

EXAMINING THE DIFFERENCES IN EXPRESSIVE AND RECEPTIVE
LEXICAL LANGUAGE SKILLS IN PRESCHOOL CHILDREN WITH
COCHLEAR IMPLANTS AND CHILDREN WITH TYPICAL HEARING

BY

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Examining Language Differences

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Abstract

To what extent is there a difference in expressive and receptive lexical language skills in children with cochlear implants and children with typical hearing?

Research has demonstrated the efficacy of the cochlear implant in improving the hearing acuity in children. Further, research has also demonstrated that hearing ability affects receptive and expressive language skills. This study examines the differences in expressive and receptive lexical language skills in children with cochlear implants and children with typical hearing by using the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4) and the Expressive Vocabulary Test, Second Edition (EVT-II). The Wechsler Nonverbal Scale of Ability was utilized to control for cognitive ability. Independent Samples T-Test and Analysis of Variance were used to examine the results. Results indicate that children with cochlear implants and children with typical hearing performed comparably on each assessment of language skill. Further, no significant differences were evident within the cochlear implant group based on age of implant or for age of identification of hearing loss.

Chapter 1: Introduction

As human beings, communication is one of the fundamental aspects of our lives. Children use language to express their needs as well as to develop their comprehension of the world around them. Imagine if that ability was somehow hindered? Research has shown that hearing loss will negatively affect language and communication development. (Sampson-Fang, Simons-McCandless & Shelton, 2000; Hoff, 2001 & 2005). However, research has also shown that early intervention can substantially increase a child's formerly limited communication skills when hearing impairment is a factor (Moeller, 2000; Nicholas & Geers, 2007). A great deal of research has been conducted comparing language and communication development in children who use hearing aids to children who have cochlear implants. A review of this literature indicates, however, that the focus has been on demonstrating that cochlear implant users demonstrate greater gains in language and communication over those with similar hearing loss who use hearing aids (Tomblin, Spencer, Flock, & Tyler, 1999; Tharpe, Ashmead, & Rothpletz, 2002; Chin, 2003; Peng, Spencer, & Tomblin, 2004; Paatsh, Blamey, Sarant, Martin, & Bow, 2004; Cleary, Pisoni, & Kirk, 2005). This research has occurred mainly with school-aged populations. There have been limited studies on the language and communication development of preschool aged children with cochlear implants. Additionally, these studies are limited by small sample size, a lack of control for enrollment in early intervention programs, and the examination of children using only one brand of cochlear implant (Meyer, Svirsky, Kirk, & Miyamoto, 1998; Robbins, Bollard, & Green, 1999; Sainz, et al., 2003).

Clearly it is important to acquire a basic understanding of typical language development before looking for differences in populations. Research has amply demonstrated that there are four major components in the development of typical language which occur when language is learned during the first four years of life: Phonology, lexicons, grammar, and communication (Reich, 1986; Kail, 1998; Hoff, 2001 & 2005). Phonology is defined as learning to understand, distinguish, and produce, or “say” the sounds of one’s language. It includes stages such as cooing, babbling, sound-symbol association, and intonation, and is typically adult-sounding by age 6 (Reich, 1986; Kail, 1998; Hoff, 2005). Lexical knowledge involves learning to identify, label, and understand words and word meaning. By age five months children are able to recognize words, and by 10 months, most are able to understand word meaning. By one year of age, children typically say their first word. Grammar is the structure of language, and it is comprised of syntax (the order of words), and morphology (small unit that gives a word meaning, such as ‘ed’ at the end of a word). Children are typically relatively proficient at grammar by age four years. Finally, communication involves understanding the function of language, how to participate in a conversation and relate to past events, and how to speak in a way that is congruent to one’s social group (Reich, 1986; Kail, 1998; Hoff, 2001 & 2005).

As 28 million Americans are hearing impaired or deaf, it is clear that there is a significant reason to work to improve communication for this population. Individuals with hearing impairments communicate in several different ways, though typically do not use oral language as proficiently as hearing individuals making communication within the hearing world more difficult. Interestingly, however, research suggests that children

who are exposed to sign language from infancy typically follow the same pattern of language development as hearing children (Hoff, 2005). They make the same errors at the same stages as children learning spoken language (Anisfeld, 1984; Mogford, 1993). However, Jensema, Karchmer, and Trybus (1978) suggest that only 15 to 55% of orally educated deaf children achieve intelligible speech (as cited by Hoff, 2005). The need to study alternative means of achieving speech and speech perception is clear.

Oral language is dominant in today's society, which clearly presents a struggle for an individual with hearing loss as it negatively impacts a person's ability to perceive oral language and to communicate orally. Feelings of uncertainty, fear, and trauma are experienced by families once they learn of a child's hearing loss (Allegretti, 2002). Parents may feel frustrated with the inability of their child to communicate exact thoughts and needs. They may fear misinterpreting attempts at communication. They often limit their child's freedom due to fear of the child's inability to hear the world around them. Children with hearing impairments struggle with interacting with hearing playmates (Tucker, 1998). In addition, children with hearing loss with average intelligence generally have verbal language abilities that measure 20 to 40 points lower than their hearing peers, which in turn, affects their reading and writing scores (Sampson-Fang, Simons-McCandless, & Shelton, 2000).

In general, children with hearing aids have an increased ability to perceive spoken language and communicate orally (Tomblin et al., 1999). Given this, it is not surprising that many parents opt for the most advanced of hearing-improving technologies, the cochlear implant (CI). A cochlear implant is a small, complex electronic device that can help to provide a sense of sound to a person with profound sensorineural hearing loss due

to degeneration of the hair cells in the ear that transmit sound to the auditory nerve. Sensorineural hearing loss originates in the cochlea which is the sense organ that translates sound into nerve impulses to be sent to the brain (Tye-Murray, 2004). The implant essentially bypasses these non-functioning cells, allowing the auditory nerve to receive stimulation, and thus, enabling the person to hear sound. A receiver is placed behind the ear, under a flap of skin, cradled next to the skull. The surgeon then drills through the skull and inserts an electrode array directly into the cochlea. The outer portion sits behind the ear. It includes a microphone to pick up environmental sound, a speech processor to process the signal, and a transmitter to send the sound to the electrode array (Tye-Murray, 2004). Cochlear implantation will likely increase the ability to hear, though not always to the equivalent of hearing peers.

Presently, the Food and Drug Administration (FDA) has approved five types of cochlear implants for use in the United States. Three separate companies manufacture these implants: Men-El Corporation (www.medel.com), which makes the Combi 40+ Cochlear Implant System, Advanced Bionics (www.advancedbionics.com) makes the Clarion Multi-Strategy Cochlear Implant, and Cochlear Americas (www.cochlear.com), which makes the Nucleus 24 Cochlear Implant System, the Nucleus 22 Channel Cochlear Implant System, and the Nucleus Multichannel Implantable Hearing Prosthesis. Often, research on cochlear implants focuses on only one of these brands at a time, making it difficult to find inclusive studies examining the effect of implants on language differences.

As previously reported, research has examined language development and differences in children with cochlear implants. Meyer, Svirskey, Kirk, and Miyamoto

(1998) found that speech perception of children with hearing loss in the 101-110 dB range experienced a greater increase in speech perception when implanted with the NUCLEUS multichannel cochlear implant than did their peers with hearing aids. However, their speech perception was only equal to that of a child with 90-100 dB loss wearing aids, indicating that although speech perception increased, it did not equal that of a typically hearing child. A similar study found that the language comprehension and production of children with cochlear implants was significantly better than that of their peers wearing hearing aids, though the differences in scores were only significant after 2 years of post-implant experience (Tomblin, Spencer, Flock, & Tyler, 1999). Of note is the fact that these studies are over 10 years old and the implant technology utilized has changed significantly.

Many studies have suggested that the efficacy of cochlear implantation varies with age at implantation and years of use (Sampson-Fang, et al., 2000; Ertmer, Young, Grohne, Mellon, Johnson, Corbett, & Saindon, 2002; Sainz, et al., 2003; Ertmer, Strong, & Sadagopan, 2003; Nicholas & Geers, 2007). This is particularly true for expressive language vocabulary (Tomblin, Barker, Spencer, Zhang, & Gantz, 2005). Further, Yoshinago-Itano, Sedey, Coulter, and Mehl (1998) suggests that the age at which a child is identified as having a hearing loss also significantly impacts their expressive and receptive language skills. Nicholas and Geers (2007) suggest that children implanted after 30 months of age may not ever catch up to their hearing peers in the area of language development. They also found that children implanted after age 24 months do not show the same increase in language levels as compared to their earlier implanted peers, even after controlling for duration of implant use (Nicholas & Geers, 2007). Overall, this data

suggests that age at identification for hearing loss, age at implantation, and years of cochlear implant use all contribute to language and communication development in children.

Due to the fact that cochlear implant technology is still relatively new, availability of extensive data is still a challenge to researchers looking to study language development in children with cochlear implants. However, Sainz et al. (2002) studied the auditory abilities of 140 children with the MEDEL COMBI 40/40+ implant for two years. Their results suggest that implantation significantly enhanced the listening abilities of the children, as measured by the Listening Progress Profile and the Monosyllabic-Trochee-Polysyllabic Word Test of the Evaluation of Auditory Responses to Speech (EARS) test. Further, though gains continued for up to two years after implantation, the most rapid gains were made in the first month after implantation. As listening skills are essential to the development of language and communication, these findings are significant. Again, only one brand of implant was examined in this study.

Despite limited research, a few studies have indicated that children with cochlear implants indeed make gains towards attaining age-appropriate language skills. Robbins, Svirsky, and Kirk (1997) found that children wearing the Nucleus (N=23) displayed an average language development rate in the first year of using the device, equivalent to that of children with normal hearing. This supports the findings of the study by Meyer et al. (1998), noted previously. Robbins, Bollard, and Green (1999) found similar results with children wearing the Clarion Multi-Strategy Cochlear Implant (N=23). Conversely, in a study that did not control for brand of implant use, Nicholas and Geers (2007) found that children who receive an implant prior to age 24 months and who were also enrolled in an

oral education program (uses oral language) at the time of implantation exhibited levels of spoken language that were on par with their hearing age-mates prior to entering kindergarten.

There is little research on the effectiveness of cochlear implantation on language development with children of preschool age. Research does suggest that early identification of hearing loss and younger age of cochlear implantation significantly affects language and communication outcomes in children. Moeller (2000) found that hearing impaired children who were enrolled in an early intervention program at a very young age (11 months) demonstrated significantly better vocabulary and verbal reasoning abilities than did later enrolled peers, with scores approximating those of hearing peers. The effects of early intervention are clear.

It is evident that further research is needed to continue the examination of communication skills in preschool children with hearing impairments and cochlear implantation. Some research suggests that the perceived benefits of cochlear implantation may outweigh a less than perfect outcome (Tucker, 1998; Miller & Wheeler-Scruggs, 2002; Dawson, Busby, McKay, & Clark, 2002). However, it is important nonetheless to continue investigations to determine exactly what these benefits are, perceived or otherwise. The importance of language and specifically, the fact that children with hearing loss struggle in this area has been demonstrated. Despite this, there are options besides implantation available to families. To make an informed decision, families need to know what research indicates regarding the language outcomes of different interventions. Families must be aware of the true result of implant surgery, rather than carrying possible false hope that their child will suddenly be able to hear and speak

normally. It seems that a comparison of children with implants and children with typical hearing of the same age enables researchers to obtain the comparative data necessary to help families to make informed decisions.

Further, much of the available research was conducted utilizing older cochlear implant technology. Significant advances in technology has allowed for dramatically different results in hearing and speaking ability within the past decade, indicating that older studies do not amply demonstrate the language skills of today's children with cochlear implants. In the 1990's, children were typically implanted between three and five years of age, rather than today's standard of 12 months of age, due in part to advances in newborn hearing screening. This allows for greater early exposure to language, improving overall language skills. Finally, a large number of studies have been conducted with school-aged subjects, with far fewer utilizing preschoolers: Particularly due to earlier implantation with new technology, studies examining language development in younger children are imperative.

The present study attempts to add to the body of literature on language development in preschoolers with cochlear implants by examining the lexical language skills of children with cochlear implants and comparing the results those of a group of children with typical hearing. The PPVT-4 and the EVT-2 were utilized to assess language skill, and the WNV was administered to control for cognitive ability.

Chapter 2: Literature Review

Hearing Loss and its Affect on Language

The idea that any amount of hearing loss, no matter how minimal, will negatively affect language and communication development has been amply demonstrated (Carney & Moeller, 1998; Sampson-Fang et al., 2000; Hoff, 2001 & 2005). The importance of early intervention in the language and communication development in children with hearing loss has also been studied (Moeller, 2000; Nicholas & Geers, 2007). While many studies have focused on language or communication development in children with hearing impairments and with cochlear implants, the focus has mainly been on demonstrating that implant users demonstrate better language skills than hearing aid users with similar levels of hearing loss, as well as on improvements in language skills after years of implant use (Tomblin, Spencer, Flock, & Tyler, 1999; Tharpe, Ashmead, & Rothpletz, 2002; Chin, 2003; Peng, Spencer, & Tomblin, 2004; Paatsh, Blamey, Sarant, Martin, & Bow, 2004; Cleary, Pisoni, & Kirk, 2005). Though there have been a few studies that demonstrate significant improvements in language development in preschoolers after implantation, due to the fact that this is a low incidence disability these studies are limited by small sample size, a lack of control for enrollment in early intervention programs, and the examination of children using only one brand of cochlear implant (Robbins, Bollard, & Green, 1999; Sainz, 2002).

