hearing losses and other people who frequently communicate with people who have hearing losses will enjoy learning about how communication difficulties may be alleviated.

In the final article, Jill Preminger and Harry Levitt present a case study about the usefulness and practicality of Computer Assisted Remote Transcription (CART). This is when a stenographer transcribes a meeting from a remote location and the transcription is simultaneously sent to a computer so a person who is deaf or hard of hearing can read the transcript on the monitor. The results suggest that this may be a practical procedure for the workplace.

In sum, there is much good information in this issue, and I am sure that you will enjoy your reading.





*The Volta Review*, Volume 99(4), 193–202

# Reading Skills in Children with Multichannel Cochlear-Implant Experience

*Linda Spencer, J. Bruce Tomblin, and Bruce J. Gantz*

*Forty children with prelingual, profound deafness who received the Nucleus multichannel cochlear implant between the ages of 2 and 13 years participated in this study. The children had an average of 63.3 months (SD=24 months) of experience with their cochlear implants. A majority of the children used simultaneous communication and attended public-school programs at the time of testing. Reading achievement was assessed using the Paragraph Comprehension subtest of the* Woodcock Reading Mastery Test–Revised, Form G *(1987). This study compared the reading-achievement levels of this group of cochlear-implant users with the results of previous studies of children with profound hearing losses who did not have the benefit of cochlear implants. Results indicated that nearly one half of the children in this study were reading at or within 8 months of their grade level. The reading-grade quotient of .74 was calculated based upon the slope of the regression line for the plot of years in school and reading grade-level achieved. This finding indicates that using a cochlear implant has a positive effect on reading achievement level.*

Studies of children who are deaf or hard of hearing's reading achievement have documented that most of these children struggle to surpass a third- to fourth-grade reading level. The difficulty of overcoming the fourth-grade reading-level barrier has been well documented over the years (Allen, 1986; DiFrancesca, 1972; Furth, 1966; Goetzinger & Rousey, 1959; Krose, Lotz, Puffer, & Osberger, 1986; Trybus & Karchmer, 1977; Wrightstone, Aronow, & Moskowitz, 1963).

Children with severe to profound hearing losses often fail to advance their reading skills from year to year. After the age of ten years, the rate of improvement is usually negligible, on average (Allen 1986; DiFrancesca 1972).

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Quigley & Paul (1990) cited many characteristics of deaf readers that may contribute to their reading difficulties, including a decreased knowledge base, decreased vocabulary and syntax skills, and, possibly, a decreased ability to form inferences. Recent research by LaSasso & Mobley (1997) focused on reading-instruction methods for children who are deaf and encouraged integrating research findings into reading approaches and materials.

Some researchers have investigated specific skills associated with reading success. Conrad (1979), for example, reported a positive effect of internal speech on reading ability. He defined internal speech as something that occurs "...when a person manipulates, generally silently, spoken words which are required to achieve some cognitive goal" (p. 9).

Conrad also reported that an analysis of covariance indicates the significant influence of internal speech on reading performance ($F_{1,292}$=36.66; $p$<0.0001), thus linking the ability to use internal speech with the ability to decode print into sounds. These findings suggest that bottom-up skills, such as

