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AVERAGE ANNUAL READING GROWTH RATE PROGRESS OF CHILDREN WHO ARE DEAF, USE A COCHLEAR IMPLANT AND ATTEND AN AUDITORY-ORAL SCHOOL

by

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An Independent Study
Submitted in partial fulfillment of the requirements for the degree of:

Master of Science in Deaf Education

Washington University School of Medicine
Program in Audiology and Communication Sciences

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Approved by:
William Clark, Ph.D. and Heather Hayes, Ph.D., Independent Study Advisors

Abstract: Reading growth rate averages were established for children who are deaf, have a unilateral cochlear implant and attend an auditory-oral school.

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LITERATURE REVIEW

Historically, children who are deaf have difficulty learning to read at the same pace as their hearing peers. On average, a 16-year-old child who is deaf reads at a 3rd grade level and when they finish high school, will have a reading deficit of approximately seven years. (Quigley et al. 2001) Lower levels and scores from reading assessments from these children have been well-documented through literature for many years. Although hearing children sometimes struggle through different stages of learning to read for a multitude of reasons, so too do children who are deaf. Research seems to converge on the fact that children who are deaf do not have the appropriate language skills or phonological awareness skills needed to develop an ability to read. (Geers, 2003) Phonological awareness skills or knowledge of how sounds and letters relate to each other, help when learning to decode, or pronounce words found in text. While deficits in phonological awareness contribute to inabilities to decode text, deficits in language contribute to the inability to comprehend or understand text. Reading Milestones, a remedial reading program geared for children who are deaf, stated, "For deaf children, the difficulty of acquiring adequate reading skills has been attributed, in part, to inadequate language development." (Quigley et al., 2001) Inadequate language development and weak phonemic awareness skills will both negatively affect a child's ability when learning to read. Therefore, an understanding of both key components plays a crucial role as children learn to read.

In the past, children who were profoundly deaf had difficulty acquiring appropriate language skills and phonemic awareness skills because they could not learn them through traditional auditory means. Unlike their hearing peers, children who were deaf could not learn spoken language or letter to sound correspondence by just listening. As a result, these reading dependent skills were difficult to acquire and their ability to read reflected these deficits. Modern

hearing aid technology and the advent of cochlear implants has provided children who are deaf access to sound and spoken language. With access to sound and spoken language, these children who are deaf have the opportunity to learn through their auditory channel. Subsequently then, it would be logical that their abilities to learn appropriate phonemic awareness and language skills would improve. If so, could their reading abilities also improve to the point that they might keep pace with their hearing peers? This literature review seeks to describe the findings of past research in an attempt to understand the learning process for reading in children who are deaf and use a cochlear implant.

While phonemic awareness and language development are just two skills that directly affect the ability of a child who is deaf when learning to read, there are many other factors that contribute as well. A study by Geers (2002) sought to determine specific factors that affect the development of language, speech and literacy skills for children who are deaf and use cochlear implants. Specifically, the study calculated correlation values for factors associated with these skills in order to determine their relationship. Geers concluded that the variables importantly affecting skills in language, speech and literacy skills include: non-verbal IQ, implant characteristics, educational variables, and the use of the oral communication mode. In other words, children who are deaf and use a cochlear implant demonstrate stronger abilities in language, speech and literacy when their non-verbal IQ is higher and they are taught in an educational environment that is enriched with oral language, such as an auditory-oral school. In the discussion of how implant characteristics can influence a child's language, speech and literacy skills, it was determined that age of implantation may also play a role. "Children who receive cochlear implants before 5 years of age are presented with auditory information at a crucial time for speech and language development." (Geers, 2002; pg 181) Through this study,

Geers suggested that children who are implanted before the critical language development period ends increase their skills associated with speech, language and literacy. While early implantation may positively correlate with the success in these skills, Geers also added, “The extent to which a child will use this information to achieve speech, language, and reading competence is affected by a variety of factors…” (Geers, 2002; pg 181) While it appears as though age of implantation can positively contribute to a child ability to learn appropriate language, speech and literacy skills, there are other factors that further affect reading competence as well. Early implantation alone will not insure that a child who is deaf will acquire the necessary skills associated with reading competence.

