PHONOLOGICAL DISORDERS I:
A DIAGNOSTIC CLASSIFICATION SYSTEM

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Data are presented to support the validity and utility of a diagnostic classification system for persons with phonological disorders. Rationale for the classification system is developed from current reviews of issues and concepts in phonology and classification systems. The system proceeds from a worksheet for reduction of phonological and other assessment data, through five hierarchical levels of classification entries. The system will accommodate lower-level elaboration of etiological subgrouping, pending appropriate research. A retrospective classification study of 43 children with delayed speech is described. Procedural details relating classification procedures to two companion papers (Shriberg & Kwiatkowski, 1982a, 1982b) are provided.

The decade of the 70's witnessed the decline of an old term, *functional articulation disorders,* and the shaky ascendance of another—*developmental phonological disorders.* This paper and two companion papers (Shriberg & Kwiatkowski, 1982a, 1982b) propose a unified conceptualization of what might be termed the paradigmatic shift (Kuhn, 1970) that has occurred. The three papers integrate theory and practice in a framework that has emerged from a 5-year research program in phonological disorders.

The first paper presents a diagnostic classification system for phonological disorders, the second presents a framework for the management of phonological disorders, and the third presents a procedure for assessing severity of involvement. The goal of this series is to make available a system that can be used for cross-institutional teaching, research, and practice in phonological disorders. Researchers may find the format presented to be useful for a variety of methodological needs. Instructors and clinicians may find these materials to be useful for organizing and interpreting assessment data and for developing a rationale for management programming.

To begin, brief historical overviews of phonology and of classification systems in communicative disorders are warranted.

INTRODUCTORY CONCEPTS

Phonology

Phonology is concerned with the structure and function of sound systems within languages (Hyman, 1975). Study of sounds in a language includes both their underlying or representational forms (the abstract level) and their surface or phonetic forms (the manifest level). Relations between these two levels are expressed as a set of generalizations (rules) that, in part, reflect the syntactic description of the grammar. Descriptions of the constituents at each level and mechanisms that interface levels are the subject of phonological inquiry.

Historically, Chomsky and Halle's (1968) description of the phonology of English divides the present era of neo-generative theories from the structural (taxonomic) descriptions that were prevalent earlier in this century. Revisions and substantially different accounts of Chomsky and Halle's "standard" theory have been proposed (Dinnsen, 1979). One common direction new theories have taken is towards less abstractness than was found in standard generative theory with correspondingly more emphasis on phonetic constraints as the primitives of theory construction.

In parallel with the active development of neo-generative theories of adult phonology, child phonologists have offered alternatives to the structuralist view of normal and delayed speech acquisition. In the normal acquisition literature, Ferguson and his colleagues at Stanford, in particular, have contributed important theoretical and empirical materials for over a decade. In the clinical literature, a seminal contribution by Compton (1970) was followed in the past decade by some three dozen clinical articles in this journal alone. Ingram's (1976) synthesis of these literatures did much to influence the "new look" apparent in the proliferation of books, articles, and conference papers on phonological disorders within the past several years.

It is difficult to discern the full impact on clinical practice of these research efforts in phonology. Instructors, speech-language pathologists, and audiologists have attempted to monitor the ascendance of this new look and have had to wrestle with unsystematic and often conflicting discussions of phonological concepts. For example, at least two major units of analysis, the *distinctive feature* and the more recent *phonological process* have been widely discussed as central to various theoretical positions and clinical procedures. To some observers, such units seem to be only more elegant terms for familiar speech phenomena. The research literature has not

yet had the impact on clinical practice that advances in other areas of linguistics have had, such as procedures for syntactic, semantic, and pragmatic analyses.

We presume that a productive clinical literature in phonological disorders requires the consolidation afforded by a diagnostic classification system. As a preface to the system we propose in this paper, a brief development of issues in classification systems for communicative disorders is necessary.

Classification Systems in Communicative Disorders

Discussions of classification systems in communicative disorders may be found in virtually every basic disorders textbook and particularly in textbooks that deal with appraisal and diagnosis. To understand the clinical bases of classification systems, in fact, one is obliged to consider the diagnostic process for which classification systems are developed. Of the many treatments of diagnostic issues, we find Nation and Aram's (1977) development most useful.

Nation and Aram view the diagnostician's task as attempting to fulfill three purposes or goals:

1. To determine if speech and language behaviors are disordered, including a rating of severity of involvement,
2. to search for causal factors and correlates of the disordered behavior, and
3. to utilize all relevant information to formulate a set of recommendations for effective and efficient management.

For the first diagnostician's purpose, the clinician must deal with complex issues in the selection of measurement instruments and the normative sources needed to identify and gauge the severity of the disorder. For the second diagnostic purpose, the clinician must confront issues in causality, including models of causal analysis (for example, medical vs. behavioral) that are common to all the helping professions. Finally, for the purposes of prediction and management, the diagnostician must weigh descriptive-severity issues ((1) above), together with probable causal-associative variables ((2) above), to develop a set of coherent recommendations.

Nation and Aram review three types of classification systems that have been used in this diagnostic process. One emphasizes etiology of the disorder, grouping clients by problem types, for example, *Cerebral Palsied* speech, *Deaf* speech, and so forth. Such systems typify a medical model of behavioral disorders. These systems have had unfortunate effects at research and clinical levels. At the research level, they inhibit the search for higher-order causal processes across speech disorders; at the clinical level, they promote clinical training and service delivery by label, rather than by the presenting problem. Behavioral classification, the second type of classification system, arose in reaction to such problems. The goal of behavioral systems was to emphasize comprehensive description of a person's communicative status and abilities without regard to etiology. Finally, the third type, process-based classification systems

utilize the main parameters or processes of communication as first-level classification headings: For example, *Phonation Disorders, Language Disorders,* and so forth. In process classification systems, sublevel headings may be by clinical entity types or by parameter descriptions. For example, the process classification of *Phonation Disorders* can be divided into sub-categories by entity types, such as *ventricular phonation,* or by descriptive types, such as *pitch problems.*

As evident in these examples, overlap among the three types of classification systems is considerable. Differences essentially are a matter of emphasis and precision of nomenclature. The traditional term *functional articulation disorders,* for example, is a hybrid of etiological and process notions of classification. The adjective *functional* is a catch-all for "nonorganic" and the term *articulation* circumscribes the disorder to the process of speech output. Both adjectives suffer from a lack of precision (Bankson, Note 1).

We hope the following classification system is responsive to the three clinical-diagnostic goals described by Nation and Aram, and to the research needs for eventual description and explanation of phonological disorders.

A DIAGNOSTIC CLASSIFICATION SYSTEM FOR DEVELOPMENTAL PHONOLOGICAL DISORDERS

Figure 1 is a graphic representation of a diagnostic classification system for persons with phonological disorders. For convenience, all procedural details for its use are provided in the Appendix. It would be useful for the reader to scan the Appendix, including the completed case example, before reading the rationale and description of each level of the system that follows. In practice, as described in the Appendix, the clinician or researcher would proceed from the available diagnostic data to Level 6, and ultimately proceed up each level to Level 1. For expository convenience here, however, description of the top three levels of the classification system are presented first, followed by description of the lower three levels.

Level 1 Phonological Disorders Versus Other Disorders

The term *phonological disorders* is the generic term in the classification system. Notice that this is a process-based classification heading. Parallel headings for non-phonological disorders in a comprehensive process system for all communicative disorders would include *hearing disorders, phonation disorders,* and so forth. In the present context, any person who has speech errors would be a candidate for classification as having a phonological disorder. Each of the two terms in this first-level classification heading warrant comment.