In a society where oral language is dominant, people with hearing loss often face significant communication difficulties. For example, 90% of children who are deaf are the first deaf person in their family, thus, leading to disbelief, trauma, and feelings of uncertainty (Crouch, 1997; Allegretti, 2005). Uncertainty can stem from an inability to

communicate exact thoughts and ideas, and a risk of misinterpretation. Parents may fear letting their child have freedoms due to their inability to hear the world around them.

Children have difficulty interacting with hearing playmates and will likely struggle in a typical educational setting. They cannot use telephones without a third party or TTY (also known as a TDD, a telecommunication device for the deaf): They must choose movies or plays that have an interpreter, they cannot hear announcements in public facilities such as schools, and they cannot plan spur of the moment meetings or gatherings without finding an interpreter (Tucker, 1998).

Typical Language Development

Even children and families who elect to receive cochlear implants struggle with communication long after implantation occurs (Allegretti, 2005). Tucker (1998) suggests that “...an individual who has an implant is still deaf. The difference is, however, that the ramifications of deafness are significantly reduced (p.12).” Therefore, it is pertinent to begin with a brief discussion of typical language development in order to form a basis of understanding for comparison when studying children whose language development may be atypical. It is widely accepted that there are four major components in the development of language: phonology, lexicons, grammar, and communication. It is also widely accepted that language is learned in the first four years of life, as the foundation for each of these components occurs (Reich, 1986; Kail, 1998; Hoff, 2001 & 2005).

Phonology. Phonology is defined as learning to “distinguish and produce the sound patterns of the adult [oral] language” (Vihman, 1988a p. 61, as cited by Hoff, 2001). Within the first year of life, children begin to learn language. It has been demonstrated that infants can not only distinguish their mother’s voices from others, but

they can also distinguish one story from another; In fact, research suggests that infants are better at recognizing phonemes than adults (DeCasper & Fifer, 1980; Clarkson & Berg, 1983). Phonemes are the meaningfully different sounds in a language. Newborns begin by making vegetative speech sounds- sounds that make vocal chords vibrate, but are not done intentionally and have no meaning (Hoff, 2001 & 2005).

Vegetative speech sounds include the sounds that accompany activities such as crying and sucking. Around six to eight weeks of age, infants begin cooing (Bonvillian, Orlansky, & Novack, 1983). Cooing initiates as one long vowel sounds, and later develops into separate vowel sounds strung together and separated by breathing. As infants age, they learn to separate their coos by adding different vowel sounds, by breathing, and by adding consonants. This occurs around 6 to 9 months of age and indicates that the child has entered the stage of babbling (Reich, 1986; Hoff, 2001). Babies begin babbling without true syllables. Once true syllables begin to emerge as repeated patterns in their speech such as [dadadada], they have entered the state of canonical babbling. This is the first development that distinguishes the speech of a deaf infant from a hearing one, as deaf infants do not produce canonical babbling. Next, babies begin nonreduplicated babbling, or adding vowels and consonants together into a series that is not repetitive. At this point, babies also begin to utilize prosody- intonation, the melody of language without using actual words (Hoff, 2005).

At around 11 months of age, babies begin to transition out of the babbling phase. Many children begin to utilize made-up words or “protowords” that have consistent meaning, but bear no resemblance to any word in their language. They also have increased their repertoire of consonants and vowels exponentially, though not yet

completely. By the end of the first year, children are typically able to babble “sentences” that have the intonation, the variation of tone used when speaking, of their language. As children’s articulatory abilities develop, these sounds begin to form words. At around their first birthday children typically say their first word. By 18 months of age, children’s phonological processes become more consistent, though not yet adult-like. For example, sounds are often altered to fit the child’s repertoire: *bottle* may become /baba/. This stage often lasts until age 3 or 4 years. Between 4 and 5 years children seem to make great strides in mastering the phonemes of their language. By age 6 years, children begin to sound nearly adult-like in their spoken language (Reich, 1986; Kail, 1998; Hoff, 2001 & 2005).

Lexical Knowledge. The development of phonemes leads naturally into lexical knowledge, or learning words. Houston, Carter, Pisoni, Kirk, and Ying (2005) describe learning words as a “fundamental aspect of learning spoken language” (p. 41). Hoff (2001) describes words as “symbols that can be used to refer to things, actions, properties of things, and more (p. 140).” Reference indicates that the word is a symbol that “stands for” the thing they are referring to, not just that the word and the thing to which they refer simply “go together.” While pointing and crying are also ways to convey information, they are not symbols. This is an important distinguishing factor that make words a unique form of communication (Kail, 1998; Hoff, 2005).

As one learns words, one organizes them in to a mental lexicon or mapping system for language. Children begin recognizing words at 5 months, and understand word meaning around 10 months (Anisfeld, 1984; Reich, 1986; Hoff, 2001 & 2005). Children typically say their first word in close proximity to their first birthday. This is

distinguished from the protoword described in the discussion of phonology because protowords are not in any way derived from the child's language; In contrast, true words are the beginning of the child's ability to communicate using their oral language (Hoff 2001 & 2005).

Between their first word at around 12 months and approximately 16 months, children begin learning an average of 8 to 11 words a month. Exposure to a new word does not necessarily result in learning that word during this period. At 16 months of age, most children have a vocabulary of 50 words, mostly consisting of nouns, and largely reflective of the child's experiences and routines. However, for most children a rapid increase in word-learning occurs after hitting the 50 word mark. Instead of 8 to 11 words a month, children begin to learn an average of 22 to 37 words a month, sometimes after being exposed to the word only once. This is referred to as the "word spurt," indicating that word-learning becomes much more efficient after a baseline of 50 words or so has been reached (Reich, 1986; Kail, 1998; Hoff, 2001).

Research suggests that the size of children's vocabularies are affected primarily by their phonological memory skills and how much they are spoken to. In addition, it also appears to be affected by the amount of speech that children hear, the nature of the speech they hear (such as a richer vocabulary with many different words), and the timing of the speech directed toward a child in response to their focus of attention (Kail, 1998; Hoff, 2001). Nonlinguistic concepts or ideas about what the word encodes also influence how children learn words. Children "map" or build onto their word knowledge by developing hypotheses about what the word means, and using the syntax or the structure of the language to derive the word's meaning (Hoff, 2005).

Finally, lexical development early in life plays an important role in children's language skills much later in life. Research indicates that word learning can influence a child's later reading and vocabulary skills and verbal memory. Rescorla (2005) studied the language skills of children who experienced receptive language delays at age two years. By comparing their performance on several measure at age 13 to the performance of typically developing children of the same age and background, she found that these children continued to experience difficulty with vocabulary, grammar, verbal memory, and reading comprehension, thus indicating the importance of early lexical development.

Grammar. Grammar, or the structure of language, is comprised of syntax, the order words are put in, and morphology, the smallest units of language that give words meaning. Children initially speak in single-word utterances, lacking the need for grammatical structure. Some children go through a period of time of stating seemingly related one-word utterances together, alluding to a relationship between the words, but not yet forming a simple sentence. Eventually, however, children begin to string two or more words together, and sentences begin to emerge. Initial sentences are typically simple active declarations such as "Off TV." Children are said to have the beginnings of a productive speech system when they can utilize words in different combinations with true meaning. For example, a child may use the word "big" in the utterances "big ball, big pants, big step," indicating that he understands how to use these words grammatically, and has a productive language system (Hoff, 2005).

Between 18 months and two years, children begin to string together series of utterances: two or three word combinations (Anisfeld, 1984; Reich, 1896). First sentences begin as telegraphic in nature- that is, they lack grammatical morphemes such as verb

endings. Between ages two and three and one half years, children begin to fill in the missing morphemes of telegraphic speech. They also begin expanding the range of sentence forms they use by including negative statements, asking questions, producing complex sentences (more than one clause), and by using passive forms of speech. Passive speech continues to grow past age five years. By the time children begin putting three words together, their sentences begin to have grammatical structure, including questions and negative statements. At four years of age children have typically mastered the grammar of adult language and have an awareness of phonological properties (Bonvillian et al., 1983; Anisfeld, 1984; Reich, 1986; Hoff, 2001 & 2005).

Communication. Children must also learn to use language as a means of communication. Communication involves pragmatics, or understanding the function of language; discourse knowledge, or understanding how to participate in a conversation and relate past events; and sociolinguistic knowledge, or understanding how to speak to others in a manner that is congruent to one's own particular social group. Around three months of age, children are able to "participate" in turn-taking behavior during communication; Parents and infants can be seen taking turns in being active and passive in "conversations," including both actual noises and movements of one's body (Hoff, 2005).

Children begin to utilize communication intentionally around 10 months of age, and by one year, are able to use words, intonation, and gesture to communicate. During the second year of life, conversation skills begin to develop as children learn the art of the narrative. They learn how to take turns while speaking, how to initiate a topic, how to repair miscommunication, and how to respond contingently (response includes the same

topic as the previous sentence and use the same sentence structure). Conversation skills in children are initially asymmetrical, as adults work to build the conversation around the children. Gradually, however, children begin to carry more of the burden of conversation. They begin to produce descriptions of past events and with the adults' help, the narrative develops (Hoff, 2002, 2005).

While alone, children will engage in an activity called private speech in which they "think out loud" or talk to themselves. This helps them to regulate their own behavior as they have not yet learned to internalize thought (Kronk, 1994). While children talk with one another, their conversations are often much more disjointed and infused with private speech than when an adult guides them (Bonvillian et al., 1983; Kail, 1998; Hoff, 2001 & 2005). Finally, between the ages of two and five years, children begin to demonstrate an understanding of sociolinguistic skills by using the style of language unique to one's social group (Hoff, 2005).

Language Development in Deaf Children: Sign Language Acquisition

The scope of the proposed study limits the discussion of research to the acquisition of oral communication skills in prelingually deaf children. Prelingually deaf indicates that hearing was lost prior to the acquiring of language. However, before cochlear implants, the native language of most prelingually deaf children was American Sign Language (ASL). Therefore, a discussion on the acquisition of ASL is warranted.

It is pertinent to begin by mentioning that it has been amply demonstrated that ASL (1) has a lexicon, (2) these lexical items are made up of a finite and discrete number of sublexical components equivalent to phonemes, and (3) this language has a grammar (Stokoe, Casterline, & Croneberg, 1965; Klima & Bellugi, 1979; Bonvillian et al., 1983).

The grammatical structure of ASL is that of a completely separate language, not at all similar to spoken English. The literature suggests that children exposed to sign language from infancy follow the same pattern of language development as hearing children.

Infants begin with manual babbling and follow this with singular manual words. This is followed by the production of multisign combinations, morphological development, and finally, an increase in the complexity of syntax (Klima & Bellugi, 1979; Hoff, 2005).

Interestingly, Klima and Bellugi (1979) tell us that deaf toddlers sign to themselves in their sleep, that deaf children sign to toys when they think they are alone, that hands “mutter” when someone is “thinking out loud,” and that deaf adults will rehearse something through sign to memorize it or sign something read to themselves in order to clarify it. This demonstrates still more similarities between the two languages.

Children who learn ASL also make the same errors at the same stages as children learning spoken language. They make errors in their morphological markers, small units of language that convey meaning such as adding an /ed/ to make something past tense (e.g., *goed*), persist in errors and ignore parental corrections (even though these corrections actually take the form of physically repositioning the hand in some cases), and make pronoun reversal errors at the same age as oral-language users (Anisfeld, 1984; Mogford, 1993).

However, some differences do exist. Children who sign seem to produce first words, acquire 10 word vocabularies, and combine words earlier than hearing children (Bonvillian, et al., 1983; Folven & Bonvillian, 1991; Bonvillian, 1999). It is also interesting to note that both oral and signing babies use gestures to communicate with

others before using actual words, which lends an advantage to a manual language-user (Goodwyn & Acredolo, 1993).

Oral Language Development in Deaf and Hearing-Impaired Children

Clearly, there are significant obstacles to acquiring spoken language when one's hearing is impaired. Jensema, Karchmer, and Trybus (1978) report that only 15% to 55% of orally educated deaf children achieve intelligible speech (as cited by Hoff, 2005). Deaf infants, even if exposed only to sign, begin by crying, cooing, and babbling, similar to hearing infants. However, during the babbling stage noticeable differences emerge. The quantity and quality of sound is different in that deaf infants do not produce clear syllabic babbling typical of hearing infants (Hoff, 2005).

According to Hoff (2005), research suggests that semantic development is similar in both deaf and hearing children. Conversely, syntactic development is typically far less well developed in deaf children than in hearing children, even when assessed at a wide range of ages (Quigley, Power, & Steinkamp, 1977; Quigley & King, 1980; Mogford, 1993). Quigley, Power, and Steinkamp (1977) authored an article which summarized the results of their extensive six-year research project which examined the use of syntactic structure in 450 deaf children ages 10-18 years. This project included the development of a battery of 22 tests that are used to evaluate the ability of deaf children to comprehend and produce syntactic structure in deaf students. A summary of their findings indicate that the rules of English syntax were not well developed at any age in deaf individuals, and though acquisition was similar to that in hearing children, it was much slower in deaf individuals. Though it was clear that syntax was very distorted for the deaf children, there seemed to be a pattern between the subjects, suggesting that understanding the

errors the Deaf make in syntax may help to better teach and clarify it (Quigley, Power, & Steinkamp, 1977).

