Butler Journal of Undergraduate Research

Volume 6 Article 20

2020

Parent Interaction between an Infant with a Cochlear Implant and Additional Disabilities

Lillian J. Southern
Butler University

PARENT INTERACTION WITH AN INFANT WITH A COCHLEAR IMPLANT AND ADDITIONAL DISABILITIES

LILLIAN J. SOUTHERN, BUTLER UNIVERSITY
MENTOR: TONYA BERGESON-DANA

Abstract

Pediatric hearing loss presents many spoken-language learning issues that can affect parent-infant interaction. Moreover, additional disabilities are likely to increase stress, which could have cascading effects on communication. The purpose of this study was to examine interactions between mother-child and father-child dyads with and without hearing loss and/or autism spectrum disorder (ASD), cytomegalovirus (CMV), and global delay. Recordings of the parents speaking with six infants were analyzed: an infant with cochlear implants and ASD (low socioeconomic status [SES]), two infants with cochlear implants and normal development (high SES and low SES), one infant with a cochlear implant and CMV (average SES), one infant with a cochlear implant and global delay (average SES), and one infant who was typically developing and had normal hearing (high SES). After analyzing the results for communication measures, such as vocalization attempts, turn-taking in utterances, mean length of utterances, and type-token ratio, it was concluded that maternal and paternal interaction were negatively affected only because of the difficulty of the hearing loss and/or additional disability, but because of a combination of factors including the disability, SES, maternal and paternal education, and home environment.

Little if any research to date has been conducted on the influence of maternal and paternal interaction when an infant has both hearing loss and additional disabilities (Beer, Harris, Kronenberger, Holt, & Pisoni, 2012; Meinzen-Derr, Wiley, Grether, & Choo, 2011). Beer and colleagues (2012) studied the language development of children with cochlear implants and additional disabilities ranging from cognitive or learning delays to autism spectrum disorders (ASDs), developmental delays, and other syndromic conditions. Understanding that typical testing would not be as effective for individuals in this population, the researchers created a battery of tests specific for testing children with disabilities. Beer et al. (2012) tested for functional auditory skills, which assesses the infant's ability to respond spontaneously to sounds in the environment, using the Infant Toddler:

Meaningful Auditory Integration Scale (IT-MAIS; Zimmerman-Phillips, Robbins, & Osberger, 1997); receptive and expressive language, using the Preschool Language Scale, 4th Edition (PLS-4; Zimmerman, Steiner, & Pond, 2002); adaptive behaviors such as communication abilities, daily living skills, socialization, and motor skills, using the Vineland Adaptive Behavior Scale (Sparrow, Cicchetti, Balla, 2005); and cognitive functioning, using the Bayley Scales of Infant and Toddler Behaviors (Bayley, 2005). After assessing the 23 children in the study with a pre-test, before cochlear implantation, and post-test, Beer et al. (2012) found that overall, the participants with hearing loss and additional disability made progress in functional auditory skills, receptive and expressive language, and adaptive skills after one year of implantation. The data were compared to those for children who also had cochlear implants at the same age at implantation who did not have additional disabilities. Beer et al. noted that the children with cochlear implants and additional disabilities did not see the same level of progress as their cochlear implant-only peers but still made some progress in language development. This research is important for the current study because it suggests that there is development of language skills in children with hearing loss and additional disabilities.

Studies from the two different fields suggest that having a disability in addition to cochlear implantation would affect mother- and father-infant interactions in many forms. When parents interact with an infant with a hearing loss, previous studies have suggested different methods of communication to maximize speech and language outcomes, such as being direct with the infant during the interaction and reinforcing the infant's vocalization attempts (Choo and Dettman, 2016). Focusing more on the interaction to ensure the infant is both understanding parental speech and trying to create a conversation of their own might also be beneficial. Being attentive to the conversation is very important, and something most parents of typical-hearing infants would not naturally focus on as thoroughly. When additional disabilities are added to the mix, communication attempts could possibly be more difficult. As such, it is hypothesized that parent interaction will be negatively affected because of the added difficulty of the conversation.

Caregiver Interaction and Cochlear Implants

Previous research done by Fagan, Bergeson, and Morris (2014) has examined how maternal interaction differed before and after an infant received a cochlear implant. The researchers compared mother-infant vocal synchrony, maternal complexity, and maternal directives and found that mothers adapted their speech to try to conform to the hearing loss, rather than using communication similar to that used by mothers speaking to infants with typical hearing. For example, mothers' mean length of utterances (MLU) was less complex than that of speech to hearing infants the same age, and mothers' utterances overlapped the infants' speech more than with hearing infants, rather than typical turn-taking. Fagan and colleagues suggested that infants' ability to perceive sounds after cochlear implantation contributes to their mothers' increasing awareness of the infants' auditory abilities, which results in changes to mothers' reciprocal communication. Many mothers change their communication habits to better fit infants' emerging vocabularies; for example, they may use simple utterances and less back-and-forth conversation when dealing with infants with cochlear implants. Fagan et al. suggest that it is important to enhance interactions to help with infants' language learning.