Phonological. As introduced earlier, for a variety of reasons, the term *phonology* and its inflections have had a

LEVEL 1 — NO DISORDER | PHONOLOGICAL DISORDER | OTHER DISORDER

LEVEL 2 — DEVELOPMENTAL PHONOLOGICAL DISORDER | NON-DEVELOPMENTAL PHONOLOGICAL DISORDER

LEVEL 3 — DELAYED PHONOLOGICAL DEVELOPMENT | RESIDUAL PHONOLOGICAL ERRORS

LEVEL 4 — PHONOLOGICAL SEVERITY INDEX | CAUSAL-CORRELATES INDEX (I II III)

LEVEL 5

PHONOLOGICAL SEVERITY CODE

SEGMENTAL	SUPRA-SEGMENTAL	
	Voice	Rhythm

CAUSAL-CORRELATES CODE

I		II		III	
A	B	A	B	A	B

LEVEL 6

CONTINUOUS SPEECH DATA SUMMARY

NATURAL PROCESSES	SEGMENTAL	SUPRASEGMENTAL
Final Consonant Deletion	PERCENTAGE OF CONSONANTS CORRECT	VOICE
Velar Fronting	OTHER SOUND CHANGES	Pitch
Stopping		Loudness
Palatal Fronting		Quality
Liquid Simplification		RHYTHM
Assimilation		Phrasing
Cluster Reduction		Stress
Unstressed Syllable Deletion		Rate

CAUSAL-CORRELATES DATA SUMMARY

I MECHANISM		II COGNITIVE-LINGUISTIC		III PSYCHOSOCIAL	
A Hearing	B Speech	A Comprehension	B Production	A Inputs	B Behaviors

ASSESSMENT DATA

FIGURE 1. A diagnostic classification system for phonological disorders.

difficult time becoming established in the clinical arena. As a minor problem, the term is not as flexible morphologically as the term it replaces, articulation. One can misarticulate a speech sound, but not misphonological it.

A more central problem is that little consensus exists on the definition of the term phonology. Just as statements about syntactic, semantic, or pragmatic processes are essentially unconcerned with the articulatory level of speech (sensory-motor level), some workers limit concern with phonological phenomena to statements about underlying representations and phonological rules (Shelton & McReynolds, 1979). We take a different position. We prefer to use the term phonological as a cover term to encompass the entire speech production process, from underlying representations to phonological rules to the behaviors that produce the surface forms of speech. As developed elsewhere, some errors (for example, articulatory distortions) do seem to be best described at the level of surface forms while others seem related more in part to semantic, syntactic and pragmatic processing (Campbell & Shriberg, in press; Paul & Shriberg, in press; Shriberg & Kwiatkowski, 1980).

The term *phonology* does not easily roll off the tongue or the pen, but we view it as the appropriate generic term in a classification system dealing with disordered speech production.

Disorders. The term *disorders* is well-established in the field of communicative *disorders*. With enactment of federal and state legislation to insure service to all children with speech-language-hearing disorders, the term has acquired well-defined legal status. Although the term *disorders* has connotative meanings that may be undesirable in some clinical contexts (compared, for example, to the terms speech *problem* or speech *difficulty*), it seems appropriate to select this term for the classification system.

Level 2 Developmental Phonological Disorders Versus Non-Developmental Phonological Disorders

Nested within the cover term *phonological disorders* are two sub-classification terms, *Developmental Phonological Disorders* and *Nondevelopmental Phonological Disorders* (see Figure 1). This division acknowledges that although the majority of phonological disorders come under the classification of developmental, not

all are classified as such. Children who sustain neurological, structural, or psychological damage with concommitant speech problems are classified as developmental. However, phonological errors acquired in adolescence or in adulthood, such as those secondary to dysphasia, oral-facial accidents, or emotional disturbance, would qualify as nondevelopmental phonological disorders. Moreover, articulation distortions due to such factors as ill-fitting dentures, a chipped tooth, or residual sensory deficits following an oral surgery accident might be subsumed by this classification. Whatever the severity of involvement, each of these origins would not be complicated by the developmental issues described presently. We leave undeveloped in this paper the branch of the classification system that deals with nondevelopmental phonological disorders.

Developmental phonological disorders includes all speech disorders observed in children from birth through 8-12 years of growth and development. Recall that a process-based system includes all disorders described by the process, regardless of the etiology of the errors. Accordingly, *developmental phonological disorders* includes the speech errors of children who may also bear clinical entity labels, such as hearing impaired, cerebral palsy, cleft palate, and so forth. As described earlier, a classification system that accommodates all the phonological disorders of children is important for research and clinical practice. That is, among children who bear clinical entity labels, some phonological errors are related to the particulars of their sensory-motor, intellectual, or psychosocial deficits, while other errors reflect developmental issues affecting all children in the first decade of life. A synthesis of data on clinical groups (e.g., cleft palate, mental retardation) indicates that many of their error patterns are similar to those of children without such deficits; however, each group may have errors which are not common in other groups (Ingram, 1976). The diagnostician's task, of course, is to parcel out errors and to program management accordingly. Successful accomplishment of this diagnostic task is precisely the goal of the diagnostic classification system proposed here, and in its potentially elaborated form as a taxonomy.

Table 1 is a preliminary sketch of a taxonomy for phonological disorders which eventually should replace the worksheet format at Level 6 (to be described). The assumption is that future research will allow for lower-level classification by etiological categories. For example, the provisional categories in Table 1 would classify a child as a "IAIa." This four term entry might read: "I" = Mechanism; "A" = Hearing Involvement; "1" = conductive loss; "a" = existent only during Phonological Stages I-II of phonological development. Another example: a child might be classified as "IC2b." Here, "I" = Mechanism; "C" = Craniofacial Involvement; "2" = bilateral cleft of palate and lip; "b" = velopharyngeal inadequacy existent through Phonology Stage III. These examples are presented only to illustrate the type of elaboration proposed for the classification system. To date, however, data have been organized only by the worksheet format for Level 6 (see Figure 1) and only for children whose phonological disorders are not associated with clinical entities such as mental retardation or cleft palate.

To summarize, the term *developmental phonological disorder* is the cover term for one of two branches of the classification system for all phonological disorders developed in this paper. As a process-based classification term, it allows phonological behavior to be described by type and severity, regardless of other clinical entity labels a child may bear. Accordingly, the system to be described can be used with two populations of children: (a) children who may have deficits such as hearing impairment, mental retardation, or emotional disturbance, and (b) children who may have minimal or no involvements other than speech errors, essentially, children with "functional articulation errors." Although use of the system can eventually provide for a unified clinical-research literature across both groups, data for only the latter group will be presented later in this paper.

Level 3 Delayed Phonological Development Versus Residual Phonological Errors

The third level of the classification system differentiates two types of developmental phonological dis-

TABLE 1. A preliminary sketch of an eventual taxonomy for phonological disorders. These provisional entries serve only to illustrate needed research in the causal-correlates branch of the present diagnostic classification system. See text for examples of lower level examples.

I Mechanism	II Cognitive-Linguistic	III Psychosocial
A. Hearing Involvement Subtype: 1, 2,...n Loci: a, b,...n	A. Cognitive Involvement Subtype: 1, 2,...n Loci: a,b,...n	A. Intrapersonal Involvement Subtype: 1, 2,...n Loci: a, b,...n
B. Motor-Speech Involvement Subtype: 1, 2,...n Loci: a, b,...n	B. Language Involvement Subtype: 1, 2,...n Loci: a, b,...n	B. Interpersonal Involvement Subtype: 1, 2,...n Loci: a, b,...n
C. Craniofacial Involvement Subtype: 1, 2,...n Loci: a, b,...n		

orders, *Delayed Phonological Development* versus *Residual Phonological Errors*. This division superficially is similar to a traditional opposition between the child with "multiple misarticulations" versus the child with only "single-sound misarticulations." Our preferred terms retain the essential quantitative and qualitative differences between these two subgroups of children, while adding the necessary precision in nomenclature to be consistent with both higher and lower levels of the classification system.

