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ASSOCIATIONS BETWEEN PHONOLOGY AND SYNTAX IN SPEECH-DELAYED CHILDREN

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Interactions between phonology and syntax are inspected in continuous speech samples from 30 speech-delayed children. Two types of interactions are examined: The co-occurrence of speech and language delay and the effects of phonological reduction on the realization of phonetically complex morphophonemes. Four possible patterns of association between the phonological and syntactic systems are outlined, and subjects are assigned to these patterns based on their phonological and syntactic performance. Results indicate that two-thirds of the subjects display evidence of overall syntactic delay, whereas half show some limitation in the use of phonetically complex morphophonemes, their performance in that area being below the level of their syntactic production. Implications of these findings for a theory of speech delay and for management programming are discussed.

Study of the speech of children who have significantly delayed speech development has shifted in the last decade from surface descriptions of speech errors to description of the underlying rules that account for surface forms (Ingram, 1976). This shift has permitted phonological questions to be incorporated into the more general study of child language development and language disorders. Phonology is one aspect of the child's developing linguistic system that can be expected to interact with other components of that system—syntax/morphology, semantics, and pragmatics—just as these components interact with each other. An example of such interaction is the restriction on the use of new syntactic forms to express old semantic functions (Slobin, 1971). The purpose of the present investigation is to explore the interaction of phonology and syntax in a sample of children who are delayed in acquiring normal phonological production.

RESEARCH IN PHONOLOGY/SYNTAX INTERACTIONS

Observations that speech-delayed children[1] also tend to be delayed in syntactic development have been reported for almost 35 years. Representative research on the co-occurrence of phonological and semantic/syntactic delays in children suggests only low to moderate association (Davis, 1937; Marquardt & Saxman, 1972; Schneiderman, 1955; Shriner, Holloway, & Daniloff, 1969; Templin, 1957; Van Demark & Mann, 1965; Whitacre, Luper, & Pollio, 1970; Williams, McFarland, & Little, 1937; Winitz, 1959; Yedinack, 1949). Winitz (1969) presents a complete review of the earlier studies. Low to moderate correlations between syntactic and articulatory performance have been found more frequently in studies involving younger children and in studies assessing syntax by means of sentence repetition tasks (Menyuk, 1969; Saxman & Miller, 1973; Whitacre, Luper, & Pollio, 1970).

A second body of literature in phonology/syntax interactions is concerned with the effects of increasing syntactic complexity on phonological performance. Several studies (Menyuk & Looney, 1972; Panagos, 1974; Panagos, Quine, & Klich, 1979; Schmauch, Panagos, & Klich, 1978) have shown that increased length and complexity of linguistic strings is associated with increased phonological production errors. These studies also used sentence repetition tasks to control length and complexity.

More recently, Panagos and his colleagues (1979) interpreted their data to suggest that grammatical complexity is a causal factor in speech-delayed children's simplifications of words. They hypothesized that the relations between syntactic and phonological deficits in these children can be attributed to a common underlying limitation in organizational ability. They argued that language is organized in the brain as hierarchies of syntactic, morphological, and phonological elements. Children with speech delays are generally limited in their capacity to manage hierarchical complexity during encoding. One result of this limitation is loss of phonetic accuracy due to competing demands for processing resources at higher linguistic levels. The hypothesis predicts that when syntactic complexity increases—in longer and more highly marked constructions such as

[1]*Delayed-speech* is proposed as a classificatory term elsewhere (Shriberg & Kwiatkowski, 1982). Essentially, it refers to children who persist in Phonological Stage III deletions and substitutions (Ingram, 1976) in contrast to the residual errors of children who have yet to complete Stage IV.

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passives or embedded sentences—the number of phonological simplifications will increase in children whose encoding capacity is limited. That is, children who show evidence of a general deficit in encoding by their protracted use of simplification processes will have even more phonological errors when the syntactic load is increased.