Furthermore, a study conducted by Connor and Zwolan (2004) also sought to determine multiple factors that influence reading ability of children who are deaf and use cochlear implants. The Geers (2002) study determined the variables that affected the language, speech and literacy skills in children with cochlear implants. This study investigated variables that affected reading comprehension of cochlear implant users. Initially, they hypothesized that communication modality, speech detection threshold (SDT), lower socioeconomic status (LSES), implanted age, pre-implant vocabulary, length of use and post-implant vocabulary could all potentially affect the reading comprehension levels of children who are deaf and use cochlear implants. The authors used a conceptual model to determine the significance of the relationships between each of these variables and reading comprehension. The conceptual model helped the authors better understand how each factor correlated with each other. They were able to reiterate the fact that a child’s reading success is ultimately impacted by a number of factors. “Our findings demonstrate that children can follow multiple pathways to stronger reading comprehension skills, with paths that include vocabulary, age at implantation, communication method and SES.” (Connor and

Zwolan, 2004) Connor and Zwolan (2004) indicated that age of implantation plays an important role in reading success. In fact, Connors and Zwolan (2004) reported that the correlation between age of implantation and reading comprehension had the most significant relationship within the entire study, with a correlation value of r = -.83. “Age at implantation directly and negatively affected reading comprehension. The younger the age of the children when they received their implant, the higher were their predicted reading comprehension scores.” (Connor and Zwolan, 2004; pg 519)

Cochlear implants provide access to sound and opportunities to learn spoken language. Therefore, considering language development is a direct skill that is needed when learning to read and comprehend text, it is understandable that the earlier children developed their spoken language skills, the earlier they might be able to demonstrate success when acquiring their reading skills as well. Therefore, when discussing the reading progress of children who are deaf, it is important also to discuss the effects on early implantation on their language development.

A study by Nicholas and Geers (2007) sought to determine if the language skills of younger cochlear implant recipients improved in comparison to older implant recipients. Specifically, the study stated, “It is already known that cochlear implantation under age 3 years, a longer duration of CI use, and better pre-implant aided hearing contribute to language development…We hypothesize that children implanted at the youngest ages will exhibit a language advantage over children implanted somewhat later, even when they are compared at the same duration of implant use.” (Nicholas and Geers, 2007; pg 1050) They reported that the age of the child at the time of implant surgery had a significant effect on their language skills. As the study affirmed, “As expected, on average, the predicted scores on linguistic measures increased with longer duration of CI [cochlear implant] experience. Moreover, the age of the child at the

time of CI surgery was shown to have a significant effect on expected overall language level over and above the effect of duration of implant use. Expected scores of children who received an implant at 12-18 months of age were consistently higher than those of children who received an implant at older ages, even with the same duration of use." (Nicholas and Geers, 2007; pg 1059) In summary, children who receive a cochlear implant earlier in life and have more practice using it, have better language skills.

Another study presented by Nicholas and Geers, (2008) also indicated similar predictive language results. The goal of the study was to determine whether children's language skills increased linearly as they were implanted at younger ages. Additionally, the study wanted to provide information about expected expressive language skills for children who were deaf and used a cochlear implant depending on the age at which they were implanted. Ultimately, their research from this study complimented the research from their previous study. Specifically, in addition to developing language milestones for children who were deaf and had cochlear implants, they also confirmed that the younger a child was implanted, the better their language scores were at 3.5 and 4.5 years old. Yet, even though these particular studies reported better language development for children implanted at earlier ages, not all of the literature reports these same findings.

In an earlier study Geers, (2004) reported that early implantation did not significantly correlate with a child's total and spoken language ability. Geers used a battery of tests to assess the speech perception, speech production, total language, spoken language and reading skills of 181 children who were deaf and used cochlear implants. The children were all between the ages of 8-9 years old and came from different educational settings all around North America. After administering the battery of assessments, she surprisingly found that age of implantation did not

significantly correlate with these skills. Specifically, when looking at the correlation between age of implant and total language for these children, there was a value of r = -.09. Generally, correlation values that are less than .5 are considered weak correlations. Therefore, this low correlation value indicated that for this study, there was no significant relationship between age of implant and total language development. This data seems to contradict the more current research results conducted by Nicholas and Geers (2007, 2008). Geers (2004) had previously reported that there was no correlation between duration of use and total language ability as well.

Although some research suggests there are strong relationships between age of implantation and language development (Nicholas and Geers, 2007) others report that there is no relationship between these same factors (Geers, 2004). Yet, if language development is important when learning to read, does age of implantation affect a child's reading skills as well? There are mixed findings when reporting a relationship between age of implantation and language development, similarly, there are mixed findings when reporting a relationship between reading skills and age of implantation as well.

Specifically, the study by Geers (2003) sought to determine if speech perception abilities could facilitate the acquisition of beginning reading skills. Additionally, the study wanted to determine if cochlear implants would promote phonological coding strategies that would then help when learning to read. In the discussion of this study, Geers reports optimistic findings related to the reading success of children who use cochlear implants. Notably, "Reading levels documented in these implanted children should raise expectations above those typical for profoundly deaf children with hearing aids. As implant technology continues to undergo improvement in its capacity to deliver speech and as children are being implanted at younger ages, before language delays are established, the prognosis for more normal acquisition of

literacy may improve even more." (Geers, 2003; pg 67) Yet, in the discussion of age of implantation as it affects reading skills, Geers reported, "Age at implant…had no impact on reading outcome." (Geers, 2003; pg 64) If adequate language development is necessary when acquiring reading skills, then it is surprising that Geers (2003) did not find a correlation in age of implantation and reading outcome.