Delayed Phonological Development. The term *Delayed Phonological Development* (or, for convenience, *Delayed Speech*) is consistent with a developmental perspective. Child development generally includes the twin notions of *growth* (physical change) and *development* (learning). In parallel, the child's gradual mastery of segmental and suprasegmental features of adult phonology is dictated by maturation of the speech mechanism *(growth:phonetic)* whereas comprehension of the segmental and morphophonemic rules of adult phonology and construction of underlying forms is dependent on increasing levels of cognitive function *(development:phonemic)*. From this perspective, children whose acquisition of speech lags behind that of their peers may have delayed phonetic growth, delayed phonemic development, or both. The selection of an adjective to characterize the severity of overall productive delay is discussed presently.

Residual Phonological Errors. The second type of developmental phonological disorder, *Residual Phonological Errors*, is the term proposed for children whose speech errors persist beyond the developmental period. As above, the problem is one of phonetic precision; the causal-correlate loci determines the phonetic classes affected. Early studies (Templin, 1957; Wellman, Case, Mengert, & Bradbury, 1931) placed the upper boundary of the developmental period at 7-8 years. More recent studies indicate that children's speech may improve without intervention up through middle school years (Arlt & Goodban, 1976; Sax, 1972). Corresponding to these more recent clinical data are findings synthesized by Kent (1976) that indicate variability of performance in several parameters of children's speech until 11-12 years. To be consistent with generic use of the term *phonological*, then, the term *Residual Phonological Errors* is appropriate for children who retain speech errors into teen years, whether or not they ever are provided with speech management services.

Level 4 and Level 5 of the Classification System

Beginning at Level 4, the classification system divides into two branches; a phonological branch and a causal-correlates branch. Procedures for deriving entries for each branch at Levels 4 and 5 are entirely clerical. The procedures are described in the Appendix. Essentially, Level 4 yields a severity adjective for the phonological disorder *(mild; mild-moderate; moderate-severe; severe)* and a 3-digit causal-correlates code. Level 5 provides

interim summary data between Level 4 and Level 6. Details for deriving these entries are also provided in the Appendix. Here we describe, in turn, Level 6 for each branch of the system.

Level 6 Phonology Branch of the Classification System

As introduced earlier, Level 6 is the summary worksheet for the classification system for both phonology and causal-correlates diagnostic information (see Figure 1). Level 6 summarizes and codifies these raw data. Within the phonology branch, we are interested in summarizing a child's speech characteristics in three areas: natural phonological processes description, segmental description, and suprasegmental description. Procedures and references for accomplishing and coding the results of such analyses are presented in the Appendix. Overviews of each component are provided here.

Natural Process Description. The first component of speech summarized at Level 6 is termed natural process description. As developed at the outset of this paper, child phonologists currently disagree about what constitutes a proper phonological analysis. The several published procedures available for describing phonological processes (Hodson, 1980; Ingram, 1981; Shriberg & Kwiatkowski, 1980; Weiner, 1979) differ markedly in underlying theory and method. Whatever procedure a clinician-researcher uses to describe a child's phonology, the goal of the analysis should embrace questions of diagnosis, prediction, and management programming. The analysis procedure we use (Shriberg & Kwiatkowski, 1980) allows questions about relations among syntactic (Paul & Shriberg, in press) and pragmatic (Campbell & Shriberg, in press) components of language as well as specific inquiry about the role of natural processes in differential diagnosis (Shriberg & Smith, Note 4) and management programming (Shriberg & Kwiatkowski, Note 2; 1982a).

Segmental Description. The second task of the diagnostician is to catalogue the segments (phonemes) a child uses in speech. The traditional term for this segment inventory, a *phonetic inventory*, is inaccurate in most cases because only a broad phonemic transcription of phonemes is undertaken. Moreover, the term *phonemic inventory* also is generally inappropriate because phoneme inventories require that a contrastive or minimal word pair be attested for each "phoneme." The neutral term *segmental description*, therefore, serves to describe a sound-by-sound tally of sounds correct and sounds in error in children's or adults' speech. As described in a companion paper (Shriberg & Kwiatkowski, 1982b), a percentage of consonants correct index is used as input for a decision on the severity of speech involvement (Level 4). Moreover, the worksheet provision for "Other Sound Changes" (other than those coded as natural processes) includes all segmental errors that may be of diagnostic significance (Shriberg & Kwiatkowski, 1980).

Suprasegmental Description. The final component of phonological description includes those nonsegmental features that reflect speech prosody. In this classification system, *suprasegmental description* divides into two sub-areas: *voice characteristics,* including *pitch, loudness,* and *quality;* and *rhythm,* including *phrasing, stress,* and *rate.* Accurate suprasegmental description is basic to the diagnostic process. As described in a companion paper (Shriberg, 1982b), the coding procedure requires the clinician-researcher to evaluate a child's suprasegmental functioning during conversational speech.

Summary. Level 6 of the phonology branch of the classification system is a worksheet for summarizing data taken from a continuous speech sample. These data are used in two ways: (a) they provide sufficient information to derive an adjective (Level 4) which classifies the severity of the problem, and (b) taken together with the causal-correlates information they are used for differential diagnosis. Hence, these data fulfill the first of Nation and Aram's tasks—to identify the disorder and to gauge its severity. For the second of Nation and Aram's tasks—to determine causal factors and other information associated with the disorder—we turn to the second branch of the classification system, the *causal-correlates* branch.

Level 6 Causal-Correlates Branch of the Classification System

As illustrated in Figure 1, Level 6 of the causal-correlates branch summarizes and codes the causes and correlates of phonological disorders into three areas: *mechanism, cognitive-linguistic,* and *psychosocial.* Before developing the rationale for this tripartite division, it is important to look briefly at causal inquiry in the study of phonological disorders.

Causal inquiry seems to have been notably out of fashion in many areas of communicative disorders, including phonological disorders, during the last two decades. The failure of some 40 years of studies to disclose compelling causal explanations of phonological delay (Shriberg, 1980; Winitz, 1969) was reflected in the widespread shift to a behavioral-descriptive emphasis in the 60's followed by a linguistic-descriptive emphasis in the 70's. In place of the group studies of etiological correlates that characterized the literature of the 40's and 50's, research in the 60's and 70's has more typically consisted of case studies and single-subject analyses. With the notable exception of multi-variate studies by Diedrich and Bangert (1981) and Shelton and his colleagues (Arndt, Shelton, Johnson, & Furr, 1977), researchers seemingly have preferred to concentrate on description rather than explanation.

The thesis of this paper is that a valued classification system must include diagnostic-explanatory content. As referenced earlier in Table 1, the 3-way classification worksheet at Level 6 reflects only provisional explanatory domains. Future research is necessary to elaborate this level to a taxonomy of etiological subtypes and loci.

To this end, a later section is a prevalence report on causal-correlates in one sample of children with delayed speech. Here, an overview precedes description of the three causal-correlates and their subdivisions.