These findings are supported by Quigley and King (1980), who explored research regarding the syntactic abilities of hearing impaired and normally hearing children ages 10-18 years as part of a series of articles examining syntactic development in deaf and hard of hearing individuals. They suggest that not only were all of the differences between deaf and hearing children statistically significant, but that 18 year old deaf individuals performed more poorly than 8 year old hearing subjects when assessed on their English language syntactic skills. They suggest that though the developmental stages for acquiring syntax is similar in both groups, the rate of development in deaf children is significantly delayed (Quigley & King, 1980). Of note is the fact that similar to Quigley, Power, & Steinkamp (1977), the children in the above-mentioned study did not utilize spoken English as their primary method of communication.

It is important to note that all of the above research occurred with deaf children utilizing hearing aids, as cochlear implants were not yet available. As cochlear implant technology became available to children, oral-language development in deaf and hearing-impaired children began to change. Geers (2007) indicates that children implanted before age 24 months who receive an oral education likely will achieve levels of spoken language equal to hearing age-mates before beginning kindergarten. Peng, Spencer, and Tomblin (2004) found that after 7 years of device experience, listeners could understand approximately 70% of what was said by pediatric cochlear implant recipients. Robbins, Svirsky, and Kirk (1997) found that after one year of utilizing an implant, children demonstrated language development rates equivalent to children with typical hearing.

This data presents a great contrast to previously presented data on oral-language abilities in deaf and hearing impaired individuals.

As oral-language development in the deaf and hearing impaired community became more feasible with the onset of cochlear implants, the education of children began to change. Niparko, Cheng, and Francis (2000) found that implanted children in full-day mainstream classes used 75% less support services than those received by children without implants. Ertmer (2002) reports that educational programs that foster building communication skills for everyday activities result in increased reinforcement of language skills. This research indicates not only change in hearing and language skill levels for a population of children, but also an increased need to examine intervention methods.

Hearing Impairments

As previously discussed, amount of hearing loss will negatively impact a person's ability to communicate orally and perceive oral language. In addition, children with hearing loss with average intelligence generally have verbal language abilities that measure 20 to 40 points lower than their hearing peers, which in turn affects their reading and writing scores (Sampson-Fang et al., 2000). In general, children with hearing aids have an increased ability to perceive spoken language and communicate orally (Tomblin et al., 1999).

It is important to note that 3 in 1,000 live births result in a child with cochlear hearing loss. One third of these children will have severe to profound bilateral hearing loss (Sampson-Fang, et al., 2000). Two primary types of screenings are given at the hospital when a baby is born. The first is the Auditory Brainstem Response (ABR) which

tests the infant's ability to hear soft sounds through miniature earphones. Sensors measure the infant's brainwaves to determine if soft sounds can be heard. The second measures the Otoacoustic Emissions (OAE) directly with a miniature microphone and sent to a special computer to determine the infant's hearing status (Mestel, 2008). Additionally, 28 million Americans are hearing impaired or deaf; five million of those individuals wear hearing aids and 2 million of those individuals are considered deaf (Northern, 1996). Table 1 provides a guide for degrees of hearing loss, which are measured in decibels (dB):

Table 1

Hearing Loss Ranges in dB levels

Type of Hearing	dB Range
Normal Hearing	0-25
Mild Hearing Loss	26-45
Moderate Hearing Loss	46-65
Severe Hearing Loss	66-85
Profound Hearing Loss	Over 85

Note. Created from information obtained from Northern (1996).

Cochlear Implants

While hearing aids can help one acquire the ability to access sound, they require that hair cells be present in the cochlea to convert incoming sound stimuli to electrical stimuli to be processed by the brain (Sampson-Fang, Simons-McCandless, & Shelton, 2000). Cochlear implantation is a process that allows individuals with profound sensorineural hearing loss to hear sounds. While fifteen million people in the United

States have significant hearing impairment, less than one percent of them are candidates for cochlear implantation. The most important criteria for candidacy is severe to profound hearing loss and that the person can no longer gain any substantial benefit from a hearing aid (Thedinger, 1996; Tye-Murray, 2004).

Sensorineural hearing loss occurs when there is a degeneration of the hair cells in the inner ear. These hair cells change mechanical sound energy into an electrical message that the auditory nerve passes to the processing center in the central nervous system. The cochlear implant seeks to replace the nonworking hair cells and relay the electrical message to the auditory nerve itself, thus enabling the individual to hear sounds (Thedinger, 1996). However, one is cautioned to realize that hearing sounds is not the same thing as comprehending spoken language, nor does it restore hearing completely (Tyler, 1993; Miller & Wheeler-Scruggs, 2002). Rather, it provides a means by which a sound sensation can enter the brain through electronic means, rather than the inner ear (National Association of the Deaf, 2000).

The Food and Drug Administration (FDA) approved the first cochlear implant in 1984. Subsequently, the first implant was approved for children in 1990 (Tye-Murray, 2004). Initially, cochlear implants had only one “channel” or electrode to convert the sound message in the design. Today’s cochlear implants are “multichannel” and include multiple electrodes which significantly improves their performance (Thedinger, 1996). Presently, the FDA has approved only 5 different types of cochlear implants for use in the United States. They are made by 3 separate companies, including Med-El corporation (www.medel.com: Combi 40+ Cochlear Implant System), Advanced Bionics (www.advancedbionics.com: Clarion Multi-Strategy Cochlear Implant), and Cochlear

Americas (www.cochlear.com: Nucleus 24 Cochlear Implant System, Nucleus 22 Channel Cochlear Implant System/Children, and Nucleus Multichannel Implantable Hearing Prosthesis). In all cases, the cochlear implant is placed behind the ear. A surgeon opens a flap of skin, drills a hole in the skull, and inserts a wire electrode array into the cochlea (Vernon & Alles, 1991; Thedinger, 1996). The magnet and receiver are also placed under the skin cradled against the skull (Tye-Murray, 2004). It can cost in excess of \$30,000, requires general anesthesia and a short hospital stay, and the surgery takes about three hours (Miller & Wheeler-Scruggs, 2002). After the implantation, the individual is fitted with a behind-the-ear microphone and a transmitter coil which is attached magnetically to the head. This portion includes the microphone, which picks up the sound from the environment, converts it into an electrical signal, and sends it via cables to the speech processor for processing of the signal. The signal is then sent to the transmitter where it is sent via electromagnetic induction or radio transmission to the electrode array (Tye-Murray, 2004). The receiver converts the code to electrical signals for the electrodes in the implant, and the electrodes stimulate auditory nerve fibers. This is recognized by the brain as sound (Thedinger, 1996).

A period of extensive multidisciplinary rehabilitation follows implantation (Vernon & Alles, 1991; Ertmer, 2002). An otolaryngologist, a physician who specializes in diseases of the ear, nose, and throat, must monitor the medical postoperative status of the child. An audiologist is needed to monitor and assess any improvements in sound and speech detection and reception. The audiologist is also responsible for “mapping” or programming the child’s cochlear implant. This is done specific to the individual child, and includes setting threshold levels, comfort levels, and turning off or “flagging”

electrodes that are problematic for that child, keeping the sound loud enough that the child is aware, but not so loud that it causes discomfort or distress (Tye-Murray, 2004).

Finally, children who receive implants require training to maximize the benefits that they receive from the device. There are three primary approaches to aural rehabilitation following a cochlear implant. Auditory-Verbal Therapy maintains that the child will learn to maximize use of his or her hearing and will learn to produce and comprehend spoken language without the use of lipreading or visual cues. Similarly, Auditory-Aural Therapy requires that the child learns to use whatever hearing abilities they have, but in combination with lip- and speech-reading (using contextual cues) to understand and utilize spoken language. The goal for both auditory-verbal and auditory-aural therapy is to provide the individual with the skills necessary to be mainstreamed in regular education and to function independently in the world. They also facilitate the development of reading and writing skills. Geers (2002) found that emphasis on an auditory-aural education post-implant is more important to language development for children with implants than any other factor.

Conversely, Total Communication, also known as simultaneous communication or sim-con, is an approach which incorporates all different means of communication including sign language, voice, fingerspelling, lipreading, amplification, writing, gesture, and visual imagery (pictures). The concept behind total communication is that the mode of communication should fit the child, not the other way around. It allows the child to utilize different strategies that will help the individual understand and communicate the most. However, best practice encourages the use of both sign and verbal language, which makes mainstreaming without supports much more difficult due to the fact that most

general education teachers are not trained in sign language or cued speech (Tye-Murray, 2004; www.agbell.org). Of note is the fact that signed language and oral language utilize completely different grammatical systems, which may limit the child's proficiency or comfort in one language or the other.

Two other communication models, seldom used in isolation by implant recipients, are American Sign Language and Cued Speech. American Sign Language (ASL) is a manual language with unique grammar, syntax, and lexicon. Of extreme importance to note is the fact that the lexicon, phonemes, and grammar of ASL is in no way similar to that of oral English, suggesting that Deaf individuals attempting to learn to utilize spoken language cannot simply "translate words"; They must learn a completely different language. ASL needs not have an oral speech component in order to be understood. Conversely, Cued Speech incorporates phonemically-based hand gestures to supplement speech-reading to increase understanding. They cue the listener to the phonemic features of the sounds being produced so that the listener can interpret the message. Used in isolation, the gestures are meaningless (Tye-Murray, 2004).

Following implantation, a communication model is chosen based on the child's unique needs. Sound and lipreading skills, as well as training in speech production and language therapy are provided. Rehabilitation should focus on developing a wide range of listening behaviors within meaningful communicative contexts, with specific focus on tasks that help with the discrimination of sound and sound identification (Thedinger, 1996; Ertmer, 2002).

Close interaction between the audiologist at the implant center, the clinician who provides rehabilitative services, and the school setting where teachers will work on a day-

to-day basis with the child is ideal, and it is typical to have daily or weekly trips to the center for several weeks following implantation. To assure optimal benefit from implants, teachers should be knowledgeable of how implants work and how to maintain them, as well as what is an appropriate level of expectation regarding the child's progress with the implant (Teagle & Moore, 2002). Again, it is important to note that cochlear implantation will likely increase the ability to hear, though not always to the equivalent of hearing peers. In fact, Tye-Murray (2004) described a cochlear implant as “a communication aid and not a bionic ear that will provide normal hearing”.... “The speech and hearing professional....makes it clear that the child will always have a hearing deficit.” (p. 735).

Eligibility Criteria

Children eligible for cochlear implantation meet specific criteria. Children typically are around 12 months old for the surgery, though children as young as 6 months of age have been implanted in the United States (Tye-Murray, 2004). Tye-Murray (2004), Sampson-Fang et al. (2000), and Thedinger (1996) describe that eligible children must have severe to profound sensorineural hearing loss usually in excess of 90 dB in both ears, derive little to no benefit from hearing aids, have no contraindicating medical or psychiatric complications, and that the child and the family must have appropriate and realistic outcome expectations and motivation, as well as a willingness to commit considerable time and effort both pre- and post-implant. For maximum benefit, Tye-Murray (2004) and Sampson-Fang et al. (2000) indicate that children should be placed in a strong aural rehabilitation intervention that emphasizes developing listening skills, and Thedinger (1996) suggests that the parents and the school must be committed to provide the appropriate aural educational setting.

Though most adults who receive implants are postlingually deaf (indicating that they have experienced the critical period for learning language), advances in the speech-processing strategy have made it possible for prelingually deaf adults to be candidates as well, which is encouraging. Kluwin and Stewart (2000) found that children are less likely to benefit from therapy if they live in rural areas with less access to the required therapy and that placement in an oral-only program increased the use of the implant for communication purposes.

Cochlear Implantation and Language Development

Cochlear implantation (CI) will likely increase the ability of prelingually deaf children to speak and perceive language to some degree, though not always to the equivalent of hearing peers (Robbins, Osberger, Miyamoto, & Kessler, 1995; Tucker, 1998; Miller & Wheeler-Scruggs, 2002; Dawson, Busby, McKay, & Clark, 2002). However, the perceived benefits of cochlear implantation may outweigh a less than perfect outcome. One study suggests that the subjective perceived quality of stress in parents of children with hearing aids and with children who are appropriate candidates for the cochlear implant are equal immediately after diagnosis. However, feelings of stress is significantly lowered in parents of children with implants after implantation is complete, while stress levels in parents of children with hearing aids remain high (Burger, Spahn, Richter, Eissele, Lohle, & Bengel, 2005).

Somers (1991) compared children with cochlear implants to children with hearing aids, using a control group of children with profound hearing loss. Her results indicate that while all children benefited from their device when compared to the control group, children with cochlear implants in an orally educated program received greater benefit

from their device than did the other children (Somers, 1991). Meyer, Svirsky, Kirk, and Miyamoto (1998) found that speech perception of children with hearing loss in the 101-110 dB range experienced a greater increase in speech perception when implanted with the Nucleus Multichannel cochlear implant than did their peers with hearing aids. However, their speech perception was only equal to that of a child with 90-100 dB loss wearing aids. This indicates that although speech perception increased, it did not equal that of a typically hearing child. Similarly, Dawson, Blamey, Dettman, Barker, and Clark (1995) found that implant users experienced a significant increase in receptive language as measured by the Peabody Picture Vocabulary Test (PPVT), though still significantly below those of hearing peers. Tomblin, Spencer, Flock, and Tyler (1999) also found that the English language comprehension and production of children with CIs was significantly better than that of their peers wearing hearing aids, though the differences in scores were only significant after 2 years of post-implant experience. Again, it is imperative to note that the above-mentioned studies all were completed over ten years ago, and thus, do not amply demonstrate today's standards of cochlear implant technology and differences in age of implantation.

