UNIVERSITY OF CINCINNATI

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The Receptive and Expressive Language Outcomes of Children who have Received Cochlear Implants and have an Autism Spectrum Disorder

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The Receptive and Expressive Language Outcomes of Children who have Received Cochlear Implants and have an Autism Spectrum Disorder

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by

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Abstract

A lack of research exists regarding the language outcomes of children who have cochlear implants (CI) and an autism spectrum disorder (ASD). The purpose of this study was to quantify and describe the receptive and expressive language outcomes of children with CIs and ASD as measured by the Preschool Language Scale – 4th Edition (PLS-4). The PLS-4 was administered to one 5-year old male child with a CI and ASD and a control subject with normal hearing (matched by age and developmental profile). Results were inconclusive when measuring language growth from pre to post implant language functioning. The study, however, did find that children with a CI and ASD may continue to have significantly lower language levels compared to their same-disabled hearing counterparts. This study has clear implications for the prognosis and treatment outcomes of this dual diagnosis. Finally, this study calls for continued research regarding this unique population.
Acknowledgements

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Table of Contents

CHAPTER I. Introduction ........................................................................................................7
Purpose of Present Study .....................................................................................................8
Hypotheses of Present Study ..............................................................................................9

CHAPTER II. Review of the Literature .................................................................................10
Benefits of Cochlear Implantation for Children with Deafness ........................................10
Benefits of Cochlear Implantation for Children with Multiple Disabilities ......................13
Benefits of Cochlear Implantation for Children with an Autism Spectrum Disorder .........17

CHAPTER III. Methodology .................................................................................................25
Subjects ...............................................................................................................................25
Identification of Subjects ...................................................................................................25
Characteristics of Subjects .................................................................................................25
History & Development: Case “Logan” .............................................................................26
History & Development: Control “Johnny” .........................................................................28
Summary of Developmental Similarities ...........................................................................29
Summary of Developmental Differences ..........................................................................30
Procedures ..........................................................................................................................33
Other Data Collected .........................................................................................................35
Analysis ...............................................................................................................................36

CHAPTER IV. Results ............................................................................................................37
Current Language Functioning: Case “Logan” ..................................................................37
Current Language Functioning: Case “Johnny” .................................................................39

CHAPTER V. Discussion ......................................................................................................43
Summary ...............................................................................................................................43
Comparing Logan and Johnny .........................................................................................43
Hypothesis Revisited ........................................................................................................44
Limitations ..........................................................................................................................45
Implications for Further Research ..................................................................................47
Implications for Professional Practice .............................................................................47
Conclusion ..........................................................................................................................48

REFERENCES ......................................................................................................................50
CHAPTER I.

Introduction

Hearing loss continues to be a significant pediatric health concern for the United States. Children born with any degree of hearing loss are automatically placed at risk for language disorders. These disorders result from decreased auditory language input that most children begin to receive through early life experiences. Early intervention for the treatment and management of hearing loss is considered to be necessary in order to facilitate functional language growth. Treatment, however, for children with profound sensorineural hearing loss now includes cochlear implantation as more beneficial than hearing aids (Carney & Moeller, 1998).

Cochlear implantation has been a revolutionary treatment option for these children with profound deafness. Since the 1980’s, this practice has been refined and now exists as a routine procedure across the county. Research strongly supports the receptive and expressive linguistic benefits of cochlear implants for children who present with a profound sensorineural hearing loss (Miyamoto, Kirk, Todd, Robbins, & Osberger, 1995). Due to this overwhelming evidence, medical centers across the United States are performing these procedures on young children who are deaf. A lack of research, however, exists on the receptive and expressive language outcomes of children with cochlear implants who have additional developmental disabilities. For this reason, medical centers around the country are reluctant to implant children who are deaf and have additional developmental disabilities.

Autism spectrum disorders (ASD) has been one of the fastest growing developmental disabilities in recent years. The United States Centers for Disease Control
and Prevention suggests that the prevalence of ASD is now as high as 1 in 150 children (CDC, 2007). The hallmark deficits of ASD primarily exist in the area of language. In most children with ASD, therapists target language skills through multiple modalities including the auditory system. Knowing this, children who have ASD and deafness are faced with even greater challenges to learn language. The decision to implant children with an additional disability such as ASD could have a significant impact on their communicative outcomes, global development, and long-term quality of life. Knowing this, research is desperately needed in order for parents and health professionals to make this possible life altering decision for implantation.

*Purpose of Present Study*

The purpose of this study is to quantify and describe the receptive and expressive language outcomes of a deaf child who has received a cochlear implant and has an additional diagnosis of autism spectrum disorder as measured by the Preschool Language Scale-4th Edition (Zimmerman, Steiner, & Pond, 2004). This study is part of a larger research project that is examining the receptive and expressive language outcomes of children who are deaf and present with an additional developmental disability- not just ASD. This study is being conducted through the efforts of a developmental and behavioral pediatrics department at a large urban children’s hospital.

This particular study is examining the receptive and expressive language outcomes of a child who is deaf with a cochlear implant and presents with the developmental disability of ASD. First, this study seeks to explore the language differences before and after cochlear implantation. Second, this study investigates the
language differences between children who have received a cochlear implant and children who have hearing and present with a similar developmental profile.

Hypotheses of Present Study

Hypothesis 1: Children who are deaf and diagnosed with an autism spectrum disorder will demonstrate significant receptive and expressive language gains after receiving a cochlear implant compared with their pre-operative language skills.

Hypothesis 2: The receptive and expressive language skills of children who are deaf and diagnosed with an autism spectrum disorder will remain lower than hearing children matched by their developmental profile after cochlear implantation.
CHAPTER II.

Review of the Literature

Developmental specialists have long recognized the important role that the auditory system plays in the development of speech and language. Individuals who experience hearing loss at birth or at an early age are placed at risk for developmental delays in the area of language. Early amplification and surgery have been treatment options for individuals with conductive hearing losses, but treatment for individuals with severe sensorineural hearing loss or deafness has been revolutionized over the last fifty years. Since the 1960’s hearing professionals have been developing and experimenting with different types of designs, materials, and surgical techniques that would provide controlled electrical stimulation to the auditory nerve. The researchers involved had early success and continued to refine their practices. In 1984, the U.S. Food and Drug Administration first approved cochlear implantation for adults and by 1990 this procedure was approved for children with profound sensorineural hearing loss. The developmental benefits of cochlear implantation for children who are deaf continue to be discussed throughout the literature.

Benefits of Cochlear Implantation for Children with Deafness

Over the years, research has consistently supported the idea that children who are deaf benefit from cochlear implantation (Cheng, Grant, & Niparko, 1999). Researchers examining the impact of cochlear implantation on language development often measure speech perception abilities. Speech perceptual abilities are consistently shown to increase after cochlear implantation for children with deafness who do not present with an additional disability (Svirsky, Teoh, & Neuburger, 2004). Speech perception refers to the
internal processes that enable individuals to understand and interpret auditory information. Having an intact auditory perceptual system enables children to internalize the speech sounds of a language into meaningful phonologic structures. This natural part of language acquisition continues to mature and will facilitate the development of skills necessary for reading, writing, and other academic exercises.

