

Maternal Temperament and Deaf/Hard of Hearing Child Language Gain:
The Relationship Between Maternal Sensitivity, Maternal Temperament, D/HH Child
Language Environment and D/HH Child Language Development

Research Thesis

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Abstract

There is vast variability in language outcomes for children who are deaf and hard-of-hearing. Many of the reasons for this variability are known, but maternal temperament is a factor that has not been previously researched in relation to language development in children who are deaf/hard-of-hearing (DHH). The present study aimed to assess the relationship between various facets of maternal temperament and child language development. In addition, the present study investigated the effects that maternal temperament and maternal sensitivity had on the child's language environment. The effect that the child's language environment had on their language development was also explored. Results showed that maternal extraversion and orienting sensitivity had a positive correlation with DHH child sign language development. Maternal negative affect was shown to correlate negatively with child sign language. Maternal sensitivity negatively correlated with the number of vocalizations a DHH child made in their everyday language environment. The present study also indicated that adult speech in a child's language environment correlated negatively with their spoken language development. Implications of these findings are discussed.

Background

The Explained Variance

There is a large degree of variability in language outcomes for deaf/hard-of-hearing (DHH) children. Research has attempted to explain this variance, and in some ways has succeeded. Approximately 90% of DHH children born to hearing parents are at high risk for language deficits and delays (Nelson, Loncke, Camarata, 1993; Rodda & Grove, 1987). The factors contributing to these delays include, but are not limited to: child age of implantation, child age at onset of hearing loss, communication mode, parent education, parental support, and residual hearing (Geers, 2002). Maternal sensitivity is also a factor that has been investigated for its effects on child language gain (Pressman, Pipp-Siegel, Yoshinaga-Itano, & Deas, 1999). We know that hearing threshold is the most consistent predictor of language outcomes in DHH individuals. Later onset of deafness and more time with auditory input has been associated with higher speech perception scores (Osberger, Todd, Berry, Robbins, & Miyamoto, 1991). Longer duration of cochlear implant use and younger cochlear implantation has also been associated

with higher speech perception scores (Fryauf-Bertschy et al, 1997; Waltzman & Cohen 1988). This demonstrates that the more time with access to auditory input, the better the speech perception score. All of these factors tell us about the variance of language outcomes in the DHH population, but they are not the full story. There is limited research on many factors that could contribute to the variance of language outcomes in DHH children, **including the role of maternal input on a DHH child's language outcome.** Further research is needed to understand the unexplained variance and facilitate the best outcomes for the DHH population.

Language Development and Maternal Interaction

Maternal interaction is thought to play a significant role in a child's language development (Greenstein, Greenstein, McConville, & Stellini, 1975). This likely means that maternal interaction is one of the many factors causing variance in DHH language outcomes. One study investigated the interplay between child receptive and expressive language and maternal parenting. **The investigators found that infants with high and low positive affect that had support from their mothers also had better expressive language outcomes (Laake & Bridgett, 2018).** This demonstrates the significance of the role mothers play in their child's language development. Language acquisition has significant implications for most areas of development, including educational outcomes (Hinshaw 1992, Hohm, Jennen-Steinmetz, Schmidt & Laucht 2007). These prior studies indicate the vast importance of language development, and parent interaction to a child's future.

Deaf and Hard of Hearing Language Development and Maternal Interaction

It is possible that DHH children are at higher risk for language delay because they may not receive optimal input living in hearing environments. They miss a lot of information hearing children receive, because they often miss information that is conveyed verbally (Spencer, 1991). DHH children are found to be less responsive if they have hearing parents than children with parents of the same hearing status (Koester 1994; Meadow, Greenberg, Erting & Carmichael, 1981). **In a study on maternal sensitivity's effect on DHH children's language gain it was found that early ratings of mother-child interactions were one of the best predictors of language acquisition** (Pressmen, Pipp-Siegel, Yoshinaga-Itano & Deas, 1999). This variance in outcomes for DHH children suggests a need for further research on this population and the factors affecting

their language acquisition. Maternal sensitivity and maternal temperament may be related, and further research on the role of maternal temperament in child language development could advance the current knowledge of how to maximize language outcomes for DHH children.