Age of Identification, Implantation, and Years of Use

Many studies have suggested that the efficacy of cochlear implantation varies with age at implantation and years of use (Connor, Hieber, Arts, & Zwolan, 2000; Sampson-Fang, et al., 2000; Svirsky, Robbins, Kirk, Pisoni, & Miyamoto, 2000; Ertmer et al., 2002; Chin, 2003; Ertmer, Strong, and Sadagopan, 2003; Nicholas & Geers, 2007). Connor, Craig, Raudenbush, Heavner, and Zwolan (2006) suggest that at any given chronological age, years of use and age at implantation are perfectly correlated. Given

this, research suggests that age of identification of hearing loss will impact later language development. Houston et al. (2005) suggest that children with cochlear implants may not develop word-learning skills as readily as hearing peers because of a period of early sensory deprivation prior to implantation, adding to the importance of early identification. Tyler (1993) suggests that children who receive implants after a short period of deafness demonstrate higher levels of speech perception than do children who have experienced longer periods of deafness.

Similarly, Yoshinaga-Itano, Sedey, Coulter, and Mehl (1999) compared the language development of 72 deaf and hearing impaired infants identified by age six months with 78 children identified after age six months. Cognitive functioning was controlled for using the Play Assessment Questionnaire. Language development was examined through the use of the expressive language scale and the comprehension-conceptual scale of the Minnesota Child Development Inventory (MCDI). Results indicated that children with hearing loss identified before age six months demonstrated significantly better scores on the MCDI than did children with hearing loss identified after age 6 months, regardless of test age, communication modes, degrees of hearing loss, and socioeconomic strata (Yoshinaga-Itano, et al., 1998). Moeller (2000) studied 100 deaf and hearing impaired children, 25 of whom had been identified prior to six months of age. Results indicate that children identified prior to six months of age maintained age-appropriate language skills and had significantly better language skills than those identified after six months (Moeller, 2000). These results indicate that early identification of hearing loss significantly impacts language development later in life.

When individuals receive cochlear implants, they typically already have a language delay when compared with normally-hearing children due to the fact that they have been deprived of hearing spoken language for some period of time. Svirsky et al. (2000) suggests that a cochlear implant keeps this delay from increasing further. This suggests an argument for earlier implantation versus later, as early implantation would result in smaller delays in language development due to smaller periods of auditory deprivation (Ertmer, Young, Grohne, Mellon, Johnson, Corbett, & Saindon, 2006). Robbins, Koch, Osberger, Zimmerman-Phillips, and Kishon-Rabin (2004) examined the differences in hearing ability in 107 children who received implants between ages 12 months and 36 months using the Infant-Toddler Meaningful Auditory Integration Scale (IT-MAIS). They divided the children into three groups: 12-18 months, 19-23 months, and 24-36 months. Results indicate that the first two groups show no differences in mean scores for the first two groups when assessed at three months and six months post-implant. However, the third group demonstrated differences due to later implant. Further, they compared these children to typically hearing children and found that when children receive CI's at a later age it takes them longer to "catch up" to hearing peers. However, all three groups of children demonstrated auditory skills similar to those of hearing children regardless of age of implant (Robbins et al., 2004).

Connor, Heiber, Arts, and Zwolan (2000) studied 147 children with cochlear implants for the purpose of examining differences in performance based on Oral or Total Communication programs. They found that regardless of program type, children who received their implant before the age of five performed better on all language assessments than did children who received implants after age five. These results are supported by the

findings of Tomblin, Barker, Spencer, Zhang, & Gantz, 2005, Geers, Nicholas, & Sedey, 2003, and Nicholas & Geers, 2007, all of which indicate that children implanted prior to age five demonstrate significantly better language development than those implanted after. Similarly, Svirsky, Robbins, Kirk, Pisoni, and Miyamoto (2000) found that children implanted at a younger age show better development in speech, language, and listening skills than those implanted when they were older. This is particularly true for expressive language vocabulary (Tomblin et al., 2005). Connor et al. (2000) found that the younger a child was when implanted, the stronger their receptive vocabulary became over time. Finally, Connor et al. (2004) used the Peabody Picture Vocabulary Test, Third Edition (PPVT-III) and a measure of consonant production accuracy to assess 100 children implanted between ages 12 months and 10 years. Their data indicated stronger outcomes at any given age for children implanted when they were younger. Overall, this data, all collected on latency-aged children, suggests implantation at an earlier age significantly affects language development.

Improvements in Language Development

Due to the fact that CI technology is still relatively new, availability of extensive data is still a challenge to researchers looking to study language development in children with cochlear implants. However, Sainz et al., (2002) studied the auditory abilities of 140 children with the MED-EL Combi 40/40+ implant for two years. They found that implantation significantly enhanced the listening abilities of the children, as measured by the Listening Progress Profile and the Monosyllabic-Trochee-Polysyllabic Word Test of the Evaluation of Auditory Responses to Speech (EARS) test. Further, though gains continued for up to two years after implantation, the most rapid gains were made in the

first month after implantation. They also confirmed that age at implantation significantly affected the children's scores. As listening skills are essential to the development of language and communication, these findings are significant. One might note, however, that only one brand of cochlear implant was utilized in this study.

In studies that examine language development in children with implants, it appears to be typical to restrict the research to one brand at a time, likely to control for differences in technology versus actual differences in the language abilities. The previously noted study by Meyer et al. (1998) found significant increases in speech perception for implanted children when compared to children who used hearing aids. However, this study utilized only the Nucleus Multichannel Cochlear Implant. Similarly, Robbins, Svirsky, and Kirk (1997) found that children wearing the Nucleus had an average language development rate in the first year of using the device, equivalent to that of children with normal hearing. This is supported by the results of Miyamoto, Svirsky, and Robbins (1997) who found that expressive language skills for implanted children were equal to those of hearing peers. Robbins, Bollard, and Green (1999) found similar results with children wearing the Clarion Multi-Strategy Cochlear Implant.

Nicholas and Geers (2007) examined 76 children who had received a CI between their first and third birthdays and who had been enrolled in an oral educational program since receiving a CI. In contrast to the previously presented studies, this study did not control for brand of implant. They compared these children to data collected from a previous study of typically hearing peers. Several important results were indicated. First, children who received their implants after age 24 months showed lower levels of language achieved than children with earlier age at implant, who have the same duration

of implant use. This indicates that even when the amount of time spent with the implant is controlled for, the children who received the implant at a younger age had better language outcomes. Secondly, children who received an implant after 30 months of age demonstrated language outcomes that indicated they may not catch up with hearing age-mates. In fact, if a child was implanted after 24 months of age, almost-identical expected language performance was predicted, regardless of duration of use. Third, the results of this study supported results found by Tomblin et al. (2005), suggesting that cochlear implantation early in the second year of life likely contributes to a steep period of language growth which is not evident in children who receive the implant after age 18 months. Finally and perhaps most importantly, the results of this study indicate that children who receive an implant and immediately enter an oral education program before age 24 months can be expected to demonstrate levels of spoken language that are similar to their hearing peers (Nicholas & Geers, 2007).

The body of literature on the effectiveness of cochlear implantation on language development with children of preschool age is still quite small. Research does suggest that early identification of hearing loss and younger age of cochlear implantation significantly affects language and communication outcomes in children. Moeller (2000) found that hearing impaired children who were enrolled in an early intervention program at a very young age (around 11 months) demonstrated significantly better vocabulary and verbal reasoning abilities than did later enrolled peers. Further, their scores approximated those of their hearing peers. However, when assessed on abstract verbal reasoning ability, these children still scored significantly lower than their hearing peers. Despite this fact, the effects of early intervention are clear.

Additionally, obvious differences are evident between research conducted only six years ago and research from the last few years. Older research yielded results indicating children with cochlear implants had hearing abilities still significantly below hearing peers (Dawson, et al., 1995; Robbins, et al., 1995; Meyer, et al., 1998; Tomblin, et al., 1999; Dawson et al., 2002). More recent studies demonstrate that children with implants are beginning to catch up to hearing peers (Geers, 2002; Nicholas & Geers, 2007). Earlier age of identification of hearing loss and earlier implantation likely account for these differences, coupled with extreme advances in technology and improvements in language measures. However, because research with such contradicting results occurred literally in the span of 6-10 years, the need to continue to examine differences in children with cochlear implants on an ongoing basis is drastically evident.

Also of importance is the fact that a great deal of the research in this area focuses on children who are school-aged (see Connor, et. al, 2006; Dawson, et. al, 1995; Paatsch, et. al, 2004; Saintz, et. al, 2003; Somers, 1991; Svirsky, Kirk, & Miyamoto, 1998). Further, research that does focus on preschool aged children either compares these children to hearing aid users, or to other groups of children with cochlear implants (Yoshinago-Itano, et. al, 1998; Tomblin, et. al, 2005). It is clear that between ages three and five or preschool age, children make great strides in mastering phonemes, that they begin utilizing adult-like grammar in their speech, that they are aware of the style of language and communication unique to their social group, and are learning between 22 to 37 per month (Hoff, 2001 & 2005). Therefore, examining the language skills of this group is imperative to assuring language differences, if any, are detected, but to continue to lend support to the argument of early identification and intervention. Further,

comparison to subjects with typical hearing is essential to ascertain language differences in need of attention.

The review of the literature amply demonstrates the need to continue the examination of communication skills in preschool children with hearing impairments and cochlear implantation. Further, it has been amply demonstrated that comparisons of these two groups with each other and with normally hearing children of the same age are important to demonstrate weaknesses that will need intervention in the future. Finally, the importance of early intervention for these children is evident.

The current study is an extension of previous literature, and addresses several limits presented in older research. Technology for cochlear implants has changed dramatically, even within the past two years. Effects of this change on hearing ability must continually be examined, as these changes create different “generations” of implant users, with different levels of hearing ability. Further, this change has allowed comparison with hearing peers rather than with peers who were hearing-aid users, as was common in past literature due to language limitations (See Miyamoto, et al., 1997 and Geers, 2007). Additionally, children can now receive implants at much younger ages than in the past, providing a new group of implant recipients whose language development has not yet been studied. Ongoing research such as the present study is critical as this is the first opportunity presented to understand the present subject group: The first generation of preschool children who were early recipients of cochlear implants. Finally, very few studies have examined language abilities of pre-school children with cochlear implants who have been educated in an oral-only setting. These four factors combined: changes in technology, younger age at implantation, availability of preschool-

aged children with implants, and the opportunity to work with children who are implant-recipients educated in an oral only setting, create a subject sample that is unique in today's literature and therefore invaluable to the present body of literature.

The present study uses the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4) and the Expressive Vocabulary Test, Second Edition (EVT-2) to examine the differences in the communication skills in three groups of preschool children enrolled in preschool programs. The Wechsler Nonverbal Scale of Ability (WNV) was utilized to control for cognitive ability. Through comparison with children with typical hearing, we have examined the extent of the difference in expressive and receptive lexical language development in preschoolers with cochlear implants and those with hearing impairments. Communication skills were examined through comparison of the groups of children's standardized score on the PPVT-4 (a measure of receptive language) and the EVT-2 (a measure of expressive language) and examining the differences.

Chapter 3: Method

Participants

Participants included nine children drawn from a population of approximately 30 students in an oral education program for children with cochlear implants and hearing impairments. For the purposes of this study, the pseudonym The Auditory Oral Center or “The Center” will be utilized to maintain the confidentiality of the participants. The Center uses the auditory/oral approach to prepare deaf students, ages birth to six years, for eventual transition into mainstream public or private schools with their hearing peers. Additionally, 42 participants were recruited from The Central School District in Smalltown, New York to serve as a control group for comparison. Again, due to confidentiality, The Central School District and Smalltown, NY are both pseudonyms to be utilized throughout the study to identify children from this school. Children were chosen based on hearing ability and parental consent.

Children referred for the study were of average intelligence based on a cognitive screening completed after permission was granted by parents, but prior to the child being accepted for the present study. Families of children shared common features of a variety of socio-economic situations and racial variability in a suburban area. All subjects were assessed during the spring of their first and second years in preschool. Parental consent was obtained for all subjects. Care was taken to ensure that the ratio of boys to girls was as equal as possible.

Site Descriptions

The Auditory-Oral Center: The Auditory-Oral Center (The Center) is a small, private suburban school specifically for children who are deaf. Preschool children attend school

five days a week in small classes of approximately six to eight students. The rooms are designed to meet the unique acoustical needs of the children and include wall-to-wall carpeting, acoustic ceiling tiles, wall coverings and ceilings mounted with soundfield and FM systems. Children receive speech and language therapy each day with a speech-language pathologist. Early literacy and numeracy, writing, science, music, art, fine/gross motor, and play time are provided through the same curriculum approved by Pennsylvania State Education Department and utilized in hearing programs across the state.

The Central School District: The Central School District is located approximately 35 miles southeast of a major city in New York State and is considered to be a rural school district. Universal Pre-Kindergarten (UPK) is offered in two elementary schools, five days a week. Development in gross and fine motor skills, reading and vocabulary skills, writing, math, and social and emotional growth are addressed through a teacher-directed and child-selected fashion and in accordance to the New York State curriculum.