Researchers have been investigating the factors that may influence an individual’s speech perceptual abilities. Frayauf-Bertschy, Tyler, Kelsay, Gantz, & Woodworth (1997) found that indeed cochlear implantation increased speech perceptual abilities of children who were deaf. Furthermore, they sought to analyze the longitudinal speech perception performance of pre-lingually deafened children who have three to five years of experience using a CI. These subjects did not present with any additional disability. The researchers examined the influence of three domains in relation to speech perception: duration of CI use, age that the child received the implant, and the amount of daily cochlear implant use. The children were tested preoperatively and then at annual intervals using a wide variety of speech perception tests. All of the subjects demonstrated speech perceptual gains compared to their pre-operative measures. Gains were most evident after 36 months of CI usage. The study was inconclusive regarding outcome differences relating the age of implantation to the level of speech perceptual abilities. Although the results showed higher trends on some measures in favor of children implanted before the age of five, these results were not statistically significant. The most significant result indicated that children who wore their device more during their waking hours received higher scores on speech perception tasks.
Questions, however, continue to linger that suggest that even earlier implantation may lead to better speech perceptual outcomes. Baumgartner, Pok, Egelierler, Franz, Gstoettner, & Hamzavi (2002) examined the speech perception abilities of 33 prelingually deaf children who did not present with an additional disability. Approximately half of the subjects were implanted before three years of age while the other half were implanted after three years of age. All children showed improved speech perception abilities. Yet those children who were implanted before their third birthday performed dramatically greater on follow-up testing compared to their later-implanted counterparts. This study supports early implantation as the best strategy for attaining the most benefit from cochlear implantation. At the same time, this study also shows that later-implanted children will still make gains, but may require more patience and support following implantation. More recent studies may also suggest that cochlear implantation under the age of two for children with no other disability may lead to even greater outcomes (Anderson, Weichbold, Haese, Szuchnik, Zuevedo, Martin, Dieler, & Phillips, 2004).

All of these researchers attempt to measure a child’s language learning potential using speech perceptual tests. Yet, researchers must look beyond speech perception in order to describe language outcomes. Speech perceptual tests may yield important information, but researchers must attempt to measure more specific outcomes regarding the subjects’ understanding and use of the linguistic and pragmatic features of language. Richter, EiBele, Laszig, & Lohle (2002) examined speech perception skills, speech production, and the receptive and expressive language of 106 children who had been using a CI for at least two years. Besides hearing loss, these subjects had no other
disability. Compared with other studies, these investigators utilized more diverse early communication measures that included the Scales of Early Communication Skills for Hearing Impaired Children (Geers & Moog, 1990). The results of their testing revealed that all children had functional auditory gains after implantation. Post-operative assessments showed that subjects made speech perceptual gains. Yet, these gains were dependent on factors relating to the degree of disability and the age of implantation. Furthermore, the authors fail to thoroughly describe their subjects’ language and early communicative functions before and after implantation. Rather they restrict their results to the quantitative data from the speech perception and production. In addition, language measures were not extensive enough to determine more specific post-operative communicative gains. Reichter et al. (2002) demonstrate an intention to investigate more specific language skills. Yet, their exploration proves shallow when they present and discuss the results of their testing.

**Benefits of Cochlear Implantation for Children with Multiple Disabilities**

The studies regarding the effectiveness of CIs have measured language outcomes of children who do not present with another disability. In fact, most of these studies intentionally exclude subjects who had coexisting conditions or any other developmental disability. Even so, researchers have estimated that as high as 46% of children with sensorineural hearing loss have an additional disability (Wiley, Meinzen-Derr, & Choo, 2004). Studies examining the benefits of cochlear implantation for otherwise typically developing children exclude a large percentage of the population who is a candidate for a CI. Since many studies exclude these children, little research exists on whether or not cochlear implantation will meet the unique challenges of this highly involved population.
Without any evidence, some researchers question the purpose of a CI for a child with an additional disability who may demonstrate little to no functional communicative gains (Winter, Johnson, & Vranesic, 2004; Hassanzadeh, 2007). Knowing that these children require even more language supports, would not cochlear implantation give these children more access to learning language?

The controversy to implant children with multiple disabilities continues to be discussed among hearing professionals. Researchers at The House Ear Institute/ House Ear Clinic performed a retrospective analysis on 10 subjects who had received a CI and had an additional developmental or behavioral disorder (Winter et al., 2004). Nine of the ten children were enrolled in oral educational programs at the time of implantation and one child was enrolled in a total communication program. Since the information was gathered over a range of years, each subject did not receive the same battery of speech and language tests. The authors analyzed post-operative assessments given to these children. They found that most of the children made insufficient gains on all auditory perceptual and receptive language tasks. They also reported that only two of the children were able to remain in the oral language programs and be classified as “functional oral communicators” as their language remained well below average. Winter et al. (2004) suggest that children with multiple disabilities coexisting with deafness, “may have difficulty acquiring language in any modality” (p. 280). The authors are also reluctant to implant these children due to insufficient post-operative treatment programming that is currently available. They stress that if implanted, these children will need evidence-based, direct, and specific support to facilitate their auditory and linguistic development. Although this study voices valid concerns, the authors were unable to control many of the
variables due to the nature of a retrospective analysis. In addition, the sample size proves to be too small for determining any conclusions.

More controlled studies, however, have found different results. Waltzman, Scalchunes, & Cohen (2000) investigated 31 profoundly deaf children ages 1-9 to 12 years and assessed speech perceptual abilities before and after cochlear implantation. All of these children had additional disabilities ranging from severe language delay, dyspraxia, autism, CHARGE syndrome, cerebral palsy, and other global developmental delays. The results of their study demonstrated that children with multiple handicaps do indeed receive significant benefit from cochlear implantation. The progress that these children made was slower compared to children who are implanted without an additional disability. Although not directly measured, the authors discuss how cochlear implantation increased each subjects overall “connectedness” to their environment. The authors also suggested that participants demonstrated increased communicative function and positive interaction. Again, this “connectedness” was discussed based on general observations and was not obtained from any objective measurement.

In order to systematically describe the benefits of cochlear implantation for children with multiple disabilities, Wiley, Jahnke, Meinzen-Derr, & Choo (2005) developed a structured interview for families using a variety of open and closed-ended questions. Responses from each family were then coded by theme in order to be analyzed and discussed. The majority of families reported a variety of benefits after implantation. The most notable of these included the following:

- 94% of families reported that their child had more awareness to environmental sounds.
• 88% reported that their child’s speaking skills have developed.
• 69% reported that their child’s interaction with peers has improved.
• 88% reported that their child was more likely to communicate wants/needs.

When looking specifically at communicative skills, parents were asked questions pertaining to the pre and post operative communicative status of their child. All children made communication progress after implantation. Some of the children continued and expanded skills using their pre-implant mode of communication while others were able to move from sign to oral communication. Even the most severe children with more than one additional handicap demonstrated increased communicative abilities. For example, one child with significant CP began to use eye gaze and facial expressions during interactions with others following implantation.

