41.11	24.24	47.52	18.92	44.31	21.42
Type/Token Ratio	0.32	0.15	0.31	0.054	0.32	0.11
Utterances/Min	14.63	7.66	12.82	3.48	13.72	5.87
Morphemes/Min	45.21	26.29	53.93	21.74	49.57	23.90
MLU	2.91*	1.09	4.14	0.817	3.53	1.13
Total Score	23.4	4.90	24.80	3.29	24.10	4.13
Direct Score	5.15	1.49	5.55	1.19	5.35	1.33
Proportion of Gesture	0.37	0.31	0.30	0.172	0.34	0.25x

Table 1. Group Means. Means and standard deviations for each measure for each group are reported. * denotes a significant difference between groups.

Parents in hH dyads use more morphologically complex utterances when talking to their children than parents in dH dyads, as demonstrated in Figure 1.

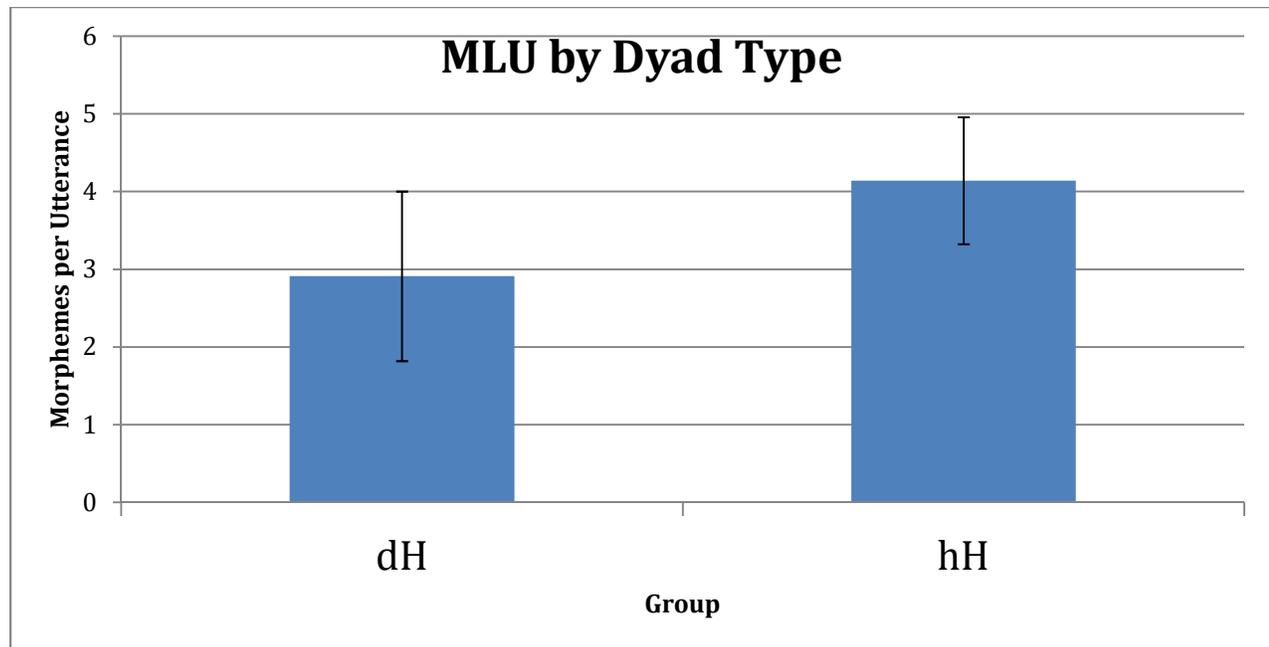


Figure 1. Morphemes per utterance by dyad type.