Instruments

Peabody Picture Vocabulary Test, Fourth Edition: The Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4) is a norm-referenced measure designed to assess receptive vocabulary individuals ages two years, six months, through age 90 years. The PPVT-4 is the fourth edition of the original PPVT created in 1959 by Lloyd M. Dunn. It was updated by Douglas Dunn (2007) to include items that broadly sample words that represent 20 content areas and parts of speech across all levels of difficulty and are supported by a review of the literature (Dunn & Dunn, 2007).

Expressive Vocabulary Test, Second Edition: The Expressive Vocabulary Test, Second Edition (EVT-2) is also a norm-referenced measure. The EVT-2 is designed to assess expressive vocabulary for individuals ages two years, six months, through age 90 year. This is the updated version from the original, created in 1997 by Kathleen Williams (Williams, 2007).

For ease in comparing expressive and receptive language skills, the EVT-2 and the PPVT-4 were co-normed on the same population. The norming sample included over 3,500 individuals, matching the current U.S. population along parameters of gender, race/ethnicity, geographic region, socioeconomic status and clinical diagnosis or special-education placement. The co-norming of the two tests allows direct comparison of the two tests' scales. Standardization for both tests occurred in fall 2005 and spring 2006 to obtain fall and spring grade-based norms, in addition to age-based norms.

The updated version of each assessment includes items that have been empirically analyzed for difficulty, validity, and bias against SES, sex, ethnicity, and gender. Both were normed on 3,540 cases for age and 2,003 cases for grade level. The manuals includes great detail on the breakdown of these groups, demonstrating careful consideration to represent all ages, grades, ethnicities, SES, and geographic regions, and closely matches the breakdown in the 2004 Census (Dunn & Dunn, 2007; Williams, 2007).

Reliability and Validity: The PPVT-4 demonstrates excellent reliability and validity. Split-half reliability is reported at .94, with alternate form reliability at .89 and test-retest reliability at .93. A standard error of measurement (SEM) of 3.6 is adequate for confident interpretation of the obtained scores. To demonstrate validity, the PPVT-4

was correlated with the EVT-2 ($r=.82$), the Comprehensive Assessment of Spoken Language (CASL; $r=.50-.79$), the Clinical Evaluation of Language Fundamentals, Fourth Edition (CELF-4; $r=.67-.75$), and the Group Reading Assessment and Diagnostic Evaluation (GRADE; $r=.43-.79$), as well as with the previous edition of the PPVT, the PPVT-III ($r=.84$). These results demonstrate that the results of this measure agree with the results expected of a valid vocabulary measure (Dunn & Dunn, 2007).

The EVT-2 also demonstrates exceptional reliability and validity scores. Again, Split-half reliability is reported at .94, with alternate-form at .87 and test-retest at .95. The SEM reported for the EVT-2 is 3.8, which also is adequate for confident interpretations of the results. Finally, correlations with other language measures to demonstrate a comparison of the scores achieved on the EVT-2 with valid vocabulary measures are as follows: CASL ($r=.50-.79$), CELF-4 ($r=.68-.88$), and the GRADE ($r=.57-.79$). The EVT-II was also compared with the first edition of the EVT ($r=.81$).

Variation in the range of correlations indicate differences in what the referenced tests are measuring as compared to the PPVT-4 and the EVT-2. Therefore, while higher and more acceptable levels of correlation exist ($r=.85+$), lower ones (i.e.: $r=.50$) suggest that the scales are likely measuring slightly different constructs (Janda, 1998).

Both assessments are individually administered and take between ten and twenty minutes. The task is for the test-taker to select the picture that best represents the meaning of the stimulus word presented orally by the examiner. Included in their norming sample are individuals with ADHD, Emotional/Behavioral Disturbance, Language Delay, Language Disorder, Learning Disability, Mental Retardation, and Speech Impairment. For the purpose of this study, it is important to note that the Standard Score Difference

from the Nonclinical Reference Group for children with cochlear implants on the PPVT-4 (N=46) is -26.1 and on the EVT-2 is -22.5. For non-cochlear implanted children with hearing impairments (N=53), the difference in scores on the PPVT-4 is -17.3 and on the EVT-2, -11.1 (Dunn & Dunn, 2007; Williams, 1997).

Cognitive Measure

Wechsler Nonverbal Scale of Ability: The Wechsler Nonverbal Scale of Ability (WNV) is a norm-referenced, individually administered clinical instrument designed to assess the general cognitive ability in individuals ages four years, zero months, through age 21 years, 11 months. The WNV was created by Dr. David Wechsler and Dr. Jack Naglieri and published in 2006. It is the first edition of this instrument. The WNV is normed on a stratified sample of 1,323 individuals in the United States and on a stratified sample of 875 from Canada. The sample from the U.S. was selected carefully to reflect the data gathered by the United States Bureau of the Census taken in 2003. Demographics reflect stratification along the variables of age, gender, race/ethnicity, education level, and geographic region (Wechsler & Naglieri, 2006).

This assessment tool was specifically chosen due to the fact that in addition to children who are gifted, children with mild or moderate cognitive ability, reading and written expression disorders, language disorders, and English Language Learners, the norm sample includes children who are deaf and children who are hard-of-hearing (Wechsler & Naglieri, 2006). More specifically, individuals in the hard-of-hearing group includes cochlear implant users. Hearing loss was either lateral or bilateral and greater than or equal to 55dB. These individuals were trained in oral speech, had attended an auditory-verbal school, or were post-lingually deaf.

Reliability and Validity: The WNV reflects excellent reliability and validity scores. Split-half reliability and test-retest reliability is reported at .74 to .91 for all subtests and overall at .91 for Full Scale IQ. A standard error of measurement (SEM) of 3.24 to 5.08 for all subtests and of 4.60 for Full Scale IQ indicates excellent indication of ability to be confident in interpretation of scores. To demonstrate validity, the WNV was correlated with several other cognitive measures appropriate for similar age groups that are not nonverbal including the Wechsler Preschool and Primary Scale of Intelligence, Third Edition (WPPSI-III; $r=.23-.68$), the Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV; $r=.57-.66$), the Wechsler Intelligence Scale for Children, Spanish Edition (WISC-IV Spanish; $r=.69-.81$), the Wechsler Adult Intelligence Scale, Third Edition (WAIS-III; $r=.60-.77$). It was also correlated with three nonverbal scales of intelligence including the Naglieri Nonverbal Ability Test, Individual Administration (NNAT-I; $r=.71-.73$), and the Universal Nonverbal Intelligence Test (UNIT; $r=.62-.73$). Finally, adequate correlation with an achievement test was indicated when correlated with the Wechsler Individual Achievement Test, Second Edition (WIAT-II; $r=.28-.67$) (Wechsler & Naglieri, 2006).

Again, the range in correlations can be explained by the fact that all referenced tests are measuring different yet overlapping constructs, indicating that certain correlation coefficients will be very low (i.e.: $r=>.85$). For example, one correlation coefficient for the WNV and the WIAT-II was .28. This is likely due to the fact that the WNV is a nonverbal intelligence test, related to but still very different in construct from the WIAT, which assesses achievement.

The WNV is individually administered and takes between ten and twenty minutes to administer to the youngest age group, ages four years, zero months through seven years, 11 months. The full battery includes four subtests: Matrixes, Coding, Object Assembly, and Recognition. The brief battery includes Matrixes and Recognition. Reliability coefficients for ages four and five on the Matrices and Recognition subtests are moderate ($r=.73-.86$). The brief battery reliability coefficient for this age group is also acceptable ($r=.85-.88$).

The Matrixes subtest involves completing a pattern using shapes and colors, and correlates with general ability, perceptual reasoning ability, and simultaneous processing. Object Assembly involves completing a small puzzle and is a good measure of general ability and perceptual organization (Wechsler & Naglieri, 2006). Coding requires the child to pair a simple symbol with a geometric shape and it is a timed test, and is linked with general ability and speed of processing. Finally, Recognition involves viewing a simple stimulus for 3 seconds and then matching it to a response option. Recognition is linked with immediate memory and general ability (Wechsler & Naglieri, 2006).

Procedure

The investigator collaborated with the directors of the preschool programs to identify children who were eligible to participate in the study. Children were identified based on a review of their cumulative file and parental consent. Medical information was provided to the examiner regarding implantation. Children in the “hearing” group were eligible if their annual hearing screening was within normal limits (WNL).

Parental consent was obtained by mailing out a packet which contained a description of the study including the fact that the individual testing results would not be

shared with anyone including the teachers and parents and their rights as participants. However, information on how to obtain results of the study will be included. Parents were informed that their child would be assigned a number and a group, and only the examiner will know the actual scores. Contact information and a form to request a copy of the study upon completion was also included. Finally, an informed consent was included to grant parental consent to work with the child, to speak with teachers, and to access academic and medical records provided by the school. Each parental packet was accompanied by a letter written by the respective school endorsing their support of the project and encouraging parents to return the form to the child's teacher.

Information regarding time in school, medical information, age at implantation, and degree (if any) of hearing loss was obtained by examining school records and by report of school professionals at both sites.

Due to the large number of children who participated in the study at The Central School District, the examiner trained two graduate students in school psychology from Alfred University to assist in the assessment of the subjects. The actual assessments were conducted in a small office with minimal distractions in the children's school building by either the investigator or by one of two trained graduate students. The children were taken out of class for a brief period during their regular school day to complete the assessment with the exception of one child who was assessed after school hours at her family's request. The examiners met the children in their classroom, and spent some time with them prior to commencing the assessments in order to lessen anxiety and build rapport. A sticker was given as a reward following completion of the assessment.

Following rapport-building, the WNV, the PPVT-4, and the EVT-2 were administered. Children with scores lower than 85 (low average, one standard deviation below the mean of 100) on the WNV were not eligible for the study due to the likelihood that cognitive deficits will interfere with language scores. This resulted in 7 of the 42 children in the hearing group being disqualified. None of the children in the cochlear implant group were disqualified based on cognitive scores. The examiner then scored protocols and the examiner compiled the results in a file for statistical comparison using The Statistical Package for the Social Sciences, Version 11 (SPSS).

Statistical Analysis

The present study is a quantitative study with a quasi-experimental design. Independent variables include cochlear implantation or typical hearing. The study is quasi-experimental because the independent variables cannot be randomly assigned as they are participant variables. Dependent variables included expressive and receptive oral language ability as measured by the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4) and the Expressive Vocabulary Test, Second Edition (EVT-2).

Variables

Hearing Group. Children assigned to the Hearing Group scored within normal limits (WNL) on their latest hearing screening done in school.

Cochlear Implant Group. Children included in this group were cochlear implant recipients. The age at implantation ranged from 12 months through 30 months, with six participants receiving a second, bilateral implant between 50 and 60 months of age. To be eligible for implantation, children all met the following criteria:

- Bilateral profound sensorineural hearing loss
- Lack of auditory skills development
- Limited benefit with appropriately fit hearing aids
- No physical contraindications for placement of the implant (i.e., CT scan results)
- No medical contraindications
- Medically cleared to undergo surgery
- No contraindicating psychiatric or organic disabilities
- Enrollment in an aural rehabilitation intervention that emphasizes developing listening skills
- Realistic expectations and commitment to follow-up appointments

(Thedinger, 1996; Tye-Murray, 2004)

Chapter 4: Results

Subjects in each group were between 43 and 77 months of age. The mean age for children who used implants was 59.4 months (4.95 years) and for children with typical hearing was 58.3 months (4.86 years). The average age of determination of deafness was 8.8 months old and children wore hearing aids prior to implant for an average of 6.1 months. The average age of first implantation was 19.2 months. Seven subjects were excluded from the study due to scoring one standard deviation or more below the mean on the cognitive assessment, indicating that language skills might have been affected by lower cognitive functioning. Subject demographics for the study groups appear in Table 2.

Table 2

Demographic Information

	Typical Hearing	Cochlear Implant
No. of subjects	42	9
No. excluded	7	0
Age at testing (months)	58.3	59.4
mean	53-66	43-77
range		
Age diagnosed (months)	--	8.8
mean	--	0-23
range		
Hearing aids worn pre-implant (months)		
mean	--	6.1
range	--	1-11
Age implantation(months)	--	19.2
mean	--	12-30
range		

Table 3 shows the mean score of each assessment for both children with typical hearing and children with cochlear implants. Some difference in test scores is evident between groups.

Table 3

Mean Test Scores and Standard Deviations

	<i>Typical Hearing</i>	<i>Cochlear Implant</i>
PPVT-4		
mean	104.97	96
standard deviation	13.98	15.46
EVT-2		
mean	106.17	105.00
standard deviation	12.7	16.87

The results of the assessments were compiled into an SPSS data file using SPSS version 13. To determine if an interaction effect exists between expressive or receptive language and cochlear implantation, two Independent Samples T-Tests were performed. Each t-test examined the difference in scores between children with typical hearing and children with cochlear implants on either the PPVT-4 or the EVT-2, and separate t-tests were utilized for each dependent variable so as to allow for understanding differences between the two language outcomes. Neither t-test indicated a significant difference between the children with typical hearing and the children with cochlear implants ($p=.100$ and $p=.819$ for the PPVT-4 and EVT-2, respectively). The two groups performed comparably on both measures. Hence, the cochlear implant enabled the child utilizing it

to perform approximately equal to the child with typical hearing on this measure of receptive or expressive language.