This study was also helpful as it provided opportunities for parents to make suggestions regarding how to improve the cochlear implantation experience for families. Many families reported that they would have benefited from more frequent mapping sessions, more classroom/teacher education, and more realistic expectations about daily life changes. All families who participated stated that they would make the same decision for implantation if given the opportunity.

Although all of these studies prepare the way for more research, the population defined as “multiple handicapped” includes a diverse collection of disorders that each present with their own unique challenges. Few studies, however, have examined more specific populations within this general category. This is most likely due to the very small population of children available for research and the lack of interest in these very
low incidence cases. Even so, researchers must pursue the benefits of implantation on these more specific populations such as autism spectrum disorder.

Benefits of Cochlear Implantation for Children with an Autism Spectrum Disorder

The lack of substantial evidence regarding the language outcomes of implanted children diagnosed with autism spectrum disorder (ASD) has been quietly addressed in recent years. The literature that does exist presents more questions than answers regarding the benefits of cochlear implantation for this dual condition. So far, most of the information published on this population has consisted of expert opinion as well as small case study designs. Children with ASD present with a wide range of profiles that all present with the same three core deficits. According to the diagnostic criteria for autism as defined in the Diagnostic and Statistical Manual of Mental Disorders- Fourth Edition, children presenting with autism show impairments in social interaction, impairments in verbal and nonverbal communication, and restricted and repetitive patterns of behaviors (American Psychiatric Association, 1994).

Having this dual diagnosis of both deafness and ASD places families in a whirl of confusion regarding both treatment and management. Katharine Beals (2004) recounted her own experiences as a mother of a son who was congenitally deaf and later diagnosed with ASD. This article was touching as it relives one mother’s personal journey through a difficult diagnosis. Beals tells of how the diagnosis of deafness was direct and clear. Her son was implanted and she soon considered the CI to be the “cure” for this diagnosis. However, after the device was activated, the same social-communicative problems that they had always attributed to the deafness were now looking like a more complex diagnosis. At this point, Beals retells another diagnostic journey that eventually led to an
ASD label. After being diagnosed with ASD, Beals was faced with a variety of early intervention decisions. Her research revealed that no formalized intervention exists for children on the spectrum who also have CIs. She found that the early intervention programs for ASD greatly contrasted with the detailed sign language and speech curriculum for deafness. This article sends a message to speech and hearing researchers and clinicians. Beals calls for more “comprehensive curriculum” to suffice the unique needs of this population.

This article is useful as it gives a real-life perspective on this dual condition and confirms that researchers still have many questions to answer regarding treatment and management after implantation. Beals calls for detailed and prescribed intervention programs. Yet, how are speech-language and hearing professionals able to create curricula for this population if a significant lack of research exists regarding the language outcomes of post-implant children with ASD?

Hayman & Franck (2005) discuss candidacy factors to consider before implanting a child with ASD. They state that CI candidacy for children with ASD should be determined in relation to the same guidelines used for children without an additional disability. As previously discussed, early implantation has been found to be the most beneficial for developing spoken language. Hayman & Franck (2005) state that the ability to develop spoken language may decrease at an earlier age for children with ASD compared with children experiencing deafness only. They suggest that implantation may not be as beneficial for children ages three to six or above six if they have a diagnosis of ASD. Next, the authors suggest that any child receiving a CI should have a formal language system and perform no more than 2 years below their chronological age. These
authors state: “It may be more effective for a child with a cognitive disability to learn to communicate with an unimpaired visual system than with an impaired auditory system managed by a cochlear implant” (p. 220). The authors also suggest that some types of behaviors could disqualify a child for implantation. Harmful self-stimulating behaviors such as repetitive head hitting may be damaging to the external and internal equipment. Information regarding such behaviors in the child’s everyday environment should be collected from the child’s parents, therapists, and other professionals working with the child.

The authors also discuss some post-operative considerations. After implantation, the authors stress that parents should be given realistic expectations regarding the effects of implantation and warned of the limited potential for success due to the additional diagnosis of autism. Finally, post-implant management may require more frequent programming. The authors anecdotally report that several implanted children with ASD who they have worked with experienced some level of adverse sensitivity to sound. This can be reduced by keeping the degree of change to a minimum with frequent programming sessions. Finally, children with autism may prefer to mouth or chew on equipment. These authors have reported that some families have used other microphone systems besides the traditional behind-the-ear models.

These are important considerations to review, but should not these considerations be explored for all children who are candidates for implantation? The authors raise good questions regarding how challenging behaviors may make CI usage difficult. However, the authors fail to mention how behavioral treatments for ASD founded on the principles of Applied Behavioral Analysis may possibly reduce or
eliminate these behaviors altogether. Additionally, the spectrum of disorders under ASD is diverse and wide. The authors do not fully describe what characteristics of ASD are more contraindicative of implantation as opposed to others.

Hayman & Franck (2004) do provide three short cases at the end of the article. The authors of this study provide these cases in order to demonstrate how the vastly different characteristics of ASD may influence candidacy for cochlear implantation.

Case 1 received a CI at the age of 12 months and was later diagnosed with PDD-NOS. When upset, he frequently took off his microphone and put it in his mouth. As a result, he required two-four cables each month. Results of post-operative evaluations reported that he demonstrated increased communicative abilities. Reports commented that he was more socially and emotionally responsive including increased eye contact, orienting, and non-verbal communication. His family and the intervention team consider that these gains were enhanced by the CI.

Case 2 was described as an 11-year-old boy with ASD who communicated through sign, natural gestures, and verbalizations throughout his daily routine. He had been placed at a manual school for the deaf with a full-time aide. From the initial interview with the parents, the authors believed that cochlear implantation should not be considered for this boy. However, testing revealed that his word identification abilities were more advanced than they had initially anticipated. From these promising results, the team recommended cochlear implantation. During formal auditory testing after implantation, the patient demonstrated increased speech discrimination and sentence identification abilities. In addition, the investigators anecdotally noted that the child had made functional communication gains in his everyday settings. The patient participated
in a total communication classroom with other children with CIs. His reading had improved to a 3rd grade level and school staff reported that his difficult behaviors had decreased.

The final case presented a 5 year-old boy who had a history of low birth weight. He was diagnosed at 18 months with a profound hearing loss and at 2.5 years of age he was diagnosed with PDD. His mother reported that he wore hearing aids without any resistance. He attended a school for the deaf with a 1:1 aide and received speech-language therapy, physical therapy, and occupational therapy. The intervention team was concerned due to the parent-school reporting discrepancies. The parents reported that their son wore his hearing aids consistently while the school reported that the parent frequently forgot to bring the aids to school. Other concerns surrounded the boy’s significantly low level of communication. The patient demonstrated no initiation to communicate with sound, sign, or gesture. The authors also reported that he demonstrated no interest in tactile or auditory cues. The school had recently begun using pictures such as Picture Exchange Communication System (PECS) to develop his vocabulary and symbolic communication through interaction. The intervention team did not recommend cochlear implantation due to his age (now 6 years old) and his recent positive responses to PECS. The authors believed that a CI could possibly be detrimental to his recent communication gains.