Additionally, parents in hH dyads use more word types per minute than parents in dH dyads, as demonstrated in Figure 2

This result was expected, as parents of hearing children know that their children can hear what they are saying, and therefore may speak with more complexity or more often, while parents of deaf children know that their children cannot hear what they are saying. That parents in hH dyads use more morphemes per utterance means that their utterances contain more morphemes and are likely more complex. However, it is important to note that there were not group differences on the measures of tokens per minute, type/token ratio, utterances per minute, and morphemes per minute. The lack of group differences on these measures is surprising, as it would be expected that parents in hH dyads generally talk more to their children than parents in dH dyads. A possible explanation for these results is that parents in hH dyads use more complicated utterances and more word types, but end up speaking about the same amount as parents in dH dyads.

Parents in hH dyads know that their children are able to understand their oral language use, and therefore use more complex utterances. Parents in dH dyads may be speaking the same amount to their children, but using simpler utterances and fewer word types, as their children have a delay in spoken language development.

A t-test revealed that there were not group differences on measures of sensitivity. It was expected that parents in dH dyads would be more sensitive, as they have learned to be sensitive towards their child's communicative needs, but this was not observed. This result, while initially surprising, may be due to the high variability in sensitivity in parents of typically developing, normally hearing children.. There are plenty of parents who are highly sensitive and there are plenty of parents who are not very sensitive. This pattern may not be expected to change for parents of deaf children, despite our prediction that it would, as parents in dH dyads may need to be more sensitive to their child's communicative needs. Again, some parents will be highly sensitive towards their child's needs (especially their communicative needs), while others will not.

Correlations

We compared the correlations across our different measures. Table 2 is a correlation table collapsed across dyad type, with r values for each correlation and p values for each significant or marginally significant correlation.

	Age	Types/ Min	Tokens/ Min	Type/ Token Ratio	Utterances/ Min	Morphemes/ Min	MLU	Total Score	Direct Score	Proportion of gesture
Age	1	0.437*	0.382*	-0.101	0.316	0.372	.217	.251	.225	.242
Types/Min	-	1	0.904**	-.495**	.570**	0.920**	.834**	.560**	.492**	.324
Tokens/Min	-	-	1	-.707**	.785**	.995**	.679**	.554**	.480**	.471**
Type/Token Ratio	-	-	-	1	-.835**	-.687**	-.292	-.613**	-.524**	-.380*
Utterances/ Min	-	-	-	-	1	.766**	.163	.543**	.498**	.401*
Morphemes /Min	-	-	-	-	-	1	.704**	.577**	.510**	.427*
MLU	-	-	-	-	-	-	1	.442*	.349	.198
Total Score	-	-	-	-	-	-	-	1	.967**	.414*
Direct Score	-	-	-	-	-	-	-	-	1	.426*
Proportion of Gesture	-	-	-	-	-	-	-	-	-	1

Table 2. Correlations collapsed across dyad type. Correlations that are significant or approach significant p values have p values reported here. Correlations that are not significant or approaching significant do not have p values reported. * denotes a p value less than 0.10, and ** denotes a p value less than 0.05.

The correlation between parental sensitivity (collapsed across dyad type) and gesture was approaching significance. Both the measure of total score and direct score had p values below 0.10 (0.070 and 0.061, respectively). These were medium-sized effects (total score = 0.414; direct score = 0.426). A larger sample size and more refined coding of gesture would allow us to assess whether a relationship between parental sensitivity and gesture does, in fact, exist.

Parental sensitivity collapsed across dyad type was significantly correlated with many language measures. There was a significant positive correlation between total score and word types per minute ($r = 0.560$), tokens per minute ($r = 0.554$), utterances per minute ($r = 0.543$), morphemes per minute ($r = .0577$), and MLU ($r = 0.42$). Direct score was significantly positively correlated with types per minute ($r = 0.492$), tokens per minute ($r = 0.480$), utterances per minute ($r = 0.498$), and morphemes per minute ($r = 0.510$), but not MLU. Both of these results indicate that parents scoring highly on our sensitivity measure use more word types, word tokens, utterances, and morphemes than less sensitive parents. Generally, parents scoring highly on sensitivity speak more than parents with lower sensitivity score. Total score was correlated with MLU, while direct score was not. This is likely due to the fact that direct score is a slightly less sensitive measure, as it is a score out of 7, while total score is a score out of 29. Total score allows for a slightly more fine-grained analysis. An unexpected result is that both total score and direct score were significantly negatively correlated with type/token ratio, with fairly strong correlations of $r = -0.613$ and $r = -0.524$, respectively. It was expected that more sensitive parents would have a higher type/token ratio, which would indicate that they are repeating themselves less often. However, it also may make sense that more sensitive

