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A FOLLOW-UP STUDY OF CHILDREN WITH PHONOLOGIC DISORDERS OF UNKNOWN ORIGIN

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Recent emphasis on early intervention programming for children with speech delays of unknown origin has yielded considerable literature on alternative forms of assessment and management. Less is known about the long-term special educational needs of such children. This study reviews the exceptional educational needs histories of 36 children who had received preschool speech services at a phonology clinic. Findings indicate that a high percentage of children continued to have speech and language and other special educational needs as they neared middle school and beyond. Many children eventually required special class placements. Discussion focuses on issues in classification, prediction, and management. On the bases of both original and follow-up data in this and other studies, the term *phonological disorder* appears to be appropriate for approximately 75%–80% of children referred early for speech disorders of unknown origin.

In 1985, Paul Weiner published a thoughtful summary of 17 follow-up studies of children with speech and/or language problems. Weiner discussed the many methodologic problems in both retrospective and prospective studies, including those due to subject, measurement, and changing paradigm issues in longitudinal research. Such problems notwithstanding, follow-up studies were viewed as valuable research investments, for they provide information on all three goals of science—description, prediction and control.

Weiner's review plus findings from other studies in Sweden (Klackenberg, 1980), New Zealand (Silva, Justin, McGee, & Williams, 1984), England (Bishop & Edmondson, 1987), and more recent papers in this country (Formby, Lougeay-Mottinger, Maxfield, & Friel-Patti, 1985; Schery, 1985; Tyler & Edwards, 1986) point to three interim conclusions about the long-term consequences of early speech and language problems. The major conclusion is that clinically significant proportions of children with early *language* involvement continue to have problems in academic, interpersonal, and vocational areas, with some studies providing as many as 20 years of confirming follow-up data. Second, intelligence seems to be an important moderating variable on outcomes within heterogeneous groups of children with early identified language problems (Bishop & Edmondson, 1987; Klackenberg, 1980; Schery, 1985). Finally, the available studies suggest that children with errors of *articulation* only (i.e., no language involvement) are not at risk for long-term clinically significant deficits (Hall & Tomblin, 1978; Tyler & Edwards, 1986).

Each of these three conclusions calls to question basic classification issues. What is an *articulation* disorder versus a *phonologic* disorder, relative to type and degree of *language* involvement? Retrospective follow-up studies have used a variety of terms and subject definitions for children with "functional" speech disorders, whereas contemporary discussions of classification have taken positions on terminology on the bases of etiologic and conceptual issues (e.g., Elbert, 1985; Shelton & McReynolds, 1979; Shriberg, 1986; Stoel-Gammon & Dunn, 1985). In contrast to such debate, data from follow-up studies could be used to provide an empirical basis for determining an appropriate nosology for this population. The goals of this study were to describe follow-up outcomes for a group of children with speech disorders of unknown origin and to relate findings to issues in classification, prediction, and management.

METHOD

Subjects

A total of 55 children were identified from an original pool of 88 children who from 1974 to 1984 had been referred statewide to a university phonology clinic for assessment and management of speech delays of unknown origin. These were children who lived in the Madison Metropolitan School District area and had been enrolled in the school district concurrent with or subsequent to receiving intervention services in the clinic. Descriptions of exceptional educational need (EEN) histories were available for 36 of the 55 children. School records were in the active files if the child was currently receiving some type of EEN service and in the inactive files if the child was no longer receiving services or was no longer enrolled in the school district. Complete records were not available for the remaining 19 of the 55 children for one of two reasons: either the child's parents refused to grant permission to review the file or the parents had elected to have the file destroyed 1 year after the child was no longer receiving EEN services or had transferred out of the district. Information available for these 19 children indicated that 15 of 17 who had transferred from the district had been receiving some type of EEN services when they transferred. The 2 children who were still enrolled in district schools were not currently receiving EEN services.

Although the 65% retrieval rate compares favorably with rates reported for other studies (Weiner, 1985) a preliminary review of records was undertaken to deter-

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mine whether the 36 children for whom school records were available might constitute a biased sample of the original subject pool. Information for all 55 children was compared, beginning with EEN class placement, a subcategory of EEN services. Whereas 23 (65%) of the 36 children for whom records were available had been assigned to an EEN classroom at some time during their school attendance in the district, only 5 (26%) of the 19 children for whom records were not available had been given an EEN class placement. One possible reason for this difference is that 5 of the children transferred out of the district prior to the time when children are ordinarily assigned to a special class. Although children with severe cognitive or language impairments are immediately placed in a self-contained class, such as EMH (educational mental handicap) or LIC (language-involved classroom) in place of or in addition to kindergarten, most children who are having difficulty are assigned to a special class only after repeating kindergarten. Moreover, children are not assigned to LD (learning disability) classes until second grade. The second comparison for the 55 children concerned the category, EEN services. Whereas 29 (81%) of the 36 sample children received speech therapy at some time during their school careers, school records indicated that only 13 (68%) of the 19 children had received speech services. Overall, these data suggest that the 36 children for whom special education records were available may represent a somewhat more involved subset of the original 55 children who had been referred to a university clinic for their intelligibility problems.

The Appendix provides individual subject data for the 36 children. Table 1 is a summary of demographic and speech-cognitive-language data, referenced to the time of enrollment for management at the university phonology clinic. As shown in Table 1, the 36 children divided into the same 3:1 ratio of boys to girls found in other studies of such children (Shriberg, Kwiatkowski, Best, Hengst, & Terselic-Weber, 1986); gender ratios have ranged from 2:1 to 3:1 in other follow-up reports (Weiner, 1985). Average age at first enrollment, 4 years 9 months, is approximately 1 year older than the current average referral age in this clinic, reflecting changes in service delivery options locally and nationally. Note in the Appendix that for the purposes of this study, school records were used that sometimes preceded age of enrollment in the clinic. The severity data are generally consistent with the percentages reported for each severity level in Shriberg et al. (1986). However, the percentage of children classified as *severe* on the Percentage of Consonants Correct metric (19%) is somewhat higher than percentages reported for three other samples (3%, 8%, 15%; Shriberg et al., 1986), again suggesting that children available for this follow-up sample may have been somewhat more involved than the parent group and other groups of speech-delayed children that have been described with the same measures. The cognitive-language data in Table 1 also are consistent with distributions reported for the three samples of speech-delayed children reported in Shriberg et al. (1986). As described in the Appendix, the large number of "no data" entries for cognitive and language status reflects a number of sampling constraints on the early availability of concurrent test scores.