The Fourteen Grammatical Morphemes and the Question of Speech/Language Interaction

Children's use of the 14 grammatical morphemes (Brown, 1973; Cazden, 1968; de Villiers & de Villiers, 1973) in continuous speech provides an opportune context for examining phonology/syntax interactions. Table 1 lists these fourteen grammatical morphemes, arranged according to Miller's (1981) stage assignments. These assignments to Brown's stages were made by Miller on the basis of data presented by de Villiers and de Villiers (1973). Additionally, the morphemes can be divided into two groups on the basis of whether or not they usually involve an increase in the surface phonetic complexity of the base word. The morphemes considered "complex" for the purpose of the present study are those that require the addition of a consonant rather than a vowel or consonant(s) change or the addition of another syllable. These phonetically complex morphophonemes (plural, possessive, regular past tense, and regular third person singular) could be expected to stimulate phonological simplification in a "limited encoding capacity" model of speech delay. The realization of phonetically complex morphophonemes would be affected, in this model, over and above any general delay in productive syntax. That is, phonetically complex morphophonemes at and below the level of the child's overall syntactic performance would be simplified because of their combined syntactic and phonetic demands, whereas phonetically simpler grammatical morphemes at higher syntactic levels would be correctly realized. According to this model, for example, a child with a limited encoding capacity whose general syntactic level corresponds to Brown's Stage V might realize phonetically simple Stage V grammatical morphemes, such as articles, correctly. This child might fail to realize developmentally earlier plural morphemes because of the phonetic complication of base words involved in the addition of an /s/ or /z/ segment.

It is important to note that the addition of phonetically complex morphophonemes to base words produces derived structures of varying complexity. For example, *shoes*, while more phonetically complex than the singular form *shoe*, is still less complex than a plural form such as *chutes*, which involves the formation of a final cluster. Similarly, *played* is less complex than *placed*. The addition of phonetically complex morphophonemes, then, does not invariably result in target words of comparable difficulty. Generally, however, the addition of these morphemes will result in the formation of phonetically more complex words than will the addition of morphemes expressed as whole syllables *(-ing)* or separate words *(in, on, a, the)* or as simple changes in vowels (irregular past: *see-saw, come-came*) or consonants *(have-has)*.

TABLE 1. Miller's (1981) stage assignments for 14 grammatical morphemes based on data from de Villiers and de Villiers (1973). Listed are simple and complex morphemes used correctly in 90% of their obligatory contexts.

Stage	*Simple*	*Examples*	*Complex*	*Examples*
II	*-ing*	walk*ing*	plural	two dog*s*
	in	*in* box		some cat*s*
III	*on*	*on* table	possessive	daddy*'s* chair
V	irregular past	*saw* *came*	regular past	walk*ed* play*ed*
	articles	*a, the*	regular third person singular	he go*es* she hit*s*
	contractible copula *be*	It*'s* green I *am* here		
V+	uncontractible copula *be*	Who's here? I *am*		
	contractible auxiliary *be*	I*'m* playing He *is* walking		
	uncontractible auxiliary *be*	Who's playing? I *am*		
	irregular third person singular	It *has* She *does*		

Another problem in determining the phonetic complexity of grammatical morphemes is that some morphemes produce phonetic complexity in some contexts and not others. Contractible copula and auxiliary *be* forms, for example, may complicate base words when the option to contract is chosen *(He's a boy).* When the contraction option is not selected, however *(He is a boy),* phonetic complexity is not increased because a whole syllable is added. For this reason, these morphemes are not listed as phonetically complex in Table 1. Although their use may increase phonetic complexity, it does not necessarily do so, because of the option to produce an uncontracted form.

Methodological Concerns in the Study of Phonology/Speech Interactions

Of the studies cited earlier, those that found evidence of increased speech errors in the production of increasingly complex linguistic strings used elicited imitation tasks. Specifically, subjects were asked to repeat sentences controlled for length and complexity, and deductions were made about language processing in the context of repetition. Such tasks may evoke unique processing strategies. In a review of issues in the use of elicited imitation procedures in child language research, Hood and Lightbown (1978) argued that elicited imitation tasks set up highly unnatural discourse contexts. Specifically, such tasks involve asymmetrical turn-taking, the production of unusual contingent responses, and the absence of the normal function of talking—an intention to communicate. In addition, Hood and Lightbown noted that sentences chosen for elicited imitation tasks, such as the passives used by Panagos et al. (1979), are generally rare in children's speech. Children of the ages Panagos and his colleagues studied (4–6 years) simply may not yet have acquired competence with passive forms (Beilin, 1975; Moore & Harris, 1978). Using sentence types that may not be part of the child's competence base to test for interactions between syntactic and phonological systems and embedding these sentences within a task that makes unusual discourse demands seems likely to produce processing strategies that will differ from those used in ordinary talking and listening. Particularly for the purpose of studying the interaction between two components of a child's language system, it seems crucial not to confound the investigation of linguistic performance with task demands related to other areas of cognitive functioning. To this end, the present study examined phonology/syntax interactions in the context of continuous speech, rather than from a speech sample elicited by imitation.

