Global Language Progress with an Auditory-Verbal Approach for Children Who Are Deaf or Hard of Hearing

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This study focused on the global language growth rate of 40 children with hearing loss (hearing aid and cochlear implant users) who received intensive auditory-verbal intervention for a period of one to four years. Three global language assessment instruments were administered to the children at least annually after auditory-verbal services were initiated. Group performances in receptive and expressive language for each year indicate that a reasonable overall expected average rate of growth should be 100% for each of the first two years of auditory-verbal intervention, even for typical older preschool children. Furthermore, performance of the “graduates” in this study shows that the gap between chronological age and language age was closed — that is, these children essentially attained linguistic competency at levels commensurate with peers who have normal hearing.

Introduction

English, according to many experts, is the primary language by which effective social and academic achievement occurs within the general American culture (Nelson & Camarata, 1996). However, children with hearing loss — particularly those who are severely or profoundly deaf — typically do not learn the English language effectively enough to become fully participating members of the larger hearing community (e.g., Brannon, 1968; Moeller, Osberger, & Eccarius, 1986). Therefore, when considering the (re)habilitation of children with hearing loss, enabling them to become proficient in English should be a high priority.

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Although most experts agree on the need for children who are deaf or hard of hearing to develop English-based language proficiency, there is unabated controversy on the appropriate approaches to intervention. A few studies showed that children who are deaf who have parents who are deaf can acquire sign language at a rate and manner similar to that of children with normal hearing acquiring spoken English (Brasel & Quigley, 1977; Schlesinger & Meadow, 1972). Based on these data, some argue that language proficiency can be best achieved through approaches that incorporate some form of manual communication. Others argue that children who are deaf will learn English best by adopting an auditory/oral approach.

A review of more recent literature indicates that the effectiveness of particular communication approaches for children who are deaf who have hearing parents are varied and equivocal (Hyde & Power, 1992; Musselman, Lindsey, & Wilson, 1988; Robbins, Bollard, & Green, 1999; Spencer, 1993; Tomblin, Spencer, Flock, Tyler, & Gantz, 1999; Yoshinaga-Itano, Sedey, Coulter, & Mehl, 1998). Regardless of approach, considerable language delays continue to be reported for children with hearing loss who have parents with normal hearing. For example, Nicholas, Geers, and Kozak (1994) noted that the average child with hearing loss who does not have additional disabilities does not use two- and three-word combinations to communicate until 5 years of age, meaning his or her prelinguistic stage is lengthy. Recent studies targeting children with cochlear implants (Bollard, Chute, Popp, & Parisier, 1999) show that the rate of language progress for these children, once implanted, can become “normal” (i.e., one year of language growth occurs within a 12-month period). However, these children still demonstrate considerable overall language delays.

Relative newcomers to this controversial educational landscape were those who proposed what is currently known as the auditory-verbal approach (Beebe, 1953; Fiedler, 1952; Griffiths, 1974; Huizing & Pollack, 1951). The auditory-verbal approach focuses on the comprehension of naturally spoken language and the development of intelligible speech by maximizing use of the child’s residual hearing, regardless of the prosthetic device used (Pollack, 1985). Advocates maintain that this approach is better suited for developing linguistic efficacy among children who are deaf (Estabrooks, 1994; Flexer, 1994). For any approach to be considered a viable option, however, it should first demonstrate the achievement of functional communication skills for children who are deaf or hard of hearing.

Information on how children develop language using the auditory-verbal approach is scarce. Essentially, proponents of the approach have relied on individual case studies or small selected samples (Daniel, 1998; Rhoades, 1982; Rhoades, Colarusso, & Layne, 1985), which is insufficient for demonstrating the viability of any communication option for children who are deaf or hard of hearing. Existing group language data with the auditory-verbal approach targets vocabulary as a measure of language growth (Yoshinaga-Itano & Pollack, 1988). Although such information is vital, the development of linguistic competency with a large-enough group of auditory-verbal chil-
Children remains unexplored. There is no known prior study of children receiving auditory-verbal intervention that specifically examines their rate of progress in global language growth over time.