Coding Procedures

Coding all relevant information on children's EEN histories eventually required three stages, involving different personnel and several procedures to maximize the scope and accuracy of the data.

First stage. School records for the 36 children through the 1984–85 school year first were inspected and coded by a research assistant, a master's level student in speech pathology who had been a classroom teacher of developmentally disordered children and, hence, was familiar with the content of school records. Following the results of a pilot study, which indicated that intrajudge and interjudge reliability for direct coding of data from the original file entries was not adequate, her task was to make systematic summaries of relevant file entries for subsequent coding by another person. The task was to abstract each entry and sort it by source and category.

Sources of EEN information in the school records included multidisciplinary team (M-Team) reports and summaries, statements of children's individualized education program (IEP) and progress toward objectives,

TABLE 1. Summary of demographic and speech-cognitive-language data for 36 children referred to a phonology clinic for management of intelligibility problems. Data are referenced to first date of enrollment; see the Appendix for description of all measures.

	Demographic data					*Speech-cognitive-language data*															
	Gender		*Age (years:months)*			*Severity of speech involvement*[a]				*Cognition*[b]				*Language comprehension*[b]				*Language production*[b]			
	Male	*Female*	*M*	*SD*	*Range*	*M*	*MM*	*MS*	*S*	*0*	*1*	*2*	*ND*	*0*	*1*	*2*	*ND*	*0*	*1*	*2*	*ND*
			4:9	1:4	2:9–7:10																
n	27	9				1	20	8	7	14	5	2	15	15	5	3	13	3	19	6	8
%	75	25				3	56	22	19	67	24	10		65	22	13		11	68	21	

[a]M = Mild; MM = Mild-Moderate; MS = Moderate-Severe; S = Severe. [b]0 = age appropriate; 1 = low average; 2 = low; ND = no data. Percentages are calculated on the bases of the available scores.

and, in a few cases, collateral data from nonschool service agencies. School sources contained entries from psychologists, social workers, occupational therapists, physical therapists, classroom teachers, and speech-language pathologists. The research assistant used a 10-category system to summarize and sort the available information. Although she had the option of creating new categories if needed, the following 10 categories were sufficient to accommodate all relevant information.

1. EEN and non-EEN academic *placements*, EEN or non-EEN *services*, and non-EEN *need areas*. EEN placements included assignment to a self-contained classroom for children with severe language involvement (LIC), developmental disabilities classified as an educable level of mental handicap (EMH), emotional disturbance (ED), or learning disability (LD). EEN services included occupational and physical therapy, speech-language therapy, and LD or ED resources. Non-EEN need areas included some form of tutoring in reading, spelling, math, writing, or fine or gross motor activities.
2. Otologic and audiologic history.
3. Cognitive level assessments and management targets.
4. Fine and gross motor assessments and management targets.
5. Language comprehension level and management targets.
6. Language production level and management targets.
7. Speech production level and management targets.
8. Social-emotional response to speech-language problem.
9. Behavior problems and management targets.
10. Learning style and successful teaching strategies.

In addition to summaries of the above information, the source of information for each entry was recorded including personnel, test title, and type of report (e.g., M-Team or IEP summary). Subsequent analyses indicated that M-Team reports and IEP summaries were the data sources for over 75% of the entries. The remaining entries were distributed among outside school sources in combination with M-Team or IEP reports, with approximately 14% of the entries requiring the classification "unspecified source." The number of years of data per child ranged from 2 years to 12 years, with most children having 2–6 years of data entries. Recall that the subject pool includes children who entered the study as late as 1984 and, hence, would have reached only their second data year at the eventual fall 1986 cutoff point.

Second stage. A second research assistant, a doctoral level student with 11 years' experience as a public school speech-language pathologist, was trained to use a 36-category, nominal coding system to reduce the school record summaries for statistical analysis. For example, for the variable Language Production: Assessment and Management Targets, subcodes were used to differentiate among semantic, syntactic, pragmatic, and general language formulation targets and their various combinations. In addition, a second-level coding tier was used to identify specific semantic, syntactic, pragmatic, and language formulation management targets. Missing data were distinguished from data that represented either a resolved problem or the failure on the part of persons who made the entry into the school record to report on an area that might still be a problem but was no longer of primary concern because of a shift in programming focus. Interjudge reliability between the research assistant who coded the data and one of the authors was 93% on a random sample of approximately 10% of the first-level data codes. These were the data to be used in the primary analyses. Interjudge reliability for the second-level data codes for the same sample dropped to 72%. To increase the reliability of codes at this level, one of the authors subsequently rechecked all entries in the data set including the summaries and, where necessary, gathered additional information from school records and personnel to resolve questionable entries and to attempt to minimize missing data codes.

Third stage. One of the authors completed a third pass through the data in which the goal was to dichotomize children's EEN history at each age and academic year into one of two groups: speech/language only EEN services (S/L EEN only) or speech/language and other EEN services (S/L and other EEN). Whereas coding decisions for speech-language services were straightforward because the relevant information was always available in the records, decisions for all other EEN services required a provision to make conservative judgments if information was unclear. A child was coded as receiving speech/language and other EEN services only if currently placed in an exceptional education classroom (LIC, EMH, LD, ED) or if receiving exceptional education services that included resource help for LD or ED, physical therapy, or occupational therapy. During this third stage available data for the then current 1986–87 school year was also recorded. With the exception of the limited data for these latter entries, the dichotomous codes reflecting S/L EEN only and S/L and other EEN services were subcoded to discriminate among the types of EEN placement and services and among types of speech-language problems. The three stages of coding ultimately yielded 202 child-years of retrospective data.