It is important for parents of infants with hearing loss and cochlear implants to be educated on how to best promote language learning and communication. Choo and Dettman (2016) examined the effect that maternal interaction has on the communication of an infant with a cochlear implant, as well as strategies to best promote interactions. Most parents and infants who have cochlear implants interact with an aural-oral approach, which focuses on visual interaction and spoken language. Choo and Dettman suggest that additional interaction might help advance the infant's communication and language learning. That is, interaction techniques can differ based on whether the focus is on the parent input or on encouraging reciprocal communication. Parent input is focused on using interesting voices, increasing frequency and consistency of the interactions. This can be done by sitting closer to the infant or using more facial expressions and gestures. Reciprocal communication involves finding ways to be more attentive and interactive in communication attempts, such as creating a back-and-forth interaction with the infant. The goal of the approach with infants with cochlear implants would be to use a combination of techniques, encouraging parents to use these strategies to not only improve their own interactions but also help their infants interact and communicate more efficiently. The more focused the interaction, the better chance the infant has at acquiring language, learning to interact well with others, and carrying out an interactive sequence.

Autism Spectrum Disorders

For more than 75 years, research has been evolving to better understand autism spectrum disorder (ASD). According to Faras, Ateeqi, and Tidmarsh (2010), ASD is categorized by three main deficits, including impaired communication, impaired social interaction, and restricted and repetitive patterns of behavior and interest. Because autism is a spectrum disorder, the impairments range in severity and can change through acquisition of additional developmental skills (Faras et al., 2010). With the characteristics of ASD in mind, the inability to communicate socially can influence the caregiver-infant interaction, creating more-stressful communication attempts because of the deficits mentioned previously. As such, the ability to understand characteristics of ASD is important for any parent who has to partake in such interactions.

Before the official age of diagnosis, signs of autistic behavior have been observed in research during play or personal interaction. These cues can range from lack of eye contact to more specific aspects, such as limiting their focus. According to Bentenuto, De Falco, and Venuti (2016), infants who were later diagnosed with ASD showed signs of limited symbolic play, or of shortening their play sequences and not creating pretend scenarios with their dolls or toys. The researchers also noticed infants limiting their selection of toys, choosing to focus on a single object rather than switching attention to more than one toy. Another behavior during infant play that has been shown to be a cue to ASD is "sticky attention," or what Sacrey, Bryson, and Zwaigenbaum (2013) describe as a child taking "longer to disengage their attention toward a second, peripheral target" (p. 442). "Sticky attention," or staring, is a cue present in many infants but is usually outgrown by the end of the first year (Sacrey et al., 2013). When that behavior continues for infants past one year old, it could be a sign of autistic behaviors.

Global Delay

Mithyantha, Kneen, McCann, and Gladstone (2017) describe global delay as a delay in two or more developmental domains. Domains can include gross or fine motor skills, speech and language, cognition, and social or personal skills, most commonly affecting children under the age of five years old (Mithyantha et al., 2017). Global delay can be classified as mild, moderate, or severe. As global delay affects more than one area of developmental domains, the additional impact of hearing loss can cause major difficulty in communication with the infant.

Cytomegalovirus

Cytomegalovirus (CMV) is the most common congenital infection that can cause disease in infants, according to Zuylen et al. (2014). Infants are infected by CMV during pregnancy, as the maternal infection crosses the placental barrier (Zuylen et al., 2014). Although a relatively mild infection for the mother, it can have devastating effects on the infant. Infants with CMV can have varying symptoms, including but not limited to unilateral or bilateral sensorineural hearing loss, vision loss, jaundice, seizures, and mental disability (Zuylen et al., 2014). According to Zuylen and colleagues, CMV is the leading cause of sensorineural hearing loss in developed countries. As such, the possibility of infants with CMV wearing cochlear implants is high. This can affect maternal and paternal interaction with infants, as hearing loss is just one of many symptoms that would affect the conversation. Understanding how best to interact with the infant will be most beneficial to parents as they try to navigate communication when cochlear implants and additional disabilities are involved.

Infant-Directed Speech and Later Language Learning

Infant-directed speech (IDS) is classified by slower rate, greater pitch variations, longer pauses, repetition, and shorter sentences (Ma, Golinkoff, Houston, and Hirsh-Pasek, 2011). Individuals can use IDS to gain an infant's attention or, as research has suggested, encourage language acquisition (Ma et al., 2011). Ma and colleagues investigated whether 21-to-27-month-old children gained a larger vocabulary when taught with IDS compared to adult-directed speech. The results suggest that IDS facilitates language learning, particularly for younger infants who have a lower vocabulary. Ma et al. concluded that presenting infants with IDS shows greater gains than adult-directed speech in language acquisition in young infants. It is therefore important for the current study for parents to implement IDS early during interactions.