This article addresses a basic efficacy concern: Does the auditory-verbal approach provide a viable communication option for the average child with hearing loss? The primary purpose of our longitudinal study was to describe the receptive and expressive language development of children with hearing loss within an auditory-verbal program. Following this are two concerns of equal importance. First, what constitutes adequate global language progress in the (re)habilitation for children with hearing loss? Second, does the gap between chronological age and language age narrow for these children? Concomitantly, an expected outcome of this study is the determination of a benchmark for acceptable (re)habilitative progress within the auditory-verbal approach.

Method

Participants

Forty children received intervention services from a private, nonprofit, center-based program that specialized in providing an auditory-verbal approach for families with children who are deaf or hard of hearing. A systematically positive family-focused, child-driven, objective-oriented program was constructed on a cognitively oriented (Weikart, Rogers, Adcock, & McClellend, 1971) auditory-comprehension-based model of functional language guidelines. These guidelines are presented as a "road map" by Rhoades (1999). All three service providers, fostering cooperative partnerships with parents, were state- and nationally certified "teachers of the deaf"; two were certified auditory-verbal therapists (Cert. AVTs) also supervising the noncertified auditory-verbal therapist. Most of the children and their parents participated in one or two hours of weekly auditory-verbal therapy sessions.

There were no preselection criteria for inclusion in this study other than expressed parental motivation in having their children learn to hear and speak and the existence of at least a moderate hearing loss in children who would receive continuous auditory-verbal intervention. Children who were not routinely seen for therapy by the program's auditory-verbal therapists were excluded from this study.

Hearing and Device Characteristics. Demographic data related to the children's hearing and prosthetic devices used are shown in Figure 1a-d. As shown in Figure 1a, the majority of children were identified as deaf or hard of hearing between 13 and 24 months of age. In fact, the mean age of identification was 17 months (range 0–37 months). Only one child was identified at 37 months. Based on age of identification, it is not surprising that all but three children were prelingually deaf. Baseline objective assessment results for the three children who were perilingually deafened indicated limited verbal language skills, if any. In fact, two of these children had become proficient in sign language.
Figure 1a-d. Hearing and prosthetic device characteristics for the 40 participants in this study.

Although cause of hearing loss could not be determined for all children participating in this study, it was known for 57% of the children, as shown in Figure 1b. Meningitis had caused hearing loss in three children, five had tested positive for cytomegalovirus (CMV) at birth or during infancy, two had tested positive for an autosomal-recessive gene (i.e., connexin 26), four were syndromic, and nine were unspecified genetic cases given that hearing loss was apparent in siblings or other family members. Interestingly, 29% of the group was known to have a family history of hearing loss.

The mean age of initial amplification for all 40 children was 20 months (range 3–40 months), with most children amplified within four months of identification (see Figure 1c). Moreover, the mean aided better-ear pure-tone
average (500, 1000, and 2000 Hz) for these 40 children was 53 dB HL (range 15-120 dB HL). Their average age at which auditory-verbal intervention services were initiated was 44 months (range 4-100 months). Within this group as a whole, 33% used only hearing aids, 38% used only cochlear implants, and 30% transitioned from hearing aids to cochlear implants during the course of this investigation (see Figure 1d).

For those children who used only hearing aids (n = 13) throughout this study, the mean age of initial amplification was 24 months, about four months later than for the group as a whole. Unaided better-ear three-frequency pure-tone averages for this subgroup of aided children ranged from moderate to profound, with two having moderate loss (47-55 dB HL), three having moderate-to-severe loss (57-70 dB HL), five with severe loss (73-90 dB HL), and three having profound deafness (90+ dB HL). Their mean unaided better-ear pure-tone average was 75 dB HL. All the aided children were well fit with either high-gain linear or programmable behind-the-ear (BTE) hearing aids, if not upon initiation of auditory-verbal intervention, then as soon as possible thereafter. For the hearing-aid-only subgroup, the mean aided better-ear pure-tone average was 30 dB HL.

The children who used only cochlear implants (n = 15) throughout this study were initially amplified at a mean age of 18 months. Audiometric histories for these children show a mean aided better-ear pure-tone average of 78 dB HL (range 40-120 dB HL). Although unaided better-ear pure-tone averages were not available for this subgroup, the implant centers reported that each of the children were profoundly deaf. Their average age of initial implant stimulation was 43 months (range 23-65 months).