Early Speech Data

A second data set for the 36 children consisted of speech data taken from audiotaped continuous speech samples obtained soon after the children had been referred to the university speech clinic. For most children this sample predated their enrollment in the public school. The taped samples had been obtained by one of the authors using a Marantz PMD220 or a Marantz C105 audiocassette recorder, a matching Marantz EC-3 external condenser microphone, and Sony LNX audiocassette tapes. The microphone was placed on a table approximately 15 cm from the child's lips, and the tape recorder was kept out of the child's view. Most speech samples were transcribed by one of the authors using a Dictaphone 2025 transcriber. Intrajudge and interjudge percentage of agreement figures reported on comparable speech samples for this examiner, using a narrow phonetic transcription system (Shriberg & Kent, 1982), average in the high 70s–low 80s across phonetic classes (Shriberg & Kwiatkowski, 1982a; Shriberg, Kwiatkowski, & Hoffman, 1984). A total of 12 of the speech samples were transcribed independently by two members of a consensus transcription team trained to similar reliability criteria by the authors (Shriberg, Hinke, & Trost-Steffen, 1987). Transcribed samples were subsequently entered into a software program for phonetic and phonologic analysis (Shriberg, 1986) that yielded a percentage of consonants correct (PCC) score, an intelligibility index, and percentage of occurrences for both natural process sound changes and nonnatural process sound changes.

RESULTS

A preliminary review of the available data indicated that there were too few entries for many of the potentially interesting variables to pose relevant descriptive questions. For example, anecdotal impressions on children's attitudes toward speech therapy were sparse, as were specific information on variables such as otologic histories, management targets, and learning styles. The following results were derived from cross sections of the database from which comparative data were deemed adequate for quantitative analysis.

Description of Exceptional Educational Needs Outcomes

Figure 1 includes summary EEN data for the 29 of the 36 children for whom trends were available each year from ages 4 through 8 (see the Appendix for subject identification). Trends for the remaining 7 children were similar, but restricting the group to the 29 children for whom data were available at the start of this period allowed the data to be reported in percentages. The upper trend line indicates that at each age, approximately 25%–75% of the 29 children required both S/L services and some other type of EEN services. Together with the other trends these data indicate that over 80% of the group continued to have some type of EEN placement or resource need during this 5-year period.

Figure 2 provides more detail on the type of speech-language involvements maintained by children during the elementary school years. The top trend is the percentage of children requiring services for both multiple articulation errors and language, the next lower trend reflects the percentage of children who received services for multiple articulation errors, and the other trends are combinations of these and services for residual articulation errors (typically, /l/, /r/ and/or /s/) or no services. These data indicate that at every year, the greatest proportion of children continued to receive services for multiple articulation errors and language, with considerably fewer children coded as having only a few residual errors or only language problems.

Figure 3 includes more detail on the type of EEN services that were provided in addition to the S/L services shown in Figure 2. The triangles are the percentage of children in special classes only; the asterisks are the percentages of children who were placed in self-contained classrooms (LIC, EMH, LD, ED) and were also receiving services other than speech and language, such as occupational therapy or physical therapy; and the square symbols are the percentage of children who were receiving EEN services other than speech and language. As shown, many of these children originally referred for their intelligibility problems were eventually placed in EEN classrooms, whereas the EENs of other children required additional special educational resources.

Prediction of Exceptional Educational Needs

To address several predictive questions a second subgroup of the 36 children was assembled that met the following two criteria: Each child must have been 4–6

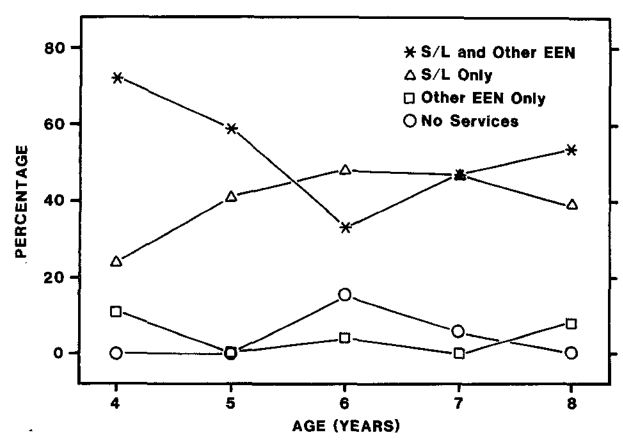

FIGURE 1. Overall exceptional educational needs (EEN) for a subgroup of 29 children with follow-up data from 4 to 8 years of age.

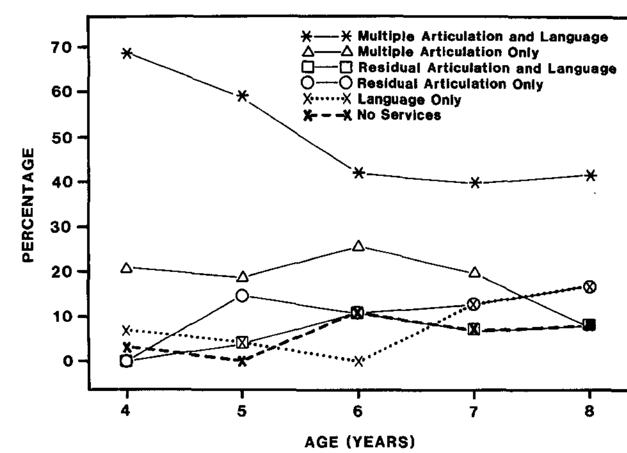

FIGURE 2. Speech-language needs for a subgroup of 29 children with follow-up data from 4 to 8 years of age.