The results of a preliminary study of continuous speech samples (Paul, Campbell, & Shriberg, Note 1) are also relevant here. That study posed the question, Do long or complex sentences in a continuous speech sample contain more instances of phonological simplification processes than short or simple sentences? Inspection of three transcripts from each of seven children indicated that when speech-delayed children produced long or complex sentences, they were not likely to use significantly more simplification processes on constituent morphemes than they were in short or simple sentences. At face value, these findings appear to be contradictory to those presented by other investigators. Both Faircloth and Faircloth (1970) and de Villiers and de Villiers (1978) presented case study data illustrating use of simplification processes on words occurring in multiword strings, whereas some of the same words were produced correctly in isolation.

With regard to the Faircloth and Faircloth study, increases in the use of simplifications in sentences over single words may be primarily a result of increased motor programming difficulty, rather than increased syntactic complexity. What seems difficult for children is the phonological programming of any multisyllabic string. Although sentences appear to be associated with more simplifications than single words, the length or complexity of the sentence from a grammatical perspective does not seem to be quantitatively related to phonological simplification. The de Villiers and de Villiers (1978) results, moreover, may not directly reflect increased length, but rather recency of acquisition.[2] In their longitudinal data, most recently acquired forms (two- and three-word utterances) were associated with simplifications of words that had been articulated correctly in old, already-mastered contexts (single-word utterances). It is possible that processes similar to those discussed by de Villiers and de Villiers may be operating in children in our present study. However, because these data are cross-sectional, it was not possible to pinpoint which structures were recently acquired for individual children.

METHOD

Possible Patterns of Association Between Phonology and Syntax

If Panagos et al. (1979) were correct in their view that limited encoding capacity underlies speech delay, then children in this population would be expected to show deficits similar to those predicted above in the marking of phonetically complex morphophonemes. However, if several patterns of association between phonological and syntactic use in this population were shown to exist, the limited capacity hypothesis would be challenged. Four patterns of association between phonology and syntax might logically occur in speech-delayed children.

One type of association, which is labeled Pattern I, would involve the appearance of both phonological and syntactic deficits. That is, Pattern I children would show an overall syntactic delay and an even greater deficit in producing phonetically complex morphophonemes. Such children, if found, would show clear evidence of a limitation in encoding capacity. A second pattern of associa-

[2]We wish to thank Robin Chapman for pointing this out to us.

tion, Pattern II, would characterize children whose general level of syntactic production was age-appropriate, but who showed deficits in correct production of complex morphophonemes at and below their age-appropriate syntactic level. This performance would also support the notion of limitation in encoding capacity. A third logical possibility, Pattern III, would show the opposite composition. Here there would be a delay in general syntactic level, but no additional limitation on the production of phonologically complex morphophonemes. The last logical possibility, Pattern IV, would involve age-appropriate production of all syntactic and morphological structures. These children would have no interaction between productive phonology and syntax; their delays would be limited to productive phonology.

The study reported here divides speech samples from 30 speech-delayed children into these four patterns of phonology/syntax associations. The proportional occurrence of each pattern is used to evaluate the hypothesis that a limitation in encoding capacity provides a sufficient explanation for developmental speech delay.

Subjects

Transcripts of 30 continuous speech samples, each from a child with mild-moderate to severely delayed speech, were drawn from a larger data base (Shriberg & Kwiatkowski, 1982). Samples ranged from 30–100 utterances in length. Table 2 (second two columns) includes

TABLE 2. Demographic, phonological, and syntactic data for 30 children with delayed speech development.