parents have lower type/token ratios. Parents who are sensitive to their children may be sensitive to when their children do not understand something, or need something to be repeated. For example, in the case of object labeling, children who don't initially map the object to the label may need their parents to repeat the label. Sensitive parents may understand this need and repeat themselves until their child maps the object to the label, while less sensitive parents may not.

Overall, it can be seen that parental sensitivity is significantly correlated with many facets of parental spoken language use. For children who cannot hear their parents' spoken language use, parental sensitivity may be a proxy measure for their language input. As noted above, children with more sensitive parents have greater language outcomes. It is possible that even if the children in this study cannot actually hear what their parents are saying to them, some of the information is coming across through the parent's sensitivity and gesture use. Once the children get their cochlear implants, those with more sensitive parents may have the upper hand in helping their children overcome any language delays they face as a result of being deaf in a family of normally hearing people. This is because these highly sensitive parents not only talk more, generally, but also may gesture more, giving their children more than one avenue to access the information being communicated, as explained in deVilliers et al. (1993).

Child's age was significantly correlated with word types per minute. This result makes sense, as older children are likely to understand the meaning of more different words. Age was also marginally correlated with word tokens per minute and morphemes per minute. This may be a result of the parents in the hH dyads understanding that their children can hear and understand their utterances, and that with age they are likely to

develop greater language abilities. The parents in the dH dyads may also intuitively expect that their children also understand more language based on age, even if their child is deaf.

Next we looked at the correlations for all the measures by dyad type. Table 3 is the correlation table for the 10 dH dyads. Table 4 is the correlation table for the 10 hH dyads.

Table 3 shows the correlations between the variables for the ten dH dyads, and Table 4 shows the correlations between the variables for the ten hH dyads. The most interesting differences between these two tables are in the correlations with sensitivity. In the dH dyads, sensitivity was correlated or marginally correlated with almost all of the parental language measures (all of them being positive correlations, with the exception of the type/token ratio correlations). These had large effect sizes, ranging from $r = 0.572$ to $r = 0.817$. In the hH dyads the only parental language measures that were correlated or marginally correlated with sensitivity measures were type/token ratio and utterances per minute. However, both total score and direct score were significantly correlated with proportion of gesture, with large effect sizes of $r = 0.632$ and $r = 0.697$, respectively. The dH dyads did not have significant correlations between sensitivity measures and gesture.

	Age	Types/ Min	Tokens/ Min	Type/ Token Ratio	Utterances/ Min	Morphemes/ Min	MLU	Total Score	Direct Score	Proportion of gesture
Age	1	0.425	0.322	-0.096	0.376	0.297	.048	.303	.337	.442
Types/Min	-	1	0.894**	-.636**	.720**	0.902**	.800**	.817**	.735**	.568*
Tokens/Min	-	-	1	-.801**	.853**	.994**	.716**	.667**	.572*	.602*
Type/Token Ratio	-	-	-	1	-.859**	-.791**	-.433	-.593*	-.490	-.370
Utterances/ Min	-	-	-	-	1	.848**	.317	.584*	.528	.365
Morphemes /Min	-	-	-	-	-	1	.730**	.712**	.628*	.568*
MLU	-	-	-	-	-	-	1	.734**	.632**	.577
Total Score	-	-	-	-	-	-	-	1	.963**	.384
Direct Score	-	-	-	-	-	-	-	-	1	.360
Proportion of Gesture	-	-	-	-	-	-	-	-	-	1

Table 3. Correlations for the 10 dH dyads. Correlations that are significant or approach significant *p* values have *p* values reported here. Correlations that are not significant or approaching significant do not have *p* values reported. * denotes a *p* value less than 0.10, and ** denotes a *p* value less than 0.05.