Donaldson, Heavner, & Zwolan (2004) sought to quantify the progress of seven children who received a CI and were diagnosed with ASD. The mean age of implantation was 4.7 years and the average time of CI usage was 25 months. Four of the children were diagnosed before implantation while three children were diagnosed after
implantation. A retrospective review of speech and language testing of pre-operative and post-operative assessment was collected and analyzed. Not all of the tests were administered to each subject. These researchers chose a variety of language assessments including the MacArthur Communicative Development Inventory, the Expressive Vocabulary Test, and the Peabody Picture Vocabulary Test. They also examined the speech perceptual scores from a variety of other measures. When looking at the results of MacArthur Communicative Development Inventory, the investigators found that four of the five subjects increased their comprehension of spoken words after implantation. Other impressive results included increased receptive vocabulary results. For example, one subject’s standard score on the Peabody Picture Vocabulary Test was less than 40 pre-operatively and increased to 72 five years after implantation. When looking at the speech perception tests, the results revealed that all subjects demonstrated significantly higher scores after implantation; the average score was 42% pre-operatively and increased to 72% post-operatively.

Additionally, Donaldson et al. (2004) administered a survey to the parents of the participating subjects. Questions from the survey asked parents about their child’s methods of communication, behavior, and family interactions. The majority of the parents indicated that their child mostly gestured to communicate. Only one family reported that their child used spoken language. When looking at pre-operative vs. post-operative behavior ratings, the most notable finding reported that each subject demonstrated an affinity for music after implantation not seen previously. Many other parents reported increased reactions to sounds, more vocalizations, eye contact, use of sign language, and increased responses to requests. When looking at family interaction
ratings before and after implantation, minimal differences were reported. The authors comment that these very small differences perhaps reflect the diverse goals and priorities of each individual family. It is interesting to note that all of the parents of children diagnosed with ASD after implantation reported that their child did worse than expected with the CI. However, the parents of children diagnosed with ASD before implantation reported that their child made “as expected” or “better than expected.”

Donaldson et al. (2004) sought to perform a preliminary quantification of the language outcomes for children who have received a CI and are also diagnosed with ASD. These researchers recognize that their findings are limited due to the inability to administer a standard battery of measures to each subject which is a limitation of a retrospective analysis. Overall, the authors suggest that cochlear implantation can be beneficial to children with ASD. Through this preliminary study, the authors call for future research to include longitudinal studies as well as more objective and standardized measures. These measures will help determine the overall linguistic and communicative benefits of cochlear implantation for the ASD population. The authors also suggest that objective tools must be developed to measure each child’s individual progress. Ultimately, this information will help speech-language and hearing professionals better counsel families about the expected prognosis for their child as well as evidence-based management and treatment strategies.

The research benefits of this unique population of individuals with both ASD and cochlear implantation are not well documented in the current literature. Most studies examining the post-operative outcomes of cochlear implantation for children with ASD have not been controlled studies using objective and standardized measurements for all
subjects involved (Hayman & Franck, 2004; Donaldson et al., 2004). Many of these same authors admit that their results are inconclusive based on these shallow research designs. As some authors suggest, this population displays certain challenges that may be contraindicative of cochlear implantation (Hayman & Franck, 2004). Yet little to no scientific evidence verifies this statement. In fact, some of the literature has described very positive communicative gains for children with ASD after receiving a CI. Reliable research, however, is needed to verify language outcomes with this small and unique population. The current study will investigate and describe the receptive and expressive communication of this unique population using controlled and objective measures.
CHAPTER III.

Methodology

Subjects

Identification of Subjects

Children eligible for this study were between 36 and 72 months of age at the time of the study and had been diagnosed with an autism spectrum disorder. All of the diagnoses and developmental assessments occurred prior to enrolling in the study. Additionally, eligibility criteria stated that all subjects in the CI group were to have been implanted before 36 months of age. After this group was identified, a control group was selected. This group presented with a similar developmental profile, but differed only by hearing status. Eligible subjects were identified through a developmental and behavioral pediatric department and a pediatric otolaryngology department at a large urban medical center. Subjects were identified by a developmental pediatrician, who evaluates children with hearing loss, including those who receive a CI.

Characteristics of Subjects

Initially, more children with CIs as well as ASD were expected to participate in this study. After eight months, however, only one subject with a CI diagnosed with ASD had participated. This subject was matched to a control subject who presented with a similar developmental profile, but had normal hearing levels. These two subjects were matched according to the following similarities: 1.) developmental level of the child, ± 5 points as measured by standardized tests (Developmental Quotient); and 2.) age at the time of study ± 1 year.
The control subject provided a way to evaluate the language gap that was hypothesized to exist between the two subjects. Table 1. shows a basic description of the two subjects compared for the purpose of this study. Note that both subjects present with almost identical chronological ages and developmental quotients.

**Table 1.**

<table>
<thead>
<tr>
<th>Subjects: Basic Demographic Information</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td><strong>Case: Logan</strong></td>
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<tr>
<td><strong>Control: Johnny</strong></td>
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<tr>
<td><strong>Sex</strong></td>
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<tr>
<td>Male</td>
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<tr>
<td>Male</td>
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<tr>
<td><strong>Age</strong></td>
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<tr>
<td>5 years, 9 months</td>
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<td>5 years, 11 months</td>
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<tr>
<td>- Autism Spectrum Disorder</td>
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<tr>
<td>Autism Spectrum Disorder</td>
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<tr>
<td><strong>Hearing Status</strong></td>
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<tr>
<td>20 Db with unilateral cochlear implant</td>
</tr>
<tr>
<td>Within Functional Limits</td>
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</table>

**History & Development: Case “Logan”**

Logan was born full-term and was found to have an aneurysm inside his umbilical cord. He had an initial 40 day hospital stay following a variety of feeding issues surrounding a condition known as pyloric stenosis, a gastrointestinal disorder exhibiting excessive vomiting and dehydration. As an infant, Logan experienced considerable issues with GERD and was on medication to control symptoms surrounding this condition. In addition, Logan has a previous diagnosis of mild asthma, which was never a significant concern through his early development. Logan currently lives with his older sister and mother who has a college degree.

Logan began to walk between 15-17 months and did not babble until approximately 15 months of age. Throughout his early years, Logan was observed to have food texture sensitivities and exhibited difficulty tolerating new foods. At 24
months of age, Logan was diagnosed with a profound bilateral sensorineural hearing loss that had been previously undetected. At that point, Logan was fitted with binaural hearing aids and the possibility of cochlear implantation in the future was discussed. In addition, the pediatrician found that Logan had developmental delays across many domains, but noted his greatest deficit to be social development. The pediatrician also observed some abnormal “autistic-like” behaviors, but felt uncomfortable making a diagnosis since these behaviors could be attributed to his untreated hearing loss. At the age of 3, Logan received a unilateral CI and his hearing thresholds increased to 20 Db. Logan also presents with some vision deficits; the extent of his visual impairment is not fully known, but considered to be mild-moderate in nature.

Logan continued to exhibit social-communicative deficits and the diagnosis of an autism spectrum disorder was becoming more evident. When he was 4 years, 6 months, the Autism Diagnostic Observational Scale (ADOS) (Lord, Rutter, DiLavore, & Risi, 2002) (Module 1) was administered to Logan in order to diagnose the presence/absence of an autism spectrum disorder (See Table 4). The ADOS is a semistructured, standardized assessment of communication, social interaction, and play for children referred for possible autism. From this test, Logan’s scores placed him in the “autism” category.