Finally, the subgroup of children who transitioned from hearing aids to cochlear implants during the study had a mean age of 17 months at initial amplification and a mean aided better-ear pure-tone average of 48 dB HL (range 30-75 dB HL). Unaided better-ear pure-tone averages were not available for all of the children in this subgroup, although all implant centers reported that each of the children had either a severe-to-profound or profound hearing loss. The mean age of initial implant stimulation for this transitional hearing device group was 46 months (range 19-70 months).

All 27 children with cochlear implants from both subgroups (68%) had been diagnosed with severe-to-profound or profound bilateral deafness. These implant users used speech-processing strategies of either CIS (Continuous Interleaved Sampling) or SPEAK (spectral peak). Seventeen of the children used Cochlear Corporation Nucleus devices (i.e., fifteen used the Nucleus-22® and two the Nucleus-24®) and nine used the Clarion® device by Advanced Bionics Corporation. Three children who began intervention using the Nucleus-22 experienced device failure. One of these children was then implanted with a Clarion device and the other two were reimplanted using the Nucleus-24 and Nucleus-22 devices, respectively. The child with the reimplanted Nucleus-22 device did not hear well for about one-and-a-half years of the four-and-a-half years in which he participated in this study. The data

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from the children with device failures were included in this study for purposes of ecological validity.

All but one of the 40 children in the study used their prosthetic devices consistently during their waking hours. The one exception was an implanted child who, for various reasons, seemed to communicate best using sign language.

**Family and Other Child Characteristics.** Demographics related to family and child characteristics are shown in Figures 2a-f. The participants are representative of infants/toddlers and preschoolers with a multiplicity of child and family characteristics.

The parents, in general, represented a well-educated group with 77% holding either bachelor or post-bachelor degrees (see Figure 2a). However, there were nine families where the parents’ education was at the high school level. English was the primary home language for 72% of the families (see Figure 2b). Of the families whose primary language was not English, only five expressed prolonged difficulties in transitioning from being bilingual to monolingual. Since none of the therapists was bilingual, it was believed important that families spoke only English at home by the end of the first year of intervention. All families in this study did make the transition to speaking only English with their children.

Figure 2c illustrates demographics related to family issues, including a bilingual home environment, which had the potential to influence the efficacy of therapy. For example, 13% of the families demonstrated multiple dysfunctions, such as an alcohol-abusive and/or verbal-abusive parent in addition to explicitly disagreeable spousal relations that resulted in marital dissolution. Poor management of child behaviors was also exhibited by 25% of the families, and 3% demonstrated poor parental follow-up of suggested intervention activities that persisted throughout most — if not all — of the auditory-verbal intervention program. Routine observation of these children, indicating that they had frequent temper tantrums and repeatedly hit their parents, was suggestive of inadequate parental management of child behaviors.

Of the children who participated in this study, 22 were male and 18 female. Prior to auditory-verbal intervention, most children were enrolled in programs based on either the Total Communication (22%) or oral communication (35%) option. Only 43% began intervention with the auditory-verbal approach. In fact, the age of auditory-verbal initiation varied considerably, with 44 months the average age of beginning intervention (range: 4–100 months). Despite their heterogeneity, all children in this study were enrolled in preschool or elementary classroom settings for children with normal hearing during the course of the investigation. These children did not receive therapy for speech-language development in their respective schools.

Developmental psychologists diagnosed six children as below average in cognitive abilities (see Figure 2d). In fact, one child was medically diagnosed with microcephaly, congenital CMV, left brain calcification, and displayed many autistic-like behaviors. Two other children came to require medication for both their ADHD and psychologically diagnosed bipolar disorder.
Figure 2a-f. Family and child characteristics for the 40 participants in this study.
Based on occupational therapy evaluations, the majority of the children (78%) were found to exhibit difficulty with sensory processing (see Figure 2e). Nearly one-third were diagnosed with moderate sensory dysfunction, and nearly another one-third with severe sensory processing disorders. These children received sensory integration therapy during the course of the study. In addition, nearly half of the children were referred to speech-language therapy solely for treatment of oral-motor dysfunction (see Figure 2f).