Maternal Sensitivity and Child Language Development

Maternal Sensitivity is defined by many factors. High maternal sensitivity includes things like enjoyment of the child, consistency, quick reactions to child distress, smooth transitions between interactions with the child, a high level of parent-child interaction, successful limit setting, and conflict resolution skills. In a study investigating the effects of maternal sensitivity on language gain in deaf or hard of hearing children, there was found to be a positive correlation between maternal sensitivity and language gain (Pressman, Pipp-Siegel, Yoshinaga-Itano, & Deas, 1999, Quittner et al., 2013). This suggests that high maternal sensitivity may be important in helping hearing mothers provide the proper care and support for their D/HH child. Many aspects of maternal sensitivity influence child language development. Maternal responsiveness influences child intelligence and language outcomes and maternal joint attention promotes early vocabulary (Baumwell, Tamis LeMonda & Bornstein, 1997). It is unclear why some mothers show higher sensitivity than others. Economic status and education seem to play a role, but many of the factors contributing to maternal sensitivity are unknown. One possibility is that maternal temperament affects maternal sensitivity and thus also impacts the language development of a DHH child.

Maternal Temperament and Child Development

A study investigating the relationship between maternal temperament in normal hearing children, child temperament and child behavioral outcomes examined how negative parenting related to maternal and child temperament. The analyses of this experiment showed that coercive parenting was predicted by child reactivity, maternal negative affect, effortful control, and perceptual sensitivity (Gölcük & Berument, 2019). Negative affect and effortful control are two of the main dimensions that determine maternal temperament scores. Because these measures of maternal temperament were found to have a large impact on child development it is possible that maternal temperament may also play a role in predicting language development.

The Need for Further Research on Maternal Temperament's Effects in Deaf and Hard of Hearing Populations

The clear gap in the literature demonstrates a need for further investigation into the effects of maternal temperament on child language development, and language environment. This study will aim to investigate the influence that maternal temperament has on DHH child language development. There is an extensive amount of data in The Ohio State University Eye and Ear Institute at the BabyTalk Project. These data provide specific information on DHH children's language development as well as the education and temperament of their maternal figures. These data also include MacArthur-Bates Communicative Development Inventories, which are a measure of child language skills, as well as coded data from Language ENvironment Analysis (LENA) devices, which provides data on the expressive skills of a child, and their daily interactions with the people around them. LENA technology is a small audio recording device that records language in the environment. A child wears the LENA for one full day at home. The LENA records everything the child hears from the time they wake up to the time that are put to bed. These devices are then sent to the lab and coded for the various types of speech a child hears throughout their day. This gives researchers a more objective way to find out what parent child interactions look like in the home. The Adult Temperament Questionnaire is also completed by each mother, which provides a clear temperament score. This study will aim to investigate the connections between DHH child language development and the temperament of their maternal figure using the data that the BabyTalk Project has to offer. Language delays in DHH children are affected by many variables. This project will help to gain information on a variable that has not yet been assessed. Knowing maternal temperament's effects on maternal sensitivity, DHH child language environment, and DHH child language development could allow us to better understand, treat, and prevent language delays in the DHH population.

Hypotheses

In the present study, I hypothesized that there would be a relationship between maternal sensitivity and maternal temperament. Specifically, I predicted that maternal temperament may be influenced by maternal sensitivity. For example, extraversion may be positively correlated with maternal sensitivity. Because I predicted there would be a connection between maternal

temperament and sensitivity, I also hypothesized that temperament would impact language. Maternal sensitivity is a known determinate of language development (Pressman, Pipp-Siegel, Yoshinaga-Itano, & Deas, 1999), so if maternal temperament and maternal sensitivity are related, maternal temperament and child language may be related also. In addition, I began the present study hypothesizing about child language environment and its relationship to child language development, maternal sensitivity, and maternal temperament. I predicted that child language environment would have relationships with maternal sensitivity, maternal temperament, and child language. Specifically, I predicted that maternal sensitivity and temperament would have an effect on the language environment in which the child lives and that the child's language environment would then affect their language development. These predictions were investigated.

Methods

Participants

Participants included 12 children with hearing loss and their mothers. Children were between 14 and 35 months of age at their 12-month hearing age appointment. This appointment happened for each participant after they had access to auditory input for 12 months. This was the appointment where language data was gathered for the present study. The mean age of the child participants was 23.92 months. Children varied in their preference between oral and total communication. Seven of twelve of the participants were cochlear implant users and the other 5/12 were hearing aid users. 8/12 children were female and the other 4/12 were male. Children had hearing losses ranging from mild to profound. Mothers were of varying ages, and varying levels of education. Education level ranged from 12 to 18 years.