Together, these studies suggest that implementation of IDS in interaction in the early stages of development has a positive effect on language acquisition—but when interacting with an infant with a hearing loss or additional disabilities, how does IDS compare across infants? It is hypothesized that parent interaction in the current study will be negatively affected by the difficulty of the conversation.

Parental Stress Associated with Hearing Loss

Parental stress can be seen in any parent-child relationship due to the obstacles that appear when raising a child. These stressors, however, can be heightened when a child has a hearing loss. When parents discover that their child has a hearing loss, they often undergo a grieving process, which can be triggered as the child continues to grow and as new hardships surface (Sarant and Garrard, 2013). Sarant and Garrard state that parents will also face "ongoing practical challenges," such as increased medical appointments, education about hearing loss and management of cochlear implants, learning how to come to terms with their child having a disability, and learning how to best advocate for their child's needs. Additional factors examined to cause stress include child age, age of diagnosis, social support, parental education, and parental income (Sarant and Garrard, 2013).

Although parental stress was not specifically studied in this research, understanding the stressors that surface when a parent has an infant with a hearing loss is important when observing the parent-infant dyads in the study. It was understood when observing the dyads that the stressors mentioned above are present in the interactions, further affecting the communication beyond the hearing loss or other disabilities present.

Methodology

Participants

In the study, LENA audio recordings were analyzed for six infants who participated in an NIH-NIDCD-funded research study with collaborators at The Ohio State University. The LENA is a recording device that the infant wears throughout the day. It records all interactions that take place and is used to pull out information about the infant's language abilities and communication skills. For this study, the LENA audio recordings were completed in each infant's home and included interactions with the infant's mother as well as select interactions with both the mother and father. This study analyzed recordings of the parents speaking with six infants: one infant with cochlear implants and ASD (low SES), two infants with cochlear implants and normal development (one high SES and one low SES), one infant with a cochlear implant and CMV (average SES), one infant with a cochlear implant and global delay (average SES), and one infant who was typically developing (high SES). The LENA recordings were filtered, pulled from interactions during mealtime, playtime, story time, or bedtime routine, a segment of the day that would yield high interaction and language content. These interactions were chosen because of the amount of time required to analyze the audio recordings, making sure specific and informative data were retrieved. This time was chosen because of to the consistency in daily interaction, as well as consistency across participants.

Procedure

The first phase of the study focused on transcribing the maternal and paternal interactions. For the infant with cochlear implants and normal development (low SES) and the infants with cochlear implants and an additional disability (ASD, CMV, global delay), the LENA recordings were transcribed at three-, six-, and nine-month intervals after activation of the infant's cochlear implant (or after the first recording session). For the infant with cochlear implants and normal development (high SES) and the infant with normal development and normal hearing, the LENA recordings were analyzed for three months after activation of the infant’s cochlear implant and three months of age, respectively. Most of the audio recordings had two to three days of recordings per monthly interval, meaning at each month interval, two to three days of LENA recordings had been recorded in the infant’s home, allowing about 16 hours of audio recording per day. The audio recordings were first timed out to determine what type of interaction would provide the best depiction of the communication occurring between the infants and their parents. After the audio file was listened to (and timed out), the transcription took place, which entailed the conversation between the infant and parent being typed out. During the transcription, codes were included that would allow for an easier understanding of the interaction that had taken place. For example, if the parent used any type of repetition or imitation of the infant's speech, a code was recorded, which can be used to understand what type of interaction the infant preferred, as well as how the parents used different strategies to elicit vocalization from the infants (see Table 1). This process was repeated for each infant.

[IMITATE]	Parent imitated child's vocalization
[LAF]	Laughing
[SENM]	Sound effect, no meaning
[SEM]	Sound effect, meaning (i.e., woof for dog barking)
[REP:n]	Repetition of a sound
[UREP]	Repetition of an utterance
[PUREP]	Partial repetition of an utterance
[EUREP]	Expanded utterance repeated
[IV]	Infant vocalization
[IC]	Infant crying
[NRC]	No response from child
[NRP]	No response from parent
[TARn:n]	Target word: number of times used
[IDS]	Infant-directed speech
[SU]	Unintelligible speech understood by parent