**Child Status at Completion of Data Collection.** The data reported here was obtained between late-1994 and mid-1999. During this period, all 40 children had undergone at least one year of therapy, 32 had received two years, 14 three years, and 6 four years. One reason for the difference in the number of treatment years was differences in starting dates. For example, a child might not have begun treatment until 1996 and, thus, it would only be possible to have three years of data. The other reason the number of years of treatment varies is because services were terminated for various reasons, such as “graduation” (i.e., the child was professionally released from the program when evaluation findings indicated that auditory-verbal services were no longer needed).

The proportion of children terminating or continuing treatment to the end of data collection, along with the number of years of total treatment prior to collection, are shown in Table I. As shown, approximately one-third (n = 14) of the 40 children were professionally released and another third continued with auditory-verbal intervention therapy. Of the 12 children lost to attrition, five were referred to self-contained classrooms, with four of them referred to auditory/oral schools and one referred back to a Total Communication environment. The remaining seven children were lost to this study because of family relocation to another auditory-verbal program or because the parents decided to terminate auditory-verbal intervention. All 12 children in this subgroup (i.e., those lost to attrition) were included in the study because at least one year of data on language progress was obtained for each of them.

It is of interest to note differences and similarities between the subgroup of 14 graduates, those children who were professionally released from the program, and the group of children as a whole. The greatest difference was in the proportion of children who wore hearing aids. Although 33% of the 40 children used hearing aids throughout their participation in this study, 57% of the graduates used hearing aids. Moreover, 29% of the graduates were implanted from the outset, and 14% transitioned from hearing aids to cochlear implants during the course of the study. Of this graduated group, the mean aided better-ear pure-tone average was 38 dB HL, compared with the mean of 53 dB HL for the group as a whole. Only one of these graduated children had a Total Communication background, and only one presented with explicit family issues that could potentially have had a negative impact on the language progress. For the group as a whole, the average age of amplification at 22 months, and of entrance into the auditory-verbal program at 44 months, remained similar. The mean age of initial implant stimulation for the 14 graduates was 43 months as compared with 47 months for the group as a whole.
Table 1. Program Status for 40 Children at Termination of Data Collection

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</table>

Note: Unduplicated count

In this graduated group, the causes of the children’s hearing losses were as follows: one (connexin 26), two (meningitic), two (syndromic), three (unspecified genetic), and seven (unknown). Referrals for sensory integration and oral-motor therapy were made for 43% and 36% of the 14 children, respectively. In terms of parental education, 14% had graduated high school, 36 had graduated college, and 50% had graduate-level educations.

Summary. The demographic data demonstrate that the children in this investigation represented a heterogeneous group. This is important, since it is well known that the populations of all children who are deaf or hard of hearing are demographically heterogeneous rather than homogenous. To demonstrate the effectiveness of auditory-verbal therapy, therefore, it is important to include children with diverse backgrounds, including those who might ultimately be diagnosed as cognitively delayed. Although some children had moderate-to-severe hearing loss and could benefit from well-fit amplification, the majority used cochlear implants because of profound deafness. Most children exhibited at least one factor that had the potential to negatively influence the outcomes of therapy. These factors were biological (e.g., cognition, sensory processing, oral-motor) and/or experiential (e.g., divorce, alcoholism, bilingualism). Auditory-verbal intervention was generally initiated with these children at a somewhat “later” age than considered typical (i.e., their average age of enrollment was 44 months). It is important to note that the 14 graduates were similar to the larger group of children in most characteristics, including their heterogeneity.

Test Instruments

Three global language measures were used for this study, partly because of the age range of the children in this study. The Sequenced Inventory of Communication Development—Revised (SIDC) is designed to measure overall language from birth to 4 years of age (Hedrick, Prather, & Tobin, 1984). The Preschool Language Scale–3 (PLS–3) assesses language from a 1- to 7-year-old
level (Zimmerman, Steiner, & Pond, 1992). And the Oral Written Language Scale (OWLS) is a language measurement designed for children between 3 and 21 years of age (Carrow-Woolfolk, 1995), although it should be noted that only the oral component of this measure was used.

Each of these three instruments measure receptive and expressive language skills independently, yielding separate age-equivalent scores for comprehension and production of language. Each of these instruments is standardized on a broad sample of children with normal hearing, allowing the linguistic proficiency of children with hearing loss to be compared to their hearing peers. All tests were administered in naturally spoken English, whereby the children could use listening, speechreading, or combined strategies. Sign language was not used during test administration because one purpose of this study is to determine the rate of spoken language progress over time. All test manual procedures were strictly adhered to in the administration and scoring of norm-referenced assessments.