Measures

Demographic Information

A Family History Form was given to each participant at their initial visit. The family history form asked the mother to report the child's chronological age, hearing age, hearing status, gender, siblings and ethnicity. The family history form also asked the mother to report her education level, socioeconomic status, marital status and ethnicity. This form was utilized to

identify and control for child chronological age, and identify factors like maternal education and maternal age.

Maternal Temperament

The Adult Temperament Questionnaire (ATQ, Rothbart, 1988) was given to each mother at their initial visit. The ATQ asked the mother questions about her response to various situations. The responses that the mother gave to each question formed scores in each of the 4 main categories of the questionnaire. These categories included negative affect, effortful control, extraversion/surgency, and orienting sensitivity. Negative affect is a combination of maternal fear, sadness, frustration and discomfort. Overall, it is a personality variable that relates to negative emotions and a negative view of the world and oneself. Effortful control, as defined by the ATQ, is a measure of attentional control, inhibitory control, and activation control. After combining these three factors, effortful control is the dimension of temperament related to self-regulation of behavior and emotion. Extraversion/surgency is a dimension of the ATQ that combines sociability, positive affect, and high intensity pleasure. It is the aspect of temperament that represents how a person handles and reacts to various situations in a positive or outspoken way. Orienting sensitivity, as measured in the ATQ, is a combination of neutral perceptual sensitivity, affective perceptual sensitivity, and associative sensitivity. All of the dimensions of orienting sensitivity help to define how the participant reacts to stimuli in the environment. The score that the mothers received on the four different sections of the ATQ were used to quantify maternal temperament in this study.

Language Input

The Language ENvironment Analysis Unit (LENA) was used to measure and categorize the language input that each participant received in their typical daily environment. Each child was sent a LENA device after 6 months of access to auditory input (we refer to this as their hearing age). LENA uses a small wearable device combined with cloud-based software to deliver detailed feedback about the sounds a child hears during the course of a certain period of time. In this experiment, the device was worn on the child from the time they woke in the morning to the time they went to sleep. This ideally allowed for an entire day of language input data, potentially recording all of the sounds that the child heard in that day. When the child was finished with

their recording, the family sent the LENA device back to the lab. At the lab, the device was synced to a software system that separated the sounds the child heard into categories. For this experiment, the category of interest was Adult Word Count, which is defined as all of the words present in the child language environment spoken by an adult. *Child vocalizations* was our second variable of interest, which is defined as all meaningful sounds the child makes on the LENA recording.

Maternal Sensitivity

At six months hearing age the child and mother were video recorded in the lab. The video recording for each participant included an approximately 20-minute interaction between mother and baby. During this interaction, mother and baby were prompted to play with 4 different sets of toys, each for five minutes. This video recording was used to code for maternal sensitivity. Sensitivity was coded according to the Ainsworth Sensitivity Scale (Ainsworth, 1967). This scale instructs coders to obtain 4 values during the interaction via observation. Ratings of the mother's sensitivity vs insensitivity to baby's signals, cooperation vs interference with baby's behavior, availability vs neglect, and acceptance vs rejection of baby's needs. These subscales were rated by the coder on a 9-point scale. After these 4 values were obtained, the average was computed. This average served as the maternal sensitivity score. Videos were coded by a separate coder 33% of the time to check inter-rater reliability. Reliability was found to be perfect ($r = 1.00$)

Child Language

Lastly, each child participant was given a MacArthur-Bates Communicative Development Inventory (MCDI, Bates et al., 1994) form at their 12-month visit. Mothers filled out the MCDI form based on the words the child was able to understand/say at that time. There are 2 main types of MCDI. These types are spoken and signed. Spoken MCDI's were for children who used verbal communication as their primary mode of communication or were being taught to do so. MCDI sign was for children who used sign language as their primary mode of communication or were being taught to do so. Parents completed both forms if their child used both verbal and sign language. These forms allowed us to obtain the child's total words spoken, and total words signed at 12 months. This form served as our main measure of child language skills in the present study.

Procedure

Values from all 5 measures were collected and placed in an Excel spreadsheet. This data was then input into SPSS Statistics software to test for correlations. Partial correlation adjusting for age were used for analyses that included vocabulary and/or language input variables (*Adult Word Count*) because vocabulary and maternal language input are strongly influenced by children's age. The r and p values of correlated variables were pulled from this statistical analysis in order to assess various relationships.