	Demographic data			*Phonological processes in continuous speech*[a]								*Syntax measures*				
Phonology/ syntax pattern	*Subject*	*Sex*	*Age*	*Final Consonant Deletion*	*Velar Fronting*	*Stopping*	*Palatal Fronting*	*Liquid Simplification*	*Assimilation*	*Cluster Reduction*	*Unstressed Syllable Deletion*	*Sentence Structure Stage (SSS)*	*Overall Grammatical Morpheme stage (OGM)*	*Are some grammatical morphemes below OGM < 75% correct?*	*Discrepant Grammatical Morpheme stage (DGM)*	*Is SSS delayed re: age?*
I (n = 9)	1	F	4–1	S	N	S	N	S	N	S	S	IV	IV–V	yes	II	yes
	3	M	4–5	S	N	S	N	S	N	A	S	IV–V	V	yes	II	yes
	6	M	4–10	S	S	S	N	S	N	S	N	IV–V	IV–V	yes	II	yes
	12	F	5–4	S	N	S	–	N	N	S	S	III	V	yes	II	yes
	17	F	5–8	S	S	S	–	S	N	A	S	III–IV	IV–V	yes	II	yes
	18	M	5–10	S	S	S	N	S	N	S	N	IV	V	yes	II	yes
	26	M	6–10	S	S	S	S	S	N	S	S	IV	V	yes	II	yes
	28	M	7–2	S	N	S	N	S	S	S	S	IV	IV–V	yes	II	yes
	29	F	8–6	S	S	S	N	S	N	S	N	IV–V	V	yes	II	yes
II (n = 6)	7	M	4–10	S	N	S	N	S	N	S	N	V+	V+	yes	II	no
	11	F	5–3	S	N	S	N	S	N	S	N	V	V	yes	III	no
	13	M	5–4	N	N	S	–	N	N	S	N	V+	V+	yes	II	no
	15	M	5–5	S	S	S	S	S	S	S	S	V	V	yes	II	no
	23	M	6–2	S	N	S	N	S	N	S	S	V	V	yes	II	no
	30	M	8–6	S	S	S	N	S	N	S	S	V	IV–V	yes	II	no
III (n = 11)	2	M	4–4	S	N	N	N	N	N	S	N	IV–V	V+	no	–	yes
	4	M	4–5	S	N	S	N	S	N	S	N	IV	V	no	–	yes
	5	M	4–10	S	N	S	N	S	N	S	N	IV	IV–V	no	–	yes
	8	M	5–0	S	S	S	S	S	S	S	N	V	IV–V	no	–	yes
	10	M	5–1	N	N	S	–	S	–	S	N	IV–V	V	no	–	yes
	14	M	5–9	S	N	S	–	S	N	S	S	IV	V+	no	–	yes
	16	M	5–11	S	S	S	N	S	N	S	N	IV	V+	no	–	yes
	19	M	6–1	S	S	S	–	S	N	S	N	II	IV–V	no	–	yes
	20	F	6–1	S	S	S	N	S	N	S	S	III–IV	II	no	–	yes
	22	M	6–3	N	N	N	N	S	N	S	N	IV–V	IV–V	no	–	yes
	24	M	6–5	N	N	S	S	S	N	S	S	IV	V	no	–	yes
IVa (n = 2)	21	F	6–1	N	N	N	N	A	N	S[b]	N	V+	V	no	–	no
	27	M	6–11	N	N	N	A	S	N	S[b]	S	V	V+	no	–	no
IVb (n = 2)	9	M	5–1	N	A	S	–	S	N	S	N	V+	V+	no	–	no
	25	M	6–6	N	S	S	N	S	N	S	S	V+	V	no	–	no

[a]Process occurrence is quantified following Shriberg and Kwiatkowski (1980): A = Always occurs (when structural description is met); S = Sometimes occurs; N = Never occurs; – = No data available.

[b]Children with no syntactic delays were classified as Pattern IVa only if they used Cluster Reduction less than three times in a speech sample.

demographic data for the 30 children. These children had originally been referred to a university speech-language-hearing clinic because of their reduced intelligibility. Essentially, they had been diagnosed as children with developmental speech delays of unknown origin. Transcription of the continuous speech sample was accomplished by trained transcribers in the Shriberg and Kwiatkowski study (1982). Associated studies indicate that the children in this data base comprise a representative sample of children with the various labels of "delayed speech," "multiple articulation errors," "functional articulation disorder" and similar terms suggesting "functional" speech delay of unknown origin (Bankson, 1980).

Analysis Procedures

Phonology. Phonological performance in each of the 30 speech samples was analyzed by means of Shriberg and Kwiatkowski's (1980) procedure for natural process analysis of continuous speech samples. The procedure yields quantitative data on the occurrence of the eight phonological simplification processes found to be most common in children with delayed speech development (Shriberg & Kwiatkowski, 1980): Final Consonant Deletion, Velar Fronting, Stopping, Palatal Fronting, Liquid Simplification, Progressive and Regressive Assimilation, Cluster Reduction, and Unstressed Syllable Deletion. Reliability and validity studies of several types are reported for this analysis procedure in the reference publication, as are all theoretical assumptions underlying coding decisions.