Logan began receiving early intervention services at an early age. Services included speech therapy, physical therapy, and occupational therapy. Logan participated in these services both privately and through a center-based preschool program. He now attends a self-contained special needs preschool classroom. His current Individualized Education Plan (IEP) goals include requesting, labeling action words, and expanding his
signed utterances by combining signs. He also continues to have auditory training goals to better utilize his CI.

History & Development: Control “Johnny”

Johnny was born at 26 weeks gestation from an emergency C-section. He spent several months in the NICU and was on oxygen for 5 months after his delivery. Johnny has a medical history of a tethered cord which was resolved by the age of 3. He also presents with mild cerebral palsy as a result of his prematurely. Johnny lives at home with his mother and father who both have college degrees.

Johnny experienced some general developmental delays including motor and speech. He did not sit up until he was 13 months old and started walking at 21 months old. He began babbling at 9 months and at 12 months consistently said, “mama” and “dada.” At 23 months, Johnny demonstrated approximately a 14 month delay across most developmental domains including adaptive skills, gross motor skills, fine motor skills, and personal social skills. His greatest delay was found to be in expressive language. At this early age, he was also observed to have noticeable sensitivity to loud noises. As Johnny matured, his social-communicative deficits continued to emerge as a primary concern. Questions relating to a diagnosis of autism lingered for a few years until he was approximately 5 years old. At that time, the ADOS (Module 2) was administered to Johnny in order to better label his communicative deficits. Scores from this test classified him as presenting with “autism.”

Johnny has been receiving early intervention services since the age of 12 months. His therapies included speech therapy, physical therapy, and occupational therapy. He also received additional private therapies through a local hospital. At the time of this
study, Johnny was participating in an integrated special education preschool program with typical developing peers. He has continued to receive all three therapies in both the school and private setting. His current IEP addresses increasing his expressive language and following auditory directions in the classroom environment.

**Summary of Developmental Similarities**

Both subjects, Logan and Johnny, have a variety of developmental similarities. Each subject experienced global developmental delays that were early identified. Because both subjects were identified early, each began receiving early intervention services around 12 months of age. These special services included speech therapy, physical therapy, and occupational therapy through their statewide early intervention program in conjunction with private speech therapy. Between the age of 2 and 3, the pediatrician of both subjects noted that their most notable delays were in the area of communication. When looking at their educational goals, both subjects have goals that address their attention skills. Logan’s goals surround his ability to attend to auditory information and ability to attend to the underlying functions of language. Johnny’s goals address his ability to maintain his attention to classroom instruction with minimal redirection.

A definitive diagnosis of ASD was given to both subjects around 4 years of age. In order to confirm this diagnosis, each subject participated in a variety of discipline specific evaluations that included a complete speech-language and a complete psychological evaluation. The Childhood Autism Rating Scale (CARS) is a common autism behavioral observation checklist that is completed by a psychologist during a psychological evaluation (Schopler, Reichler, & Renner, 1988). This checklist was
completed for each subject at the time of their psychology evaluations. According to the examiners, both subjects experienced the same level of deficit relating to Emotional Response, Fear/Nervousness, and Sensory Responses (Taste, Smell, and Touch Response and Use) (see Table 2). Both subjects were also found to have the same deficits in Verbal Communication. It must be noted that Logan’s signs were scored as “Verbal Communication.” The Gilliam Autism Rating Scale (GARS) (Gilliam, 1995) is another autism behavioral observation checklist that typically accompanies the CARS. This checklist, however, is completed by a caregiver. According to each caregiver, both subjects demonstrated similar deficits in the area of Social Interaction (see Table 3). Each subject was reported to demonstrate decreased eye contact and imitation of others during play. In addition, each subject was noted to withdraw or remain aloof in group situations. Logan and Johnny were both found to have “Below Average” probability of having an autism spectrum disorder on this observational rating.

Finally, the ADOS was administered by a speech-language pathologist as part of the autism diagnostic process. Each subject’s score placed them in the diagnostic category of “Autism” (see Table 3). Although Logan and Johnny received different modules (Module 1 and Module 2 respectively), each received similar communication ratings in relation to their language level. They both were noted to have unusual eye contact and occasional hand flapping when happy or excited; no abnormal behaviors (i.e. overactivity, tantrums, anxiety) were noted during each assessment.

*Summary of Developmental Differences*

Although these subjects have similar developmental patterns, Logan and Johnny have clear differences- especially in the area of language functioning. At 24 months of
age, Logan received amplification through hearing aids for the first time in his life. Due to this decreased auditory input, Logan demonstrated delayed vocalizations and began to babble approximately at 15 months of age. Johnny, however, started babbling at 9 months of age. It is interesting to note that even at this early age, the language gap between Logan and Johnny had already begun to significantly widen. In addition, each subject had vastly different educational goals as seen through their IEPs. Logan’s IEP goals primarily focus on increasing his length of utterances through the combination of 2 signs. Johnny’s IEP goals, however, are designed to facilitate his ability to respond to more complex language such as appropriately answering wh-questions.

The results of the CARS found that Logan was consistently rated one degree more severe than Johnny (see Table 2). For example, Johnny was noted to be “Mildly Abnormal” for the behavior categories of Imitation, Body Use, Object Use, and Adaptation to Change. Logan, however, was noted to be “Moderately Abnormal” for these same behavioral categories. Logan struggled to demonstrate these early social-communicative behaviors, while Johnny experienced only mild difficulties with these fundamental aspects of language. The overall accumulative GARS scores were similar for Logan and Johnny (see Table 3). The Communication section examines verbal production only and could not be administered since Logan used almost all signs and gestures. There were some small variations seen in the area of Stereotyped Behaviors (see Table 3). Johnny was rated as a “picky eater,” while Logan’s caregiver noted no unusual eating patterns.

Finally, the most significant areas of difference from the ADOS were related to language level (see Table 4). For example, Logan’s overall non-echoed language was
given a descriptive label of “No words or word approximations,” while Johnny’s language label stated that “Speech is primarily two-three word utterances, with minimal to no grammatical markers.” In the area of Reciprocal Social Interaction, Johnny was observed to consistently respond to his name while Logan did not look toward the caregiver after verbal attempts to gain his attention. When looking at joint attention behaviors, Johnny was able to follow the examiner’s gaze and turn his eyes in the direction of the target. Logan, however, made no spontaneous initiation of joint attention to reference a distant object. While playing with objects, Johnny demonstrated limited creative or make-believe play; Logan demonstrated no pretend play.

Table 2.