Results

Maternal Sensitivity and Maternal Temperament

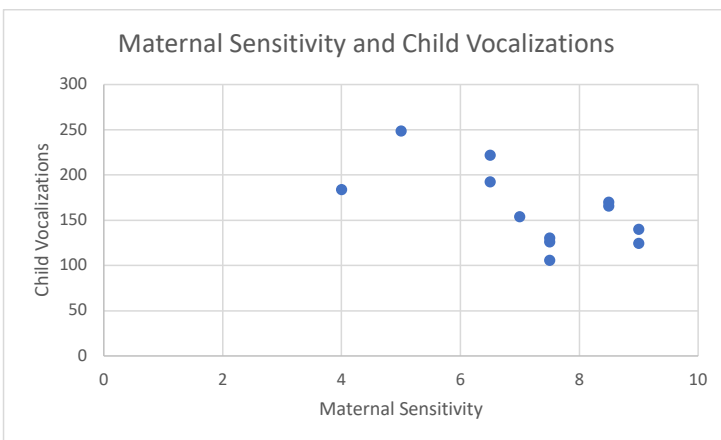
I hypothesized that maternal sensitivity and maternal temperament would be correlated. To test this hypothesis, I conducted multiple correlation analyses in order to calculate the relationship between maternal sensitivity and the various measures of maternal temperament. There are four main measures of temperament according to the ATQ. These measures included negative affect, effortful control, extraversion/surgency, and orienting sensitivity. I conducted a correlation analysis to calculate the correlations between maternal sensitivity coded with the Ainsworth Sensitivity Scale and maternal negative affect, effortful control, extraversion/surgency and orienting sensitivity. There were no statistically significant correlations between maternal sensitivity and negative affect ($r = -0.008, p = 0.983$), effortful control ($r = -0.62, p = 0.865$), extraversion ($r = 0.443, p = 0.200$), or orienting sensitivity ($r = 0.432, p = 0.213$). These set of analyses suggested that maternal temperament and maternal sensitivity were not related. These data do not provide support for my hypothesis. Despite the lack of correlations between maternal sensitivity and temperament, I remained curious about the effects of maternal sensitivity on child language environment.

Maternal Sensitivity and Child Language Environment

LENA devices allowed for in depth investigation of each child participants language environment. I calculated the relationship between maternal sensitivity and adult words spoken in the LENA recording. I predicted that a higher maternal sensitivity would correlate with higher LENA *Adult Word Count*. I conducted a partial correlation (controlling for age) between LENA adult word count and maternal sensitivity. According to my analysis, there is no significant

correlation between the two variables ($r = 0.412, p = 0.237$). I also anticipated that maternal sensitivity and child vocalizations in the LENA would be positively correlated. To assess this hypothesis, I conducted a partial correlation analysis (controlling for age) between LENA child vocalizations and maternal sensitivity ratings as determined by the Ainsworth sensitivity scale.

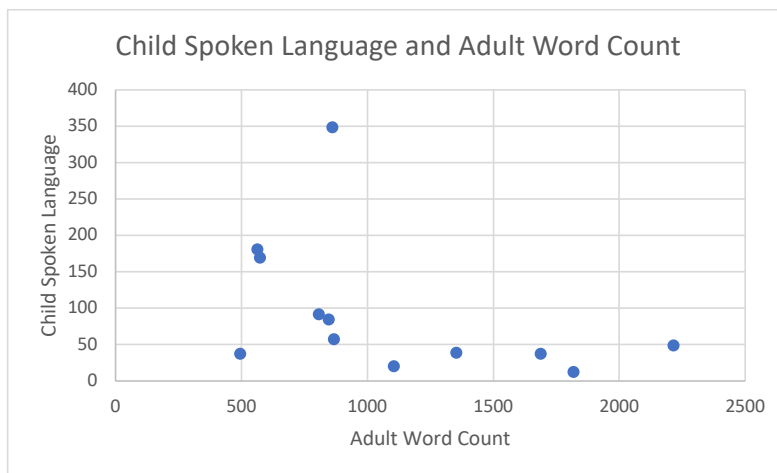
There was a significant negative relationship between maternal sensitivity and child vocalizations ($r = -0.625, p = 0.050$). I hypothesized that this correlation would be significant and positive, when in reality the data shows it is significant and negative. This means according to this data, mothers with more sensitivity had children with less vocalizations on their LENA recordings. This finding led me to wonder- Do these aspects of child language environment I have been researching effect child language development?