	Age	Types/ Min	Tokens/ Min	Type/ Token Ratio	Utterances/ Min	Morphemes/ Min	MLU	Total Score	Direct Score	Proportion of gesture
Age	1	.514	0.474	-.160	0.283	0.478	.538	-203	.106	-.055
Types/Min	-	1	0.968**	-.345	.724**	0.973**	.857**	.130	.131	.138
Tokens/Min	-	-	1	-.556*	.854**	.999**	.738**	.306	.300	.294
Type/Token Ratio	-	-	-	1	-.842**	-.545	-.016	-.810**	-.776**	-.526
Utterances/ Min	-	-	-	-	1	.853**	.310	.627*	.617*	.480
Morphemes /Min	-	-	-	-	-	1	.749**	.301	.297	.268
MLU	-	-	-	-	-	-	1	-.194	-.200	-.230
Total Score	-	-	-	-	-	-	-	1	.982**	.632**
Direct Score	-	-	-	-	-	-	-	-	1	.697**
Proportion of Gesture	-	-	-	-	-	-	-	-	-	1

Table 4. Correlations in the 10 hH dyads. Correlations that are significant or approach significant p values have p values reported here. Correlations that are not significant or approaching significant do not have p values reported. * denotes a p value less than 0.10, and ** denotes a p value less than 0.05

The differences seen in the language correlations with sensitivity could be due to the fact that the parents in the hH dyads know their children can hear what they are saying, and therefore their means on most of the parental language measures are higher than those of the parents in the dH dyads. There may be less variability in the amount of speech and the complexity of speech for the parents in the hH dyads. Looking at the standard deviations for the parental language variables, it can be seen that generally, the dH dyads had greater standard deviations than the hH dyads, indicating more variability in their spoken language use.

The differences in gesture correlations with sensitivity could be due to the parents in the dH dyads generally gesturing more (mean proportion of gesture for dH dyads = 0.37, mean proportion of gesture for hH dyads = 0.30). Perhaps most of the parents in the dH dyads are gesturing more because they know they need to do so to communicate with their child, rather than doing so because they are more or less sensitive towards the child's needs.

Results from Individual Dyads

Viewing results by dyad may help further understanding of what kinds of behavior the dyad is displaying. For example, dyad P21 has the largest type/token ratio (Figure 3) out of all dyads, but this dyad also has the smallest MLU (Figure 4) out of all dyads. This suggests that this parent is not repeating him or herself very much, and is not using many words in their utterances. We can speculate about this parent's behavior in the play session. It is possible that this parent is doing mostly object labeling during the play session. We can also speculate that this parent will not score as highly sensitive on the sensitivity evaluation, based on the assumption that this parent is displaying mostly

object labeling behavior. More sensitive parents will try to engage their children more, rather than simply giving labels to nearby objects.