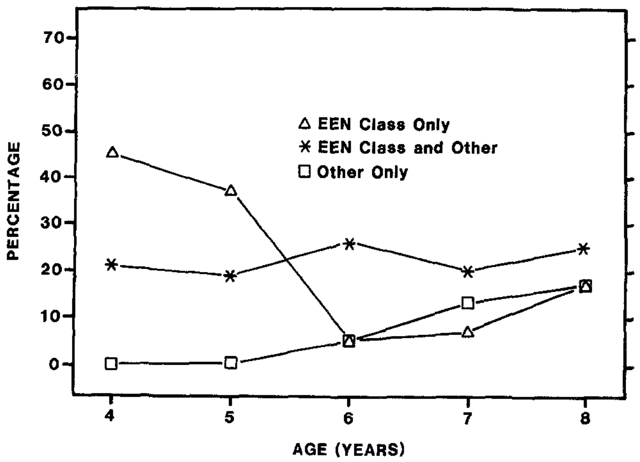

FIGURE 3. Non-speech/language exceptional educational needs (EEN) for a subgroup of 29 children with follow-up data from 4 to 8 years of age.

years old when first referred to the phonology clinic, and each must have sufficient EEN outcome records available to describe eventual EEN status. The goal was to assemble a data set of children whose eventual exceptional educational needs during the period of the study were known, although their actual years of follow-up data might vary. A total of 18 children met these two criteria (one child's age actually rounded up to 6:1), with follow-up data for each of these children sufficient to establish their long-term EEN status (see the Appendix, Groups 1 and 2). As shown in Table 2 the 18 children were divided into two EEN subgroups, which fortuitously were well balanced in number and several other respects. (See the Appendix for individual subject identification.) The first subgroup of 9 children eventually required only speech-language services in the schools (S/L only), whereas the second subgroup were among those who eventually were placed in a special class or who required some other type of EEN services in addition to speech-language services (S/L and other EEN). As shown in Table 2 children in the two groups were also comparable in gender and age. This crossbreak was used to pose several questions about relationships between early and later language and speech information and, more specifically, to see if outcome data could inform terminological alternatives raised at the outset of this paper.

Early speech status. The 18-child crossbreak was first used to assess whether the speech data recorded when the children were 4–6 years of age differed for the two EEN outcome groups. That is, the question was whether some aspect of the speech data could have been used to predict EEN outcomes. Figure 4 includes the means and standard deviation data for the two primary speech measures. These data were considered sufficient to compute one-way analyses of variance on the arcsine transformed percentage scores. Although children in the two outcome groups did not differ statistically on their average percentage of consonants correct scores [$F(1,16) = 2.08$, $p > .05$], which can be viewed as an overall severity measure, they did differ significantly on intelligibility index scores [$F(1,16) = 6.66$, $p < .05$]. As shown in Figure 4, children who at some time were placed in a special classroom (8 of the 9 children) or who received EEN resource services in addition to S/L services (other EEN) had lower intelligibility scores than children who were as severely involved in speech but did not eventually require other EEN services (S/L only).

To further explore the predictive power of the speech data alone relative to EEN outcomes, speech-error profiles for children in the two groups were generated by means of programs in the speech analysis package. Figure 5 is a profile of the two groups by type and frequency of speech sound changes, including natural process errors and other types of sound changes defined in the figure legend. Rationale and response definitions for coding the

TABLE 2. Exceptional educational needs (EEN) of a subgroup of 18 children who met two criteria involving age and follow-up data (see text).

Group 1				*Group 2*			
Child	*Gender*	*Age at enrollment (years:months)*	*EEN placements/services in addition to S/L*	*Child*	*Gender*	*Age at enrollment (years:months)*	*EEN placements/services in addition to S/L*[a]
8	M	3:10	None	10	M	4:0	ED
14	M	4:3	None	16	M	4:4	LD
15	M	4:3	None	19	M	4:9	EMH
20	M	4:9	None	21	M	4:11	ED
22	M	5:0	None	23	M	5:2	EMH
24	M	5:4	None	27	M	5:6	LIC
26	M	5:6	None	28	F	5:7	OT/PT
30	M	5:10	None	31	M	5:11	LD
33	M	6:1	None	32	M	6:0	ED
		M = 5:0				*M* = 5:2	
		SD = 0:9				*SD* = 0:8	

[a]ED = emotional disturbance; LD = learning disability; EMH = educational mental handicap; LIC = language-involved classroom; OT/PT = occupational therapy/physical therapy.

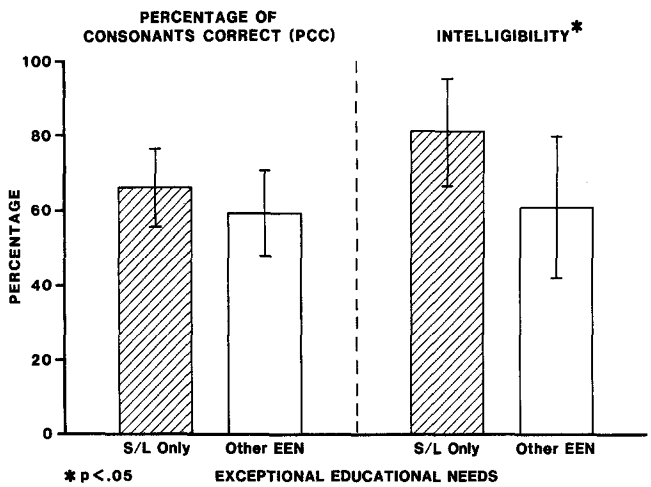

FIGURE 4. Early speech status of two groups of speech-delayed children divided on the basis of exceptional educational needs (EEN) outcomes. Group 1 (see the Appendix) required resources only for speech/language needs (S/L EEN only), and Group 2 required resources for speech/language needs plus special class placement and/or other EEN resources (S/L and other EEN).

occurrence of the eight natural sound changes in the figure legend were originally described in Shriberg and Kwiatkowski (1980) with supplementary validity and reliability studies presented elsewhere (Shriberg, 1986; Shriberg & Kwiatkowski, 1982a, 1983; Shriberg et al., 1986). Although inferential statistics were not deemed appropriate for the 27 possible between-group contrasts in Figure 5, three differences in error profiles are notable. First, the word-final contrasts between groups are almost all greater than word-initial differences, with the more involved EEN group averaging more word-final errors. Second, articulation of clusters is poorer in the more involved group, especially in word-final contexts. Third, the more involved group averaged more deletion of unstressed syllables in words of three or more syllables. These observed differences suggested that type and distribution rather than severity of speech errors (i.e., Figure 4, Panel A) might be more associated with eventual EEN outcomes of children originally referred for intelligibility problems.