Figure 2 is a graphic conceptualization of the three major causal-correlate domains of phonological disorders. The innermost circle represents the phonological characteristics of a person with a phonological disorder. The next three rings reflect, in turn, the influence on phonology of hearing-speech mechanism functions, cognitive-linguistic function, and psychosocial function. Hence, this conceptualization sorts into three categories or domains, the universe of factors that could be causal or contributing variables to a phonological disorder. This particular graphic form, as opposed to other possible Venn-type portrayals, acknowledges two problems associated with all causality paradigms.
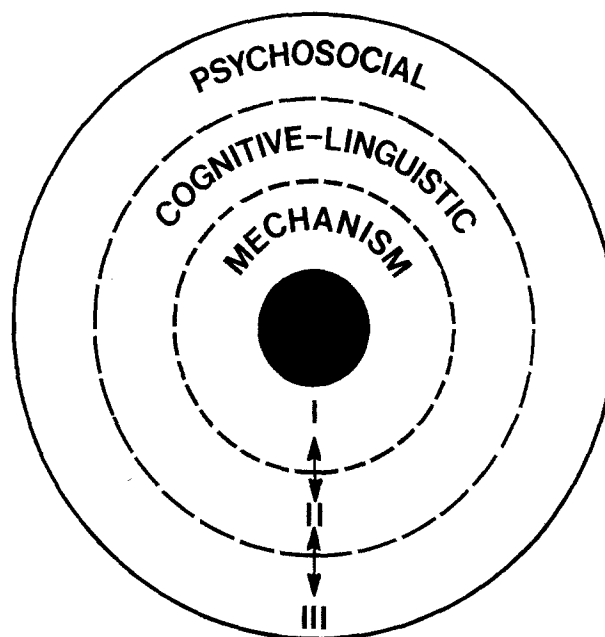

FIGURE 2. A conceptualization of the three major causal-correlative domains associated with phonological disorders.

First, the concentric rings schema reflects the problem of *reductionism* (Perkins, 1977), with each smaller ring assumedly closer to the basic cause of the disorder. Explanations in the behavioral sciences are always capable of being reduced to explanations at biological levels. In the present context, for example, explanations at the outermost ring, psychosocial factors, may be sufficient for certain clinical purposes. If explanatory data could be found at either of the two other rings, however, these data would be considered more "basic."

A second and related problem in causal schemas is the *mind-body duality* issue. Psychological and biological realms are never clearly divided in the behavioral sciences, nor should they be in a classification system. The permeable boundaries (dotted lines) and double-headed arrows between circles in Figure 2 allow for the bidirectional forces between mind and body.

In summary, although the three explanatory components are arranged in parallel tracks in the diagnostic classification system (see Figure 1), they are not at all mutually exclusive. Rather, the schema in Figure 2 acknowledges that disordered behavior generally can be related to more than one area. The notion of multiple causality, then, is accommodated in this classification system and is considered basic to individual management programming (Shriberg & Kwiatkowski, 1982a). As discussed next, children are rated on the degree of involvement in each of these causal-correlate areas.

Causal-Correlates—I: Mechanism Factors. The first causal-correlates section in Figure 1, *mechanism,* is divided into two subareas, *hearing* and *speech.* Within each subdivision, respectively, the structural and functional adequacy of hearing and speech mechanisms are assessed by means of perceptual and instrumental measures. The particular perceptual and instrumental procedures used for these analyses depend on the training of the examiner and available facilities. For example, whereas acoustic immittance measures have become routine in most clinical settings, aerodynamic measures have not. The 1980's will undoubtedly see major emphasis placed on simple, reliable instrumental approaches to assessment of neuromuscular systems. Currently, however, audiological assessment and the oral-peripheral examination provide the basic mechanism information, with case history data (for example, developmental data, medical history) providing information that may contribute to the causal-correlates picture. Overall, the clinician-researcher is interested in documenting any historical and/or maintaining factors that may delimit speech perception or production.

Causal Correlates—II: Cognitive-Linguistic Factors. The second causal-correlates section (Figure 1) reflects the effect of a person's cognitive-linguistic functioning on phonological development. The subdivisions are *comprehension* and *production.* In this area of assessment, theoretical and methodological differences are widely debated (Miller, 1981); no one protocol has gained consensus. Whichever the particular assessment measures used, a certain proportion of children with phonological disorders have cognitive-linguistic deficits as important causal or contributing factors.

Causal-Correlates—III: Psychosocial Factors. Psychosocial functioning, the third causal-correlates domain is perhaps the least well-described area in diagnostic classification. Subcategory A, *input,* includes information on caregivers, home, school, and other sources of input to the child's psychosocial development. Subcategory B, *behaviors,* allows for rating of the child's overt performance in these different settings.

Summary of the Classification System

The classification system proposed in Figure 1 is oriented to the diagnostic goals of explanation, prediction, and management. The classification system assigns to a child with a developmental phonological disorder:

(a) a classificatory descriptive type—*Delayed Phonological Development* versus *Residual Phonological Errors,* (b) a severity rating—*mild, mild-moderate, moderate-severe, severe* and (c) numerical ratings—0, 1, 2—signifying relative involvement in each of three historical and/or maintaining causal-correlative factors. This system satisfies the purposes of the diagnostic process as described by Aram and Nation: to identify the problem, to rate the severity of the problem, and to determine the causal background of the problem. Goals for the system are to promote more effective clinical practice and a more productive research literature. The Appendix provides instructions for using the system.

A RETROSPECTIVE CLASSIFICATION STUDY

The study reported here provides an initial demonstration of the system's validity and utility. A test of the system's concurrent validity would require the availability of an accepted system against which to compare findings. In the absence of such an instrument, data reported here can be inspected only for their descriptive adequacy (face and content validity), relevance (construct validity) and productivity (clinical and research utility).

Subjects

Five groups of children were available for retrospective study as the classification system achieved its present form. All children had been referred to a University speech and hearing clinic for assessment or management of their "intelligibility problems." One group of 10 children had been followed twice yearly in a longitudinal study begun in 1975. Four other groups had been seen for intensive group and individual management programs (Shriberg & Kwiatkowski, Note 2; Note 3). Approximately 10 children were in each of the five groups with some children participating in several of the groups. Data on 43 children in these five groups were assembled to assess the validity and utility of the classification system and to provide preliminary data on the prevalence of the six causal-correlates factors in children with speech delays of unknown origin.

Assessment Data

Several common sources of information provided assessment data for each of the three main areas: a case history report, parent observations, physician records and observations, teacher observations, school records, and our own observations in the course of assessment and management of these children. Most children were given a standard oral peripheral examination; some also were assessed in aerodynamic studies and with several experimental indices of dyspraxia. All children were assessed for speech-language functioning by means of

analyses of continuous speech samples, including description of comprehension and productive language status (Miller, 1981) and natural phonological processes (Shriberg & Kwiatkowski, 1980). All received hearing screenings by staff audiologists; some received follow-up threshold audiometry and tympanometrics.

The general procedure for each child was to use all case history data for the purposes of completing a classification sheet similar to Figure 1. The Appendix presents these procedures in sequence. Basically, the procedures for completing the phonology branch of the

classification system were similar to those described in Shriberg and Kwiatkowski (1982b). The procedure for completing the causal-correlates branch was to sort all available data into the six causal-correlates sub-areas and rate each datum on a three-point scale. The three-point scale assesses degree of involvement: 0 = no involvement or normal; 1 = questionable or mild involvement; 2 = moderate or severe involvement. Ratings represented a consensus between the two authors. A complete list of the 90 descriptors on which at least one child was rated 1 or 2 is presented in Table 2.

TABLE 2. Index of descriptors for rating the causal-correlates information available for 43 children referred for delayed speech of unknown origin. Only assessment data for which at least one child was rated 1 or 2 are included in this table.