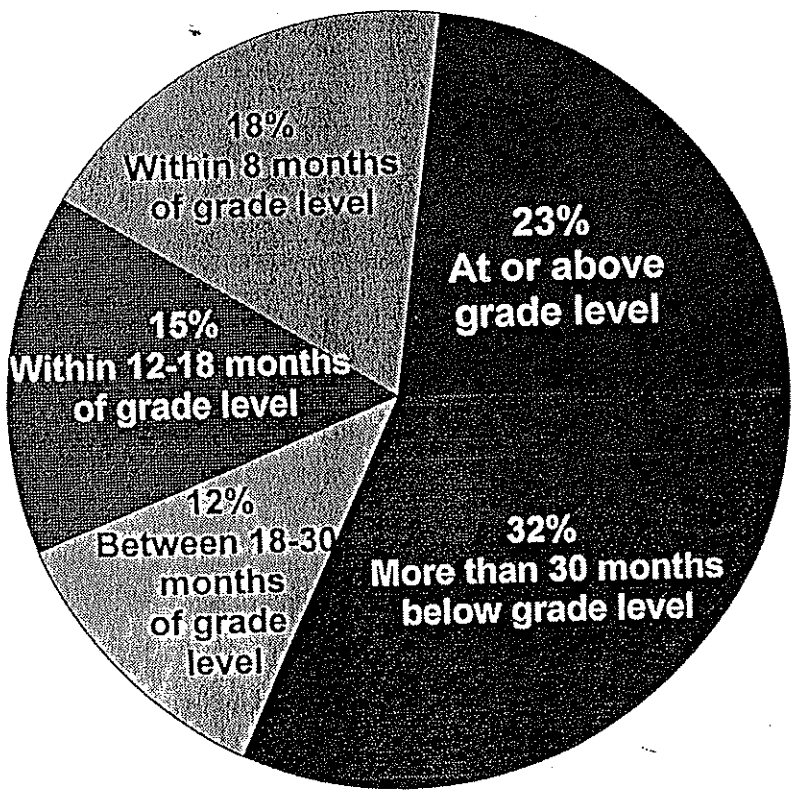


**Figure 1.** Relative reading performance levels of children with cochlear implants.



word recognition as a whole unit, may predict reading outcomes. His findings also may provide evidence that using a phonics approach is beneficial for successful reading development. Webster (1986) argued however, that the influence of internal speech on reading achievement may not be so much that it aids with decoding, but that it provides "... access to the articulatory rehearsal system of working memory" (p. 184).

Geers and Moog (1989) and Jensema (1975) cited factors associated with positive reading outcomes in children educated in oral programs. These included: good use of residual hearing, early amplification and educational management, average or above average nonverbal intellectual ability, middle-class family environment, and oral English-language ability. Finally, communication mode may interact with reading achievement (e.g., oral, manual, simultaneous communication), although the exact relationship between method and reading performance is unclear (e.g., DiFrancesca, 1972; Lane & Baker, 1974; Rogers, Leslie, Clark, Booth, & Horvath, 1978; Vernon & Koh, 1970).

The purpose of this study was to investigate the reading performance of a group of children with prelingual, profound deafness who have had more than two years' experience with multichannel cochlear implants. We examined whether children with multichannel cochlear-implant experience exceeded expectations of reading achievement attained by children with severe to profound hearing impairments who did not use cochlear implants and who participated in large-scale studies.

One could predict that children with multichannel cochlear-implant experience would have an advantage over children with profound hearing losses.

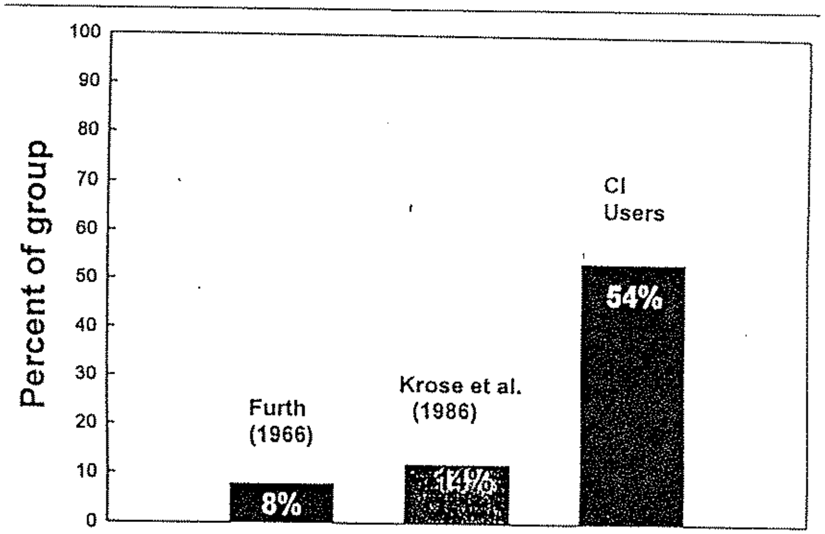


**Figure 2.** A comparison of the percentage of deaf children between Grades 4 and 12 who achieve a fourth-grade or higher reading level.

**Table 1.** Difference (in Years) Between Grade in School and Achieved-Grade Status on Reading Test

| *Age of group* | *7–9 years* | *10–12 years* | *13–14 years* | *15–17 years* |
|---|---|---|---|---|
| Children without cochlear-implant experience* | N=26<br>-1.5 | N=33<br>-4.0 | N=36<br>-6.0 | N=41<br>-9.0 |
| Children with cochlear-implant experience** | N=15<br>-.8 | N=15<br>-1.94 | N=6<br>-1.3 | N=4<br>+.15 |

* numbers based on text on p. 79 of Yoshinaga-Itano and Downey (1996), paragraph-comprehension subtest of the *Woodcock-Johnson Psycho-Educational Battery*, (Woodcock & Johnson, 1977).