A third analysis sought to pursue this possibility by asking whether the observed word-final consonant differences might be associated with language differences between children in the two groups, specifically, those involving grammatical morphemes. The final consonant singleton and cluster data from both groups were inspected to determine if errors of the children in the two outcome groups differed by morphophonemic load. Unfortunately, the available data allowed comparisons only for clusters and only for third person singular and contracted forms of the copula *be*.

Analyses based on these few data indicated that the percentage of correct word-final consonants in the two groups did not differ by the syntactic load of the consonant. The means trends were essentially similar across consonant types for both groups. Hence, these data do not shed light on the lowered final consonant performance of

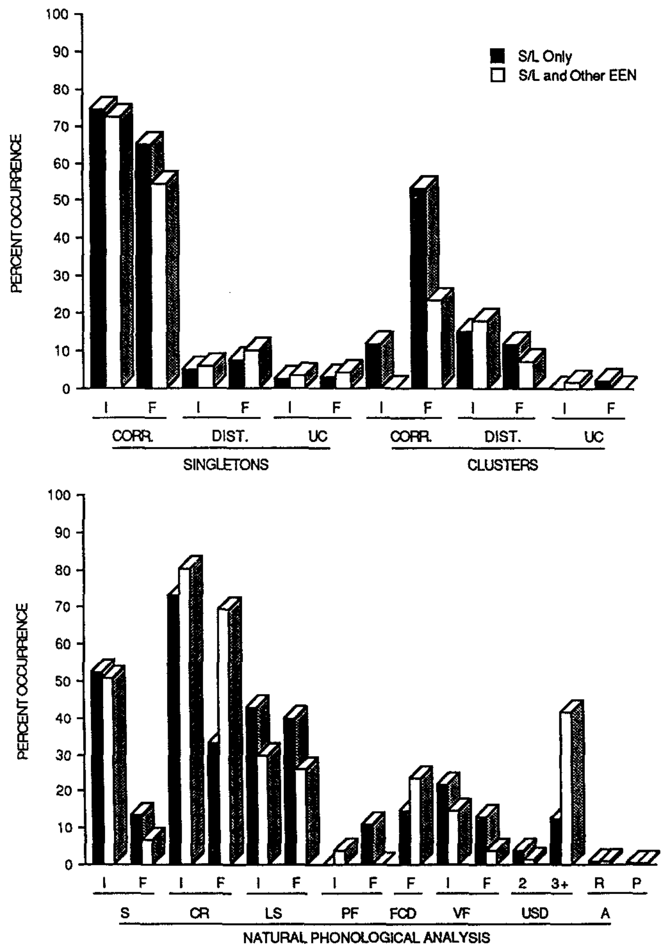

FIGURE 5. Average percentage of occurrence of 27 sound change categories for the 9 S/L EEN only children (filled bars) and the 9 S/L and other EEN children (open bars). Data in the top panel are divided by singleton consonants and clusters. I = Initial; F = Final; CORR = Correct; DIST = Distortion; UC = Uncoded. Data in the bottom panel include 8 sound change categories termed natural phonologic processes. S = Stopping; CR = Cluster Reduction; LS = Liquid Simplification; PF = Palatal Fronting; FCD = Final Consonant Deletion; VF = Velar Fronting; USD = Unstressed Syllable Deletion—2 syllables, 3 or more syllables; A = Assimilation—Regressive, Progressive.

the children who eventually required more EEN resources. However, the possibility that children's EEN placement outcomes might be predicted by individual analyses of final consonants by syntactic load should be pursued with a suitable data set.

Early cognitive-linguistic status. A second predictive question concerns relationships among early cognitive-linguistic data and later EEN status. In question was the degree to which eventual EEN outcomes might be determined by cognitive-linguistic status at time of referral. To allow for quantitative processing of the limited cognitive-linguistic data at original intake (see the Appendix), the available data were collapsed into two categories to reflect *age-delayed* and *age-adequate* performance. Formal test data were not available for all subjects, with *ns* for cognitive, language comprehension, and language production scores ranging from four to six scores for the speech/language only group and seven to eight scores for

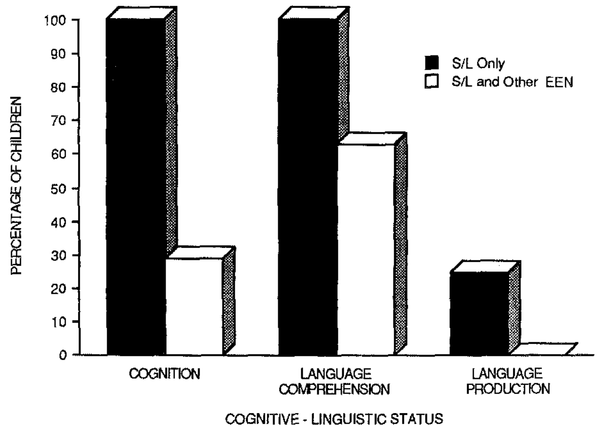

FIGURE 6. Percentages of children in the two follow-up subgroups who tested age adequate in cognition, language comprehension, and language production when first referred to the phonology clinic.

the speech/language and other EEN group. As described earlier, missing test scores can reasonably be interpreted as a lack of concern about child involvement in that domain at that time, because the standard practice in the school district is to do formal testing only when indicated.

The trends shown in Figure 6 indicate the expected predictive association between early cognitive-linguistic status and later EEN needs. The two EEN outcome groups were clearly different in cognitive and language status based on their first recorded test scores. For available data in the S/L only group, 100% of the children had age-adequate cognitive and language comprehension scores. In the S/L and other EEN group, in contrast, only 29% and 63% of children had age-adequate scores, respectively, on these two attributes. Moreover, whereas 25% of the S/L only group had age-adequate language production scores, none of the children in the S/L and other EEN group had age-adequate scores.