Table 1. Codes Used During Transcription of Parent-Infant Interactions

Once the transcripts were complete for each infant at each month interval mentioned above, the transcript was processed through software called Systematic Analysis of Language Transcripts (SALT; Miller, Andriacchi, & Nockerts, 2015), which provided detailed analyses based on the language used during the conversation. During the three-month interval, the analyses focused on vocalization attempts (parent initiating a conversation with the infant or responding to the infant-initiated conversation), turn-taking in utterances ("switching between comprehending the partner's utterance and producing an appropriate and timely response"; Corps, Gambi, & Pickering, 2018), MLU (calculated by the number of morphemes, or smallest element of language, in each utterance—e.g., "I like dogs" is an MLU of 4 because of the –s added to dog; Williamson, 2014), and type-token ratio (total number of different words divided by the total number of words; Templin, 1957) for the parents and the infant. When comparing the infants with cochlear implants and additional disabilities, with cochlear implants, and with normal development, SALT analysis was further used to determine the target-word repetition (how many times the parent would specifically repeat a word to try to provide a language-learning opportunity—e.g., repeating the word "milk" so the infant would associate the word with the object being discussed), repetition (the number of times the parent repeated what the infant said during the conversation), IDS, electronic use (amount of media used daily in the home), and American Sign Language (ASL) use for the parent and infant across the six- and nine-month intervals (see Tables 2–4).

Results

The Role of Additional Disabilities

When considering the role of additional disabilities in the study, no differences across groups were discovered (Tables 2–4). Although there are no differences, noting that the additional disabilities did not affect parent-infant interactions is an important result.

The Role of Socioeconomic Status

Specific details about the communication attempts of both the parents and infant were analyzed using SALT. When comparing the averages acquired across the six dyads (Table 2), the families with high SES had a higher number of vocalization attempts, had more turn taking, and used more utterances in their interactions than those with low SES. For example, two dyads have infants with cochlear implants and normal development, but one of those dyads has a high SES and the other has a low SES. Concerning their vocalization averages, the dyad with high SES had an average of 98 attempts, while the low had an average of approximately 22 attempts. Because the infant diagnosis is the same, the family's SES is a key contributor in how the communication between the parents and the infant is affected. It was assumed that the dyads that have a cochlear implant and an additional disability would have similar results, but that is not the case. The dyads with CMV and cochlear implants and those with global delay and cochlear implants both have an average SES, while the dyad with ASD and cochlear implants has a low SES. The average-SES dyads have vocalization and turn-taking attempts more than double those of the low-SES dyad, as well as a higher MLU, with averages more similar to those of the high-SES dyads. Because the ASD-and-cohclear implant dyad was so much lower than the others, it is assumed that SES plays a significant role.

	SES		Vocalization		TT (Utterances)		MLU (Words)		TTR	
	M	**I**	**M**	**I**	**M**	**I**	**M**	**I**	**M**	**I**
ND/NH	High		43.5	16	4.39	1.58	7.65	1.00	0.42	0.16
	M	**I**	**M**	**I**	**M**	**I**	**M**	**I**	**M**	**I**
ND/CI	High		98	106	1.94	1.87	4.87	1.04	0.41	0.16
	M&F	**I**	**M&F**	**I**	**M&F**	**I**	**M&F**	**I**	**M&F**	**I**
ND/CI	Low		21.67	36	2.16	2.24	2.79	1.12	0.51	0.40
	M&F	**I**	**M&F**	**I**	**M&F**	**I**	**M&F**	**I**	**M&F**	**I**
ASD/CI	Low		16.5	29.3	1.63	2.59	3.13	1.00	0.55	0.06
	M	**I**	**M**	**I**	**M**	**I**	**M**	**I**	**M**	**I**
GB/CI	Average		47.5	15.5	3.00	1.29	4.46	1.00	0.57	0.14
	M	**I**	**M**	**I**	**M**	**I**	**M**	**I**	**M**	**I**
CMV/CI	Average		83	24	4.31	1.18	4.19	1.00	0.31	0.11

Note. ASD = autism spectrum disorder; CI = cochlear implant; CMV = cytomegalovirus; GB =global delay; I=infant; M = mother; M&F = mother & father; MLU = mean length of utterances; ND = normal development; SES = socioeconomic status; TT = turn taking; TTR = type-token ratio.

Table 2. Comparison of Average Infant and Parent Communication, 3 Months after Activation of Cochlear Implant

The Role of the Environment

For six and nine months, averages were documented in terms of vocalization attempts, turn taking in utterances, MLU, type-token ratio, target-word repetition, repetition, IDS, electronic use, and use of ASL (Tables 3 and 4). For both time intervals, each dyad had similar averages for vocalization attempts, unlike in the three-month results. This similarity could be due to the parents becoming more familiar with their infants' hearing loss and disability, the parents learning how to better communicate with their infants, or due to the therapy that both the parents and infants were receiving, causing interactions to come with more ease. The ASD-and-chochlear impant dyad was still lower in certain aspects of the interaction, however, such as lower MLU and IDS at six months post-activation, and lower turn taking and target-word repetition at nine months post-activation.

This infant was also exposed to three times the amount of media and electronics use than those in other dyads were, which can drastically affect language and communication. These factors combined showed that the environment can have a significant impact on the interaction, demonstrating that the interaction is affected by more than the infant having a hearing loss and additional disability as originally hypothesized.