** numbers based on test results of children with cochlear-implant experience on the paragraph-comprehension subtest of the *Woodcock Reading Mastery Test–Revised, Form G* (Woodcock, 1987).

They might be expected to develop reading skills that would exceed the skills attained by children who are deaf and have no cochlear-implant experience. Studies have found that children with multichannel cochlear-implant experience generally perform better than hearing aid users on speech-perception tests (Miyamoto, Kirk, Todd, Robbins, & Osberger, 1995; Tyler, Fryauf-Bertschy, Gantz, Kelsay, & Woodworth, 1997), speech-production tests (Miyamoto, Svirsky, Kirk, Robbins, Todd, & Riley, 1997; Tye-Murray, Spencer, & Woodworth, 1995), and measures of language acquisition (Miyamoto, Svirsky, & Robbins, 1997; Tomblin, Spencer, Flock, Tyler, & Gantz, in press). Thus, we should expect to see an association between speech and language status and reading.

## Method

### *Participants*

Forty children with prelingual deafness who received Nucleus multichannel cochlear implants between the ages of 2 and 13 years participated in this study. The average grade level at the time of testing was fifth grade, third month. The range in grades was kindergarten through 12th grade, while the ranges in ages was 6 years, 9 months, to 17 years, 5 months. The mean age of the group was 11 years, 2 months ($SD$=2 years, 9 months). The average experience level with a cochlear implant at the time of testing was 63.3 months ($SD$=24 months) with a range of 24 months to 108 months. Thirty-four of the children used simultaneous communication and attended public-school programs at the time of testing. One child was educated in an oral public-school program, three children had transferred to a private oral school within two years before the test date, one child had transferred to a private oral school after one year of implant experience, and one child transferred to a state school for the deaf two years before the test date.

None of the children in the group was identified as having concomitant learning disabilities. One child qualified for a gifted-and-talented program in public school.

### *Reading Measure*

The paragraph-comprehension subtest of the *Woodcock Reading Mastery Tests–Revised, Form G* (Woodcock, 1987) was administered. This test was designed to assess a child's ability to comprehend a passage of two to three sentences then fill in a missing word of the passage via a modified cloze procedure. The test was constructed so that the child had to understand the entire passage to fill in the missing word. The passages in the subtest were drawn from a variety of reading materials that included textbooks, newspapers, and

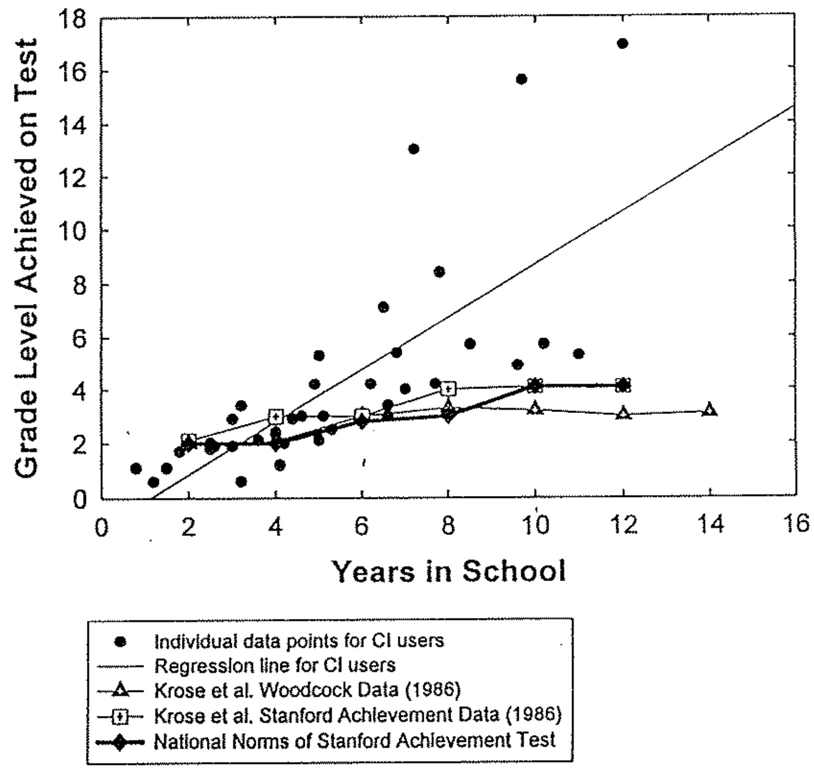


**Figure 3.** Grade level achieved on *Woodcock Reading Mastery Tests–Revised, Form G.* (Woodcock, 1987), plotted as a function of years in school. Regression line indicates a slope value of .74.

household and business documents. Passages were chosen because they delineated between general passage comprehension and comprehension of specialized vocabulary.