Data Collection

One of the three global language measures was administered to each child upon entry into the auditory-verbal intervention program. Progress was then monitored at least annually for each child. Although every attempt was made to obtain the annual data at 12-month intervals, actual testing occurred between 9 and 15 months, depending on scheduling issues and other considerations. In total, data were collected for a minimum of one year and for as long as four years of treatment since not all of the children remained in the study for its duration. The number of children tested each year decreased, because of either attrition or “graduation” or because of the different points at which services were initiated.

When the ceiling on one assessment instrument was reached, another global language measure was used. For example, a child below the one-year language-age equivalency could only be administered the SICD. A child who demonstrated a one- to three-year language-age equivalency could be administered either the SICD or the PLS–3. A child between a three- to four-year language-age equivalency could be administered the OWLS, PLS–3, or SICD. A child who demonstrated a four-year language-age equivalency or higher could only be administered the PLS–3 or OWLS at any given time. And a child who demonstrated a six-year language-age equivalency or higher could only be administered the OWLS. Thus, the data reported here are the receptive and expressive language-age-equivalent scores regardless of assessment instrument.

Results

Receptive and expressive equivalent language-age scores were available for the 40 children who completed at least one year of auditory-verbal therapy. Of these 40 children, 32 completed a second year of therapy, 14 a third year, and 6 a fourth year.

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Change in Equivalent Language Age. The receptive and expressive language-age equivalency data obtained from the children were examined as a function of the number of years of auditory-verbal intervention as illustrated in Figures 3 and 4, respectively. In each figure, the vertical axis indicates the equivalent language age in months, while the horizontal axis shows the mean age of the children at the test interval. Data are reported at pre-entrance to the program to the end of one year of therapy for all of the children \((n = 40)\); from the completion of one year of therapy to the completion of two years for the first subset of children \((n = 32)\); from the completion of two years of therapy to the completion of three years for the second subset of children \((n = 14)\); and from the completion of three years of therapy to the completion of four years for the third subset of children \((n = 6)\). The mean equivalent language-age scores obtained for the group as a whole over the first year and the subsets over the subsequent years are indicated by the filled symbols, while the line without symbols indicates expected language-age growth for children with normal hearing. Examination of Figures 3 and 4 reveals growth in both receptive and expressive language abilities for these children over the period in which they received auditory-verbal therapy.

The same receptive and expressive language-age equivalency scores obtained for each year in therapy (i.e., Year 1 \([n = 40]\), Year 2 \([n = 32]\), Year 3 \([n = 14]\), and Year 4 \([n = 6]\)) were subjected to a two-way repeated measures analyses of covariance (ANCOVA) to examine the independent variables of language measure (i.e., receptive vs. expressive) and time (i.e., beginning vs. end of each year of therapy). The covariate was the actual time expressed in number of months between the test administrations for each child (see Table II). Perhaps the most important finding of these analyses was that the main effect of time was significant in each. That is, there was a statistically significant increase in the equivalent language ages from the beginning to end of each year of therapy (see Figures 3 and 4). The main effect of language measure (receptive vs. expressive) was significant in the first and second years only. In both cases, receptive-equivalent language ages were slightly higher than expressive-equivalent language ages. More important, however, were the findings related to the interaction between language measure and time. For those children who received only Year 1 of therapy, this interaction was significant — with an increase of 17 months of growth in the receptive domain and 14 months of growth in the expressive domain. This finding may be related to an emphasis on receptive language in auditory-verbal therapy. During Year 2 and Year 3 of auditory-verbal intervention, the mean growth in receptive language ages was essentially equivalent to the mean growth in expressive language ages, thus resulting in lack of significant interactions. Finally, the interaction between language measure and time was again significant for those children in Year 4. Interestingly, the growth in expressive language age (which averaged 20 months) was quite a bit higher than the mean growth in receptive language age (i.e., 12 months). These findings are important, since they may be interpreted to suggest that despite an emphasis on receptive language in auditory-verbal
Table II. Summary of Analyses of Covariance on Receptive and Expressive Equivalent Language Age

<table>
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Note: Values enclosed in parentheses represent mean square errors.