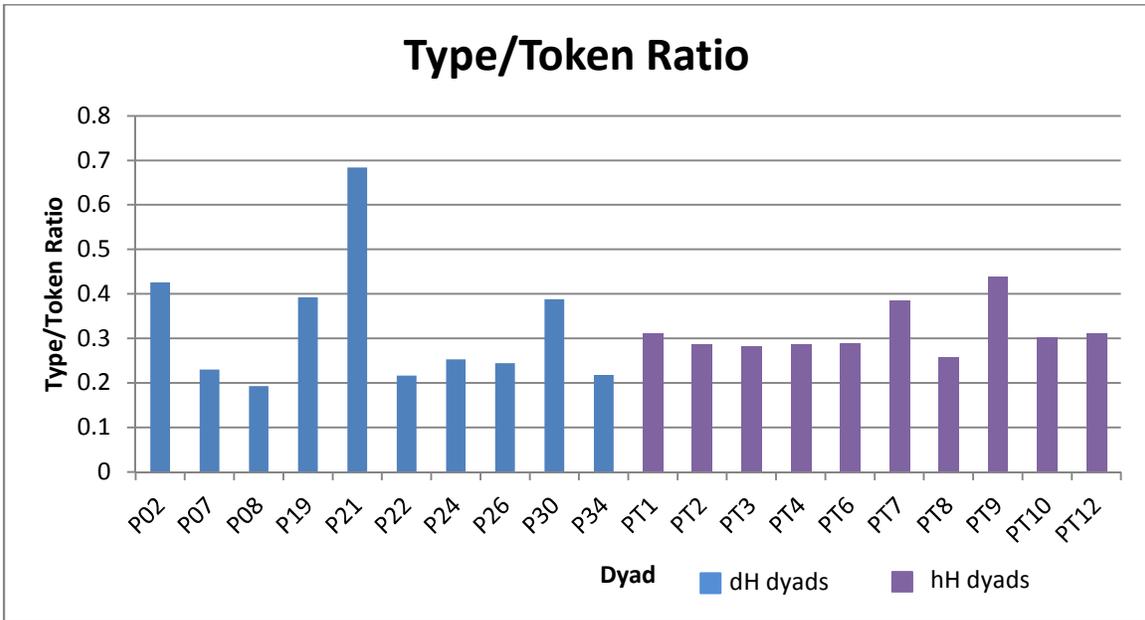


Figure 3. Type/token ratio by dyad.

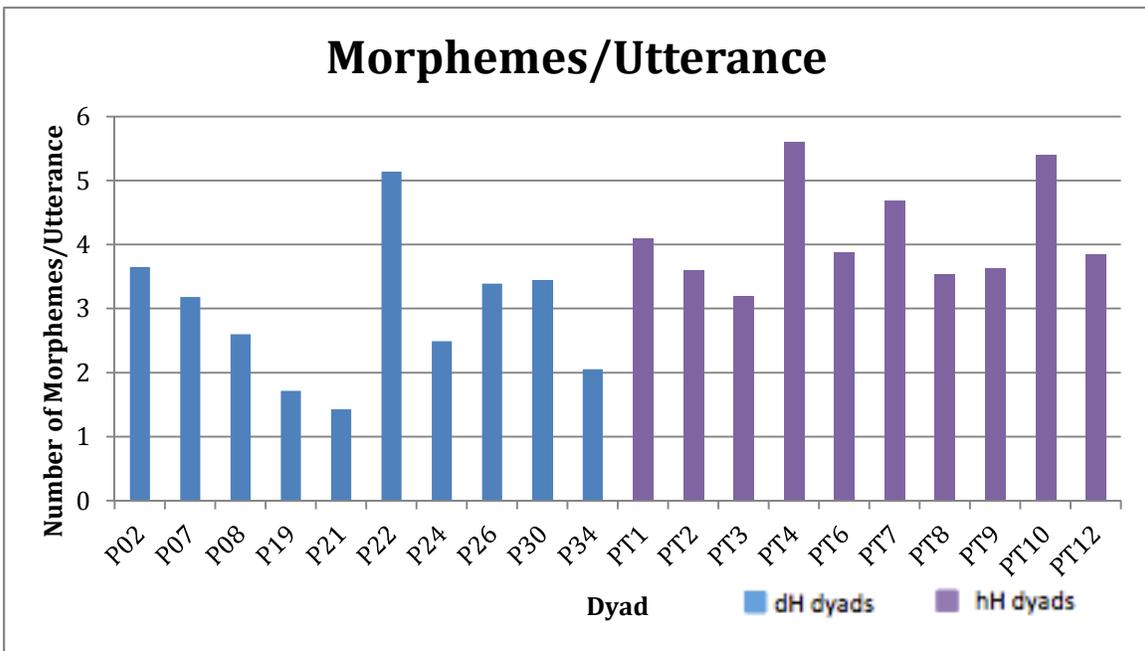


Figure 4. MLU by dyad.

Looking at the sensitivity ratings, we can see that the parent in dyad P21 was, indeed, rated as less sensitive. Using the individual parent language data can be helpful in predicting parental behavior, particularly parental sensitivity.