DISCUSSION

Service Delivery Issues

The first of several interrelated discussion issues concerns the long-term exceptional educational needs of children identified early as having intelligibility problems. Although several pieces of evidence indicate that these children may have been somewhat more severely involved than children reported in other samples, these data are consistent with those found in every follow-up study to date. A significant number of preschool children who are identified as having intelligibility deficits require special educational resources through at least the elementary school years. Even for the children who had minimal cognitive-linguistic involvements, extended speech-language services were required for an administratively significant percentage of children. Policy makers need to be made aware of such data in considering issues involving the allocation of funds and availability of special education resources (Conaway, 1987).

Classification Issues

A second issue concerns the classification questions introduced at the outset of this paper. The "label" a child inherits as a consequences of changing theoretical paradigms and special education legislation plays a significant role in children's long-term access to appropriate educational resources. Since the onset of this retrospective study, which corresponded with the Education for All Handicapped Children Act (1975; and recently, Public Law 99-457, Education of the Handicapped Act Reauthorization, 1987), children with only an articulation disorder are less likely to receive early special education resources because of the increased demand for those services. Despite considerable early debate in the literature and an increasing trend in this decade toward use of the term *phonological disorder,* terminological issues have not been resolved on empirical grounds. Do these EEN outcome data provide empirical support for any of the alternative terms *articulation disorder, phonologic disorder,* or *language disorder?* On balance, these data do seem to support the term phonologic disorder as the cover term that best accounts for both the originally obtained speech-language and cognitive data and the eventual outcome data. Rationales for this conclusion, which are based on consideration of each term in relation to findings from both the original and follow-up outcome analyses, are as follows.

The candidate term articulation disorder would not seem to be an appropriate classification term to apply to any of the children in this study. In relation to the original speech data, all 36 of the children originally referred to the phonology clinic for intelligibility problems of unknown origin had deletion and substitution errors on at least several consonants. That is, none of these children defined as "speech-delayed" (Shriberg, 1980; Shriberg & Kwiatkowski, 1982a) had only distortion errors. As can be shown in additional analyses of the same continuous speech samples, many deletions and substitutions occurred on sounds that were said correctly elsewhere—in another token of the same word, in the same word-position in other word types, and/or in another word position in the same or some other word (e.g., Shriberg & Smith, 1983). Such distributional properties have been proposed as the hallmark of a phonologic error because articulatory competence is demonstrated on the same sound within the same corpus (e.g., Ingram, 1976; Stoel-Gammon & Dunn, 1985).

The second set of findings considers the follow-up outcome data on children's error types. As shown in Figure 2, fewer than 20% of these children were later classified as needing speech services for residual errors, whereas approximately 80% at each age were classified as needing services for multiple articulation and language errors or multiple articulation errors only. Neither these data nor other available follow-up speech data indicate whether children with deletion and substitution errors *invariably* proceed to have distortion errors (e.g., of /r/, /l/, /s/) before finally normalizing. The present follow-up data indicate only that some, but not all, children followed this route.

Hence, the label articulation disorder would seem to be inappropriate to describe any of the children at original intake and would account for outcomes through at least 8 years of age for no more than 20%–25% of the children. Perhaps close acoustic analysis might indicate that the residual distortion patterns of children who do emerge from early phonologic involvement differ from distortions of the same sounds by children whose early speech development was otherwise normal; for relevant discussions, see Locke (1983) and Leonard (1985). Support for such effects would also suggest that the application of the term articulation disorder to all children with "functional" speech errors would miss important individual differences in the time course of speech acquisition.

A second alternative to classifying these children as having a phonologic disorder is to term their delay or deficits a subcategory of a language disorder. Several findings would seem to argue against this position. First, the data shown in Figure 6 indicate that at least some of these children had deletion and substitution errors with no associated cognitive, language comprehension, or language production problems. In related work with larger samples the data have indicated that although only approximately 40% of speech-delayed children have language comprehension problems, approximately 75% have language production problems (Shriberg et al., 1986). In this sample too, note that most of the children did not have early cognitive or language comprehension involvements. Moreover, for those children who did have language production problems many errors may have involved surface forms that are constrained by the speech deficits (Paul & Shriberg, 1982).

Second, the follow-up data indicate that the early data of the two outcome groups could not be differentiated by severity of speech involvement (Figure 4, Panel A) or by profile of speech involvement (Figure 5). Moreover, post hoc analysis of those error classes that at least visually appeared to differ between groups failed to demonstrate that morphophonemic load was interactive with outcome groups. Hence, at least when assessed early, the speech patterns of children who did and did not have associated language problems at some point were not readily differentiated. Only the cognitive-linguistic measures themselves and the intelligibility data, as discussed presently, were associated with follow-up outcomes.

These findings yield little empirical support for use of the terms articulation disorder or language disorder for all children, again suggesting that the term phonologic disorder might suffice until research leads to a defensible nosology. Of course, language disorder might still be preferred as the cover term on purely formal grounds because it subsumes phonology or because associated intelligibility deficits are unrelated to demonstrated problems at the speech-motor level of phonology (cf. Elbert, 1985; Shriberg, 1986; Stoel-Gammon & Dunn, 1985; Winitz, 1984). Again, what is critical in the present context is that follow-up studies do force this discipline to deal with these fundamental classification issues. They require clear descriptions of the type and severity of speech involvement, a notable problem in most of the follow-up studies available to date.

Prediction Issues

Intelligence. A third set of issues concerns early predictor variables for EEN outcomes. First, recall that the literature indicates that intelligence is the major moderating variable for EEN outcomes within children with early diagnosed language involvements. Because formal intelligence tests were not routinely given in the phonology clinic, there was not an opportunity in the present study to test the predictive power of intelligence for children with phonological involvement. Clearly, however, the available early cognitive data, together with the language comprehension and language production data, were strongly associated with EEN outcomes (Figure 6).