Child Language Environment and Child Language Development

I hypothesized that certain aspects of the child's language environment would correlate with their language abilities. Specifically, I wanted to investigate if child MCDI scores (spoken or signed) correlated with LENA adult word count. I predicted that Child MCDI Score and LENA adult word count would be positively correlated. I conducted a partial correlation analysis (controlling for age) between the two variables to test this hypothesis. I found that there was a statistically significant negative correlation between child MCDI spoken and LENA adult word count ($r = -0.764, p = 0.045$). This finding contradicts my original hypothesis and could indicate that more adult words spoken on the LENA mean less vocabulary expressed verbally by the DHH child. These findings made me curious about the relationships between the various measures of maternal temperament and child language environment. If there is a relationship

between maternal temperament and child language environment, then there may also be a relationship between maternal temperament and child language.



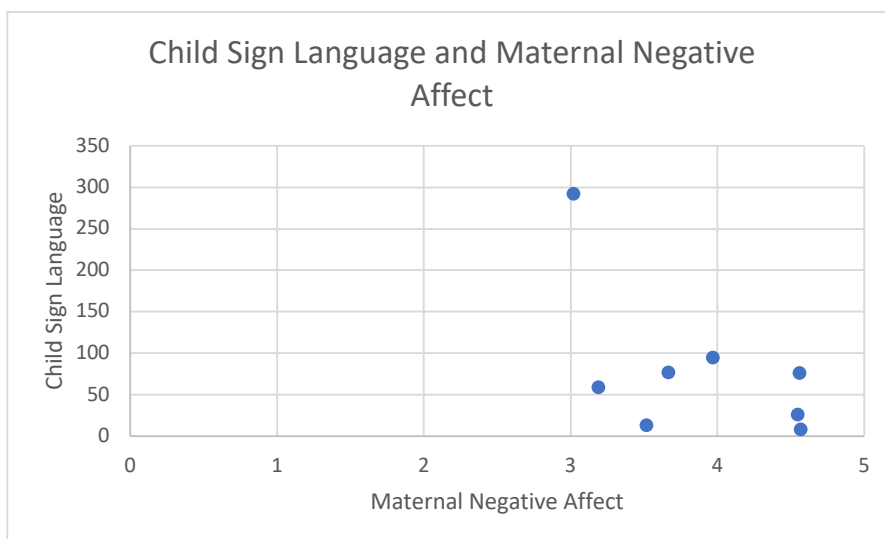
Maternal Temperament and Child Language Environment

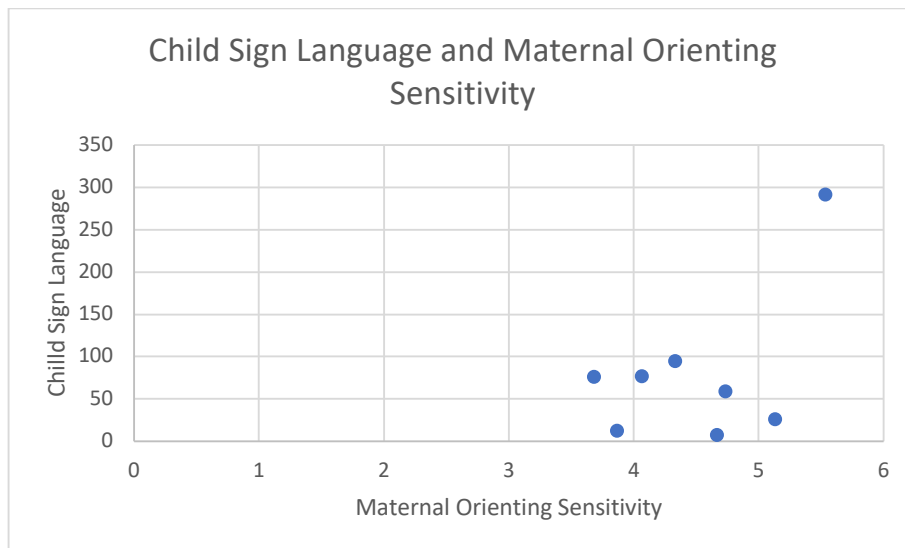
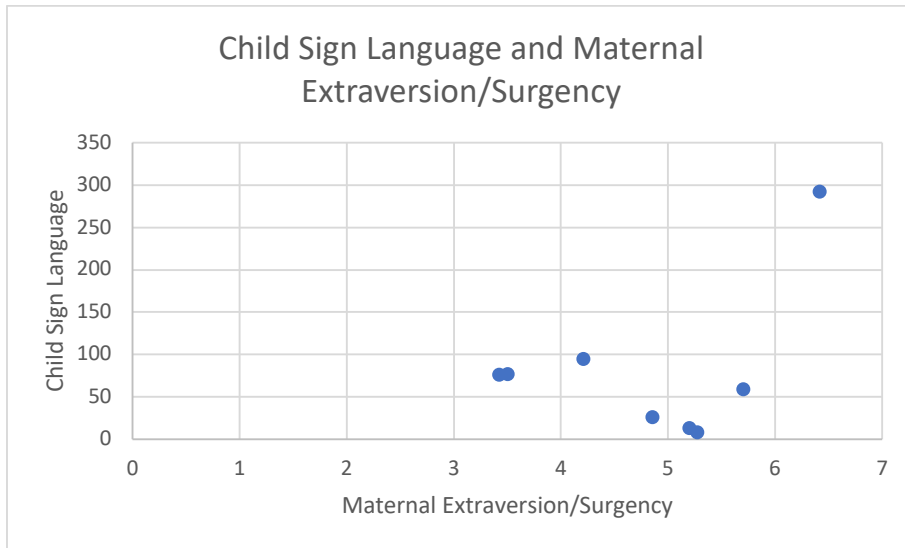
I hypothesized that measures of maternal temperament may correlate with sounds in the child language environment. Specifically, I predicted that adult words spoken in the child's language environment would be negatively correlated with maternal negative affect. To assess this, I conducted a partial correlation analysis, controlling for age, between maternal negative affect and adult word count according to the LENA data. The correlation approached statistical significance ($r = -0.627, p = 0.052$). This indicated a negative relationship between maternal negative affect and adult words spoken near the baby. My findings from other correlations in the present study indicated that child language environment and child language development were related. The findings in the correlation currently being discussed indicated a relationship between temperament and child language environment. Because of this, I moved forward in investigating maternal temperament's relationship with child language.