To attempt to control for differences in sample size, ten random samples were selected from the typically hearing group. The two t-tests were again performed for each of the ten samples against the cochlear implant group. This allowed for control over differences in subject number, and allowed the two groups to be equal. Ten random samples were chosen to assure that differences between groups were not due to the random sample itself. No differences in either PPVT scores or EVT scores were found between the cochlear implant group and any of the random group samples.

Additionally, an Analysis of Variance (ANOVA) was conducted to examine the variance in test scores that account for age of implant. Previous research indicates that age of implantation plays a significant effect on language acquisition post-implant. Therefore, if age of implantation is indeed associated with the variables, examining the differences in language scores for children who were implanted before 18 months of age versus after 18 months of age as compared to children with typical hearing will increase the likelihood in finding a difference between the groups if one is truly there. After adjusting for age of implantation, there was no significant effect of the between subjects factor group on PPVT-4 scores, $F(2, 48) = 0.828, p = .443$, partial eta squared = .03. ANOVA was conducted a second time to examine variance in EVT-2 test scores accounted for by age of implantation. Again, no significant effect was found on EVT-2 scores, $F(2, 48) = .020$,

$p = .980$, partial eta squared = .001. Adjusted mean test scores suggest that test scores did not vary regardless of the age at which the subject received their cochlear implantation.

Finally, to determine if an interaction exists between the early and late diagnosis of deafness with early defined as before 12 months of age and late defined as after 12 months of age, and the EVT-2 or PPVT-4 scores, two Independent Samples T-Tests were conducted. Results indicate that once again, neither t-test yielded significant results ($p=.082$). Of note is the increased likelihood of finding a Type II Error (not finding a significant result if one is truly present) due to the small sample size of this population. Table 4 shows the mean test scores and standard deviations for subjects diagnosed early versus late in life.

Table 4

Mean Test Scores and Standard Deviations for Age Diagnosed

	Diagnosed Before 1 Year	Diagnosed After 1 Year
PPVT-4		
mean	101.40	89.25
standard deviation	17.02	11.90
EVT-2		
mean	113.40	94.50
standard deviation	17.98	7.93

Note. Standard Deviation for both assessments is 15 points.

Chapter 5: Discussion

Comparative performances on the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4) and the Expressive Vocabulary Test, Second Edition (EVT-2) were conducted to examine differences in expressive and receptive language skills between preschool children with cochlear implants and preschool children with typical hearing. The purpose of the study sought to identify factors contributing to language differences, if any, between these two groups. Additionally, the age at which subjects were diagnosed as deaf was also examined to identify any extraneous variables that might have contributed to test performance. Cognitive ability was controlled for through a cognitive screening, the WNV, to rule-out limited cognitive ability as a factor contributing to language learning.

Previous research has indicated that cochlear implants increased the ability to hear, though not always to the extent of hearing peers (Robbins et al., 1995; Dawson et al., 1995; Robbins, Svirsky, & Kirk, 1997; Meyer et al., 1998; Tomblin et al., 1999; Dawson et al., 2002). It has been demonstrated that earlier versus later diagnosis of deafness, meaning before three years, significantly impacts language skills (Tyler, 1993; Conner et al., 2006; Ertmer et al., 2006). However, earlier studies though valuable, were limited by utilizing school-aged subjects, later ages of diagnosis implantation due to older technology and practice standards, limiting to one brand of implant at a time, and a lack of control for cognitive ability.

Efficacy of Cochlear Implants The present study found no difference in expressive or receptive language skills in children with cochlear implants and children with typical hearing. Similarly, Robbins, Svirsky, and Kirk (1997) found that children

with cochlear implantation all had language development rates equivalent to hearing peers. Also supporting the present study, Miyamoto, Svirsky, and Kirk (1997), Robbins, Bollard, and Green (1999), and Nicholas and Geers (2007) found no difference between expressive language skills of children with cochlear implants and children with typical hearing.

The present study amply demonstrates that when assessed on lexical expressive and receptive lexical language skills, children with implants show no difference from children with typical hearing. The implications of this are far-reaching as lexical development is one of the four recognized components of learning to utilize and produce spoken language. For children who have been diagnosed severely to profoundly deaf, the notion that they are able to recognize the sound of a given word and to produce the word when shown a picture seems nearly unbelievable. This study lends evidence to the argument that children with implants are indeed able to achieve at least one component to oral language that is nearly identical to hearing peers.

Age of Identification Research indicates that the efficacy of cochlear implantation varies with age of identification or diagnosis of the hearing impairment (Yoshinaga-Itano, et al., 1998; Connor et al., 2000; Moeller, 2000; Tomblin et al., 2003 & 2005; Nicholas and Geers, 2007). While the results of this study do not indicate statistically significant differences between children identified as hearing impaired before age 1 year and children identified after age one year, there is some evidence of practical significance. Of note is the fact that the average score on the PPVT and the EVT is 100, with a standard deviation of 15, similar to most intelligence tests that follow a normal distribution. The EVT and the PPVT were both designed in this way for ease in

demonstrating a comparison between language scores and scores on cognitive assessments.

The difference on EVT scores for children identified as being deaf before one year versus identified as being deaf after one year is 12 points; A score nearly one standard deviation apart (15 points). As compared to older studies this discrepancy is significantly lower, likely due to differences in the definition of early versus late age of diagnosis. Early versus late implant was previously defined as before age three and after age three, adding support to the argument that early diagnosis is key to language development (Tyler, 1993; Robbins, et al., 2004; Ertmer, et al., 2006).

The present study not only directly supports that argument, but also demonstrates that though mathematical statistical significance is not present, in a practical sense a child identified as deaf after one year of age may indeed show some relative weakness in expressive language skills. This is directly supported by the findings of Connor et al. (2000) who found that the younger a child was when implanted, the stronger their receptive vocabulary became over time. Connor et al. (2004) also found that overall, children implanted at an earlier age performed better on the PPVT-III.

Therefore, though results indicate similarity to hearing peers in the area of lexical development, a relative weakness is evident for expressive language skills. Awareness of this allows not only early intervention for the child, but an argument for continued strong focus continuing to monitor and explicitly teach expressive language to children with implants. Rescorla (2005) found that children who experience lexical language deficits delays at age two continued to struggle at age 13 with vocabulary, grammar, and verbal memory. Lexical language development significantly affects later reading and

vocabulary skills. Identifying weaknesses in lexical language at a young age allows intervention to occur before permanent deficits are established.

Age of Implantation Research also shows differences in language abilities in children due to age of cochlear implantation and years of cochlear use, indicating that earlier implantation exposes the child to language earlier, thus increasing their ability to both utilize and understand spoken language (Svirsky et al., 2000; Robbins, et al., 2004; Ertmer et al., 2006; Ertmer, Strong, & Sadagopan, 2003; Nicholas & Geers, 2007).

Results of the present study do not indicate a difference in expressive or receptive language skills in children implanted before 18 months of age or after 18 months of age. This finding is directly supported by the findings of Robbins et al. (2004) who found no difference in language abilities in children implanted between 12 and 23 months of age, but significant differences in children implanted after age 24 months.

Again, the implications of this finding are clear: While one child in the present study was implanted at age 30 months, the rest of the subjects were implanted at or before age 24 months. This supports the findings of Robbins et al. (2004) and lends validation to the argument that the earlier a child receives cochlear implants, the more likely they are to catch up to hearing peers in terms of lexical language development.

Educational Setting The present study demonstrates that the children educated in an Auditory-Oral program demonstrate expressive and receptive lexical language development nearly identical to hearing peers. Children educated in Auditory-Oral programs which have a focus only on spoken language are likely at an advantage when assessed on language skills as compared to programs that utilize other forms of communication as well. Geers (2002) found that educating children in an auditory-oral

setting immediately post-implant is the most important factor in language development. This lends support to studies such as Nicholas and Geers (2007) and Tomblin et al. (2005) who indicate that children with implants who immediately enter an oral education program will demonstrate levels of spoken language that are similar to hearing peers. It can be deduced that the auditory-oral program is an effective instructional approach for children with cochlear implants in order to assist them in the development of spoken language.

Again, this result is of extreme importance not only to demonstrate the efficacy of auditory-oral programs, but to support the eventual transition of children with implants into general education. Auditory-Oral programs focus entirely on spoken language with the purpose of preparing the students for entering a typical school. Demonstrating that children educated in this particular setting exhibit language skills approximately equal to hearing peers provides some evidence that these children can be successful in the general education setting. Education in general education will not only expose the child to spoken language daily, but will likely increase social interaction with hearing peers, allow the child to participate in activities and community programs with hearing peers, and will provide the child with the experience necessary to understand and truly integrate into the hearing world. For a family concerned that a child with implants will eventually thrive in the hearing world, this is an extremely important implication.

Practical Applications

Research in the field of cochlear implantation is shifting. A definite trend is emerging that is beginning to demonstrate that cochlear implantation at a young age is

indeed increasing the ability of children to hear closer and closer to that of typically hearing peers. The implications of these findings are widespread.

Community Education Clearly, this suggests the need for widespread education for community service agents who work with children. It is likely that as technology continues to improve and the choice to obtain cochlear implants becomes increasingly popular due to mounting evidence that implants can provide near-typical hearing, community service providers will have more and more contact with children who use implants. Physicians will be required to not only provide basic medical care for children with implants, but to recognize when a symptom may be associated with their implant, to network with implant specialists, and to understand when to refer a family to speak to a audiologist about the possibility of implantation. Coaches for children's sports teams will need to understand basic safety and maintenance associated with cochlear implantation. Due to the fact that hearing loss is a low-incidence handicap, the likelihood of encountering a staggering number of children who use cochlear implants is low. However, of concern is increasing both the availability of and the understanding of where to find resources to assist community service agents in how to best serve these children.

Implications for Schools Most importantly, schools need to be prepared for working with children with cochlear implants. The Center used in this study prepares preschool children with hearing loss to enter into mainstream educational settings, as is typical for many programs with a focus on spoken language for children with hearing loss. This indicates that the mainstream or general education setting must be prepared to accept this child once they are ready to transition.

Presently, teachers in general are prepared to follow best practice concepts for working with children with any type of hearing loss; they might have them sit at the front of the room and pay special attention to multisensory learning strategies. Often, when working with a child with hearing loss, additional instructional approaches to assist in academic learning, particularly reading, are employed. These strategies are borrowed from the field of learning disabilities, as they are evidence-based and teachers are familiar with them. Teachers will often work closely with the school psychologist and speech pathologist due to the need to continue extensive speech and auditory training and to aid in providing any necessary social supports the child may need. Finally, teachers and other school personnel are already aware that teaching the child about the limitations and differences in learning they experience due to their implant will increase both the awareness of the school personnel and will assist the child in becoming their own self-advocate (Thomas & Grimes, 2002; 2006).

Training A stronger foundation in typical language development would benefit general education teachers a great deal. All school personnel would benefit from understanding that cochlear implantation does not “make” a child “hear”, and that they can continue to be affected by noisy situations, big group discussions, and interacting with new people (Lukomski, 2006). Though maintenance, therapy, mapping, and the implant itself is not the responsibility of the school district, it is imperative that personnel learn to recognize when the equipment is functioning properly and if it is not, to assist the family in addressing the issue. Recognizing when a change in behavior or quality of work may be due to a hearing issue will prevent the child from being penalized for

something that is out of their control and easily fixed. However, recognizing a need for “remapping” and learning these behavioral cues requires training (Lukomski, 2006).

Training would enable them to not only understand where the child with an implant is presently with language development, but assist them, as the primary contact for that child at school, in identifying when a child may be falling behind with regard to language skills- perhaps even before it begins to affect their grades. Additionally, understanding typical language development is essential to understanding and teaching literacy. Reading is traditionally a skill that children with hearing impairments struggle with (Thomas & Grimes, 2002). Research also indicates that children with implants utilize up to 75% less support services than children with hearing impairments without cochlear implants (Niparko, Cheng, & Francis, 2000). This indicates that classroom teachers will have much less support for working with children with implants. Hence, becoming more educated in the special needs of this population is imperative.

Limitations and Implications for Future Research

Of importance is the extremely small body of literature which indicates that children with cochlear implants and children with typical hearing can indeed evidence similar or nearly identical language skills. Clearly, there remains a need to expand the literature and where possible, utilize larger sample sizes. However, as evidenced by Robbins, Bollard, and Green (1999), Tomblin, et al., (1999), Dawson, et al. (2002), and Peng, Spencer, and Tomblin, (2004) amount others, due to the low incidence of children with cochlear implants, smaller studies with lower samples sizes are more accepted in this field.

Therefore, research should focus on expanding the focus of the language skills examined. The present study examined expressive and receptive lexical language development, and preliminary results suggest similarity in skills between children with typical hearing and with implants. Logically, however, all aspects of preschool language development would be necessary to truly state that cochlear implants improve language skills to match those of hearing peers. This would include a study of preschool-appropriate phonology or distinguishing and producing the sounds of language age-appropriately, grammar or the structure of language, and finally, using language to communicate with others. Only through a thorough examination of all language properties expected at preschool age, can we truly determine potential equality of language skills between children with cochlear implants and children with typical hearing.

Additionally, further study of the present subject group is necessary to ascertain continued equality of skill when compared to children with typical hearing. Language at preschool age is clearly much less sophisticated than adult-like language, thus, allowing for less error. As the children it becomes even more important to continue to examine differences, if any, as they would clearly become more obvious as language skills develop. Further, this would allow for expanding the research to include literacy skills which in preschool, are much more limited.