Conversely, when determining factors associated with reading comprehension, Connor and Zwolan (2004) indicated that there was a strong correlation between age of implantation and reading comprehension skills. They indicated that the earlier a child was implanted, the higher their reading comprehension skills seemed to be. Further research is needed on the topic of age of implantation and reading success because current findings yield mixed results.

The topic of reading skills in children who are deaf and use a cochlear implant has been one that has recently shown an increase in research and interest. It has long been documented in literature that children who are deaf have had difficulties when learning to read. Yet now with the ever increasing advanced technology of cochlear implants, research is beginning to question if children with cochlear implants will be able to catch up in their reading abilities when compared to their hearing peers. In order to determine this, research studies need to identify exactly what factors are affecting reading success in these children. Likewise, reading growth rates of these children need to be established in order to best observe how and at what pace they are learning to read. It was therefore, based on this prior statement and the documented research presented, that the idea for the present study to determine reading growth rates of children with cochlear implants was founded. Knowing the rates at which these children learn to read will help contribute to the growing amount of research available discussing the specific topic of reading skills in children with cochlear implants.

PURPOSE OF THE PRESENT STUDY

The process of learning to read is a very difficult skill for many children. This process then becomes even more difficult for children who are deaf or hard of hearing when it is combined with the fact that they often have a later start in acquiring the necessary phonemic awareness and language development skills due to the fact that they do not have initial access to sound and spoken language. Therefore, because of their initial reading progress delay, in order for children who are deaf or hard of hearing to eventually "close the gap" to their hearing peers with their reading skills, they must often make over a year's progress in their reading skills within just one year's time. In other words, they must learn to read at a faster rate than is expected of their hearing peers.

An individual's reading ability and progress can be accessed and documented using formal achievement tests. These achievement tests often produce standard scores, scaled scores and grade equivalent scores that depict how an individual is doing in comparison to a norm group. Furthermore, when the same formal reading assessment test is given in successive years, an individual's rate of growth can be calculated. Using a rate of growth, educators can see whether c hildren who are deaf are making progress slower, faster or right on average in comparison to other children. Knowing this, educators have long been able to report a child's growth rate from year to year; however as an overall group of children who are deaf, this progress has not been quite as well documented. Therefore, on the whole, one of the main purposes of this study is to compute an average rate of growth for these children's reading skills.

Although the main goal of this study is to describe the reading growth rates of children with cochlear implants who attend an auditory-oral school, it will also seek to investigate

whether a child's age of implantation directly affects their reading growth. The study will therefore seek to address the following questions:

1.) What is the average rate of reading growth for children who are deaf, have a cochlear implant and attend an auditory-oral program?

2.) Does age of implantation affect the rates at which children who have a cochlear implant learn to read?

METHOD

Participants

Participants from this study were selected from two auditory-oral schools for the deaf in St. Louis, Missouri. A total of 35 participants were selected. Specifically, the study group consisted of 20 females and 15 males. Past standardized reading scores were taken from each participant's file in order to calculate individual growth rates. All test scores were produced between 1998 and 2006. At the time the test scores was obtained, the students were between the ages of 5 years 8 months and 12 years 5 months with an average age being 9 years 3 months old. All participants were unilaterally implanted and assumed to be pre-linguistically deafened. Their ages of initial implantation varied greatly. For instance, 12 children were implanted under the age of three years old, 10 children were implanted between the ages of three and five years old and 13 children were implanted after turning five years old. Overall, data from 93 individual tests were collected. Each participant took between two and six tests, with the average being 2.7 tests each. Participants were only admitted into this study if they produced two or more test scores, so that a rate of progress could be established. A chart with the descriptions of these participants in this study is included under Table 1.

Additionally, it should be noted that within this study, no participants had any additional severe disabilities; yet, a few of the subjects had Attention Deficit Hyperactive Disorder (ADHD) or a Learning Disability (LD). These subjects were still kept within the study though. This decision was made based on the idea that it very well may be that other participants in the study also had additional learning disabilities. Yet due to their confounding deafness, an official diagnosis was never identified. Their potential additional disabilities will be noted and considered when manipulating data.

Table 1- Description of research participants

Gender	
Females	20
Males	15
Implantation Age	
0-3 years old (0-36 months old)	12
>3-5 years old (37-60 months old)	10
>5 and above (61 months and older)	13

Procedure

Reading scores were investigated from the formal achievement test, the *Stanford Achievement Test- Ninth Edition (Stanford 9.)* The norms for *Stanford 9* were developed from a norm group sample of more than 10 million students and according to the manufacturers of the test, the sample statistically represented the current U.S. student population as described by Census data.