Syntactic measures. Two syntactic measures were calculated for each transcript following procedures described by Miller (1981).[3] Sentence structures in both simple and complex sentences were analyzed with reference to Miller's emergence criterion. Essentially, Miller's emergence criterion for assigning a Sentence Structure Stage (SSS) to a transcript requires locating the highest stage of structural development represented by at least two examples. Stages are identified by comparing sentences in the transcript to normative data. The highest stage that appears twice in the sentence structures in the transcript is considered to be the child's emerging level of structural development, that is, the child's SSS.

The second syntactic measure was the percentage of occurrence in obligatory contexts of the 14 grammatical morphemes studied by Cazden (1968) and de Villiers and de Villiers (1973). As described earlier (see Table 1), Miller (1981) assigned the 14 grammatical morphemes to Brown's stages based on the data presented by de Villiers and de Villiers (1973). For each transcript, the highest stage at which at least one morpheme from that stage was used correctly in 85–90% of its obligatory contexts was considered to be the subject's stage of Overall Grammatical Morpheme development (OGM). One exception to this rule was made. Although none of the morphemes are considered to have been mastered in Stage IV according to Miller's criteria, an OGM stage of IV–V was assigned to a transcript when (a) both Stage III morphemes were 90% correct and (b) some of the Stage V morphemes were 50% correct, but none reached the 85–90% criterion level.

Comparison of SSS and OGM. The SSS for each child was compared to his or her OGM to determine whether there was a difference between sentence structures and overall grammatical development.

The Discrepant Grammatical Morpheme stage (DGM) index. A second comparison among the syntactic measures was made to determine the effect on speech production of phonetically complex morphophonemes. If at least one morpheme one or more stages below the OGM was produced correctly in less than 75% of its obligatory contexts, a discrepancy in morphological use was considered to be present. The stage at which the less frequently realized morpheme appears is labeled the Discrepant Grammatical Morpheme stage (DGM). When such a discrepancy was identified, an analysis of the particular morphemes involved was made to determine whether in fact the missing morphemes were in the phonetically complex group (see Table 1).

Comparison of age and SSS. Because we were interested in the proportion of speech-delayed children who had syntactic delay, we compared age expectations for the subject's stage assignments to each child's chronological age. Chronological ages predicted for stage values in Miller and Chapman's (1981) analysis provided the reference data.[4] When the child's age was more than 1 standard deviation above that predicted by the sentence structure stage according to the Miller and Chapman data, the child's performance was considered delayed.

Reliability. To assess the reliability of all syntactic assignments, a clinician experienced in using modifications of Miller's (1981) procedures independently assigned stages to a randomly selected 17% sample of the transcripts. In cases where a range of two SSS stages was assigned to a transcript by the first judge, an overlap of at least one stage was counted as an agreement. The reliability judge agreed with the criterion judge on 100% of the SSS, DGM, and age expectation assignments.

[3]The term *syntax* is used to include grammatical relations coded at both the morphemic and the sentence levels. Fromkin and Rodman (1974) discussed the difficulties inherent in the traditional distinction between syntax and morphology and argued that syntax often determines the particular phonological realization of morphemes in context. Miller (1981) considered an analysis of the 14 grammatical morphemes to be one component of a syntactic analysis; in our study, too, the morphological analysis is considered to be a member of the set of syntactic analysis procedures.

[4]These data are based on structural stages indexed by mean length of utterance. Because Miller and Chapman's data include children only up to 60 months of age, the data were extrapolated for the older children in the present sample.

RESULTS

Table 2 is a summary of the demographic, phonological, and syntactic data for each of the 30 subjects. Subject numbers were originally assigned by increasing chronological age and are retained here.

Age

The age variable was assessed by testing whether significant age differences were present across all the classification patterns. Kruskall-Wallis nonparametric analysis of variance revealed no significant differences ($p > .25$) between the ages of children classified as Patterns I, II, III, and IV.[5] In this sample, then, age did not covary with the association between phonological and syntactic performance. In fact, two of the oldest children were classified as Pattern I, showing delays across all measures with additional delays in morphological use.