	SES		**Vocalization**		**TT**		**MLU**		**TTR**	
	M&F	**I**	**M&F**	**I**	**M&F**	**I**	**M&F**	**I**	**M&F**	**I**
ND/CI	Low		44.2	33.6	2.12	1.66	4.26	1.10	0.47	0.38
	M&F	**I**	**M&F**	**I**	**M&F**	**I**	**M&F**	**I**	**M&F**	**I**
ASD/CI	Low		32.3	47.3	1.61	1.72	4.10	1.00	0.53	0.05
	M	**I**	**M**	**I**	**M**	**I**	**M**	**I**	**M**	**I**
GB/CI	Average		44.00	22.00	2.27	1.47	4.71	1.00	0.48	0.12
	M	**I**	**M**	**I**	**M**	**I**	**M**	**I**	**M**	**I**
CMV/CI	Average		23.00	14.00	2.06	1.47	5.23	1.00	0.51	0.14

	TWR	**Repetition**	**IDS**	**Education Level**	**ASL Use**
	M&F	**M&F**	**M&F**	**M&F**	**M&F**
ND/CI	3.8	5.6	5.0	HS/GED	0
	M&F	**M&F**	**M&F**	**M&F**	**M&F**
ASD/CI	0.7	7.67	1.5	9th grade and HS/GED	0
	M	**M**	**M**	**M**	**M**
GB/CI	7.5	4.0	8.0	HS/GED	0.5
	M	**M**	**M**	**M**	**M**
CMV/CI	1.0	1.5	4.5	Associates Degree	2.5

	Age	**Electronic Use**				
	I	**I**				
ND/CI	25 months	5%				
	I	**I**				
ASD/CI	21 months	22%				
	I	**I**				
GB/CI	23 months	4%				

	I	**I**				
CMV/CI	19 months	8%				

Note. ASD = autism spectrum disorder; ASL = American Sign Language; CI = cochlear implant; CMV = cytomegalovirus; GB = global delay; HS/GED = high school diploma; I = infant; IDS = infant-directed speech; M = mother; M&F = mother & father; MLU = mean length of utterances in words; ND = normal development; SES = socioeconomic status; TT = turn taking in utterances; TTR = type-token ratio; TWR = target-word repetition.

Table 3. Comparison of Average Infant and Parent Communication, 6 Months after Activation of Cochlear Implant

	SES		**Vocalization**		**TT**		**MLU**		**TTR**	
	M&F	**I**	**M&F**	**I**	**M&F**	**I**	**M&F**	**I**	**M&F**	**I**
ND/CI	Low		46.00	30.67	2.09	1.66	4.51	1.49	0.50	0.46
	M&F	**I**	**M&F**	**I**	**M&F**	**I**	**M&F**	**I**	**M&F**	**I**
ASD/CI	Low		57.30	54.30	1.25	1.04	5.41	1.05	1.02	0.46
	M	**I**	**M**	**I**	**M**	**I**	**M**	**I**	**M**	**I**
GB/CI	Average		48.5	13.00	3.8	1.04	4.88	1.00	0.29	0.16
	M	**I**	**M**	**I**	**M**	**I**	**M**	**I**	**M**	**I**
CMV/ CI	Average		78.00	20.50	6.40	1.05	4.65	1.00	0.34	0.09

	TWR	**Repetition**	**IDS**	**Education Level**	**ASL Use**
	M&F	**M&F**	**M&F**	**M&F**	**M&F**
ND/CI	4.33	6.67	3.33	HS/GED	2.67
	M&F	**M&F**	**M&F**	**M&F**	**M&F**
ASD/CI	0.25	14	7.5	9th grade and HS/GED	0
	M	**M**	**M**	**M**	**M**
GB/CI	2.5	1.5	5	HS/GED	4
	M	**M**	**M**	**M**	**M**
CMV/ CI	3	5.5	14	Associates Degree	1

	Age	**Electronic Use**				
	I	**I**				
ND/CI	28 months	7%				

	I	**I**				
ASD/CI	24 months	29%				
	I	**I**				
GB/CI	26 months	N/A				
	I	**I**				
CMV/ CI	22 months	N/A				

Notes: ASD = autism spectrum disorder; ASL = American Sign Language; CI = cochlear implant; CMV = cytomegalovirus; GB = global delay; HS/GED = high school diploma; I = infant; IDS = infant-directed speech; M = mother; M&F = mother & father; MLU = mean length of utterances in words; ND = normal development; SES = socioeconomic status; TT = turn taking in utterances; TTR = type-token ratio; TWR= target-word repetition.