I. MECHANISM

A. Hearing

Item	Rating Criteria			Total S's Rated "1"	Total S's Rated "2"
	0	1	2		
Associated/Developmental					
1 allergies	none	mild; controlled with mild medication	severe; persistent; strong medication	3	0
2 sinuses	normal	intermittent sinus condition; warrants medication	chronic sinus condition; treated with medication	2	0
3 hearing; observationally	normal	"does not always seem to hear; is sometimes indifferent to sound"	"seems to always have trouble hearing"	3	1
Auditory Canal					
4 wax build-up	none	periodic; wax build-up warrants medical attention	frequent; excessive wax build-up warrants medical attention	3	2
Eustachian Tube					
5 function	normal	suspected or confirmed dysfunction in one ear	confirmed dysfunction in both ears	4	2
Middle Ear					
6 acoustic reflex	normal	slightly elevated on at least one occasion	significantly elevated on at least one occasion	1	4
7 impedance	normal	negative pressure in one ear on at least one occasion	negative pressure in both ears on at least one occasion	5	1
8 infections	none	frequent; require medical attention and possible PE tubes	frequent; PE tubes placed in both ears	8	6
9 tympanic membrane	normal	scoring in one ear	scoring bilaterally	1	1
10 pure tone	normal	mild conductive loss in one or both ears on at least one occasion	mild-moderate conductive loss on repeated occasions in one or both ears	13	1

B. Speech

Item	0	1	2	Total S's Rated "1"	Total S's Rated "2"
Adenoids					
11 size	normal	slightly enlarged	significantly enlarged	1	0
Associated/Developmental					
12 heredity factor	not present	single family member with same problem	more than one family member with same problem	1	0
13 pregnancy	normal	threat of miscarriage late in pregnancy	frequent threat of miscarriage throughout pregnancy	1	1
14 "blue"	not present	blue at birth; short period; oxygen not required	blue at birth for extended period; oxygen required	1	0
15 jaundice	not present	jaundice at birth: short duration	jaundice at birth: extended duration	0	1
16 neurological	normal	suspected minimal brain damage; "soft signs"	medically confirmed minimal brain damage	1	0
17 neuromotor	normal	suspected dysarthria or dyspraxia	confirmed dysarthria or dyspraxia	5	1
18 walking: onset	normal	slightly delayed	significantly delayed	2	0
19 chewing	normal	noticeably slow, but coordinated	significant difficulty coordinating movements	1	1
20 choking	none	periodically chokes on food	frequently chokes on food	1	0
21 drooling	none	drools when concentrates on tasks	chronic drooling	1	1

(Continued)

TABLE 2. (Cont'd.)

I. MECHANISM

B. Speech

Item	Rating Criteria			Total S's Rated "1"	Total S's Rated "2"
	0	1	2		
Larynx					
22 quality	normal	somewhat hoarse	hoarse to aphonic	0	3
23 web	not present	web present, but not obstructing airway or vocal folds	web present; obstructs movement of vocal folds	1	0
Lips					
24 movement	normal	slightly limited during speech	significantly limited during speech	1	1
Mandible					
25 movement	normal	slight extraneous movement relative to tongue movement	considerable extraneous movement relative to tongue movement	1	0
Palate: hard					
26 arch	normal	slightly high and narrow	significantly high and narrow	1	0
Palate: soft					
27 length	normal	somewhat short; x-ray recommended prior to adenoidectomy	significantly short; associated with velopharyngeal incompetence	4	1
28 movement	normal	limited	limited, with demonstrated velopharyngeal incompetence	3	1
Respiratory					
29 mouth breathing	not present	intermittent	habitual	2	2
Resonance					
30 hypernasality	not present	mild-intermittent	moderate-severe; persistent	2	1
Speech					
31 diadokokinesis	normal	accurate, but slow and/or arhythmic	significantly slow and/or arythmic	1	0
32 dyspraxia test	normal	mild involvement	moderate-severe involvement	1	3
33 precision	normal	noticeable decrease in precision with increase in rate	imprecise at all rates	3	1
34 rate	normal	noticeably slow	significantly slow	1	2
35 sequencing test	normal	mild problem with rate and accuracy of sound/syllable sequencing	moderate-severe problem sequencing sounds and/or syllables	2	0
Teeth					
36 condition	good	some cavities; filled or not; missing teeth	extensive cavities; filled or not; extensive missing or capped teeth	1	1
37 occlusion	normal	mild malocclusion; jumbled teeth	moderate-severe malocclusion; jumbled teeth	7	1
Tongue					
38 elevation	normal	noticeably difficult	significantly difficult	4	0
39 extraneous movement	none	slight	significant	0	1
40 lateral movement	normal	noticeably difficult	significantly difficult	1	0
41 position at rest	normal	slight deviation from midline	significant deviation from midline	1	0
42 size	normal	somewhat large in relation to oral cavity	significantly large in relation to oral cavity	1	0
Tonsils					
43 size	normal	slightly enlarged	significantly enlarged	4	0

II. COGNITIVE-LINGUISTIC

A. Comprehension

Item	0	1	2	Total S's Rated "1"	Total S's Rated "2"
Academic					
44 directions	grade level	up to one year delay in ability to follow directions	beyond one year delay in ability to follow directions	2	0
45 grade	age appropriate	repeated grade	special class placement	2	3
46 learning	normal	parent/teacher question learning ability	confirmed learning problem	1	6
47 reading	grade level	up to one year delay	beyond one year delay	1	0
Lexical					
48 PPVT	age appropriate	up to one year delay in vocabulary comprehension	beyond one year delay in vocabulary comprehension	6	2
Memory					
49 auditory	normal	questionable	confirmed deficits	1	0

(Continued)

TABLE 2. (Cont'd.)

II. COGNITIVE-LINGUISTIC

A. Comprehension

Item	Rating Criteria			Total S's Rated "1"	Total S's Rated "2"
	0	1	2		
Syntax					
50 Miller-Yoder Test of Grammatical Comprehension	age appropriate	passed 80% of age level items	passed less than 80% of age level items	0	1
51 questions	age appropriate	up to one year delay in comprehension of question forms	beyond one year delay in comprehension of question forms	1	1

II. COGNITIVE-LINGUISTIC

B. Production

Associated/Developmental					
52 formulation	age appropriate	suspected problem in ability to formulate ideas	confirmed problems in ability to formulate ideas	4	1
53 talking: onset	normal	parents report up to one year delay	parents report beyond one year delay	0	1
54 Preschool Language Scale: Zimmerman, Steiner and Evatt	age appropriate	up to one year delay on Verbal Ability Scale	beyond one year delay on Verbal Ability Scale	2	0
Lexical					
55 retrieval	normal	suspected problem in ability to retrieve words	confirmed problem in ability to retrieve words	2	3
Syntax					
56 development	age appropriate	up to one year delay	beyond one year delay	21	12

III. PSYCHOSOCIAL

A. Inputs

Friends					
57 age	appropriate	somewhat limited to younger children	plays only with younger children	1	0
Parents					
58 abuse	no reports	suspected child abuse	confirmed child abuse	0	1
59 behavior management	normal	somewhat ineffective	considerably ineffective	1	3
60 caregiving	supportive	somewhat nonsupportive	considerably nonsupportive	0	1
61 concern	appropriate	somewhat over-concerned with child's problems	considerably over-concerned with child's problems	1	3
62 effectiveness	effective	need some parenting training	need extensive parenting training	1	2
63 independence training	normal	somewhat reluctant to train child to be independent	considerably reluctant to train child to be independent	1	0
64 language stimulation	normal	somewhat limited	significantly limited	0	1
65 marital stability	normal	unsettled; some separation threats and disputes	considerably unstable; disputes	3	0
66 responsibility	normal	slightly overwhelmed by parenting responsibilities	considerably overwhelmed by parenting responsibilities	2	1
67 sibling comparison	normal	somewhat unfavorable comparison of child to sibling(s)	considerably unfavorable comparison of child to sibling(s)	0	1
68 therapy support	positive	parent somewhat indifferent to child's speech progress	parent does not make effort to see or support child's speech therapy	1	1

III. PSYCHOSOCIAL

B. Behaviors

69 affect	appropriate	limited	significantly limited	2	0
70 aggression	normal	periodically over aggressive	consistently over aggressive	1	1
71 compliance	normal	compliant when expectations are made clear	compliant only in highly structured situations	4	1
72 dependence on adults	normal	somewhat too dependent	overly dependent	0	2
73 separates from adults	normal	separates from parents only after encouragement	cannot be encouraged to separate from parents	0	1
74 maturity	age appropriate	somewhat immature behaviors	considerably immature behaviors	3	6
75 need for approval	normal	somewhat high	considerably high	0	2
76 nervous habits	none	limited to some situations	consistently in many situations	2	0

TABLE 2. (Cont'd.)