Comparison Among Syntax Measures

Comparison of children's assigned SSS (Table 2) to their OGM stage yielded only four cases in which there was a difference of more than a stage. For these four children (S12, S14, S16, S19), OGM was higher than SSS, indicating morphological development in advance of sentence structures. For the remaining 26 children, there is no evidence of a general morphological delay relative to sentence structure level. In this sample, realization of grammatical morphemes is generally commensurate with, and occasionally in advance of, sentence structure complexity.

A second comparison inspected possible discrepancies in morphological use. Were some speech-delayed children failing to realize correctly some morphophonemes below the OGM? The answer to this question is shown in the third-to-last column in Table 2. Fifty percent of the subjects, classed as Patterns I and II (see below for explication of pattern assignment criteria), had some discrepancy in production of grammatical morphemes. To determine whether those morphemes leading to the discrepancy were in fact the phonetically complex morphemes, the percentage of occurrence of the two types of grammatical morphemes (simple, complex) was examined for each child. Results are shown in Table 3. As shown, children who did have discrepancies in morphological marking (Patterns I and II; see below) were consistently correct on the phonologically simple stage II and III morphemes *(-ing, in, on)* and consistently less correct on the phonetically complex morphophonemes (plural and possessive) at the same syntactic levels. A similar pattern of use is found in the comparison of regular and irregular past tense marking for children classed as Patterns I and II. These subjects, on the average, show a greater discrepancy between regular and irregular past realizations than do children classified in the other patterns. Again, the difference for Pattern I and II subjects is in favor of the phonetically simpler irregular past tense marker.

These findings confirm the prediction that when children show discrepancies in morphological marking, the morphemes most affected are those that are phonetically more complex.

The last comparison concerns the proportion of speech-delayed children who show syntactic delay relative to their chronological age. As shown in the right-most column in Table 2, two-thirds of the subjects, those assigned to Patterns I and III, had lower sentence structure complexity stages than would be expected for their age.

Patterns of Association Between Phonology and Syntax

The results of the comparisons above allowed us to sort the children into four patterns of association between phonological and syntactic performance. Table 4 is a summary of the criteria used. The following discussion describes each pattern in turn and summarizes the prevalence of occurrence data across the 30 subjects.

Pattern I. Nine of the subjects (30%) are characterized as Pattern I based on their linguistic performance on the continuous speech samples. They have a general syntactic delay (see Table 2, right-most column). Additionally, their use of grammatical morphemes that require the addition of phonological segments to the ends of base words (phonetically complex morphophonemes) is more delayed than their sentence structures (see Table 2, third column from right). That is, Pattern I transcripts contain discrepancies in the use of phonetically simple versus complex morphemes. For example, these children often use the articles *a* and *the* and irregular past tense verbs such as *said, came,* and so forth. At the same time, they do not often use morphemes that are at the same or lower stages of morphological development but that complicate the segmental structure of base words, such as plurals and possessives. Phonetically simpler morphemes at the child's general syntactic level are present, while the production of more phonetically complex markers is limited by the use of the natural simplification processes of Final Consonant Deletion and Cluster Reduction. For these children, phonological delay is assumed to interact with the production of certain morphophonemic forms.

Child 1 is an example of a Pattern I speaker (see Table 2 and Table 3 for data described in these examples). Her highest sentence structures in both simple and complex sentences correspond to Brown's early Stage IV (expected age range: 29–47 mos.; Miller, 1981), which represents a significant delay for her age (49 mos.). Her overall use of grammatical morphemes corresponds to this level. She uses irregular past tense correctly 75% of the time and articles are correct in 33% of their obliga-

[5]A nonparametric procedure was used because of the differences in sample size among the groups and the small number of subjects in Patterns II ($n = 6$) and IVa/IVb ($n = 4$).

TABLE 3. Comparison of percentage correct use of simple versus phonetically complex morphophonemes by 30 children with delayed speech.