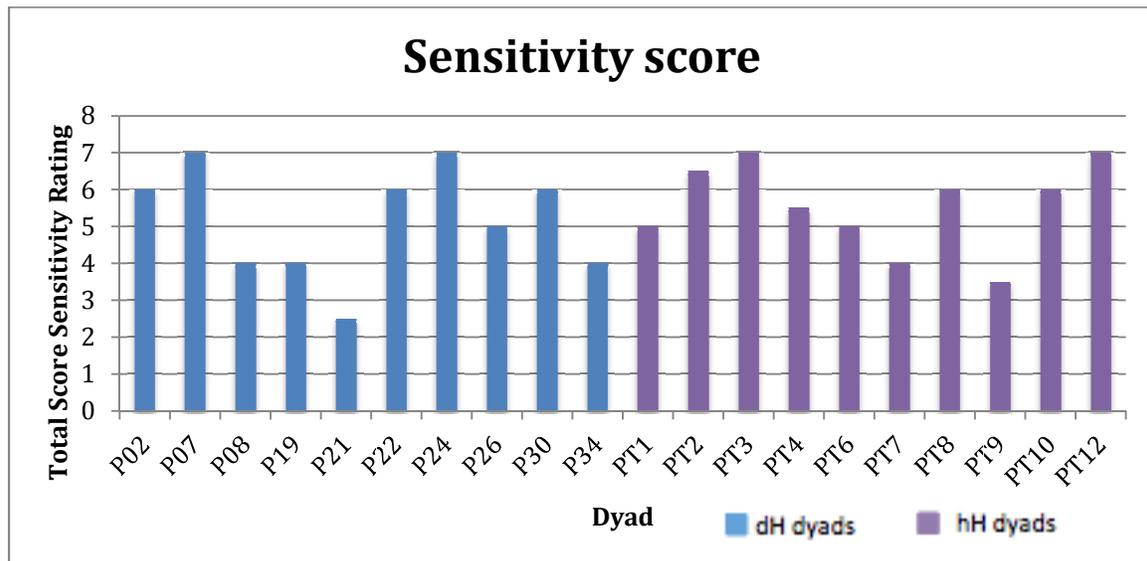


Figure 5. Total Score Parental sensitivity ratings by dyad.

Additionally, looking at individual language data in addition to gesture data may help predict parental sensitivity even more. For example, the parent in dyad P22 had a high MLU (Figure 4) and a high proportion of gesture (Figure 6). This parent is using long, morphologically complex utterances (MLU = 5.138) and gesturing at least once per 30-second interval (proportion of gesture = 1.0). MLU is significantly positively correlated with parental sensitivity, and proportion of gesture is approaching significantly positively correlated with parental sensitivity. Since both of these positively correlate with parental sensitivity, it can be estimated that the parent in this dyad rates highly on sensitivity. Indeed, the parent in dyad P22 has a sensitivity rating of 6.