Table 4. Comparison of Average Infant and Parent Communication, 9 Months after Activation of Cochlear Implant

Discussion

It was hypothesized that parent interaction would be negatively affected by the added difficulty of the conversation when an infant has a hearing loss and an additional disability; however, the findings suggest that the interactions were not affected by the additional disability alone but rather by other factors influencing the interaction.

Socioeconomic Status Effect

As described previously, maternal interaction with an infant with a cochlear implant and an additional disability can cause stressful communication attempts; however, results of this study indicate that the disability is not the sole cause of the stress. One major component of the stress was the SES of the family observed. When evaluating maternal interaction with an infant with a cochlear implant and ASD, it is important to understand the environment that the infant has grown up in, as well as what resources and treatments the infant has had access to before or after diagnosis. To acquire the most accurate information, the parents' SES can be taken into consideration.

There are varying views and opinions in the research about how SES and rate of ASD in infants are related. According to Rai and colleagues (2012), epidemiological studies in the United States often find a relationship between higher SES and a diagnosis of ASD, whereas studies from other countries with universal health care, such as Sweden, reveal a correlation between lower SES and a diagnosis of ASD. Rai and colleagues discovered that infants with ASD were more than likely to come from families with lower income, as well as from families with parents that work in manual occupations or unskilled manual labor. The study was administered in Sweden, so the population that was studied is an important factor in the results. Swedish parents and infants have access to free universal health care, which includes routine screenings and easier access to diagnosis and treatment of disorders, such as ASD. Similarly, Fujiwara (2013) found a correlation between lower SES and ASD in Japan, another country with access to free universal health care. After seeing the results from the Japan study compared to results in the United States, Fujiwara associates the findings of the U.S.-based studies (higher SES and ASD) with the healthcare system. Families of higher SES often have higher education levels, higher income, and better access to diagnosis and treatments of ASD at earlier ages than do those of a lower SES. With those comparisons in mind, it is understandable that the United States would see a relationship between higher SES and ASD, as many infants with lower SES could have never been diagnosed, which would exclude them from any studies or research compiled in the United States.

SES can also be indicative of the infant's ability to process skills for language development and the infant's access to therapy or strategies to combat issues pertaining to ASD and issues pertaining to hearing loss and cochlear implants. According to Fernald, Marchman, and Weisleder (2012), significant differences in vocabulary and language development exist between children of low- and high-SES families by 18 months of age, and a gap of 6 months' development exists between the two groups by 24 months of age with regard to language development. When adding in the difficulty of hearing loss and ASD, this discrepancy can become even more apparent in an infant's ability to communicate effectively with his or her parents, lowering the ability to have a successful parental interaction.

Environmental Factors

Extended television and media use in the home negatively affected the communication attempts made by parents during the study. Previous research has suggested that the effect of media usage can vary based on SES of the family, as well as on the age at which the infant is exposed. Mendelsohn and colleagues (2008) completed a study on the impact of infant television use on interactions in low-SES households. The goal of the study was to determine the percentage of infants who watched television in low-SES households compared to high-SES households, as well as how the interactions between the infant and parent were affected by the early exposure to television. Although television use is not recommended until at least two years of age, according to the American Academy of Pediatrics, many parents allow their infants to watch television because of the entertainment and perceived educational programming shown on child-centered television stations (Mendelsohn et al., 2008).

In their study, Mendelsohn and colleagues (2008) found that 96.8% of the low-SES mothers reported daily media exposure in their household, with the average exposure being at least 60 minutes per day, and exposure of television seen most in parents with lower levels of education and familial income. The results also indicated that interactions were reported most during educational child-oriented programs (42.8%) and that about half of the infant's exposure was toward programs not aimed for children. Even with a higher interaction based in educational child-oriented programming, however, the study determined that infant-directed educational programming was not a good substitute for co-viewing and verbal interaction, claiming that increased television use (even when it seems educational) is not beneficial to the infant's overall development. Even when infants watch education-based programming, the need for increased interaction and discussion during the program exists. For example, it would be more beneficial for the infant's development if the parent watched the program, too, allowing a conversation and educational opportunities to emerge around the program, than if the parent allowed the infant to view the program alone. Increased television use without measures to counteract the potential developmental issues (i.e., decreased verbal interaction, loss of focus to other objects or people due to focus on television, limited exposure to reading and play) can have a negative effect on an infant's language and social development. Low SES is only one factor related to increased television use, however, and is not always indicative of delayed development or of acquisition of disorders.