<table>
<thead>
<tr>
<th>Rating Category</th>
<th>Case “Logan”</th>
<th>Control “Johnny”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relating to People</td>
<td>3- Moderately abnormal</td>
<td>1- No evidence</td>
</tr>
<tr>
<td>Imitation</td>
<td>2- Mildly abnormal</td>
<td>1- Appropriate</td>
</tr>
<tr>
<td>Emotional Response</td>
<td>2- Mildly abnormal</td>
<td>2- Mildly abnormal</td>
</tr>
<tr>
<td>Body Use</td>
<td>3- Moderately abnormal</td>
<td>2- Mildly abnormal</td>
</tr>
<tr>
<td>Object Use</td>
<td>3- Moderately inappropriate</td>
<td>2- Mildly inappropriate</td>
</tr>
<tr>
<td>Adaptation to Change</td>
<td>3- Moderately abnormal</td>
<td>2- Mildly abnormal</td>
</tr>
<tr>
<td>Visual Response</td>
<td>3- Moderately abnormal</td>
<td>2- Mildly abnormal</td>
</tr>
<tr>
<td>Listening Response</td>
<td>2- Mildly abnormal</td>
<td>1- Age appropriate</td>
</tr>
<tr>
<td>Taste, Smell, and Touch Response and Use</td>
<td>2- Mildly abnormal</td>
<td>2- Mildly abnormal</td>
</tr>
<tr>
<td>Fear or Nervousness</td>
<td>1.5- Normal/Mildly abnormal</td>
<td>1- Normal fear or nervousness</td>
</tr>
<tr>
<td>Verbal Communication</td>
<td>2- Mildly abnormal (sign)</td>
<td>2- Mildly abnormal</td>
</tr>
<tr>
<td>Nonverbal Communication</td>
<td>2- Mildly abnormal</td>
<td>1- Normal</td>
</tr>
<tr>
<td>Activity Level</td>
<td>1- Normal</td>
<td>1- Normal</td>
</tr>
<tr>
<td>Level and Consistency of Intellectual Response</td>
<td>2- Mildly abnormal</td>
<td>1- Intelligence is Normal</td>
</tr>
<tr>
<td>Category Rating</td>
<td>“Mild/Moderate Autism”</td>
<td>“Non-Autistic”</td>
</tr>
</tbody>
</table>

Table 1: CARS is an autism behavioral checklist that is completed by the examiner. Above are the scores from Logan and Johnny. Note that most of Logan’s scores are one degree more severe than his normal hearing counterpart.
Table 3.

<table>
<thead>
<tr>
<th>Rating Category</th>
<th>Case “Logan”</th>
<th>Control “Johnny”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stereotyped Behaviors</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Communication</td>
<td>n/a</td>
<td>9</td>
</tr>
<tr>
<td>Social Interaction</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Developmental Disturbances</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Autism Quotient-Standard Score</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>Probability of Autism</td>
<td>“Below Average”</td>
<td>“Below Average”</td>
</tr>
</tbody>
</table>

Table 2: The GARS is an autism behavioral checklist that typically accompanies the CARS. However, this checklist is completed by the caregiver. Note that all the sections could not be administered to Logan due to his mode of communication.

Table 4.

<table>
<thead>
<tr>
<th>Rating Category</th>
<th>Case “Logan”</th>
<th>Control “Johnny”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Reciprocal Social Interaction</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Communication + Social Interaction Total</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Play (Module 1)</td>
<td>5</td>
<td>n/a</td>
</tr>
<tr>
<td>Imagination/Creativity (Module 2)</td>
<td>n/a</td>
<td>1</td>
</tr>
<tr>
<td>Stereotyped Behaviors and Restricted Interests</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>ADOS Classification</td>
<td>Autism</td>
<td>Autism</td>
</tr>
</tbody>
</table>

Table 3: This table demonstrates the results from the ADOS, a “gold standard” autism diagnostic tool. Due to Logan’s significantly lower language level, he was given Module I, while Module II was administered to Johnny.

Procedures

Subjects were identified at a large urban medical center as previously described. The case subject, Logan, was matched to the control subject, Johnny, as being of the same age, developmental profile, and having normal hearing levels. This additional background information was obtained from a chart review. The background information
gathered further supported the developmental similarities between the two subjects. After being selected, both Logan and Johnny participated in a language evaluation that examined their receptive and expressive language functioning.

During the evaluation, the Preschool Language Scales- 4th Edition was administered along with a parent questionnaire. A sign language interpreter was used during Logan’s language evaluation, since he used a combination of verbalization and sign to communicate in his everyday environments. During Logan’s evaluation, the test item was first presented verbally by the evaluator. If he responded correctly, his correct response was immediately recorded. If Logan responded incorrectly or did not respond at all, the test item was presented using sign. Two separate scores were calculated for both the auditory comprehension and the expressive portions of the test. One score indicated the child’s level of accuracy after receiving auditory stimuli only and his verbal production of expressive responses. Another score indicated the child’s responses from using supplemental sign language; this included signed instruction and his signed production of expressive responses. Due to the strong iconic nature of American Sign Language, a combination of American Sign Language and Signed Exact English were used to present all test items; this also aligned with Logan’s experience with sign language. Two scores were calculated and reported along with a description of Logan’s receptive and expressive communication. The results of this language evaluation were qualitatively and quantitatively described in relation to the control subject’s level of language.
Assessments

The study coordinators used the Revised Gesell Developmental Schedules (Gesell, 1949), a common developmental assessment, to calculate each participant’s Developmental Quotient prior to enrollment in the current study. In addition, results from previous assessments including the CARS, GARS, and ADOS were obtained through a chart review. These tests, previously described, are routinely administered to children who present with a possible autism spectrum disorder.

As part of the current study, the Preschool Language Scales- 4th Edition (Zimmerman et al., 2004) was administered to each participant. This tool is a routine and standardized measure of receptive and expressive communication for ages birth to 6 years; 11 months. The auditory comprehension portion of the test assesses basic vocabulary, concepts, and grammatical markers in preschool children. It also assesses higher-level abilities such as understanding complex sentences, making comparisons, and inferences for older children. The expressive language portion assesses a preschooler’s ability to name objects, use concepts that describe objects, express quantity, and usage of grammatical markers. For older children, the expressive portion examines the production of linguistic features such as word segmentation, completing analogies, and telling a short story in sequence.

Other Data Collected

During the language evaluation, a simple questionnaire was given to the parents in order to collect basic biographical information. Information from the questionnaire included subject characteristics, current description of educational programming of
subject, types of therapies attended, level of intensity of therapies attended, and educational level of parents.

Analysis

Data collected for this matched-subject case study was descriptively analyzed using both qualitative and quantitative means. Information regarding current receptive and expressive language functioning was obtained from a complete language evaluation involving the PLS-4. Logan’s language functioning from his preimplantation status was compared to his current, post-implantation functioning. In addition, the results from Logan and Johnny’s evaluation were compared in order to indicate Logan’s expected language functioning with normal hearing levels.
CHAPTER IV.

Results

Current Language Functioning: Case “Logan”

The PLS-4 was administered to Logan in order to determine his receptive and expressive language abilities. The results of the language evaluation found that Logan’s expressive and receptive language was significantly below his same-age hearing peers; his standard scores for all subtests were more than three standard deviations below the mean. It must be noted that Logan’s language score increased with the use of supplemental sign which is more reflective of his actual understanding and use of language. Logan had significant difficulty sustaining his attention during the evaluation. He appeared overwhelmed by the toys and his attention wandered quickly from toy to toy. Throughout the evaluation, Logan did not respond to his name when it was spoken or signed. Logan has a fascination with spoons and his mother reported that she often holds a spoon in front of his face to gain his attention. Throughout the evaluation, Logan made several vocalizations and was observed to continually sign throughout the session.