III. PSYCHOSOCIAL

B. Behaviors

| Item | Rating Criteria | | | Total S's Rated "1" | Total S's Rated "2" |
	0	1	2		
77 psychosocial development	normal	somewhat delayed	significantly delayed	0	1
78 self concept	positive	somewhat poor	significantly poor	0	1
Sensitivity					
79 others	normal	somewhat overconcerned about other's feelings	considerably overconcerned about other's feelings	1	0
80 self	normal	somewhat too sensitive; feelings easily hurt	overly sensitive; feelings very easily hurt	1	1
Social Responsiveness					
81 first year	normal	somewhat nonresponsive	significantly nonresponsive to social contacts	0	1
82 new situations	normal	somewhat shy, quiet, fearful	considerably shy, quiet, fearful	9	1
83 play	normal	often chooses to play alone	consistently chooses to play alone	1	2
84 questions	normal	somewhat unresponsive to direct questions	generally unresponsive to direct questions	1	1
85 reinforcement	normal	needs somewhat more external reinforcers	needs considerably more external reinforcers	2	2
Speech Related					
86 avoidance	normal	some avoidance of difficult speech tasks	frequent avoidance of difficult speech tasks	2	1
87 intelligibility	consistent	somewhat variable by situational context	considerably variable; associated with situational context	0	1
88 requests for clarification	normal	often unwilling to repeat an utterance	consistently unwilling to repeat an utterance	2	0
89 response to speech therapy	normal	often frustrated; needs encouragement	consistently frustrated	2	0
90 willingness to talk	normal	hesitant in many situations	hesitant in most situations	1	0

The purpose for providing these detailed data (see Table 2) is to illustrate use of the 3-category system. Obviously, the content for each item reflects the often arbitrary clinical judgments that are common to diagnosis. That is, no claim is made that the 3-way descriptors for each item are the only correct possibilities. What has been accomplished, however, is that we have tried to be comprehensive and explicit in culling the assessment data. What is "normal" versus "somewhat subnormal" versus "moderately to severely subnormal," for each mechanism, cognitive-linguistic, or psycho-social variable, is a matter to be established by research. The diagnostician can only assemble and interpret a battery of assessment information. Different theoretical orientations, practical limitations, and the state of the art in assessment areas all are influential in determining the content of assessment materials. Table 2 reflects simply those variables on which we had data on children, and on which at least one child was rated "1" or "2." Because these descriptors were specifically written to cover assessment data for these 43 children, no intrajudge or interjudge agreement assessment was undertaken.

Completion of Levels 4 and 5 of the classification summary sheet (see Figure 1) as described in the Appendix is straightforward. The procedure is to carry upwards the highest number entered at any lower level. Thus, for example, a 3-digit entry of "102" at Level 4 (see Figure 1) indicates that the highest rating for a

mechanism variable was "1"; the highest cognitive-linguistic variable was "0"; the highest psychosocial variable was "2." Note that this procedure yields entries that act as a "flag" for data at lower levels. For example, a "2" at Level 4 indicates only that a "2" was entered for at least one variable below.

RESULTS AND DISCUSSION

A summary of the coded data available for each of the 43 children is presented in Table 3. Following are some findings that support the content validity of the classification system and that may be viewed as preliminary prevalence data on one sample of children referred for delayed speech of unknown origin. For convenience, these findings are summarized in the form of three questions roughly corresponding to data presented from left-to-right in Table 3.

1. How prevalent is suprasegmental involvement in this sample?

The classification system summarizes suprasegmental involvement at Level 5 of the phonology branch (see Figure 1). Within this sample of 43 children, approximately two-thirds of the children were rated 1 or 2 on

one or more of the six suprasegmentals. The summary data are as follow: Voice—0=34%, 1=13% and 2=53%; Rhythm—0=37%, 1=34% and 2=29%. Within the six suprasegmentals, *Quality* was most often rated 2. Because of methodological difference it is inappropriate to compare these data to other normative data on children's suprasegmentals. Normative data on children's voice and rhythm characteristics in continuous speech samples will need to be obtained before differences among population samples will allow for theoretical speculation. For example, ratings of *Quality* may be distributed similarly in normal and delayed speech groups, while *Rate* or *Stress* involvement might be more prevalent in children whose segmental errors suggest motor speech involvement. Conditional probabilities for the co-occurrence of such segmental and suprasegmental findings should form the bases for follow-up instrumental analyses and

eventual differential diagnoses. In any case, we were impressed with the findings that only one-third of these children obtained 0 or "no involvement" in voice and/or rhythm suprasegmentals, as rated perceptually by procedures described in Shriberg and Kwiatkowski (1982b).

2. How prevalent are the four severity categories in this sample?

The classification system provides a *Phonological Severity Index* at Level 5 of the phonology branch. An adjective, *mild, mild-moderate, moderate-severe* or *severe*, is derived primarily from the Percentage Consonants Correct (PCC) value, with age and suprasegmentals playing a minor role for borderline PCC values (Shriberg & Kwiatkowski, 1982b). Of the 29 continuous speech sam-

TABLE 3. Summary data at Level 5 and 4 of the classification system for a group of 43 children with speech delays of unknown origin.