Maternal Temperament and Child Language

I hypothesized that many measures of maternal temperament would have a relationship with DHH child language development. Specifically, I hypothesized that maternal negative affect would be negatively correlated with child MCDI scores. I also predicted that maternal extraversion would be positively correlated with MCDI score. Lastly, I predicted that maternal orienting sensitivity would be positively correlated with child MCDI score. To assess the

relationship between child language and maternal negative affect, I conducted a partial correlation analysis (controlling for age) to determine the relationship between child MCDI scores and maternal negative affect according to the ATQ. The correlation was not statistically significant for child MCDI score when using spoken language, ($r = 0.445, p = 0.197$). It was, however, statistically significant for child MCDI score when using sign language ($r = -0.662, p = 0.037$). This could mean that mothers with more negative affect have children who sign less vocabulary at the twelve-month hearing age mark. I conducted a partial correlation analysis (controlling for age) to calculate the correlations between child MCDI scores and maternal extraversion/surgency according to the ATQ. There was no significant correlation between maternal extraversion and MCDI spoken. ($r = -0.176, p = 0.626$). However, there was a significant correlation between maternal extraversion and MCDI signed. ($r = 0.854, p = 0.015$), which indicated that mothers who had high levels of extraversion/surgency also had babies with high levels of signed vocabulary. I conducted a partial correlation analysis (controlling for age) to calculate the correlations between child MCDI scores and maternal orienting sensitivity according to the ATQ. Child MCDI words spoken, and maternal orienting sensitivity did not have a significant correlation ($r = -0.046, p = 0.899$). Child MCDI words signed, and maternal orienting sensitivity did have a statistically significant positive correlation ($r = 0.754, p = 0.050$). This could suggest that mothers with higher orienting sensitivity have babies that sign more words.





Discussion

Maternal Sensitivity and Child Language Environment

The present study indicated no significant correlation between maternal sensitivity and LENA Adult Word Count. This lack of correlation could indicate that maternal sensitivity does not affect the quantity of adult words present in a DHH child’s language environment. This lack of significant correlation should be further investigated using a large sample size to determine if there truly is no relationship between these variables. There was, however, a significant negative relationship between maternal sensitivity ratings (determined by the Ainsworth Sensitivity Scale)

and the amount of child vocalizations detected on a LENA recording. This could indicate that children of mothers with higher sensitivity speak less during their day. This correlation could be due to the fact that mothers with higher sensitivity are more likely to respond the first time the child calls out. Babies with mothers who are more sensitive may spend less time calling for their mothers and therefore, have significantly less spoken words recorded on the LENA. This correlation could also indicate that mothers with higher sensitivity speak to their D/HH child more, giving the child less time to speak. It is unknown because LENA software is unable to separate the adult words spoken to the target child, and adult words spoken to other targets. This correlation needs to be further researched with a larger sample size before conclusions are drawn.