Specifically, although the *Stanford 9* reports scaled scores and grade equivalent scores in many academic domains, only the scores produced on the reading subsection were used for this study. This specific subtest of the assessment examines the participants' abilities in the areas of: Reading Vocabulary, Reading Comprehension and Word Study, or the ability to understand sounds within words. The test also produces a Total Reading Score. While all subsection scores were examined for this study, only the Total Reading Scores were used to calculate reading growth rates.

As the participants from this study were attending one of the auditory-oral schools, they were tested with the *Stanford 9* as part of a battery of assessments given to them on an annual basis. The records of these tests were then kept in each school's respective files. The files of these auditory-oral schools were accessed in order to collect the necessary data needed to fulfill this study. Their produced grade equivalent scores were used to calculate their rate of growth. By

subtracting one grade equivalent scores from the previous year's grade equivalent score, an annual rate of progress could be determined. Therefore, after all data points were collected, reading growth rates in between each test were calculated. An average rate of growth was then averaged for each participant and for the collective group. The Human Research Protection Office (HRPO) of Washington University in St. Louis approved all the procedures described in this study.

Lastly, it is important to know that when reporting average reading growth rates for children who are deaf and use a cochlear implant all rates are reported in decimals. When understanding exactly what these decimals mean, the following conversion chart (Figure 2) taken from the *Stanford 9* manual can be used. School years are approximately 40 weeks long, therefore, Table 2 represents a 40 week long school year divided into decimals. Decimal rates will be used in discussion of the results; however the conversion table can be referenced when understanding these rates as they correspond to weeks completed in a school year.

Table 2- The conversion of decimal rates to approximate completed weeks in school.

Decimal	**Weeks in School**
.0	0-4
.1	5-8
.2	9-12
.3	13-16
.4	17-20
.5	21-24
.6	25-28
.7	29-32
.8	33-36
.9	37+

RESULTS

To establish an average reading growth rate for children who are deaf and use a cochlear implant, their grade equivalent scores from each *Stanford* 9 assessment test were first collected. In order to calculate their reading growth made between each year of testing, their grade equivalent scores were then subtracted from their prior year's score. The differences of the two grade equivalent scores resulted in their personal growth rate made for that year. This procedure was then repeated for every test the subjects took while they were attending their auditory-oral school. After their personal growth rates were calculated between each year of testing, an average rate of reading growth was calculated for each of the 35 participants. These grade equivalent scores, individual growth rates and average growth rates are reported in Table 3.

Using all of the individual averaged reading growth rates, a group average was calculated. It was found that the average reading growth rate for all children who use a cochlear implant and attend an auditory-oral school was found to be .66 years progress within one year's time. In other words, children who are deaf, use a cochlear implant and attend an auditory-oral school, on average, appear to be making just over a half school year's growth within one year's time. If this average rate of reading growth persists, instead of catching up to their typically hearing peers, they will only continue to widen the gap.

Table 3- This chart show the documented grade equivalent (GE) scores for each participant, the differences between each produced test, each subject's average rate of growth as well as the overall average rate of growth.

	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Diff. between Tests					
Subject	GE	GE	GE	GE	GE	GE	(2-1)	(3-2)	(4-3)	(5-4)	(6-5)	Avg. Growth Rate
1	1.8	2.4	3.5	3.7			0.6	1.1	0.2			0.63
2	K.8	1.7	2	2.6	3.5	4.2	0.9	0.3	0.6	0.9	0.7	0.68
3	1.5	2.8	2.3				1.3	-0.5				0.4
4	1.9	3.1					1.2					1.2
5	K.4	1.4					1					1
6	2.2	2.8	3.4				0.6	0.6				0.6
7	1.6	2	2.8	3.3			0.4	0.8	0.5			0.56
8	2.1	2.3	3.2	3.5			0.2	0.9	0.3			0.46
9	1.8	2.2	2.4				0.4	0.2				0.3
10	K.7	1.5	1.8				0.8	0.3				0.55
11	1.4	2.5					0.9					0.9
12	K.4	1.6	2	2.4			0.4	0.4				0.4
13	K.6	1.5	2.3				0.9	0.8				0.85
14	1	1.6	2.4				0.6	0.8				0.7
15	2.3	3.6					1.3					1.3
16	2.5	2.7					0.2					0.2
17	2.7	3.1					0.4					0.4
18	2.5	3.3					0.7					0.7
19	3	3.7					0.7					0.7
20	2.6	3.3					0.7					0.7
21	3.8	4					0.2					0.2
22	1.9	2.4					0.5					0.5
23	2	2.6	3.1				0.6	0.5				0.55
24	2.4	2.5	3.4				0.1	0.9				0.5
25	3.7	4.6					0.9					0.9
26	2.4	2.6	3.2				0.2	0.6				0.4
27	2.6	3.5					0.9					0.9
28	2.8	4.8					2					2
29	2.5	3.4					0.9					0.9
30	2.6	2.8					0.2					0.2
31	2.2	2.6					0.4					0.4
32	2.6	2.8	4.9				0.2	1.1				0.65
33	2.4	2.6					0.2					0.2
34	2.8	3.3					0.5					0.5
35	2.4	3.3					0.9					0.9
									AVERAGE GROWTH RATE			**0.66**