Child	Age	Sex	Phonology Branch Level 5			Level 4	Causal-Correlates Branch Level 5						Level 4		
			Seg-mental*	Supra-segmental			Mechanism		Cognitive-Linguistic		Psychosocial		Mechan-ism	Compre-hension Pro-duction	Psycho-social
				Voice	Rhythm		Hearing	Speech	Compre-hension	Pro-duction	Inputs	Behaviors			
1	4-0	M	-	-	-	-	0	0	0	1	0	0	0	1	0
2	4-1	F	(74)MM	2	2	MM	0	1	0	1	1	2	1	1	2
3	4-4	M	(73)MM	1	0	MM	2	1	0	1	1	2	2	1	2
4	4-5	M	-	-	-	-	1	1	0	1	2	0	1	1	2
5	4-6	M	-	2	0	-	1	0	-	-	1	0	1	-	1
6	4-6	M	(72)MM	0	1	MM	2	0	1	1	1	1	2	1	1
7	4-8	F	-	2	1	-	2	1	2	2	2	2	2	2	2
8	4-9	M	(89)M	0	1	M	1	2	0	2	0	0	2	2	0
9	4-10	M	(82)MM	2	0	MM	2	1	1	1	0	2	2	1	2
10	4-10	M	(65)MM	0	1	MM	2	1	0	1	0	1	2	1	1
11	4-10	M	(74)MM	0	1	MM	2	2	0	1	0	0	2	1	0
12	4-10	M	-	0	2	-	0	0	-	-	2	2	0	-	2
13	5-0	M	(71)MM	2	2	MM	0	1	0	2	2	2	1	2	2
14	5-0	M	(63)MS	0	2	MS	2	0	1	2	2	2	2	2	2
15	5-1	M	-	-	-	-	-	0	0	0	-	-	-	0	-
16	5-1	M	(79)MM	2	2	MM	2	1	2	1	0	0	2	2	0
17	5-2	M	(82)MM	1	0	MM	1	1	1	1	0	2	1	1	2
18	5-3	F	(67)MM	1	0	MM	1	2	0	0	0	0	2	0	0
19	5-4	M	(72)MM	0	1	MM	0	0	0	0	0	0	0	0	0
20	5-4	F	-	0	0	-	1	1	0	1	2	2	1	1	2
21	5-7	F	-	0	0	-	0	0	-	-	2	0	0	-	2
22	5-8	F	(48)S	2	2	S	0	1	0	1	0	0	1	1	0
23	5-10	M	(91)M	0	1	M	1	1	0	1	0	1	1	1	1
24	5-10	M	(65)MM	2	1	MS	2	0	0	1	0	0	2	1	0
25	5-10	M	(54)MS	2	2	MS	1	1	0	1	1	1	1	1	1
26	5-11	M	(56)MS	2	0	MS	1	1	0	2	1	2	1	2	2
27	5-11	M	-	2	0	-	1	1	1	1	0	1	1	1	1
28	6-0	F	(73)MM	1	0	MM	0	0	0	2	0	0	0	2	0
29	6-1	F	-	-	-	-	1	0	0	1	0	0	1	1	0
30	6-1	F	(54)MS	2	2	MS	0	2	2	2	2	2	2	2	2
31	6-2	M	(64)MS	2	1	MS	0	0	0	1	0	0	0	1	0
32	6-3	M	-	-	-	-	2	0	2	2	0	2	2	2	2
33	6-4	M	(86)M	1	0	M	0	1	0	2	0	1	1	2	1
34	6-5	M	(62)MS	0	0	MS	0	2	0	0	0	1	2	0	1
35	6-5	M	-	0	2	-	1	1	0	1	0	0	1	1	0
36	6-5	M	(59)MS	2	0	MS	0	0	0	2	2	2	0	2	2
37	6-11	M	(71)MM	2	1	MM	2	2	0	2	2	0	2	2	2
38	7-2	M	(58)MS	0	1	MS	1	1	1	1	0	1	1	1	1
39	7-3	F	-	2	0	-	2	1	-	-	0	1	2	-	1
40	7-3	M	(75)MM	2	1	MM	0	0	0	1	2	2	0	1	2
41	8-5	F	(78)MM	2	2	MM	2	2	2	2	0	1	2	2	1
42	8-6	M	(77)MM	2	1	MM	1	2	2	2	1	1	2	2	1
43	8-11	M	-	2	2	-	0	1	2	2	0	0	1	2	0

*The number in parenthesis is the percentage of consonants correct. The letters are the corresponding severity adjectives: (moderate) M, (mild-moderate) MM, (moderate-severe) MS, (severe) S.

ples that were appropriate to use for this purpose (see Table 3) the following are the prevalence figures for each adjective: *mild* = 10%, *mild-moderate* = 55%, *moderate-severe* = 31%, *severe* = 3%. Obviously, age is a variable that will influence the relative proportions, although some of our oldest children retained a rating of *moderate-severe*.

One useful perspective on these preliminary values is that very few children with delayed speech warrant the severity adjective *severe* as defined for this classification system. And at the other end, few children who are referred for delayed speech problems have PCC values that convert to *mild*. Most children, over 85% in this study, may be viewed as *mild-moderate* (55%) or *moderate-severe* (31%). Pending confirmation in subsequent samples, such figures should provide bases for service delivery questions in schools, including case selection, individual programming, and other issues requiring quantitative evidence of need and change.

3. How prevalent are involvements in each of the causal-correlates factors in this sample?

Level 5 of the classification system provides six 1-digit entries that reflect the highest digit used for each causal-correlate factor at Level 6 (see Figure 1). Hence, a 1 or a 2 in any of the six causal-correlate boxes indicates that at least one factor was rated that digit among all the diagnostic data. Figure 3 is a graph of the group data; these data summarize the individual data presented in Table 3.

These data displayed in Figure 3 may be viewed as a first approximation to the goal of an eventual taxonomy of phonological disorders. Among the interesting proportions we observe that (a) approximately two-thirds of the children have some case history data indicating middle-ear or hearing involvement and/or entries for speech mechanism factors, (b) only one-third have language comprehension involvement, whereas 90% have language production involvement, and (c) approximately 40-60% have psycho-social involvements. It is important to underscore that these figures only summarize the data
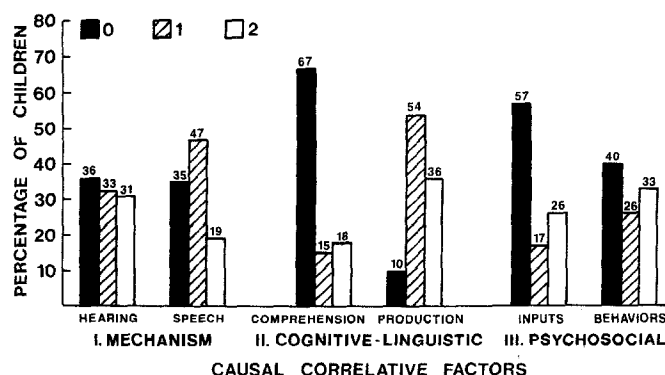
pool; differences between ratings of 1 versus 2 and different causal-correlate implications for each of the 90 factors described in Table 2 are pronounced. The value of such summary data, again, is for lending some order to the disparate approaches to the study of phonological disorders and for generating questions.

As an example of the potential of the system for generating questions about the origins and effects of phonological disorders, consider Table 4. These data, taken from the individual data in Table 2, allow for gross inspection of the association between hearing factors and language comprehension. Although inferential statistics are not warranted for these post hoc displays, two observations are noteworthy. First, even an "involved" hearing history (i.e., "2") does not imply deficits in comprehension as assessed in this study. Among the 26 children rated 1 or 2 on hearing factors, their comprehension ratings were distributed across 0, 1, and 2. Only 11 of the 26 children (42%) were rated 1 or 2 on comprehension, with 14 rated as 0. This figure is not too different from the unconditional probability of 1 or 2 ratings on comprehension (see Figure 3) which is 33%. The second observation, however, concerns the obverse situation—the hearing history for children rated 1 or 2 on comprehension. Of the 13 children rated 1 or 2 on comprehension, 11 (85%) had histories of 1 or 2 hearing factors. The unconditional probability for 1 or 2 ratings on hearing history is only 64% (see Figure 2) suggesting that proportionately more children with reduced comprehension ratings have a history of hearing involvement. Once again, these data are presented only to illustrate the utility of the system for generating hypotheses.

TABLE 4. Association between hearing data and comprehension data for 38 children coded on both. Tabled entries are the number of children coded within each cell*.

| | | HEARING | | | |
		0	1	2	Total
	0	11	9	5	25
Comprehension	1	0	3	3	6
	2	2	1	4	7
	Total	12	13	13	38

*0 = no involvement; 1 = questionable or mild involvement; 2 = moderate to severe involvement. See Table 2 for descriptors for each hearing and comprehension variable.

CONCLUSIONS

The descriptions provided by this initial data set are viewed as supportive evidence for the potential utility of a diagnostic classification system—as a clinical-diagnostic tool and as a tool for research in phonology.

As a clinical-diagnostic tool, the system should promote a focus on the methods and output goals of the assessment process. Clinicians routinely collect data such

FIGURE 3. Causal-correlates data for a group of 43 children with delayed speech.

as found in the case folders we reviewed. What is needed, however, is a system to organize and interpret these data for prediction and management. A subsequent paper (Shriberg & Kwiatkowski, 1982a) describes predictive and management implications of classifying children in the manner proposed here.

As a research tool, the data in Table 3 invite several kinds of inquiry. Ordinal coding of all relevant variables should allow for correlational and experimental studies of children with delayed phonology. The data set columns in Table 3 can be cross tabulated to begin to parcel out nonchance relationships. Such diagnostic studies, directed to the discovery and description of etiologically based subgroups within developmental phonological disorders, would seem to warrant high priority by this field.