Child Language Environment and Child Language Development

The present study indicated that there was a significant negative correlation between Child MCDI score using spoken word, and adult word count. This correlation could indicate that the more adult speech a child hears, the less spoken vocabulary they develop. This correlation is the opposite of what was expected based on past research. Research shows that normal hearing children who hear more adult words as infants develop more language. However, there are not many studies assessing this relationship in DHH children's language development. Because of this lack of information on the DHH populations language gain, further research should be conducted before drawing conclusions. It is possible that the present finding is inaccurate due to possible bias in MCDI forms filled out by the mother, or coding errors in the LENA software. It is also possible that the present correlation is an accurate depiction of the relationship between LENA Adult word count and child spoken vocabulary. It is important to note that the nature of the LENA could allow children to hear adult words anywhere around them, not just directed to them. This correlation could speak to overbearing adult speech causing less language learning, or adults being distracted and talking to their other adult friends causing less language learning for the DHH child because the child is receiving less attention and less direct input. Further research needs to be conducted with a larger sample size.

Maternal Temperament and Child Language Environment

According to the present study, there is a significant negative correlation between maternal negative affect and the adult words spoken in a child's language environment. This could indicate that mothers with higher levels of negative affect speak less around their DHH children than mothers who have lower negative affect. Negative affect is a temperament variable that includes feeling and portraying negative emotions. High negative feelings about oneself or one's parenting abilities may deter mothers from speaking to their child, or to the other people present in the language environment. This lack of speech to the child could in turn effect the amount of mother child interaction the child receives. A shortage of mother-child interaction could become a problem for the child, because mother child interactions are essential to the acquisition of language (Greenstein, Greenstein, McConville, & Stellini, 1975). This finding could be important in early intervention. Mothers of DHH children could benefit from knowing the ways that their temperament and language input effects their DHH child's language acquisition.

Maternal Temperament and Child Language Development

There was a significant negative relationship detected between maternal negative affect and child MCDI signed. This finding could suggest that mothers of DHH children with higher levels of negative affect have children who sign less vocabulary at the twelve-month hearing age mark. Negative affect in the mother may cause the DHH child to feel less confident in their signing abilities, because the mother is not providing as much positive feedback. This may cause the child to partake in less signing than a child whose mom has lower negative affect. This lack of confidence in signing ability could lead to a lower development of signed vocabulary. We know from past studies that in DHH children, child-mother interaction is a key factor in child language development (Greenstein, Greenstein, McConville, & Stellini, 1975). It is possible that mothers with higher levels of negative affect do not interact as frequently with their children. This is an alternative explanation for why DHH children who have mothers with high levels of negative affect may develop less sign language. It is imperative that this topic is further researched in order to draw accurate conclusions. Teaching mothers about how the different facets of temperament may affect their DHH child's sign language abilities could positively influence the language development of the DHH population. The present study indicated no significant correlation between Maternal extraversion/surgency and a Child's MCDI score using

spoken word. The present study did, however, indicate that there is a significant positive relationship between maternal extraversion/surgency and the number of words the child expresses according to their MCDI using sign language. This finding could indicate that a mother with a more extraverted personality will have a DHH child that produces more words in sign language, but a mother with a more extraverted personality does not affect a DHH child's spoken language abilities. It could also indicate that mothers with more extraverted personalities spend more time working with their DHH children on sign language, and therefore produce DHH children with higher signing abilities. Mothers with more extraversion/surgency may also be more likely to reach out for help in teaching their DHH children ASL, and therefore have DHH children with higher scores on the MCDI signed. Also, mothers with higher extraversion/surgency may provide more positive feedback to the child. This motivator may lead to more sign language development. It is important to note that this finding could also be caused by a presence of maternal bias, as the MCDI measure can be subjective. This is preliminary data and needs to be further investigated. Maternal orienting sensitivity and DHH child MCDI score when using sign language are significantly and positively correlated. This could indicate that mothers with higher orienting sensitivity are better able to help their DHH children learn sign language to communicate. Orienting sensitivity is an assessment of a mother's reactivity to stimuli in her environment, so it makes sense that mothers with higher reactivity to environmental stimuli would be more present and available to facilitate DHH child sign language gain. They may be more likely to pay attention to their child's needs and spend more time communicating with them because of this ability to notice the child's needs. Orienting sensitivity could also be an indicator of higher maternal responsiveness. Maternal responsiveness has been shown to yield benefits for skills that support child language learning over a period of time. (Tamis-LeMonda, Kuchirko, Song, 2014)