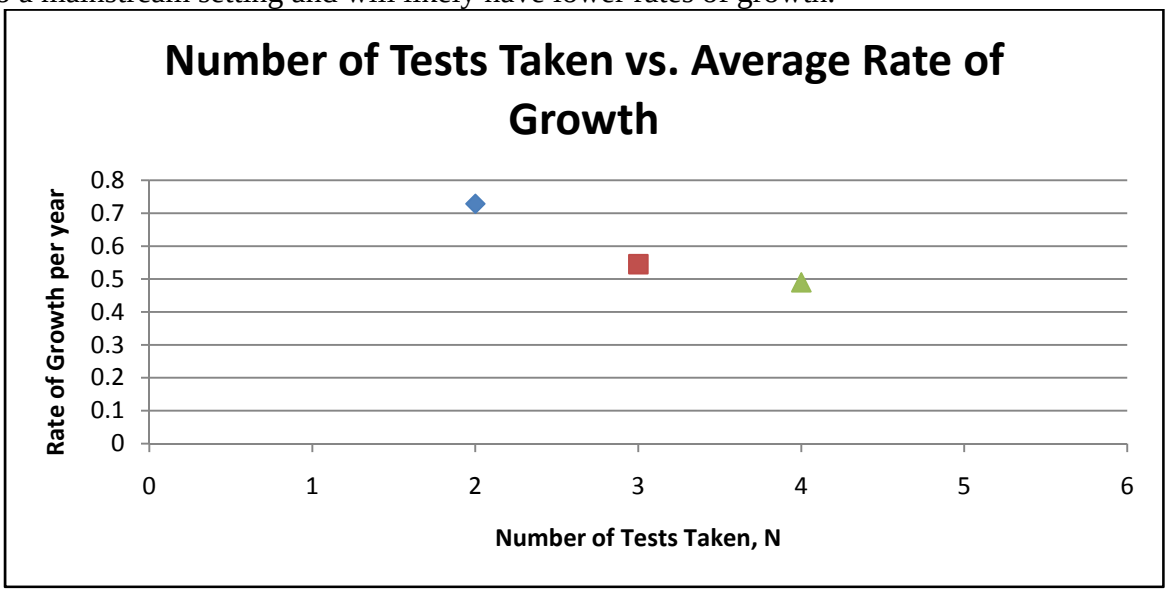
Each participant took between two and six tests with the average being 2.7 tests each. It is possible that the children, who stayed longer in their auditory-oral setting and subsequently produced more test scores, directly affected the average reading growth rate produced. The children who stayed in this type of special education setting longer may not have been making quite as much progress as their peers who mainstreamed at earlier ages and therefore produced fewer test scores. In order to determine if this was a factor to the overall produced reading growth rate or not, averages were also calculated based on the amount of test scores produced. The results for each amount of test scores taken are recorded in the table in Table 4.

Table 4- Average growth rates for children who took different numbers of tests while in an auditory-oral school. Generally speaking, younger children took fewer tests and had higher rates of annual growth.

N tests	N children	Average age at CI in years	Average growth rate in years	Mean grade equiv at last test	Mean age at last test in years
2	20	3.71	.75	3.20	9.49
3	10	4.90	.60	2.92	10.18
4	4	4.85	.58	3.23	11.38
6	1	5.75	.68	4.20	12.42

Table 4 reveals that there were 20 children who took two tests, 10 children who took three tests, four children who took four tests and just one child who took 6 tests. For the most part, the mean age at which they were implanted, increased as they produced more tests. Overall, it can be seen that the trend in their reading growth rates decreased as the number of their tests increased. This general trend is not including the one child who took six tests and appears to be an outlier. Excluding that specific outlying participant, the inverse relationship between the number of tests taken and the average reading growth rates produced can be seen in the graph in Figure 5.

Figure 5- This chart shows the rate of growth by the number of tests in successive years. Intuitively, students who stay longer in an auditory oral school setting are not ready to progress into a mainstream setting and will likely have lower rates of growth.