Conclusion

While clearly the results of the present study replicate findings of other research seeking to examine the language skills of children with cochlear implants, continued evidence is necessary to validate that the findings in these studies are not simply due to

the setup of the experiment, researcher bias, or chance: that there is a real and nearly probable chance that a family considering implantation for their child will have realistic expectations for that child's hearing ability when they believe it will be near that of a typically hearing child. While cochlear implantation is not the choice for every family, the results of this study clearly demonstrate that technology is improving and that the impossible is becoming a reality- Given the right circumstances of age of diagnosis, implantation, and demographic and social factors, cochlear implants can indeed assist children in the production and comprehension of spoken language; Perhaps even similarly to their hearing peers.

References

- Allegretti, C. (2002). The effects of a cochlear implant on the family of a hearing-impaired child. *Pediatric Nursing*, 28, 614-620.
- American Academy of Audiology. (2008, February). Cochlear Implants in Children. Retrieved February 16, 2008 from <http://www.audiology.org/publications/documents/positions/PedRehab/cochlear.htm>.
- American Academy of Audiology. (2008, February). Newborn Hearing Screening. Retrieved February 16, 2008 from <http://www.audiology.org/aboutaudiology/consumered/guides/EHDI.htm>.
- Anisfeld, M. (1984). *Language Development from Birth to Three*. New Jersey: Lawrence Erlbaum Associates, Inc.
- Bonvillian, J. (1999). Sign Language Development. In Barrett, M. (Ed.) *The development of language*, (pp. 277-310). New York: Psychology Press.
- Bonvillian, J., Orlansky, M., & Novack, L. (1983). Developmental milestones: Sign language acquisition and motor development. *Child Development*, 54, 1435-1445.

- Burger, T., Spahn, C. Richter, B., Eissele, S., Lohle, E., & Bengel, J. (2005). Parental distress: The initial phase of hearing aid and cochlear implant fitting. *American Annals of the Deaf*, 150, 5-10.
- Carney, A., & Moeller, M. (1998). Treatment efficacy: Hearing loss in children. *Journal of Speech, Language, and Hearing Research*, 41, S61-S84.
- Clarkson, M., & Berg, W. (1983). Cardiac orienting and vowel discrimination in newborns: Crucial stimulus parameters. *Child Development*, 54, 162-171.
- Cleary, M., Pisoni, D., & Kirk, K. (2005). Influence of Voice Similarity on Talker Discrimination in Children with Normal Hearing and Children with Cochlear Implants. *Journal of Speech, Language, and Hearing Research*, 48, 204-223.
- Chin, S. (2003). Children's consonant inventories after extended cochlear implant use. *Journal of Speech, Language, and Hearing Research*, 46, 849-862.
- Connor, C., Craig, H., Raudenbush, S., Heavner, K., & Zwolan, T. (2006). The age at which young deaf children receive cochlear implants and their vocabulary and speech-production growth: Is there an added value for early implantation? *Ear and Hearing*, 27, 628-644.

Connor, C., Hieber, S., Arts, H., & Zwolan, T. (2000). Speech, vocabulary, and the education of children using cochlear implants: Oral or total communication?

Journal of Speech, Language, and Hearing Research, 43, 1185-1204.

Crouch, R. (1997). Letting the deaf be Deaf: Reconsidering the use of cochlear implants in prelingually deaf children. *The Hastings Center Report*, 27,

14-21.

Dawson, P., Blamey, P., Dettman, E., & Clark, G. (1995). A clinical report on receptive, vocabulary skills in cochlear implant users. *Ear & Hearing*, 16,

287-294.

Dawson, P., Busby, A., McKay, C., & Clark, G. (2002). Short-term auditory memory in children using cochlear implants and its relevance to receptive language.

Journal of Speech, Language, and Hearing Research, 45, 789-801.

DeCasper, A., & Fifer, W. (1980). Of human bonding: Newborns prefer their mothers'

voices. *Science*, 208, 1174-1176.

Ertmer, D. (2002). Challenges in optimizing oral communication in children with cochlear implants. *Language, Speech, and Hearing Services in Schools*, 33,

149-152.

- Ertmer, D. (2002). Technological innovations and intervention practices for children with cochlear implants. *Language, Speech, and Hearing Services in the Schools*, 33, 218-221.
- Ertmer, D., Strong, L., & Sadagopan, N. (2003). Beginning to communicate after cochlear implantation: Oral language development in a young child. *Journal of Speech, Language, and Hearing Research*, 46, 328-340.
- Ertmer, D., Young, N., Grohne, K., Mello, J., Johnson, C., Corbett, K., & Saindon, K. (2002). Vocal development in young children with cochlear implants: Profiles and Implications for Intervention. *Language, Speech, and Hearing Services in Schools*, 33, 184-195.
- Folven, R. & Bonvillian, J. (1991). The transition from nonreferential to referential language in children acquiring American sign language. *Developmental Psychology*, 806-816.
- Geers, A. (2004). Factors affecting the development of speech, language, and literacy in children with early cochlear implantation. *Language, Speech, and Hearing Services in Schools*, 3, 172-183.
- Geers, A., Nicholas, J., & Sedey, A. (2003). Language skills of children with early cochlear implantation. *Ear & Hearing*, 24, 46S-58S.

Goodwyn, S. & Acredolo, L. (1993). Symbolic gesture versus word: Is there a modality advantage for onset of symbol use? *Child Development*, 64, 688-701.

Hoff, Erika. (2001). *Language Development, 2nd Edition*. Connecticut: Wadsworth.

Hoff, Erika. (2005). *Language Development, 3rd Edition*. United States: Wadsworth.

Houston, D., Carter, A., Pisoni, D., Kirk, K., & Ying, E. (2005) Word learning in children following cochlear implantation. *The Volta Review*, 105, 41-72.

Janda, L. (1998). *Psychological Testing: Theory and Applications*. Boston: Allyn & Bacon.

Kail, Robert V. (1998). *Children and Their Development*. Upper Saddle River, New Jersey: Prentice Hall, Inc.

Klima, E. & Bellugi, U. (1979). *The Signs of Language*. Cambridge: Harvard University Press.

Kluwin, T. N., & Stewart, D. A., (2000). Cochlear implants for younger children: A preliminary description of the parental decision process and outcomes. *American Annals of the Deaf*, 145(1), 26-32.

- Lukomski, J. A. (2002). Best Practices in Program Planning for Children Who Are Deaf and Hard-Of-Hearing. In A. Thomas & J. Grimes (Eds.), *Best Practices in School Psychology* (pp. 1393-1403). Bethesda, MD: NASP Publications.
- Mestel, R. (2008). How's That? The Aural Mechanics. Retrieved February 16, 2008 from <http://www.audiology.org/aboutaudiology/consumered/guides/auralmechanics.htm>.
- Meyer, T., Svirsky, M., Kirk, K., & Miyamoto, R. (1998). Improvements in speech perception by children with profound prelingual hearing loss: Effects of device communication mode, and chronological age. *Journal of Speech, Language, and Hearing Research*, 41, 846-858.
- Miller, K., & Wheeler-Scruggs, K. (2002). Entertainment television and hearing students? Attitudes regarding the pediatric cochlear implant. *American Annals of the Deaf*, 147, 20-25.
- Minnett, A., Clark, K., & Wilson, G. (1994). Play behavior and communication between deaf and hard of hearing children and their hearing peers in an integrated preschool. *American Annals of the Deaf*, 139, 420-429.

- Moeller, P. (2000). Early intervention and language development in children who are deaf and hard of hearing. *Pediatrics*, 106, 43-64.
- Miyamoto, R., Svirsky, M., & Robbins, A. (1997). Enhancement of expressive language in prelingually deaf children with cochlear implants. *Acta Oto-Laryngologica (Stockh)*, 117, 154-157.
- Mogford, K. (1993). Oral language acquisition in the prelinguistically deaf. In D. Bishop & K. Mogford (Eds.), *Language development in exceptional children*, (pp. 110-131). Hove, England: Erlbaum.
- Moore, D. F. (2001). *Educating the Deaf: Psychology, principles, and practices* (5th ed.). Boston: Houghton Mifflin.
- National Association of the Deaf. (2000). NAD position statement on cochlear implants. Silver Spring, MD: Author. Available: <http://www.nad.org/infocenter/newsroom/positions/CochlearImplants.html>.
- Nicholas, J., & Geers, A. (2007). Will they catch up? The role of age at cochlear implantation in the spoken language development in children with severe to profound hearing loss. *Journal of Speech, Language, and Hearing Research*, 50, 1048-1062.

- Niparko J., Cheng A, & Francis H. (2000). Outcomes of cochlear implantation: assessment of quality of life implant and economic evaluation of the benefits of the cochlear implant in relation to costs. In: J. K. Niparko, K. I. Kirk, N. K. Mellon, A. M. Robbins, D. L. Tucci, & B. S. Wilson, Eds. *Cochlear Implants: Principles and Practices*. Philadelphia: Lippincott Williams & Wilkins; 269-288.
- Northern, J.L. (Ed.). (1996). *Hearing Disorders (3rd ed.)*. Boston: Allyn and Bacon.
- Paatsch, L., Blamey, P., Sarant, J., Martin, L., & Bow, C. (2004). Separating contributions of hearing, lexical knowledge, and speech production to speech-perception scores in children with hearing impairments. *Journal of Speech, Language, and Hearing Research*, 47, 738-750.
- Peng, S., Spencer, L., & Tomblin, J. (2004). Speech intelligibility of pediatric cochlear implant recipients with 7 years of device experience. *Journal of Speech, Language, and Hearing Research*, 47, 1227-1236.
- Quigley, S. & King, C. (1980). Syntactic performance of hearing impaired and normal hearing individuals. *Applied Psycholinguistics*, 1, 329-356.
- Quigley, S., Power, D., & Steinkamp, M. (1977). The language structure of deaf children. *The Volta Review*, 79, 73-83.

Reich, Peter A. (1986). *Language Development*. New Jersey: Prentice Hall.

Rescorla, L. (2005). Age 13 language and reading outcomes in late-talking toddlers.

Journal of Speech, Language, and Hearing Research, 48, 459-472.

Robbins, A., Bollard, P., & Green, J. (1999). Language development in children

implanted with the Clarion cochlear implant. *Advances in Oto-Rhino-*

Laryngology, 117, 113-118.

Robbins, A., Koch, D., Osberger, M., Zimmerman-Phillips, S., & Kishon-Rabin, L.

Effect of age at cochlear implantation on auditory skill development in infants

and toddlers. *Archives of Otolaryngology- Head and Neck Surgery*, 130, 570-

574.

Robbins, A., Osberger, M., Miyamoto, R., & Kessler, K. (1995). Language development

in young children with cochlear implants. *Advances in Oto-Rhino-Laryngology*,

50, 160-166.

Robbins, A., Svirsky, M., & Kirk, K. (1997). Children with implants can speak,

but can they communicate? *Otolaryngology and Head and Neck Surgery*,

117, 155-160.

Sainz, M., Skarzynski, H., Allum J., Helms J., Rivas A., Martin J., Zorowka P., Phillips L., Delauney J., Brockmeyer S., Kompis M., Korolewa I., Albegger K., Zwirner P., Van De Heyning P., and D'Haese P. (2003). Assessment of auditory skills in 140 cochlear implant children using the EARS protocol. *Journal for Oto-Rhino-Laryngology and Its Related Specialties*, 65, 91-96.

Sampson-Fang, L., Simons-McCandless, M., & Shelton, C. (2000). Controversies in the field of hearing impairment: Early identification, educational methods, and cochlear implants. *Infants and Young Children*, 12, 77-88.

Somers, M. (1991). Speech perception abilities in children with cochlear implants or hearing aids. *The American Journal of Otology*, 12 (supplement), 174-178.

Stokoe, W., Casterline, D., & Croneberg, C. (1965). *A Dictionary of American Sign Language On Linguistic Principles*. Washington D.C.: Gallaudet College Press, pg. 273-287.

Svirsky, M., Robbins, A., Kirk., K., Pisoni, D., & Miyamoto, R. (2000). Language development in profoundly deaf children with cochlear implants. *Psychology Science*, 11, 153-158.

Teagle, H., & Moore, J. (2002). School-based services for children with cochlear implants. *Language, Speech, and Hearing Services in Schools*, 33, 162-171.

Tharpe, A., Ashmean, D., & Rothpeltz, A. (2002) Visual attention in children with normal hearing, children with hearing aids, and children with cochlear implants. *Journal of Speech, Language, and Hearing Research*, 45, 403-413.

Thedinger, B.S. (1996). Cochlear Implants. In J. L. Northern (Ed.), *Hearing Disorders* (pp. 291-298). Boston: Allyn and Bacon.

Tomblin, J., Barker, B., Spencer, L., Zhang, X., & Gantz, B. (2005). The effect of age at cochlear implant initial stimulation on expressive language growth in infants and toddlers. *Journal of Speech, Language, and Hearing Research*, 48, 853-867.

Tomblin, J., Spencer, L., Flock, S., & Tyler, R. (1999). A comparison of language achievement in children with cochlear implants and children using hearing aids. *Journal of Speech, Language, and Hearing Research*, 42, 497-511.

Tye-Murray, N. (2004). *Foundations of Aural Rehabilitation*. United States: Delmar Learning.

Tyler, R.S. (1993). Cochlear implants and deaf culture. *American Journal of Audiology*, 26-31.

Tucker, B. (1998). Deaf culture, cochlear implants, and elective disability. *The Hastings Center Report*, 28, 6-14.