ACKNOWLEDGMENTS

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APPENDIX

Classification Procedures

The diagnostic classification system described in the text provides a framework for organizing assessment data at successively more consolidated levels. For certain clinical or research

purposes, the summary data at Level 6 or even the assessment data beyond Level 6 will be required. For other purposes, entries at higher levels will be useful. This Appendix is a procedural guide for use of the system.

Classification of a child or adult with a phonological disorder requires that the clinician-researcher (a) complete a diagnostic appraisal of the person, (b) code the diagnostic information in the manner described in this Appendix, and (c) enter the coded information and derive the values in each appropriate box on a classification form (a facsimile of Figure 1). In practice, the actual sequence of completing all operations varies according to practical matters. For expository clarity in this procedural guide, however, all operations will be described in step-by-step sequences.

PROCEDURES FOR COMPLETING THE CLASSIFICATION SYSTEM'S PHONOLOGY BRANCH

Step 1: Tape record a continuous speech sample

All speech data are taken from a tape-recorded speech sample of approximately 3-4 minutes. Suggestions for sampling and recording procedures are described elsewhere (Shriberg & Kwiatkowski, 1980); structural characteristics of continuous speech samples are described in Shriberg & Kwiatkowski, 1982b. Free speech of 3-4 minutes should yield for the child with *average* utterance lengths, approximately 100 intelligible words, including 180 consonants (see Shriberg & Kwiatkowski, 1982b; and Table 9).

Step 2 (optional): Complete a Natural Process Analysis including a description of "Other Sound Changes"

Step 2 is an optional step at present, pending further elaboration of the classification system. Natural process analysis and a detailed description of sound changes not attested as "natural" (Shriberg & Kwiatkowski, 1980) are viewed as important for differential diagnosis. At present, however, work correlating specific error types with etiological types has only begun (Shriberg & Smith, Note 4). For purposes of deriving a severity adjective in this classification system, a PCC value and suprasegmental coding value (described next) are sufficient.

Step 3: Calculate Percentage Consonants Correct (PCC)

Complete details for deriving a Percentage Consonants Correct (PCC) value from the continuous speech sample are provided in Shriberg and Kwiatkowski, 1982b. The resultant value is entered in the appropriate box at Level 6.

Step 4: Rate suprasegmental performance

As shown in Figure 1, the six suprasegmentals of interest are Pitch, Loudness, Quality, Phrasing, Stress, and Rate. Procedures for rating these suprasegmentals on a 0-1-2 coding system are provided in Shriberg and Kwiatkowski, (1982b). The resultant values are entered in each appropriate box at Level 6.

Step 5: Derive the Phonological Severity Codes for Level 5

Level 5 of the phonology branch of the classification system

provides for a consolidation of the data at Level 6. Deriving the entries, a severity adjective and two suprasegmental values, is a clerical matter. For the segmental severity adjective, Figure 2 in Shriberg and Kwiatkowski (1982b) is used to find the appropriate adjective for the PCC value entered at Level 6. For the suprasegmental values, *the highest value* recorded in each subsection is carried upwards. For example, if a child's Voice suprasegmentals at Level 6 were Pitch = 0, Loudness = 1, Quality = 2, a "2" would be entered in the Level 5 box for Voice. Another example: if a child's Rhythm suprasegmentals were Phrasing = 1, Stress = 0, Rate = 1, a "1" would be entered in the Level 5 box for Rhythm.

Step 6: Derive the Phonological Severity Index for Level 4

The final task within the phonology branch of the classification system is to derive one adjective that quantifies "severity of involvement." Procedures for deriving this adjective, in consideration of the child's age, PCC value, and suprasegmental values, are again described in the summary section of Shriberg and Kwiatkowski (1982b).

CASE EXAMPLE

Figure 4 is a case example illustrating a completed diagnostic classification form for a 5-year-old boy. This case example was selected because of the variety of illustrative coding decisions. Entries were taken directly from his clinic folder. Notice that only information coded as 1 or 2 are entered on the classification form. All other available assessment data are assumed to be coded 0.

Causal-Correlates Data Entries for Figure A

I. Mechanism
  A. Hearing
    (1) Pure Tone: Mild conductive loss identified at age three. Subsequent pure tone tests indicated normal hearing.
    (2) Infections: Frequent; requiring medical attention. PE tubes considered, but judged "not warranted."
  B. Speech
    (1) Speech: Noticeable decrease in precision of consonant production as speech rate is increased to within normal range.
II. Cognitive-Linguistic
  B. Production
    (1) Syntax: Nearly 2-year delay: variable use of articles; me/I; deletes all grammatical markers on verbs, with exception of present-progressive
    (2) Formulation of Ideas: Suspected problems; frequently is slow to respond; pauses for long periods during utterances.
    (3) Word Retrieval: Suspected problems; mislabelling, long pauses before lexical items.
III. Psychosocial
  A. Inputs
    (1) Behavior Management: Parents are somewhat ineffective; express concern about tantruming; when child tantrums, mother exhorts and threatens and then cajoles or gives in.
  B. Behaviors
    (1) Social Responsiveness: Somewhat shy, quiet, fearful in new situations.

Needed encouragement to participate, interact with peers in group.

(2) Compliance: Needs clear expectations and consis-

tent management. Initially "tests" limits.

(3) Maturity Level: Considerably immature; frequently tantrums.

LEVEL 1

| NO DISORDER | | PHONOLOGICAL DISORDER | ✓ | OTHER DISORDER | |

LEVEL 2

| DEVELOPMENTAL PHONOLOGICAL DISORDER | ✓ | NON-DEVELOPMENTAL PHONOLOGICAL DISORDER | |

LEVEL 3

| DELAYED PHONOLOGICAL DEVELOPMENT | ✓ | RESIDUAL PHONOLOGICAL ERRORS | |

LEVEL 4

| PHONOLOGICAL SEVERITY INDEX | *moderate-severe* |

CAUSAL-CORRELATES INDEX	I	II	III
	/	2	2

PHONOLOGICAL SEVERITY CODE	
SEGMENTAL	SUPRA-SEGMENTAL

LEVEL 5

SEGMENTAL	SUPRA-SEGMENTAL	
moderate-severe	Voice	Rhythm
	2	0

CAUSAL-CORRELATES CODE					
I		II		III	
A	B	A	B	A	B
/	/	0	2	/	2

LEVEL 6

CONTINUOUS SPEECH DATA SUMMARY		
NATURAL PROCESSES	SEGMENTAL	SUPRASEGMENTAL
Final Consonant Deletion ✓	PERCENTAGE OF CONSONANTS CORRECT 56	VOICE
Velar Fronting ✓	OTHER SOUND CHANGES	Pitch
Stopping ✓	/h/ initial deletion	Loudness
Palatal Fronting	/s/ /z/ variable	Quality harsh, tense, tremulous 2
Liquid Simplification ✓	nasal substitutions	RHYTHM
Assimilation		Phrasing
Cluster Reduction ✓		Stress
Unstressed Syllable Deletion		Rate

CAUSAL-CORRELATES DATA SUMMARY					
I MECHANISM		II COGNITIVE-LINGUISTIC		III PSYCHOSOCIAL	
A Hearing	B Speech	A Compre-hension	B Production	A Inputs	B Behaviors
(1) /	(1) /		(1) 2	(1) /	(1) /
(2) /			(2) /		(2) /
			(3) /		(3) 2

ASSESSMENT DATA

FIGURE A. Example of a completed diagnostic classification form for a 5-year-old boy with delayed speech. See the text for the causal-correlates entries corresponding to the numbers in parentheses.

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