*p < .05  
**p < .01

intervention, children with hearing loss who participate will obtain significant growth in both receptive and expressive language abilities. The question remains, however, as to whether the rates of growth can be attributed solely to the effects of maturation. In other words, are the growth rates equal to or greater than would occur with increasing chronological age?

Rate of Growth in Equivalent Language Age. One way to examine these data is to calculate the “rate of language growth.” This was done using the following formula:

\[
\frac{(\text{Score B} - \text{Score A})/\text{M}}{\times 100}
\]

where:  
Score A = age-equivalent language score at the first evaluation  
Score B = age-equivalent language score at the next evaluation  
M = number of months between evaluations

This means, for example, that if the age-equivalent receptive language score at the initial evaluation was 32 months and it was 44 months at the first annual evaluation — a 12-month interval — the child would have a 100% language
growth rate. However, if the language growth remained the same but the interval between testing had been 9 months instead of 12, the growth rate would be 125%.

To explore the rates of growth, the mean receptive and expressive language percent growth data (+/- one standard error) occurring as a function of year in therapy are illustrated in Figure 5, which shows that mean growth rates were well in excess of 100% for intervention Year 1, Year 2, and Year 4, and close to 100% for the 14 children participating in intervention Year 3. Receptive language growth rates of 139%, 124%, 86%, and 128% follow the same general pattern as expressive language growth rates (121%, 115%, 94%, and 163%) over the four-year period. In children with normal hearing, we would expect that as they matured over a 12-month period there would be an equivalent 12-month increase in language age. Similarly, it is possible for
Figure 4. Equivalent expressive language ages for children receiving one, two, three, and four years of auditory-verbal therapy. The solid line indicates expected language growth for children who are developing normally.

A child with hearing loss to show 12-month increases in language age due simply to maturation. In the present data there was a general pattern of greater than 12 months growth in language age over a 12-month period. This finding may be interpreted to suggest that, on average, children receiving auditory-verbal therapy will progress more than might be expected as a function of normal development growth alone. Although there is no clear explanation for the finding that mean language growth rates for children in Year 3 of therapy were less than 100%, it is possible this reflects a “plateau,” a typical phenomenon in the learning process for children with normal hearing (Kagan et al., 1978).

Language Age vs. Chronological Age. A question remains as to whether it is possible for children with hearing loss who participate in an auditory-verbal intervention program to achieve language ages equivalent to their chron-
Figure 5. Rate of receptive and expressive language growth as a function of year of treatment.

logical ages. To address this issue, the data from the 14 children who were professionally released (i.e., "graduated") was examined.

Figure 6 shows mean chronological ages, equivalent receptive language ages, and equivalent expressive language ages (+/- one standard error) for these 14 children pre-entrance and at their graduation from the auditory-verbal program. It can be seen that prior to therapy, both receptive and expressive language ages were less than the children's mean chronological age. At the point of graduation, however, there were essentially no differences between the children's chronological ages and their equivalent receptive and expressive language ages. In fact, the mean expressive language age was higher than either the mean chronological or mean receptive language ages at the point of graduation. The data was subjected to a repeated measures analysis of variance (ANOVA). Results revealed a significant main effect of age measure (F(2,26) = 4.0, MSE = 141.22, p = .03) and test time (F(1,13) = 88.7, MSE = 317.29, p < .001), as well as a significant interaction between the two
(F(2,26) = 19.5, MSE = 39.4, p < .001). As illustrated in Figure 6, this finding reflects greater changes in receptive and expressive language over time than in chronological age. These results are very encouraging because they demonstrate that the gap between language age and chronological age can indeed be narrowed for at least some children with hearing loss who participate in auditory-verbal therapy.

**Discussion**

As noted above, information on language development in children within the auditory-verbal approach is limited. This, in part, has led researchers to reexamine issues in current educational practice (Easterbrooks, 1999). Therefore, it is the responsibility of auditory-verbal therapists to adhere to the mandate of ongoing accountability and objective monitoring in language progress (Brookhouser & Moeller, 1986). Routine administration of standard-
ized assessment measures should enable practitioners to best serve the child's language needs (Elliot, Ysseldyke, Thurlow, & Erickson, 1998).