Vernon, M. & Alles, C.D. (1994). Issues in the use of cochlear implants with prelingually deaf children. *American Annals of the Deaf*, 139, 385-492.

Yoshinaga-Itano C., Sedey, A., Coulter, D., & Mehl, A. (1998). Language and early- and later- identified children with hearing loss. *Pediatrics*, 102, 1161-1171.

Appendix A: Informed Consent Letters

Informed Consent Letter- The Central School District

My name is Annie Unterstein and I am inviting you to participate in a study that examines language differences between children who have received cochlear implants and children with typical hearing. This research is part of my doctoral dissertation in pursuit of my Doctorate of Psychology (Psy.D.) in School Psychology at The University. I am interested in helping both parents and educators better understand the language skills in children with implants, so as to help us to better serve this population of children. By allowing your child to participate, you are helping us to better understand how children with cochlear implants differ from other children, and thus, how to help them learn better.

In this study, I am asking you to grant permission for a graduate student to use three measures, the Wechsler Nonverbal Scale of Ability, the Peabody-Picture Vocabulary Test, Fourth Edition, and the Expressive Vocabulary Test, Second Edition, to assess your child's cognitive ability and vocabulary skills. The tests will take no longer than 45 minutes to complete, and should your child wish to discontinue testing at any time, he or she will immediately be returned to their class. Their participation will occur during a period of time during the school day where they will not be missing any crucial academic information. Please be aware that all of their responses will be kept confidential, and that their response sheets will contain only a subject number, and not their name, to assure confidentiality.

Your participation in this study is completely voluntary. If you do decide to participate, your child's responses will remain strictly confidential. Your child's paperwork will not contain their name and their school site will not see their responses. Additionally, data will only be analyzed via group data and not by individual responses.

If you do not wish for your child to participate in this study, or decide to discontinue their participation at any time, you are free to do so. Any data associated with your child's responses will be discarded upon completion of the study. Your completion of the attached permission slip for your child's participation will be considered your informed consent to participate.

If you have any questions concerning this research, or if you want additional feedback or results, please feel free to contact me at: Annie Unterstein, (516) 455-1536, apu1@alfred.edu.

You may also contact my dissertation chairperson, Dr. Cris Lauback, Division of School Psychology, Alfred University, at 607-871-2212, or Dr. Jana Atlas, Chair of the Human Subjects Research Committee, Alfred University, at 607-871-2213.

Thank you for your help.

Sincerely,

Annie Unterstein, MA/CAS

Informed Consent Letter-The Auditory-Oral Center

My name is Annie Unterstein and I am inviting you to participate in a study that examines language differences in children who have received cochlear implants. This research is part of my doctoral dissertation in pursuit of my Doctorate of Psychology (Psy.D.) in School Psychology at The University. I am interested in helping both parents and educators better understand the language skills in children with implants, so as to help us to better serve this population of children.

In this study, I am asking you to grant permission for a graduate student to use three measures, the Wechsler Nonverbal Scale of Ability, the Peabody-Picture Vocabulary Test, Fourth Edition, and the Expressive Vocabulary Test, Second Edition, to assess your child's cognitive ability and vocabulary skills. The tests will take no longer than 45 minutes to complete, and should your child wish to discontinue testing at any time, he or she will immediately be returned to their class. Their participation will occur during a period of time during the school day where they will not be missing any crucial academic information. Please be aware that all of their responses will be kept confidential, and that their response sheets will contain only a subject number, and not their name, to assure confidentiality.

Your participation in this study is completely voluntary. If you do decide to participate, your child's responses will remain strictly confidential. Your child's paperwork will not contain their name and their school site will not see their responses. Additionally, data will only be analyzed via group data and not by individual responses.

If you do not wish for your child to participate in this study, or decide to discontinue their participation at any time, you are free to do so. Any data associated with your child's responses will be discarded upon completion of the study. Your completion of the attached permission slip for your child's participation will be considered your informed consent to participate.

If you have any questions concerning this research, or if you want additional feedback or results, please feel free to contact me at: Annie Unterstein, (516) 455-1536, apu1@alfred.edu.

You may also contact my dissertation chairperson, Dr. Cris Lauback, Division of School Psychology, The University, at 607-871-2212, or Dr. Robert Maiden, Chair of the Human Subjects Research Committee, The University, at 607-871-2213.

Thank you for your help.

Sincerely,

Annie Unterstein, MA/CAS
School Psychologist

Appendix B: Request to Conduct Research- The Auditory-Oral Center

Mrs. XXXX, Director
The Auditory Oral Center
XXX Street
Town, PA XXXXX

Dear Mrs. XXXX,

My name is Annie Unterstein and I am a 5th year doctoral student in the School Psychology Program at The University. I am interested in working with deaf/hard of hearing children and their families. With this in mind, I am utilizing my dissertation research to conduct a study which compares the rate of lexical language acquisition in children with cochlear implants to their typically hearing peers.

At this point I have completed an extensive literature review on this topic and I've found that the research lacking in certain areas. This includes research on children at the preschool level, studies which compare CI users matched to typically hearing peers, and particularly, studies that control for cognitive factors. My research is designed to add to the body of information about preschool-aged children with CIs in comparison to matched typically hearing age peers, while controlling for cognitive ability. I think this study will be well-received by the academic community due to the fact that there have been very few studies conducted to date which follow this design and this research is so important in helping us to better understand and teach children with CIs and their families.

The methodology of my study involves administration of two vocabulary tests, the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4) and the Expressive Vocabulary Test, Second Edition (EVT-2). I am also going to administer a non-verbal cognitive measure which is appropriate for use with both children with hearing impairments and children with typical hearing. Additionally, a review of case files will also be necessary to collect information about demographic information (such as age at implant, type of hearing loss, etc.). In the event that The Center-Pa has already administered any of these measures, an alternate form will be used.

Dr. XXXX is a member of my dissertation committee and has participated in several meetings regarding my progress at this point. Due to the fact that my committee has decided that the project is approaching a point where we can begin collecting data, Dr. XXXX provided me with your name and address. I would like to invite families of The Center's preschoolers with cochlear implants to participate in my study. My study will adhere to all of the requirements of The University's IRB and ethical principles of practice. I am hoping that you will allow me to present my project to The Center's families and invite their participation. I will eagerly await your written response. However, should you require more information prior to making a decision, I would be happy to provide additional details of my proposal for her perusal.

Kind Regards,

Annie Unterstein, MA/CAS
School Psychologist
5th Year Doctoral Student
The University

Appendix C: Curriculum Vitae

Ann P. Unterstein

 17 Sayles Street * Alfred, NY 14802 * (516) 455-1536 * apu1@alfred.edu
Education

Doctor of Psychology (2010)	Alfred University , Alfred, NY School Psychology, (APA Accredited) GPA: 3.90
Master of Arts (2006)	Alfred University , Alfred, NY School Psychology, (NASP Approved) GPA: 3.90
Master of Arts (2003)	Marist College , Poughkeepsie, NY Counseling and Community Psychology, GPA: Cum: 3.67 GPA: Psych: 3.85
Bachelor of Arts (2002)	Marist College , Poughkeepsie, NY Major: Psychology GPA: Cum: 3.39 GPA: Psych: 3.52

Clinical Experience**Supervisor of Child and Family Services**, The Counseling Center, Wellsville, 4/09-present

- Provide clinical supervision to MsEd Interns and Master's level clinical staff
- Maintain a caseload of a variety of clients and provide individual, family, play, and marital therapy
- Manage data from and chair a variety of committees including Trauma Systems Therapy, Tier II Collaborate Team, and Child and Family Clinic Plus
- Carry out a variety of administrative duties as part of the agency Management Team

Program Evaluator for ACT-II Domestic Violence Program, Allegany County Department of the Sheriff, 1/09-present

- Complete all batterer risk assessment for the local domestic violence treatment and prevention program
- Participate in team meetings regarding individuals deemed fit for the program
- Generate a comprehensive list of recommendations regarding necessary treatment for individuals assessed

Clinical Counselor, The Counseling Center, Wellsville, 9/08-4/09

- Provide Supervision to MsEd Interns
- Provide individual, family, and play therapy, as well as comprehensive Mental Health Diagnostic Assessments
- Collaborate with medical, law enforcement, and Department of Social Services personnel for provision of services
- Facilitate Trauma Systems Therapy program and Child and Family Clinic Plus program

Doctoral Intern, The Counseling Center, Wellsville, 7/07-9/08

- Provide supervision to MsEd Interns
- Provide individual, family, and play therapy
- Complete comprehensive Mental Health Diagnostic Assessments

- Provide forensic services within the Allegany County Jail
- Collaborate with medical, law enforcement, and Department of Social Services personnel for provision of services
- Facilitate Trauma Systems Therapy program

Clinical Extern, The Counseling Center, Wellsville, 7/06-7/07

- Provided individual, family, and play therapy
- Provided therapy in a variety of modalities to clients ages 6-51
- Collaborated with medical personnel for clients
- Collaborated with law enforcement personnel

Intern, Addison Central School, Addison, 7/06-7/07 (600 hours or more)

- Provided individual therapy for children ages 12-18
- Completed a wide variety of both psychological and psycho-educational assessments
- Provided consultation to various school personnel on a variety of academic and behavioral issues
- Facilitated a group for girls ages 9-11

Graduate Clinician, Child and Family Services Center, Alfred University, 9/05-5/06

- Provided individual, family, and play therapy
- Participated in interpreting psycho-educational assessments and developing recommendations
- Participated in consultation on fellow clinicians cases

Graduate Assistant, Rural Justice Institute, Alfred University, 09/04-present

- Assistant Editor of the *Rural Justice Review*, official publication of RJI
- Helped distribute and collect data from statewide teacher training survey
- Trained in the implementation of the Second Step Violence Prevention program
- Collected data tracking progress and effects of the Second Step Program

Practicum Student, Allegany-Limestone School District, Allegany, NY 09/04-05/05

- Consulted with teachers on various topics, including academic interventions
- Practiced administration, scoring, and interpreting academic and social-emotional assessments
- Tutoring and social skills practice with a variety of different aged students
- Development and implementation of an academic intervention

Graduate/Research Assistant, Division of School Psychology, Alfred University, 09/04-05/05

- Researched Animal-Assisted Therapy for clinical use and future publication
- Researched Eating Disorders for future publication and APA presentation
- Participated in data collection, analysis and interpretation for APA presentation
- Teaching Assistant for undergraduate child psychopathology class

Extern, Research and Assessment, Four Winds Hospital, Katonah, NY, 9/03-12/03

- Observed psychological testing and assessments in progress
- Improved and implemented research skills
- Improved and implemented computer skills
- Participated in various workshops on different issues in psychology

Intern, Clinical Psychology and Counseling, Four Winds Hospital, Katonah, NY, 01/02-05/02

- Learned assessment and treatment planning techniques
- Observed counseling sessions with patients and implemented acquired skills
- Observed family counseling sessions
- Increased knowledge of medication issues in the field of psychology

Teaching Experience

Psych 302: Psychological Measurement: An introduction to psychological assessment through a survey of the principles of test design, scoring, and interpretation for tests of achievement, intelligence, personality, neurological, career interests, and attitudes. Specific concepts include: item analysis and norms, reliability and validity, ethical and legal standards.

Psych 472: Child Interventions: This seminar introduces students to interventions for children and adolescents with disabilities and mental health disorders. Treatment strategies will be explored (such as behavior modification, play therapy, family therapy) along with treatment settings in which such therapies are delivered (schools, community mental health centers, institutions).

Coun 603: Foundations of Mental Health Counseling: This graduate level course is designed to familiarize students with topics specific to counseling within mental health agency settings. Models of community agencies will be examined, along with current issues in agency counseling. Students will be introduced to issues relative to ethics, licensing, program and state regulations, insurance and managed care, and systemic issues related to mental health services with a variety of clientele.

Related Work Experience

Mental Health Worker, Adolescent Unit, Four Winds Hospital, Katonah, NY, 01/02-08/03

- Aided in the creation and implementation of treatment plans
- Developed and facilitated different group therapy sessions
- Drew upon knowledge of counseling and psychology in daily interactions with patients
- Utilized assessment techniques in determining patient safety

Research Coordinator, Four Winds Hospital, Katonah, NY, 08/03-08/04

- Created and maintained hospital databases
- Aided in developing research projects for the hospital
- Collected data for ongoing projects
- Utilized different assessments, questionnaires and psychological tests for research projects
- Supervised research interns for Four Winds Hospital

Preschool Teacher/Teacher's Aide, Care Bear Day Care & Preschool Program, Hyde Park, NY, 1/00-12/02

- Assessed children for developmental issues
- Created and implemented educational plans
- Worked with the families of children in the program

Certifications

Certified Instructor- Second Step Violence Prevention Program (2004)

Certified in Therapeutic Crisis Intervention (TCI)

Certified in Life Space Crisis Intervention (LSCI)

Professional Affiliations

American Psychological Association

National Association of School Psychologists

Awards/Professional Recognition

Rural Justice Fellowship (2004-2007)

Psi Chi – National Psychology Honor Society

Academic Scholarship, Marist College

Publications/Presentations

Atlas, J.G., Barszewski, A., Pryslopski, H., & Unterstein, A. (August, 2006). Media exposure, expectancies, and eating disorder symptoms. Presented at the 114th Convention of the American Psychological Association, New Orleans, LA.

Dissertation Topic

Examining the differences in expressive and receptive lexical language skills in preschool children with cochlear implants and children with typical hearing.

References

Available Upon Request