All disabilities observed in the study (ASD, CMV, and global delay) can adversely affect communication and an infant's ability to interact with others. Early exposure to media usage can therefore cause a delay in development and acquisition of language. Heffler and Oestreicher (2016) demonstrated how media affected infants with ASD: Since increase of television access starting around the 1980s and the even higher level of acces in the 1990s and 2000s, ASD diagnosis in infants has risen, potentially demonstrating the correlations between ASD and increased television use. Infants are naturally attracted to media, without having an understanding of social interaction. For example, Heffler and Oestreicher (2016) state, increased television exposure creates a lack of understanding of real-life social interaction, which means that when the infant watches the actor on the television screen and tries to smile, coo, provide joint attention (sharing focus), or interact with a conversation (turn taking, eye contact, etc.), the infant experiences no interaction back. This lack of back-and-forth interaction can both confuse and discourage the infant, resulting in the infant stopping attempts at social interaction and lacking the motivation to communicate with the television actors or real-life people, such as their parents. The authors state that the "socially disengaged infant" would continue to lose shared attention opportunities and lack the ability to learn from his or her environment and develop language. Interest in interactive speech would be diminished, and eventually, the infant would stop attending toward parents or other individuals in social interactions, resulting in a bigger developmental delay in language (Heffler and Oestreicher, 2016). Heffler and Oestreicher continue to explain that an infant who did not orient during a social interaction would be unlikely to partake in imitation and turn taking, which are key cues when evaluating ASD.

Parental Interaction and Cochlear Implants

When evaluating paternal interaction, research from Broesch and Bryant (2017) suggests, it is important to understand the differences and variation in paternal interaction, as it can affect later language outcomes, similar to maternal interaction. When mothers speak to infants, they often change their speech compared to how they talk with adults; however, in fathers' speech, differences arise because of societal factors rather than age of the communication partner. The researchers determined that when communicating with infants, fathers often modified their acoustic features of speech (e.g., pitch) based on their SES (low, average, or high). Broesch and Bryant suggest that fathers in small-scale societies "emphasize relationships and emotional attunement" while fathers in urban societies "focus on language learning and formal education." These findings indicate that fathers use IDS differently based on their own upbringings or on the cultural groups with which they are currently associated. Although Broesch and Bryant's study does not involve infants with hearing loss, it is still important to understanding the basis of parental interaction and how fathers may differ in interactions based on their societal situation, which can affect how the infant receives and acquires language. Whether the mother or father is communicating with the infant, when hearing loss is involved, it is imperative that the parents learn effective ways to communicate to provide optimal language learning.

Conclusion

Parent interaction was not negatively affected by only the difficulty of the additional disability but rather by a combination of factors, including the disability, SES, maternal and paternal education, and the home environment. The prominent example in the study was the ASD-and-cochlear implant dyad. The family had a low SES, lower maternal and paternal education (the mother completing only ninth grade and the father with a high school diploma or GED equivalent), extensive media and television use in the home, and a disability that has proven to affect language and communication. The parental interaction also played a role, as the father was more involved in the daily interaction than the mother because he stayed home with the infant. The combination of factors caused the parental interaction in this dyad to be less engaging than in their similar cochlear implant and additional disability counterparts. The factors have been shown in research to have a negative effect on language and vocabulary growth, further stunting an efficient interaction between the parent and infant.

Because this study is based on a selective and limited number of participants, further research would need to be done to determine if the results stem from the factors included or if the small sample size and limited disabilities play a role. In the future, it would be beneficial to compare the ASD-and-cochlear implant dyad of low SES to a similar dyad of high SES and caregiver education to see if those factors did indeed cause the decreased communication. As of the time of this paper's publication, however, no dyad in the NIH-NIDCD funded research study at The Ohio State University meets that criterion, though that would be the ideal next step.

References

Bayley, N. (2005). *Bayley Scales of Infant and Toddler Behaviors.* San Antonio, TX: Pearson Early Childhood.

Beer, J., Harris, M., Kronenberger, W., Holt, R., & Pisoni, D. (2012). Auditory skills, language development, and adaptive behavior of children with cochlear implants and additional disabilities. *International Journal of Audiology, 51*, 491–498. doi:10.3109/14992027.2012.664291

Bentenuto, A., De Falco, S., & Venuti, P. (2016). Mother-child play: A comparison of autism spectrum disorders, Down syndrome, and typical development. *Frontiers in Psychology, 7*(1829), 1–9. Retrieved from http://doi.org/10.3389/fpsyg.2016.01829

Broesch, T., & Bryant, G. (2017). Fathers' infant-directed speech in small-scale society. *Child Development, 89*(2), 29–41. doi:10.1111/cdev.12768

Choo, D., & Dettman, S. (2016). Video analysis of mother-child interactions: Does the role of experience affect the accuracy and reliability of clinical observations? *Deaf & Education International, 18*(1), 13–24. Retrieved from https://doi.org/10.1179/1557069X15Y.0000000009

Corps, R., Gambi, C., & Pickering, M. J. (2018). Coordinating utterances during turn-taking: The role of prediction, response preparation and articulation. *Discourse Process, 55*(2), 230–240. Retrieved from https://doi.org/10.1080/0163853X.2017.1330031