Receptively, Logan received a standard score of below 50 and an age-equivalent of 0 years, 10 months when supplementary sign was utilized (See Table 4.). When the evaluator would call attention to an object, Logan would momentarily attend to the object at hand. In addition, Logan would activity search for the source of sounds when the source was not visible. Logan was able to follow simple directions such as “sit down” and “throw the ball.” He used more than one object during play and demonstrated appropriate use of these objects. Logan, however, was not able to identify familiar objects from a group of objects and was not able to point to photographs of familiar items.
Expressively, Logan received a standard score of less than 50 and an age-equivalent of 1 year, 4 months with the use of supplemental sign (See Table 4.). Logan was able to sign at least 25 different words throughout the evaluation. He signed single utterances such as “ball,” “bye-bye,” “water,” “fly,” “more,” and “please.” Although few verbal words were heard during the current evaluation, Logan’s mother reported that he demonstrates emerging verbal skills in the home environment. For example, Logan has verbalized the words “Sponge Bob,” “milk,” “more,” and “bubbles” at home. He, however, has been inconsistent with these emerging verbal utterances and prefers to sign across domains. When looking at books, Logan used signs to label various objects in the pictures such as “cat” and “spoon.” His mother reported that he produces the following vowels and consonant sounds in verbal utterances: /u/, /a/, /d/, /p/, /r/, /l/, /v/, and /s/. He was also observed to produce the syllables /ma/ and /ba/ as well as the blend /gr/. These productions are also inconsistent in the home setting. Logan was not observed to initiate any turn-taking games with others or participate in 1-2 minutes of a play routine.

Overall, Logan’s communicative functioning is significantly below his same-age, hearing peers. Logan has not yet acquired the skills necessary to demonstrate his full realm of knowledge. This is most likely due to his decreased ability to attend to others and objects/people in his environments. Even with supplemental sign, Logan continues to use limited signed utterances to request his wants and label the world around him. His decreased ability to attend, however, limits his interactions as he is unable to participate or initiate play routines. These social-communicative deficits including his decreased attention and social interactivity are consistent with individuals with an autism spectrum disorder.
Current Language Functioning: Case “Johnny”

The PLS-4 was administered to Johnny in order to assess his receptive and expressive language abilities. The results of the language evaluation found that Johnny’s receptive and expressive language functioning was moderately below average compared to his same-age peers; his standard scores for all subtests were almost two standard deviations below the mean. Johnny was accompanied to the evaluation by his mother who observed the evaluation from the observation room. Upon meeting Johnny, he was visibly agitated about leaving the waiting room due to an intense fear of getting shots. He soon calmed and appeared to enjoy interacting with others. Throughout the evaluation, Johnny was overly verbose and frequently talked about topics unrelated to the present conversation. When he was unsure of a response, Johnny frequently would revert to his “silly” voice that resembled a growl. Even so, Johnny was easily redirected during his inattentive moments.

Receptively, Johnny received a standard score of 81 and an age-equivalent of 4 years, 9 months (see Table 4.). Johnny demonstrated understanding of a variety of linguistic concepts including the following: qualitative concepts (tall, long), qualitative concepts (longest, small/black), and simple time concepts (first, last and seasons). Johnny, however, struggled to demonstrate understanding of more complex concepts such as “more/ most” and passive voice sentences. He was able to identify rhyming words, but not identify words that started with the same letter.

Expressively, Johnny received a standard score of 72 and an age-equivalent of 3 years, 10 months (see Table 4.). Johnny described how simple objects are used (spoon, coat), utilized possessive structures of nouns (girl’s, cat’s), and produced the correct past
tense verb forms. Johnny, however, was unable to answer open-ended questions in a logical manner. For example, when asked “What would you do if your hands were dirty?” Johnny perseverated on previously presented pictures and replied, “I eat some oranges.” In the same way, Johnny was unable to answer questions about hypothetical events. When asked, “What would you do if you got food on your shirt?” Johnny replied, “Because, I can’t get food on my shirt.” When asked “Why do we wear jackets?” Johnny replied “Have to wear jackets.” When looking at Jonny’s articulation, he did demonstrate mild articulation errors on airflow sounds, but these sound substitutions did not interfere with his overall intelligibility.

Overall, Johnny presented with moderately- below average receptive and expressive language abilities compared with his same-age peers. He demonstrated greater understanding of language concepts compared to his expressive communication. Johnny struggled to respond to stimuli of a more abstract and open-ended nature. If he was unsure, Johnny responded with off-topic comments or spoke in his “silly” voice. He may have understood that a response was required, but was not able to organize and produce a clear, meaningful sentence pertaining to the topic of conversation. These communication deficits such as the inability to maintain topic and attend to others is typical of an individual with an autism spectrum disorder.
Table 4: This table compares the standard scores, percentile rankings, and age-equivalents from each scoring section of the PLS-4. Note that there are two scores for Logan. His scores are presented with and without the use of supplemental sign.

<table>
<thead>
<tr>
<th></th>
<th>Auditory Comprehension</th>
<th></th>
<th>Expressive Communication</th>
<th></th>
<th>Total Language Score</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Logan</td>
<td>Johnny</td>
<td>Logan</td>
<td>Johnny</td>
<td>Logan</td>
<td>Johnny</td>
</tr>
<tr>
<td>Standard Score</td>
<td>50</td>
<td>81</td>
<td>50</td>
<td>72</td>
<td>50</td>
<td>74</td>
</tr>
<tr>
<td>50*</td>
<td></td>
<td></td>
<td>50*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentile Rank</td>
<td>1</td>
<td>10</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>1*</td>
<td></td>
<td></td>
<td>1*</td>
<td></td>
<td>1*</td>
<td></td>
</tr>
<tr>
<td>Age-Equivalent</td>
<td>0-6</td>
<td>4-9</td>
<td>1-0</td>
<td>3-10</td>
<td>0-9</td>
<td>4-2</td>
</tr>
<tr>
<td>0-10*</td>
<td></td>
<td></td>
<td>1-4*</td>
<td></td>
<td>1-2*</td>
<td></td>
</tr>
</tbody>
</table>

* score derived from utilizing supplemental sign
Figure 1: This graph depicts the developmental age gap that exists between each subject’s chronological age and developmental age-equivalents on the PLS-4. Note that the age gap is given in age units of months. Figure 1 demonstrates that although each subject has significant delays, Logan’s delays are much greater than Johnny’s delays.
CHAPTER V.

Discussion

Summary

This study sought to investigate the language outcomes of children with cochlear implants who also have an autism spectrum disorder. This study stands as a small subset of a much larger study that is examining the language outcomes of children with developmental disabilities— not just ASD. Due to the limited number of subjects with this dual diagnosis, the language functioning of one subject, “Logan,” with a CI and ASD was investigated. In order to better isolate Logan’s language level in relation to his hearing loss, a control subject, “Johnny,” was enrolled in the study; he presented as a same-age peer with a similar developmental profile, but had normal hearing levels. Each subject participated in a language evaluation that included the administration of the PLS-4. Results from this investigation reveal no definitive conclusions regarding Logan’s level of language growth from his pre-operative to his post-operative status. This study, however, did yield important conclusions implying the effects of hearing level on language growth of a child with ASD.