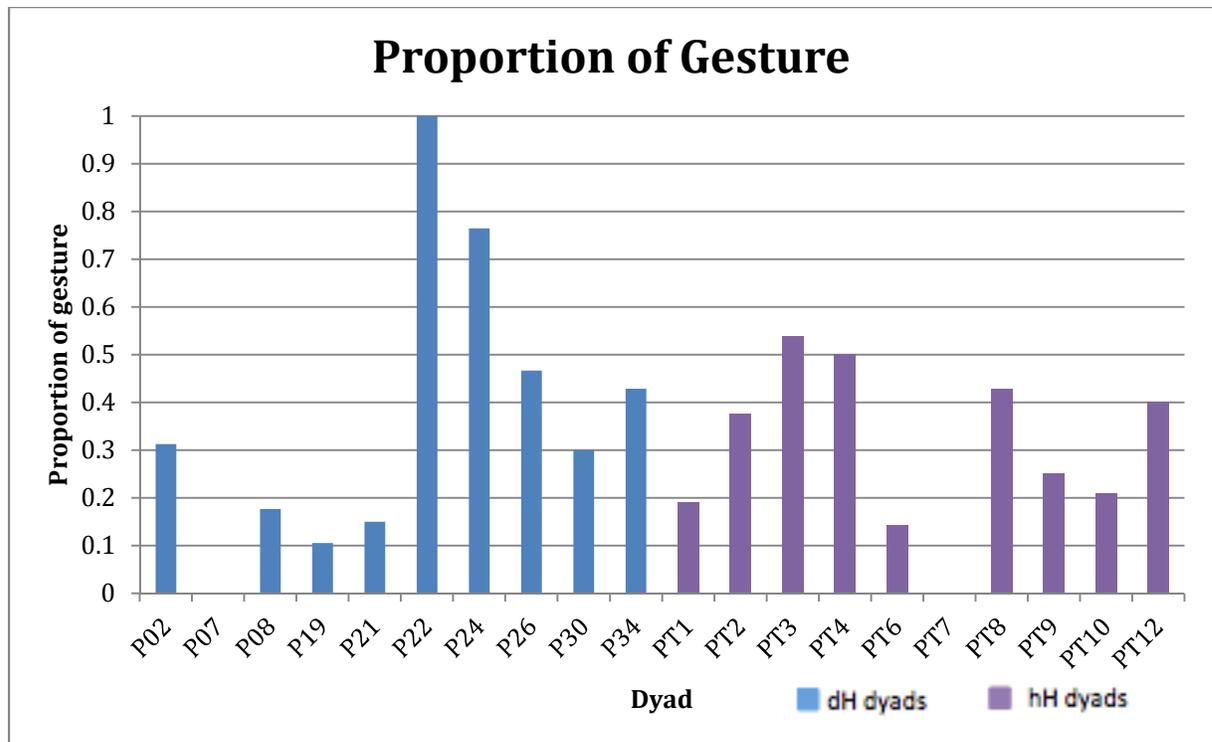


Figure 6. Proportion of parental gesture by dyad.

Looking about both language and gesture data by individual dyad may help predict parental behavior. This can be helpful in understanding what the parent is doing during the play session, without actually watching the video.

In addition to the above results, an exploratory regression was conducted.

Regression

An exploratory regression analysis was performed, using Proportion of gestures and MLU as independent variables and Total Score as an outcome variable. Proportion of gestures and MLU significantly predicted 30.1% of the variance in Total Score ($R^2 = .301$, $F(2,19) = 4.082$, $p = .034$). MLU significantly predicted Total Score, $\beta = 1.455$, $t(19) = 2.115$, $p = .048$. Proportion of gesture approached significantly predicting Total Score, $\beta = 5.211$, $t(19) = 1.624$, $p = .121$.

Proportion of gesture and MLU significantly predicted 30.1% of the variance in Total Score, meaning that both significantly predicted parental sensitivity proportion of gesture and MLU together. Additionally, MLU significantly predicted Total Score and proportion of gesture approached significantly predicting Total Score. While still a small sample size and certainly an exploratory analysis, this may help further our understanding of how these variables are related to one another. If parental sensitivity is predicted by parental MLU and use of gestures, then it is possible that increasing both gesture and MLU may increase parental sensitivity towards the child. If parental sensitivity is higher, it is more likely that the child will have positive language outcomes, despite any potential language delays, such as being deaf in a family of normally hearing people.

Conclusions

It was found that parental MLU was correlated with and predicted parental sensitivity. This result was for the correlations collapsed across dyads and for the correlations for only the dH dyads. However, MLU was found to be significantly greater in the hH dyad group. While this result makes sense, as deaf children cannot hear their parents' utterances, increasing parental sensitivity in dH dyads may increase parental MLU. Increased parental sensitivity towards their deaf children may, in turn, aid in the child's language outcomes, as found in several studies (ex: Quittner et al., 2013; Pressman et al., 1999).

More sensitive parents generally used more speech with their children (word types/min, word tokens/min, utterances/min, morphemes/min, and MLU were all positively correlated with parental sensitivity measures). More sensitive parents also may gesture more than less sensitive parents, giving their children information in the visual

modality. This may be particularly important for deaf children, as they cannot easily access information in the auditory modality.