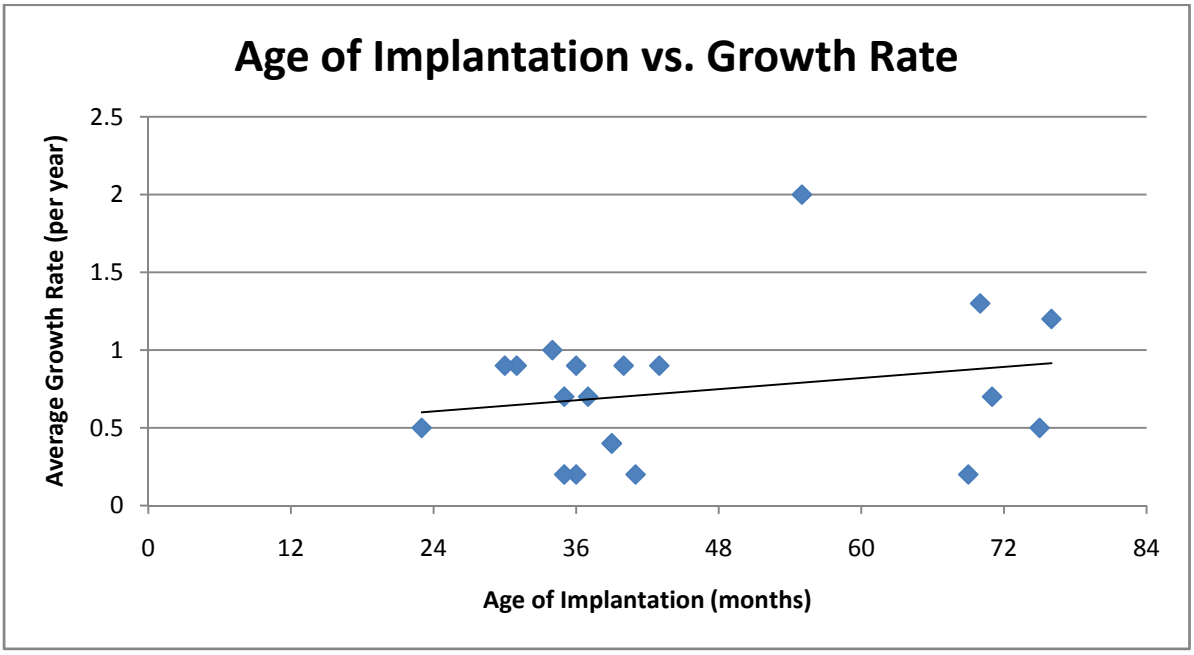
By looking at children who only took two tests, it can be seen that their average rate of reading growth was .75 year's worth within one year's time. Although this rate is still delayed when compared to hearing peers, it is higher than the overall average rate of reading growth for all children considered in this study.

Furthermore, within the group of children who only took two tests, it may be assumed that the children who were implanted earlier also had higher reading growth rates. Perhaps their having access to sound and language at an earlier stage in their life also somehow gave them an advantage when learning to read as well. In order to determine if there was a correlation between the age of implantation and reading growth rates averages, a statistical analysis was calculated. These calculations were specified for only the 20 children who took two tests. When interpreting correlation values, it is important to remember that a value less than .5 is considered weak while a value more than .8 is considered strong. After statistical analysis was completed, it was found that the correlation value calculated for age of implant and reading growth rates was $r = .131$, $p =$

.583. In other words, there was no significant relationship between age at implant and reading growth. This low correlation can also be seen in the graph in Figure 6. A relatively flat correlation line illustrates the lack of a relationship between variables. Therefore, it appears as though the age of implantation did not affect reading growth.

This lack of a significant relationship between age of implantation and average growth rate is not as surprising considering past reviewed literature. In fact, this finding supports similar results indicated in Geers (2003). While it was initially hypothesized that early implantation would lead to better reading skill development, the research did not show a high correlation between the two factors. Instead, perhaps it was not the age of implantation that ultimately affected reading skills, but the duration of use instead. Therefore, in order to determine if the present study's data supported this finding as well, the duration of use was also considered.