Phonologic involvement only. The second conclusion relevant to prediction is the finding that children with only "articulation errors" (Hall & Tomblin, 1978) or "pure phonological impairment" (Bishop & Edmondson, 1987), that is, phonologic problems in the absence of language involvement, "are not at risk for academic problems" (Tyler & Edwards, 1986). Tyler and Edwards's recent follow-up questionnaire study provides the most appropriate comparison group for findings in the present study. These authors began with a clinical database of approximately 130 children seen from 1981 to 1984 whose records indicated "articulation" or "phonological" problems (A. Tyler & M. L. Edwards, personal communication, 1987). They reduced the subject pool to 42 after excluding children with any other suspected or tested involvements in areas such as motor and cognitive development. The pool was further reduced by excluding 16 children who had only mild articulation errors. Teacher and parent reports were then obtained on the speech, reading, and writing histories of the remaining 26 children whose early phonologic involvement was described as moderate to severe. Parents and teachers reported that the majority of these children no longer exhibited significant speech production problems at follow-up from 5:3 (years:months) to 9:10. Of the 16 children for whom speech therapy records were available, only 6 children had been enrolled for services through second grade. Moreover, most of the children reportedly did not experience difficulties in reading, writing, and spelling. Although many methodologic differences exist between the Tyler and Edwards (1986) study and the present report, the two studies offer the opportunity to address several interesting questions.

Tyler and Edwards (1986) and others who find that children with only phonology problems do not experience later academic difficulties make three claims. First they claim that it is appropriate to differentiate children with phonologic problems into groups that do and do not have associated language deficits, rather than use the term language disorder for the first group and articulation disorder for the latter group. With reference to the previous discussion on terminology and classification, we, too, endorse this use of phonologic disorders as the more appropriate cover term for both groups of speech-involved children.

The second claim is that most children with originally moderate to severe phonologic involvement without associated language involvement do not require special educational resources for speech needs, and the third claim is that such children do not require services for academic needs. Tyler and Edwards's (1986) findings are consistent with the present findings for the estimated 20%–25% of speech-delayed children without associated cognitive-linguistic involvement (i.e., the S/L only group). As discussed previously, the current study (Figure 6) and a study of 114 children (Shriberg et al., 1986) indicated that approximately 20%–25% of children with phonologic disorders do not have associated language involvement. The numbers provided by Tyler and Edwards are quite consistent with this prevalence estimate, with approximately 20% of their candidate pool considered "phonologic" disorders without associated language involvement. Furthermore, approximately 63% (10 out of 16) of these children did not require additional speech-language services by the time they reached first and second grade age, which is consistent with the 78% "good outcome" rate for Bishop and Edmondson's (1987) children with "pure phonological impairment" and with the present data as shown in Figure 2.

Until systematic replications of methodologies used in follow-up studies are available, it seems premature to predict that phonology-only children are not at risk for later academic problems. However, the evidence from several studies suggests that such children are, at least, less likely to have received the varied types of services required by children with associated developmental involvements. Importantly, these prevalence data suggest that such children may constitute only one fifth to one fourth of children referred for "speech" disorders of unknown origin, which supports the need for thorough diagnostic assessment of such children whichever classification label they eventually inherit.

Intelligibility. One finding from the present study that has interesting predictive potential is the data indicating that lower intelligibility scores were obtained from the children who were eventually placed in the special education classrooms. Severity of speech involvement, as assessed by the percentage of consonants correct (PCC) metric was not associated with EEN outcomes in this study, nor was it associated with good outcomes as defined in the Bishop and Edmondson (1987) study. Interestingly, Tyler and Edwards also found that severity of speech involvement, as measured in the diagnostic assessment, was not predictive of children's continued need for speech therapy services in the schools (personal communication, 1987). In several studies to date (Bishop & Edmondson, 1987; Shriberg et al., 1986; Shriberg & Kwiatkowski, 1982b), correlations between the PCC and intelligibility measures have averaged in the low to mid .40s, suggesting relatively little common variance between the two domains. In recent associated work with Native American children who had negative versus positive histories of recurrent otitis media with effusion, intelligibility differences across groups were also found to be statistically significant, whereas PCC scores were not (Shriberg, 1987; Thielke & Shriberg, 1987). Unintelligible words in a corpus or data set typically have been treated as "noise" and excluded from phonologic analyses. These recent findings, however, suggest that inquiry into the contexts for unintelligible words may be a fruitful research topic. Specifically, unintelligible speech may reflect the confluence of segmental, suprasegmental, and language form and function variables in disordered speech.

Management Issues

A fourth and related observation concerns management issues in research with these children. What are the appropriate measures of success, and what success rates can we expect in early programs emphasizing speech normalization? Recently developed procedures based on general behavioral or linguistic training claim to be successful with at least some children with phonologic problems (cf. Bernthal & Bankson, 1988; Newman, Creaghead, & Secord, 1985; Stoel-Gammon & Dunn, 1985), but are we truly meeting these children's needs when we concentrate only on speech development? That is, is a change in the number of consonants articulated correctly a sufficient criterion of a successful program or should more broad-based dependent variables be required, such as those that assess changes in cognitive and language development? One possible consequence of the current problem in classification terms discussed previously is that children's needs have been too fractionated. For example, proliferation of materials that claim to help "eliminate phonological processes" may be counterproductive to an integrated view of the children's needs. If the term *phonology* is meant to imply speech-language processing, then relevant management goals should include measures that are sensitive to meaningful gains in speech-language development rather than be focused solely on speech sound development.

Database Research

Finally, findings from this relatively small database do seem to support the potential value of large scale follow-up studies. At a time when funding support for longitudinal studies of children with special educational needs is tenuous at best, a clear research need exists to document the outcomes of service delivery options. With database software readily available in clinical settings, carefully designed follow-up studies conducted by local speech-language pathology agencies could contribute the needed longitudinal perspective on such issues. Indeed, many of the prediction, case study, and longitudinal data in this literature have evolved from relatively modest school district projects with limited general distribution.

Records management and technology issues are central to this literature. In the present case, potentially important records were lost to follow-up analysis, perhaps because of the sheer administrative loads on paper and pencil systems. As data from special educational services become more routinely computerized, these particular obstacles should be less problematic. With appropriate planning, careful documentation, and inexpensive database technology, it would seem that this field can learn much about basic questions by tracking the long-term progress of its clients.