Using objective measurements, the present study focused on the language growth of 40 children with significant hearing loss who received from one to four years of intensive auditory-verbal intervention. Data were examined in terms of the absolute number of months growth in equivalent receptive and expressive language ages as well as in the rates of language growth.

In interpreting the performance data, several points should be considered. Ideally, an investigation into the efficacy of a language intervention program should use matching subjects in nonrandomized studies (Imbens-Bailey, 1998), but that was not feasible for this study. Nevertheless, the children in this study represent a typical heterogeneous group of children with hearing loss, albeit one with well-educated parents. For that reason, it might not be possible to apply the findings to a group of children with hearing loss who have parents with less education.

Given the considerations above, several important results emerged from this study. First, findings confirm the auditory-verbal approach to be a highly viable communication option for children who are deaf or hard of hearing, regardless of prosthetic device usage. In spite of wide individual variability in test performance, mean recepetive and expressive language growth typically continued rather steadily over a four-year period of auditory-verbal intervention. The average rates of equivalent language-age growth indicate that it is possible for children in auditory-verbal therapy to achieve, on average, growth in equivalent language ages that is at times higher than the number of months they mature chronologically. In addition, based on the findings that for three of the four years data were obtained mean language growth rates exceeded 100%, an average expected language growth rate of approximately 100% for each year of therapy may be a realistic goal or benchmark for language intervention with typical children who are deaf or hard of hearing.

It should be noted that when auditory-verbal intervention was initiated most of the children in this study were preschool-age but older — that is, the average age of intervention initiation was relatively late, at just over $3\frac{1}{2}$ years. An important implication of the results is that auditory-verbal intervention seems to be a highly effective communication option for children beyond the first three years of life. Although auditory deprivation research findings indicate that the plasticity of the developing auditory system is most pronounced during the first years of life (Rubin & Rapin, 1980), the relatively late ages at which intervention began in this study did not preclude the children, on average, from attaining better than 100% rates of language growth. Furthermore, when the data for the study's 14 "graduates" are examined, it seems that children who are deaf or hard of hearing can attain language ages equivalent to chronological ages. This finding is particularly encouraging, since it suggests that average children with significant hearing loss who have measurable language delays at 12 months of age will not necessarily — as Yoshinaga-Itano (1999) suggested — have delays that persevere
with age (to 7 years). Perhaps the current findings are related to known physiological data demonstrating that auditory maturation processes occur well after auditory stimulation is introduced beyond the first three years of life (Werner, 1996). In other words, it is certainly possible that children as old as 4 can learn language rapidly enough so that their “language age” may become commensurate with their chronological age (i.e., risk is not destiny).

It is important to note that while, on average, the 14 children who graduated from the auditory-verbal program demonstrated linguistic competency equivalent to their chronological ages, it remains to be demonstrated with sociometric data, independent discourse, pragmatic evidence, and future academic achievement whether they have fully assimilated into the mainstream community. Long-term follow-up on these graduates would be important information in the future for those trying to select a communication option for children with significant hearing loss.

Some experts have suggested that identification of variables is needed to help predict linguistic potential (Yoshinaga-Itano & Stredler-Brown, 1992). To this end, the data from the present study are being examined to determine the potential influence of multiple factors (e.g., cognitive delay, prosthetic device, ages of identification, amplification, implantation, and initiation of auditory-verbal intervention) on these children’s rates of language growth. At this point, however, it is important to remember that when a young child has a hearing loss, myriad interdependent factors must be sorted through if there is to be a positive intervention outcome. Boothroyd (1980) categorizes these factors as influences of nature and nurture. The heterogeneity and the progress of the children in this study highlight the fact that we cannot foresee how the numerous variables inherent in nature and nurture will interact in a child’s language progress.

In summary, the auditory-verbal approach has been shown to be a viable communication option for children who are deaf or hard of hearing. The children in this study were not preselected; rather, they were presented as a cross-section of the population. In addition, the data support that, on average, children with hearing loss can learn language at the same rate — or at a more rapid rate — as their same-age peers with normal hearing. Finally, the data for the study’s 14 “graduates” supports the conclusion that auditory-verbal intervention makes it possible to narrow the gap between chronological age and global language age.

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