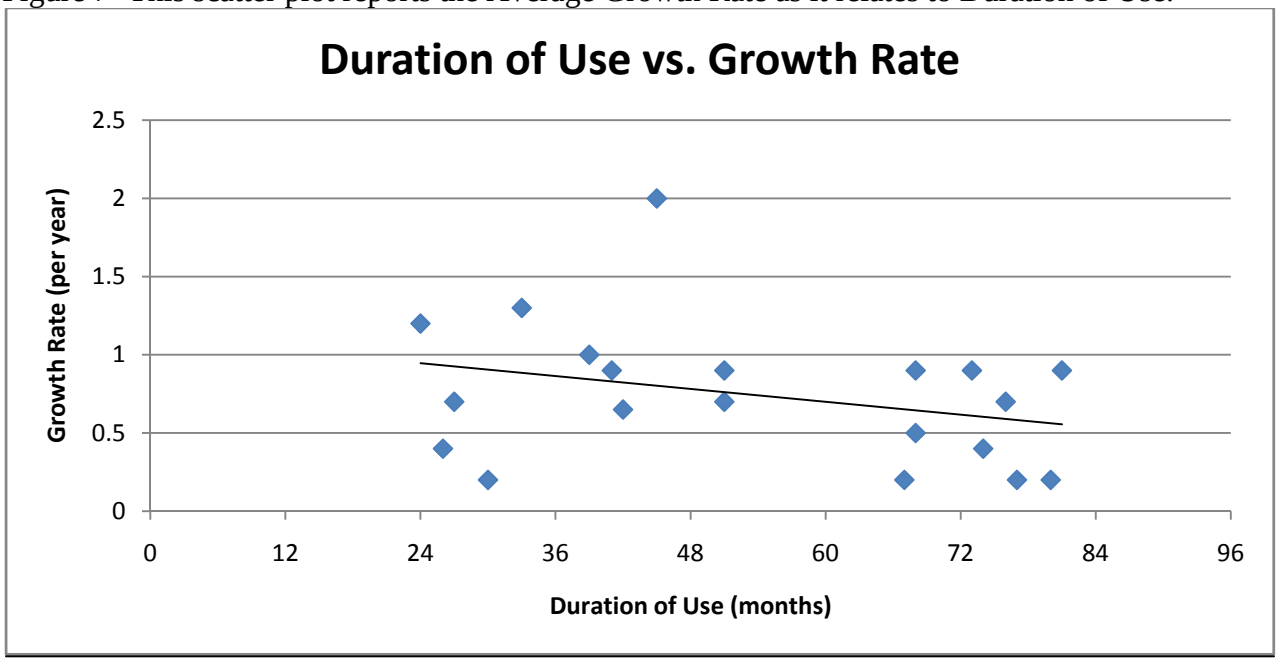
Figure 6- This graph shows a scatter plot relating Growth Rate in years to Age of Implantation. The practically flat trend line indicates that there is relatively no correlation between the two factors.



However, after further statistical analyses were completed for the present data, it was found that the duration of use was also not found to be significant in determining the rate of reading growth progress. Specifically, $r = -.372$, $p = .106$. Once again, the low correlation value can be visually observed through the scatter chart in Figure 7.

In describing the results, it can be said that with all the participants in the study, an average growth rate of .66 year's worth of progress in one year's time. However, because the rate of growth was negatively affected by a smaller percentage of subjects who took more tests and therefore affected them with greater weight, an average reading growth rate for students who only took two tests was also established. This rate of growth was not surprisingly, slightly higher at .75 year's worth of progress in one year's time. Additionally, it through this specific study, it appears as though age of implantation and duration of use did not significantly affect a child's reading rate of growth.

Figure 7- This scatter plot reports the Average Growth Rate as it relates to Duration of Use.



DISCUSSION

It was hypothesized that although educators are encouraging children who are deaf with a cochlear implant and attend an auditory-oral program to make over one year's progress in one year's time with their reading skills, on average, this is not taking place. This hypothesis was supported when the overall average reading growth rate was found to be .66 year's progress in a year. Even when a reading growth rate was established for students who only took two tests, the hypothesis was still confirmed as their average reading growth rate was only slightly better at .75 year's progress in a year. Generally speaking, as an entire group, it seems as though most children who are deaf and use a cochlear implant are not making the annual progress wanted. Ultimately, these lower growth rates are resulting in larger gaps between these students and their typically hearing peers.

The main focus of this study was to establish average reading growth rates for this small subset of children who are deaf and use a cochlear implant, it also sought to determine if the age of implantation affected the rates at which these children learned to read. The correlation between age of implantation and average growth rate was not significant though. This study focused on the reading growth rates of children at relatively young ages. Perhaps if this reading growth rate analysis was extended for older children as well, the research would better support if early implantation played a more significant role.

Since early implantation did not significantly affect reading growth rate progress, duration of use was also investigated. It would make sense that the longer a child has used their cochlear implant, the more complete their language system would be, which might influence their reading skills as well. However, correlation values between duration of use and reading growth rate progress were also not significant.

Overall, while this present study was able to determine growth rates for this particular test with this particular population of children who are deaf, it is likely that these are still underestimations to the true existing values. Specifically, children who are struggling to learn to read will have lower reading growth rates and are likely to stay in auditory-oral school setting longer. These children's scores negatively affect the average rate of reading growth more so than their peers who graduate earlier. Similarly, rates could not be established for children who only took one test before graduating from the program. It is likely then, that these higher rates of reading growth were left out because not enough data was available to include them in the study. Both of these factors negatively impacted the rate of growth established for this study.

As it was mentioned at the beginning of this study, no children with severe additional disabilities were admitted into this study, but children with ADHD and LD were included. These particular students still had average or above average cognitive abilities, yet it is probable that their additional disabilities made it more difficult for them to learn to read. Once again, this would have negatively affected the established average reading growth rate. While these subjects could have been removed from this particular study, the problem still would not have been completely remediated. Instead, many children who are deaf are often suspected of having additional learning disabilities, but they are not officially diagnosed because of their difficulty in learning language caused by their deafness. Therefore, even if the children with diagnosed additional disabilities were removed from this study, it is likely that other subjects would have still had these same additional disabilities, just undiagnosed. In any event, the established reading growth rate average would have still been negatively affected by this fact.