## Results

The subjects' scores were compared with norms from the test, based on the number of years of education the subjects had. The subjects achieved a mean reading grade-level equivalent of 4.13 ($SD$=3.65). Because many older children fail to surpass the fourth grade reading level, we calculated scores for the 28 children who were in grades 4 through 12 separately. This group achieved a mean grade-level equivalent of 5.15 ($SD$=3.9). Figure 1 provides a graphic representation of the comparison between actual and achieved grade as categorized by relative performance levels. Nearly one fourth of the children in this study were reading at or above their grade levels, and almost one fifth were reading within eight months of their grade levels. Fifteen percent of the children were reading at levels that were within 12 to 18 months of their grade levels, while 12% were within 18 to 30 months of their grade levels. Over one fourth of the children, however were reading at levels that were 30 months or more below their grade levels.

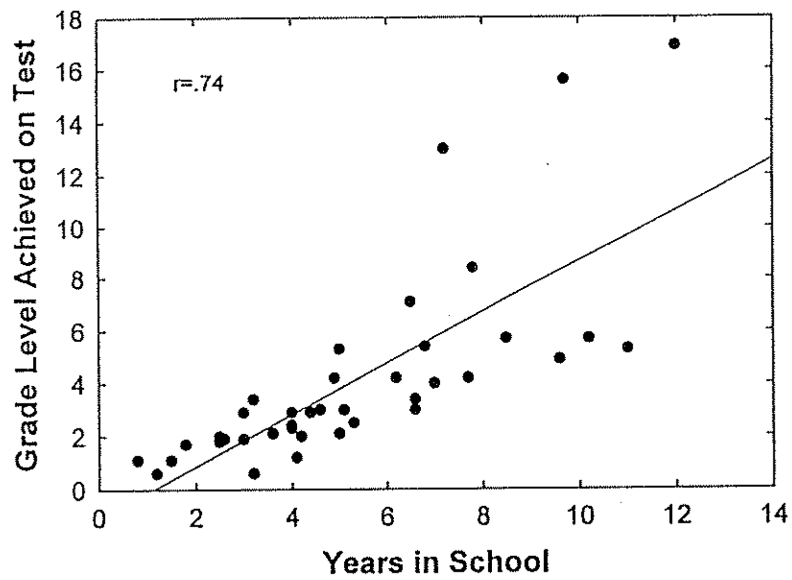


**Figure 4.** A comparison of the plot of years in school and reading grade achieved by cochlear-implant users with a plot of reading performance as a function of age as based on results from Krose et al. (1986) and the national norms provided on the reading subtest of the *Stanford Achievement Test* (Madden, Gardner, Rudman, Karlsen, & Merwin, 1972).

Figure 2 shows the reading levels of the 28 children in this study who were in grades 4 through 12 compared to children in the same grades who did not have cochlear-implant experience and who had severe to profound hearing losses. The data from the current study were compared with data from Furth (1966), who reviewed reading test scores from 5,224 children who are deaf or hard of hearing and were between the ages of 10.5 years and 16.5 years, finding that only 8% achieved higher than a fourth-grade reading level. We also compared results with Krose et al. (1986) who used the passage-comprehension subtest of the *Woodock Reading Mastery Test* (Woodcock, 1973) to assess subjects between 9.6 and 20 years of age. This study found that 14% of these subjects achieved higher than a fourth-grade reading level. The current study found that 54% of the children between grades 4 and 12 who have cochlear-implant experience read above the fourth-grade level; these results are considerably better than those reported by previous investigators.

Table 1 illustrates the gap between the actual grade level and the achieved grade-level status for subjects in this investigation and subjects studied in a previous investigation by Yoshinaga-Itano and Downey (1996). Average performance levels were determined by calculating the mean of the years in school and subtracting the mean of the grade level achieved on the test. In the group of cochlear-implant users, the smallest gap between mean grade level and mean achieved reading score, was a .15-year *advantage* in the oldest group. The largest gap was a 1.9-year *deficit* in the 10- to 12-year-old group. Note, however, that the number of subjects in the oldest age group of the current study is only four. In the subjects who did not use cochlear implants, the performance gap ranged from a 1.5-year deficit at age 7 years to a 9-year deficit by age 17 years.