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APPENDIX

The table at right provides subject data for the 36 children. Explanations of entries in each column are described in the following notes.

1. Age entries in column 3 reflect ages of the children when first referred for assessment at the phonology clinic. As shown in the third column from the right, data entries for this follow-up study also included information available in school records that preceded referral.

2. Speech severity data and intelligibility data, as entered in columns 4–6, were obtained from continuous speech samples, except for Child 29 whose PCC score was taken from articulation test results (Pendergast, Dickey, Selmar, & Soder, 1969). This child was too unintelligible to assess by means of a continuous speech sampling procedure (cf. Shriberg & Kwiatkowski, 1985). All categorical severity assignments were based only on the Percentage of Consonants Correct (PCC) values (Shriberg & Kwiatkowski, 1982b; cf. Shriberg et al., 1986): Mild (M) = > 85%; Mild-Moderate (MM) = 65%–85%; Moderate-Severe (MS) = 50%–65%; Severe (S) = < 50%.

3. Cognitive and language status data, as entered in columns 7–9, are based on several sources, depending on children's placement at the time of referral. Although some children were not receiving any services other than in the phonology clinic, many were being seen in some form of special educational program, such as early childhood programs and summer language programs. Much of the cognitive-language data were obtained from these referral sources. The relatively large number of missing data points reflects a decision to include only those data available at the time of enrollment at the phonology clinic (i.e., column 3). In all settings, cognitive and language status was assessed only if there was some question about the child's development in that domain. Available cognitive data ranged from Piagetian measures, to parent report scales such as the Minnesota Child Development Inventory (Ireton & Twing, 1974), to formal intelligence tests. Available language comprehension measures were taken from a battery that included the Peabody Picture Vocabulary Test (Dunn & Dunn, 1981), the Preschool Language Scale (Zimmerman, Steiner, & Evatt Pond, 1979), the Boehm Test of Basic Concepts (Boehm, 1971), the Miller-Yoder Test of Grammatical Comprehension (Miller & Yoder, 1984), and informal measures, such as a question comprehension and locative task. Available language production data included analyses of language samples to determine structural stages for NP, VP, QUES, NEG, and COMPLEX sentence development and grammatical morpheme usage (Miller, 1981). The entries for the cognitive and language data are keyed as follows: 0 = age appropriate; 1 = low average (3-month to 1-year delay in all areas or 3-month to 1-year delay or greater in any one or more areas); 2 = low (more than 1-year delay in all areas); ND = no data.

4. The rightmost two columns provide keys to the subgroup analyses described in the text. The 29 children whose data are shown in Figures 1–3 are indicated in column 11. The 18 children whose data are shown in Figures 4–6 and Table 2 are indicated in column 12, with 1 = Group 1 and 2 = Group 2.

		Status at enrollment in phonology clinic							*Key to subgroup analyses*		
			Speech			*Cognitive-linguistic*					
Subject	*Gender*	*Age (years:months)*	*Severity score*	*PCC category*	*Intelli-gibility*	*Cognition*	*Language compre-hension*	*Language produc-tion*	*Age at first data entry (years)*	*Figures 1–3 (29 children)*	*Figures 4–6, Table 2 (18 children)*
1	M	2:9	30.8	S	53.3	0	0	1	1	X	
2	F	2:10	67.0	MM	64.6	0	ND	ND	2	X	
3	M	3:0	72.4	MM	87.8	0	0	1	3	X	
4	M	3:1	70.5	MM	72.8	ND	0	0	3	X	
5	M	3:2	66.2	MM	73.6	0	0	1	2	X	
6	F	3:4	72.7	MM	71.9	0	0	0	2	X	
7	F	3:8	66.0	MM	84.6	ND	ND	ND	3	X	
8	M	3:10	72.6	MM	87.9	ND	ND	ND	4	X	1
9	M	4:0	46.2	S	87.7	0	0	0	1	X	
10	M	4:0	52.2	MS	32.5	ND	0	1	4	X	2
11	M	4:1	70.5	MM	82.7	1	1	2	3	X	
12	M	4:1	67.9	MM	88.5	ND	0	1	3	X	
13	M	4:2	81.3	MM	93.7	1	1	1	4	X	
14	M	4:3	74.1	MM	64.8	0	0	1	3	X	1
15	M	4:3	70.6	MM	95.9	ND	ND	ND	3	X	1
16	M	4:4	69.2	MM	47.4	0	0	1	3	X	2
17	F	4:4	54.2	MS	68.3	ND	2	2	2	X	
18	F	4:5	51.2	MS	85.2	ND	ND	1	4	X	
19	M	4:9	68.0	MM	91.9	2	2	1	3	X	2
20	M	4:9	47.6	S	77.9	ND	0	1	4	X	1
21	M	4:11	72.9	MM	86.1	ND	ND	1	4	X	2
22	M	5:0	60.8	MS	53.5	0	0	1	3	X	1
23	M	5:2	48.9	S	66.8	2	1	2	4	X	2
24	M	5:4	64.3	MS	92.2	ND	ND	ND	5		1
25	F	5:5	46.6	S	96.0	0	0	1	3	X	
26	M	5:6	73.6	MM	87.4	0	ND	ND	4	X	1
27	M	5:6	66.9	MM	53.9	ND	0	1	3	X	2
28	F	5:7	40.5	S	58.8	ND	2	1	4	X	2
29	F	5:8	36.9	S	–	1	ND	2	4	X	
30	M	5:10	57.4	MS	84.3	0	ND	ND	5		1
31	M	5:11	64.5	MS	59.9	ND	ND	1	5		2
32	M	6:0	54.2	MS	59.7	1	0	1	5		2
33	M	6:1	79.5	MM	93.2	0	ND	ND	5		1
34	F	7:5	83.5	MM	100.0	0	1	2	6		
35	M	7:7	84.1	MM	87.1	1	1	2	4	X	
36	M	7:10	88.9	M	98.0	ND	ND	1	7		