We speculate that using measures such as parental sensitivity, gesture, and various spoken language measures may be more appropriate indicators of a child's language ability or future language ability than a clinical screener such as the PLS-5, especially for deaf children. The PLS-5 was not used in analyses because there were ceiling effects for the children in the hH dyads. However, when we analyzed the data from the play sessions, we saw quite a bit of variability in all the measures, even within just the hH dyads. Our measures were more able to detect the nuances of the parent-child interaction. Generally, the PLS-5 is conducted in a spoken language. Deaf children who cannot hear the instructions or questions are likely to do very poorly on this clinical screener. The measures used in the current study may be better able to estimate the child's language environment than the PLS-5 or other such clinical screeners.

Additionally, we saw the same pattern with the Stark scale. The children in the hH dyads had ceiling effects, while the children in the dH dyads had quite a bit of variability.

Recently, more and more hearing parents of deaf children are opting to give their children cochlear implants to aid their language development and give the parent and child a common mode of communication. Eighty percent of deaf children in developed countries receive cochlear implants (Humphries et al., 2012). As with any surgery, cochlear implantation surgery has many risks. Between 40 and 74 % of patients experience vertigo that can last for years after the operation (ex: Steerson, Cronin, & Gary, 2001). The cochlear implant apparatus may fail due to traumatic damage or technical failure, requiring further surgeries (Borokowski, Hildmann, & Stark, 2002).

Additionally, the success rate of cochlear implants is highly variable, and predictors about which children may succeed with a cochlear implant have little explanatory power (Fink et al., 2007). Humphries et al. (2012) advise that researchers study children who are successful with their cochlear implants and identify what factors predict success in language outcomes with an implant. We speculate that parental sensitivity should be taken into account as a potential predictor for a child's success with a cochlear implant, especially considering that the parent language measures in this study were almost all correlated with sensitivity scores for the dH dyads. This supports the idea that sensitive parenting may be even more helpful for the language development of children who are likely to have language delays. Parents rated as more sensitive also used more speech overall and more complex speech only in the dH dyads. The hH dyads did not see a strong correlation between parental language measures and sensitivity. Highly sensitive parents may give their children an advantage in learning spoken language because they generally use more spoken language with their children, as well as gestures to accompany or complement their speech, giving the child two modalities from which to understand the communication.

Future Directions

The current study assessed the correlations between parental spoken language use, parental gesture, and parental sensitivity in hearing parent-deaf child dyads. Results demonstrate that parents of hearing children use more morphologically complex utterances. Correlations were found between parental spoken language measures and parental sensitivity, as well as parental gesture use and parental sensitivity. The current study was not longitudinal, though it is a part of a large, longitudinal study; so the effects

of parental sensitivity cannot be assessed over time, nor can directionality be assumed. Examining the effects of parental language use, gesture, and sensitivity over time is important. Additionally, these particular deaf children were candidates for cochlear implantation at the time of the study. Post implantation, an examination of their oral language development in light of these different pre-implantation measures will be informative.

The current study involves both hearing children of hearing parents and deaf children of hearing parents, but it does not involve deaf children of deaf parents. Deaf children of deaf parents make up only about 5 – 10% of the total deaf population, limiting our ability to recruit them. A future direction of this study would be to include deaf child and deaf parent (dD) dyads as additional controls once we have the ability to recruit them. These dyads would help to disentangle questions about how parents of deaf and hearing children communicate differently, as the parents would share an ideal mode of communication with their children.

This study only investigated English language use in the dyads. Some dyads had to be excluded from the study because the parent spoke another language besides English during the play session. Also, ASL and other sign languages did not count as spoken language and were coded as gesture, not language use. Going forward this study should examine the use of sign language in the sessions between the parents and their children, especially as the children get older and communicate more with their parents. Additionally, the use of other spoken languages should be included in the analyses. Children who receive input from more than one spoken language may have different trajectories in terms of language development, which will be important to investigate.

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