Even though it is likely that the reading growth rate established through this study is an underestimation of the overall annual performance, it is still a useful tool for educators. Knowing

that these children, on average, are making approximately .66 to.75 year's growth in one year's time, it can help when reporting their annual progress. This can be especially useful when highlighting a child's abilities to a parent. For instance, when reporting to parents, educators can now share how they are doing in comparison with other similar children. A parent may be more willing to accept that their child, who is making .8 year's progress in one year's time, is actually above the average rate when compared to his own peers.

Even though this average growth rate has been established for the intent of sharing progress with parents and other educators, when possible, children who are deaf and use a cochlear implant should still be compared to their typically hearing peers. Ultimately, it is the goal of an auditory-oral program to prepare their students to successfully function in a mainstream school. In order to do this, children who are deaf need to be held to the same standards and their mainstream peers. Therefore, although an average reading growth rate of has now been established for children who are deaf, they should still be encouraged to make as much progress as possible in order to close the gap.

By further tracking the reading growth rate progress of children who are deaf and have a cochlear implant, in the future, it is hoped that they will continue to increase their rate of learning even more. Perhaps, with high quality deaf education services, children who are deaf will eventually reach an average goal of making over a year's progress within one year's time.

LIMITATIONS AND IDEAS FOR FUTURE RESEARCH

In conducting this research experiment, there were limitations that, if this study were to be repeated or continued, should be highly considered. Ultimately, for future studies, it would be ideal if more participants could be included. For this particular study, only 35 subjects were used from two auditory-oral schools in St. Louis. If possible, more subjects should be included from different auditory-oral schools around the country in order to justify the results further. Yet, because deafness is considered a low incidence disability, it is often very difficult to recruit these higher numbers of participants who will fit the specific criteria targeted for each study.

It would be encouraged that a more recent assessment test be used for further reading growth rate studies. The *Stanford 9* was used for this study particularly because it provided the highest quantity of already documented reading score results in multiple auditory-oral schools. However, more recent tests and assessment tools are now available and are being used within these same schools. Ideally, different auditory-oral schools would also aim to use the same assessment materials so that their data is consistent across different settings. Not only would this assist researchers in further studies, but it would also assist in consistency efforts for reports written to mainstream school districts as well as other working professionals. This once again is difficult to do though due to the fact that new assessment tests are constantly being created or updated.

As mentioned in the discussion of this report, it is probable that the average growth rates found in this study were actually underestimations due to the procedures used. In order to be included as a subject for this test, in addition to being deaf and using a unilateral cochlear implant, a student had to have at least two documented *Stanford 9* test scores on file at one of the auditory-oral schools. Obviously, students who only had one test score were not admitted into

the study because a growth rate could not be determined from just one year's testing. It is likely then that the students who only took one test and were then ready to learn in a mainstream environment had higher reading growth rates than their peers who were still in the auditory-oral schools and were admitted into this study. Due to this fact, it may be assumed that the growth rates generated were underestimations of all deaf children who have a cochlear implant and attended an auditory-oral program. In order to potentially remedy this conundrum, it would be strongly recommended that annual reading, language and speech assessment tests still be administered to these students continuing their education in a mainstream setting. Not only would this provide further research data to determine reading growth rate scores closer to their true estimations, but it would also let professionals know exactly how these students are progressing within domains that are typically difficult for them to master.

CONCLUSIONS

When including all children within this study who are deaf, have a unilateral implant and attend an auditory-oral school, it appears as though their average annual reading growth rate is .66 of a year within one year's time. However, when looking at the children who only took two standardized tests and subsequently graduated from their auditory-oral school earlier, it appears as though their reading growth rate progress is .75 of a year within one year's time. Although this rate is slightly better, it is still under a year's progress within one year's time. Therefore, if children who are deaf and use an implant continue to learn to read at a rate slower than their typically hearing peers, they will always report a deficit in their abilities. It is hypothesized though that these rates are still an underestimation of all children who are deaf, have a unilateral implant and attend an auditory oral program. More research is needed to investigate these findings though.

Despite the fact that this study sought to report an average reading growth rate for children who are deaf, educators and professionals should still continue to measure their progress in comparison to typically hearing peers as well. In order to survive within a mainstream setting, children who are deaf and use a cochlear implant need to be able to function similarly to a typically hearing child. In order to catch up to their hearing peers then, despite the lower reading growth rates reported, educators should still encourage their children to make as much progress as possible within one year's time. While educators should continually encourage their children who are deaf to close the gap, they should just become more aware of what is considered typical in annual reading growth for this subset of children.

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