The Big Picture

The present study introduces the concept that aspects of maternal temperament may play a contributing role in children's language development. The findings in the present study have the potential to help professionals learn to better coach parents on the most effective way to interact with their DHH children in order to best facilitate language growth. This study showed that factors of maternal temperament such as extraversion/surgency and orienting sensitivity

relate to higher signed vocabulary in DHH children that use sign language as a mode of communication. It also demonstrated that maternal negative affect may have a negative impact on DHH child sign language. The way that these facets of temperament effect DHH child sign language is a vital piece of the puzzle that is language gain in DHH children. Because of the significance these findings could have on early intervention and maternal coaching, it is imperative that these preliminary findings are further researched. These ideas should be taken into consideration when working with parents of DHH children and instructing them on how to positively impact their DHH child's language development. The present study also showed correlations between facets of LENA recordings and DHH child language development. LENA devices are a unique research tool that allow researchers to obtain glimpse into a child's language environment over the course of a typical day in their life. This typical day is, in theory, an accurate representation of the auditory input that the participants experience most often. This study demonstrated a connection between adult speech present in the child's language environment in a day, and the child's MCDI score using spoken communication. This could mean that higher counts of adult speech in LENA recordings indicate that parents are distracted talking to other people and not attending to the child directly. This could be what causes the DHH child to gain less spoken language. This finding could speak to the importance of meaningful and direct interactions in the DHH child language environment. Just speaking near the DHH child may not have a positive effect on language, and meaningful/direct interactions may be vital in DHH child language development. The relationships identified in this study need to be further investigated to help researchers and other professionals understand how to best adjust DHH child language environment in order to facilitate language in DHH children and create successful early intervention plans.

Future Directions

The findings in the present study are preliminary and need to be further investigated. In order to better understand the way maternal temperament affects child language the present study should be repeated using a larger sample size. This will increase the validity and reliability of the study. In future studies it will also help improve validity if the measures used are more objective, as opposed to being completed by the mother. This research is preliminary and should be seen as a jumping off point in the investigation of the effect maternal temperament and language

environment play in deaf and hard of hearing children's language development. There should also be further research done investigating the relationship between the child language environment and DHH child language development. Learning the factors in the language environment that effect DHH child language development and making adjustments according to these findings could lead to better language outcomes for DHH children.

Limitations

Several limitations in the present study should be noted. First, the measure of maternal temperament (Adult Temperament Questionnaire) was completed by the mother. This means that the measures was somewhat subjective and potentially biased. The study should be repeated with a more objective measurement of maternal temperament.

Next, the sessions used to obtain maternal sensitivity ratings using the Ainsworth Sensitivity Scale are only 15-20 minutes in length, and they take place in a lab setting. These conditions are not completely representative of how mother and child interact at home, which makes this data less representative of situations outside the home. Also, mother knew that they were being recorded during these interactions, which could lead her differences in her interaction style.

It is also important to note that the values pulled from the LENA recordings were all automatically generated by the LENA software. This output is not 100% accurate, because often the sounds present around the child at home are difficult to categorize. Reliability would be increased in the LENA output was also hand coded by researchers. This leads us to our next limitation: time. The time limit on the present study was approximately one year, so hand coding of LENA output and completion of different, less subjective language and temperament measurements were not obtainable.

Lastly, and arguably the most significant limitation is the number of participants in the present study. Only 12 available participants fit the inclusion criteria for this study. While this allows preliminary data to be gathered, it does not accurately represent the entire D/HH population. Studies with significantly more participants need to be completed to increase the validity and reliability of the findings.

Conclusion

In conclusion, this data is preliminary, and should be further investigated to determine the role that maternal temperament plays in the development of language in DHH children. There is a very small amount of information currently available about the effect that maternal temperament has on normal hearing child's language, and even less on the effect it has on /HH child's language. The current study shows a potential relationship between various facets of maternal temperament and DHH child sign language development. It also shows potential relationships between child language development and language environment. These relationships could be an essential piece in maximizing child language gain in DHH children and must be further researched.

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