Figure 3 presents the reading-grade quotient (.74) for the subjects in this study, which was determined by calculating the slope of the regression line for the plot of years in school and reading-grade level achieved. This reading-grade quotient is in contrast with the .2 value reported by DiFrancesca (1972).

Finally, Figure 4 presents a comparison of the plot of years in school and reading-grade achieved by cochlear-implant users with a plot of reading performance as a function of age, as based on results from Krose et al. (1986), and the national norms provided on the reading subtest of the *Stanford Achievement Test* (Madden, Gardner, Rudman, Karlsen, & Merwin, 1972).

## Discussion

This study documents that children with cochlear-implant experience attain higher reading-achievement levels than children who are deaf or hard of hearing have in the past. Almost four times as many children in this study attained a reading level above the fourth-grade barrier when compared to previous studies of children who are deaf or hard of hearing of the same age and did not use multichannel cochlear implants (Furth, 1966; Krose et al., 1986). Moreover, the mean level of reading achievement of children with cochlear-implant experience exceeded mean levels achieved in previous studies of children with hearing losses. For example, the average grade-level performance for children with cochlear-implant experience at a mean age of 11 years, 2 months, was 4.13; a 1-year advantage over children studied by Lane and Baker (1974), who had severe to profound hearing losses and used hearing aids.

When children use cochlear implants, reading levels may continue to improve with years of education. The gap in reading performance as compared to grade level in this study remained relatively small. By contrast, previous studies have documented that this gap grows with age (Yoshinaga-Itano & Downey, 1996).[1]

Most of the children in the current study came from public-school environments. Their peer groups were composed mostly of children who had normal hearing and possibly some children with hearing losses that ranged from mild to profound. Additionally, most of the children in this study communicated using simultaneous communication; some communicated via oral-aural methods exclusively, while others communicated in both total-communication and oral-aural environments. The children came from families that had a variety of levels of ability to commit resources toward specialized educational programming, but they all had in common the opportunity to listen to spoken English throughout their school day. Although the study did not control for types of programming options, it does illustrate that children with cochlear-implant experience who are educated in public schools close to their homes have an excellent chance of surpassing the fourth-grade reading level and maintaining skills that are close to their grade in school.

The factors that contribute to reading achievement are complex but may include linguistic skills and comprehension of grammar, syntax, and even figurative language. Conrad (1979) suggests that one skill that has been found to have a positive influence on reading achievement in children who are deaf is the ability to use the speech code. Through a recoding process, children who are deaf may use that information to decode the written word. If using the speech code is indeed intrinsic to the reading process, it may be that the information provided by cochlear implants facilitates that skill. Future research could focus on the influence of cochlear-implant experience on phonetic coding as it relates to the reading process.

[1] This trend was not evident in the current study. Although the numbers of children in the older age group are smaller, we see that there is a general pattern of improvement in the performance/grade gap as age increases. The caveat to this claim is that our study is cross-sectional rather than longitudinal.



## Acknowledgments

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*The Volta Review,* Volume 99(4), 203–218

# The Effectiveness of Repair Strategies Used by People with Hearing Losses and Their Conversational Partners

*Rachel Caissie and Crysta L. Gibson*

*This study investigated the effectiveness of requests for clarification by adults who are deaf or hard of hearing and of partner responses to these requests in overcoming communication breakdowns in everyday conversations. Twenty-five adults with acquired sensorineural hearing losses were videotaped while conversing with normally hearing partners. The conversation samples were analyzed for the occurrence of three types of clarification requests and eight types of partner repair strategies and for the frequency with which the repair strategies successfully solved misperceptions. Overall, nonspecific clarification requests, requests for the repetition of a specific constituent, and requests for confirmation by the participants with hearing losses were all similarly effective in managing communication breakdowns. In contrast, some partner repair strategies were more effective than others; paraphrase and confirmation of the message were the most effective strategies, while message elaboration was the least effective. Partial repetition of the message was highly effective following a request that the partner repeat a specific constituent but not following a nonspecific request for clarification. The effectiveness of full repetition of the message was unaffected by the preceding clarification-request type. Except for requests for confirmation, which nearly always elicited confirmation responses, the type of clarification request used did not consistently elicit the most effective repair strategy from partners. Partners had more control over the facility with which communication breakdowns were repaired, because they could select particular repair strategies, than did the adults who are deaf or hard of hearing through their selection of clarification-request types. This emphasizes the essential role conversational partners play in effective management of communication breakdowns.*

People who are deaf or hard of hearing frequently experience communication breakdowns because they misperceive their conversation partners' spo-

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