Comparing Logan and Johnny

It remains difficult to accept that the great disparity between Logan and Johnny is not related to their cognitive functioning— rather their language level. Both Logan and Johnny are below average compared to their same-age peers and both present with social-communicative deficits characteristic of ASD. However, Logan is clearly functioning at a lower language level than his normal-hearing, same-disabled counterpart. Both subjects have social-communicative deficits, but Logan’s deficits are more prelinguistic
in nature. In other words, communication abilities such as the ability to attend to objects/people are fundamental to learning and expressing more complex language concepts. For example, Logan’s inability to respond to his name restricts him from jointly attending to learning experiences with others. These early language skills are still emerging in Logan, while Johnny has moved beyond these basic communication concepts. Johnny will indeed respond to his name in order to attend to verbal redirection. His social-communicative deficits, however, break down on the conversational level. Johnny is unable to attend to the topic of conversation. He continues to acquire the skills necessary to understand and express more abstract language ideas such as wh-questions. When he is unsure of an exact response, Johnny will resort to perseveration on words or phrases.

Hypothesis Revisited

More specifically, Hypothesis 1 stated that “Children who are deaf and diagnosed with an autism spectrum disorder will demonstrate significant language gains after receiving a cochlear implant compared to their pre-operative language skills.” Based on the results of this investigation, Logan’s level of language gain cannot be determined at this time. A pre-operative language score from the Revised Gesell Developmental Schedules was not documented at 24 months of age. Logan’s pediatrician noted that she was unable to formally assess his language due to the nature of his significant language delay. She, however, did note that he had difficulty with joint attention tasks and had little to no eye contact. Expressively, the pediatrician noted that Logan reportedly knew approximately 35-40 signs and would request items by pulling people towards objects. Closely before Logan’s implantation, the Rossetti Infant- Toddler Language Scale
(Rossetti, 1990) was administered to Logan. At this time, his language age was found to be 6 months. The results of the current study identified his language age to be approximately 13 months of age. These numbers suggest some degree of language gain after implantation, but these gains remain limited considering Logan demonstrated only 6 months of growth over a period of approximately 3 years. From this basic communication data, specific and reliable functional language growth can neither be determined nor implied.

In addition, Hypothesis 2. stated that “The language skills of children who are deaf diagnosed with an autism spectrum disorder will remain lower than hearing children matched by their developmental profile after cochlear implantation.” Based on the results of the current investigation, Hypothesis 2 was correct. Logan’s language skills post-implantation remained remarkably lower than his normal hearing counterpart (refer to Table 4 and Figure 1). Logan continues to acquire the understanding and expression of basic linguistic concepts that underlie more complex communication. Johnny’s deficits, however, exist at a higher language level. As Logan struggles to attend to the world around him, Johnny struggles to attend to a single topic of conversation.

Limitations

Considering that the population of individuals with a CI and ASD is small, large group studies are near impossible to complete. Studies examining this unique population must rely on small group and case study research designs to describe the language functioning of these individuals. These types of research designs, however, may not reflect the larger, general CI and ASD population. The results of the present study are further limited since the language functioning of only one dyad pair was examined.
Knowing this, it remains even more difficult to make assumptions about the CI and ASD population based on just this one pair.

In addition, the full realm of any individual’s communicative abilities cannot always be determined through a brief, isolated session using a single standardized measure. A combination of both formal and informal assessments should ideally be utilized to evaluate an individual’s communication. Informal assessments should be authentic in nature and include a variety of structured observations across a child’s everyday environments including the home and school setting. This type of assessment may also include in-depth interviews of parents, teachers, and any other caregiver who regularly communicates with the child. Finally, more natural assessments may perhaps be more useful for the CI and ASD population where communicative skills may be inconsistent across environments. These types of evaluations, however, are not always practical in the large medical setting.

Finally, research investigating the effects of a CI of the ASD population on the development of language is limited by a variety of factors that cannot always be controlled. When matching subjects, researchers must be careful to control for other factors that may impact language growth. Many of these highly-involved populations have been receiving early intervention services and therapies for years. Each child has different therapy goals and each therapist will approach these goals differently. How are researchers able to measure the effects of the CI only if language gains could be attributed to therapy intervention?
Implications for Further Research

The literature regarding the language functioning of children with a CI and ASD is scarce. Continued investigation of pre/post implantation language outcomes using both qualitative and quantitative measures is necessary in order to make decisions relating to CI candidacy, expected prognosis, and appropriate treatment. Outcomes of studies using more than one dyad pair would better reflect the general population and researchers should gather information using a combination of formal and informal methods. Matching these dyad pairs by “hearing age” rather than “chronological age” may be better representative of a child’s expected language outcomes. By making this distinction, researchers are able to consider hearing experience in order to compare expected receptive and expressive gains. Finally, investigators should consider conducting longitudinal studies on this unique population. Perhaps these children do indeed acquire language that more closely resembles their normal-hearing counterparts, but need more time and therapy to process language utilizing their CI. Longitudinal studies would be able to track the degree and onset of these language gains compared to the date of implantation.

Implications for Professional Practice

The level of language gain that children with ASD make after implantation is not fully known. However, it can be suggested that any level of progress will take a great deal of time and patience. Expected gains may be attained at a much lower rate compared to this population’s normal-hearing ASD counterparts. Clinicians should take this into account when creating treatment plans and educating parents about expected timelines for language growth.
Clinicians should also be careful not to make assumptions of a child’s cognitive functioning based on their receptive and expressive language scores. Professionals often imply a child’s level of cognition parallels their receptive language scores. Logan and Johnny both had similar cognitive functioning, but vastly different language scores. Logan’s language score would imply a much lower cognition compared to Johnny’s cognition. This will also allow clinicians and parents not to underestimate their child’s learning potential.

The typical therapies that involve children with a CI and children with ASD should all be utilized for this dual diagnosis population in order to make the best possible gains. Knowing that multiple disciplines are involved, collaboration and communication among professionals will be better equipped to serve these highly-involved children. Knowing that any progress a child with a CI and ASD makes may be significantly lower than their normal-hearing counterparts, treatment should be conducted through multi-disciplinary initiatives.

Conclusion

Clinical decisions for any population must be firmly supported through evidence-based means. Children with cochlear implants and an autism spectrum disorder exhibit communication challenges thought to be beyond the level of their normal-hearing, same-disabled peers. Efforts to explore the language outcomes of this unique population have yielded results that are inconclusive. As seen through the literature, the benefits of cochlear implantation on language functioning for this population have scarcely been described or even quantified. The present study sought to accomplish such a task, but was limited by the number of subjects as well as a lack of preimplantation data. Even so,
this study stands as a forerunner for future research initiatives. Research is desperately needed in order to determine implantation candidacy, expected prognosis over time, and appropriate treatment approaches. In this way, speech-language and hearing professionals are better equipped to provide ethical service delivery options as well as advocate for these children’s most basic communication needs.
References