Fagan, M., Bergeson, T., & Morris, K. (2014). Synchrony, complexity, and directiveness in mothers' interactions with infants pre- and post-cochlear implantation. *Infant Behavior and Development, 37*(3), 249–257. Retrieved from https://doi.org/10.1016/j.infbeh.2014.04.001

Faras, H., Ateeqi, N., & Tidmarsh, L. (2010). Autism spectrum disorders. *Annals of Saudi Medicine, 30*(4), 295–300. doi:10.4103/0256-4947.65261

Fernald, A., Marchman, V., & Weisleder, A. (2012). SES differences in language processing skill and vocabulary are evident at 18 months. *Developmental Science, 16*(2), 234–248. Retrieved from https://doi.org/10.1111/desc.12019

Fujiwara, T. (2013). Socioeconomic status and the risk of suspected autism spectrum disorders among 18-month old toddlers in Japan: A population-based study. *Journal of Autism Developmental Disorders, 44*(6), 1323–1331. doi:10.1007/s10803-013-1988-3

Heffler, K., & Oestreicher, L. (2016). Causation model of autism: Audiovisual brain specialization in infancy competes with social brain networks. *Medical Hypotheses, 91*, 114–122. doi:10.1016/j.mehy.2015.06.019

Ma, W., Golinkoff, R., Houston, D., & Hirsh-Pasek, K. (2011). Word learning in infant- and adult-directed speech. *Language Learning and Development, 7*(3), 185–201. doi:10.1080/15475441.2011.579839

Meinzen-Derr, J., Wiley, S., Grether, S., & Choo, D. I. (2011). Children with cochlear implants and developmental disabilities: A language skills study with developmentally matched hearing peers. *Research in Developmental Disabilities, 32*(2), 757–767. Retrieved from https://doi.org/10.1016/j.ridd.2010.11.004

Mendelsohn, A., Berkule, S., Tomopoulos, S., Tamis-LeMonda, C. S., Huberman, H., Alvir, J., & Dreyer, B. (2008). Infant television and video exposure associated with limited parent-child verbal interactions in low socioeconomic status households. *Archives of Pediatrics and Adolescent Medicine, 162*(5), 411–417. doi:10.1001/archpedi.162.5.411

Miller, J., Andriacchi, K., & Nockerts, A. (2015). Systematic Analysis of Language Transcripts [Computer software]. Middleton, WI: SALT Software LLC.

Mithyantha, R., Kneen, R., McCann, E., & Gladstone, M. (2017). Current evidence-based recommendations on investigating children with global developmental delay. *Archives of Disease in Childhood, 102*(11), 1071–1076. doi:10.1136/archdischild-2016-311271

Rai, D., Lewis, G., Lundberg, M., Araya, R., Svensson, A., Dalman, C., Carpenter, P., & Magnusson, C. (2012). Parental socioeconomic status and risk of offspring autism spectrum disorders in Swedish population-based study. *Journal of the Academic Academy of Child and Adolescent Psychiatry, 51*(5), 467–476. doi:10.1016/j.jaac.2012.02.012

Sacrey, L. A., Bryson, S., & Zwaigenbaum, L. (2013). Prospective examination of visual attention during play in infants at high-risk for autism spectrum disorders: A longitudinal study from 6 to 36 months of age. *Behavioural Brain Research, 256*, 441–450. Retrieved from https://doi.org/10.1016/j.bbr.2013.08.028

Sarant, J., & Garrard, P. (2013). Parenting stress in parents with cochlear implants: Relationships among parent stress, child language, and unilateral versus bilateral implants. *Journal of Deaf Studies and Deaf Education, 19*(1), 85–106. Retrieved from https://doi.org/10.1093/deafed/ent032

Sparrow, S., Cicchetti, D., & Balla, D. (2005). *Vineland Adaptive Behavior Scales* (2nd ed.). San Antonio, TX: Pearson Clinical Psychology.

Templin. M. (1957). *Certain language skills in children; their development and interrelationships.* Minneapolis: University of Minnesota Press.

Williamson, G. (2014, January 29). *Mean length of utterances.* Retrieved from https://www.sltinfo.com/mean-length-of-utterance/

Zimmerman, I. L., Steiner, V., & Pond, R. E. (2002). *Preschool Language Scale* (4th ed.). Minneapolis, MN: Pearson Assessments.

Zimmerman-Phillips, S., Robbins, A. M., & Osberger, M. J. (1997). *Meaningful Auditory Integration Scale (MAIS)/Infant Toddler: Meaningful Auditory Integration Scale (IT-MAIS).* Sylmar, CA: Advanced Bionics.

Zuylen, W., Hamilton, S., Naing, Z., Hall, B., Shand, A., & Rawlinson, W. (2014). Congenital cytomegalovirus infection: Clinical presentation, epidemiology, diagnosis and prevention. *Obstetric Medicine, 7*(4), 140–146. Retrieved from https://doi.org/10.1177/1753495X14552719