		Stage II			*Stage III*		*Stage V*					*Stage V+*					
Pattern	*Subject*	*-ing*	*in*	*Plural*[a]	*on*	*Possessive**	*Irregular past*	*Articles*	*Regular past**	*Regular third person singular**	*Contractible copula*	*Uncontractible copula*	*Uncontractible auxiliary*	*Contractible auxiliary*	*Irregular third person singular*	*OGM*	*DGM*
I (n = 9)	1	100	100	67	100	–	75	33	–	0	25	100[b]	–	0	–	IV–V	II
	3	100	100	0	–	–	100	88	17	–	0	–	–	67	100[b]	V	II
	6	100	100	29	100	–	67	0	–	0	0	–	–	0	0	IV–V	II
	12	100	100	0	–	0[b]	–	90	25	21	0	–	–	17	–	V	II
	17	–	100	0	100[b]	–	60	20	–	0	33	–	–	–	0[b]	IV–V	II
	18	100	100	50	100	0[b]	83	92	33	33	50	–	–	27	–	V	II
	26	100	100	0	100	–	100	91	–	0[b]	0[b]	100	–	–	–	V	II
	28	100	100[b]	0[b]	100	–	86	36	–	0	–	0	–	–	–	IV–V	II
	29	100	100	75	100	100	67	95	–	0	0	50	–	50	0	V	II
$\bar{x}$		100	100	24	100	33	80	61	25	7	14	63	–	27	25		
II (n = 6)	7	100	100	71	100	100[b]	–	100	50	100[b]	100	–	–	100	0[b]	V+	II
	11	100	100	100[b]	100	100[b]	100	100	–	100[b]	25	–	–	100[b]	–	V	III
	13	–	100	67	100	–	100	100	100	0	89	100	–	100[b]	–	V+	II
	15	100[b]	100	17	100	0	60	96	33	0	22	–	–	–	0[b]	V	II
	23	100[b]	100[b]	75	100	67	100	100	100	–	0[b]	100[b]	–	–	–	V	II
	30	100	100	20	100	33	23	79	50	0	77	–	–	0[b]	0	IV–V	II
$\bar{x}$		100	100	58	100	40	77	96	67	40	52	100	–	75	0		
III (n = 11)	2	100	100[b]	100	80	–	67	100	–	0	33	100	100	60	–	V+	V
	4	100	100	100	100	–	80	90	50	50	88	–	–	13	–	V	V
	5	100	100	100	83	–	20	61	100[b]	20	33	100	100	18	0[b]	IV–V	IV–V
	8	100	100	100	100	–	–	85	–	0	0[b]	–	–	0[b]	–	IV–V	IV–V
	10	100	–	0[b]	100	–	–	83	100	50	100	–	–	0	–	V	V
	14	100	–	100	100	100[b]	100	100[b]	0[b]	–	100[b]	100[b]	100	67	50	V+	V
	16	100	100	80	100	–	50	86	40	14	100	100[b]	–	40	–	V	IV
	19	100	100	92	100	–	0	60	0[b]	0	50	–	–	–	–	IV–V	IV–V
	20	–	100[b]	33	–	–	–	–	–	0[b]	0[b]	–	–	–	–	II	II
	22	100	100	100	100	–	60	54	–	0	0[b]	–	–	33	–	IV–V	IV–V
	24	100	100	100	–	100[b]	100	94	100	0	100	–	–	29	–	V	V
$\bar{x}$		100	100	83	96	100	60	81	56	13	55	100	100	29	25		
IVa (n = 2)	21	100	100	100	100	100[b]	100	79	83	0[b]	100[b]	–	–	87	–	V	V
	27	100	100	100	100	–	100	91	100	100	100	100[b]	–	100	50	V+	V+
$\bar{x}$		100	100	100	100	100	100	85	92	50	100	100	–	94	50		
IVb (n = 2)	9	100	100	100	100	–	89	100	100	100	100	100[b]	–	100	–	V+	V+
	25	100	100	100	100	100[b]	100	92	100	100	100	–	–	20	0[b]	V	V
$\bar{x}$		100	100	100	100	100	95	96	100	100	100	100	–	60	0		

Note. No instance of obligatory context.

[a]Morphemes that usually involve the addition of a segment to a base word, that is, phonetically complex morphemes.

[b]Only one instance of obligatory context occurred in the speech sample (if a 1/1 case was the *only* instance of a morpheme reaching criterion at a given stage, that stage was not assigned as OGM or DGM).

tory contexts. The only phonetically complex Stage V morpheme for which her transcript has a context is the regular third person singular, and she never uses that morpheme correctly. Plurals, which were placed at Stage II, are correct only 67% of the time. However, the phonetically simple Stage II and III morphemes, *in*, *on*, and *-ing*, are always used correctly. This child's use of phonetically complex morphemes is delayed even further than is her overall syntactic performance.

Pattern II. Six of the children (20%) whose transcripts can be classified as Pattern II do not exhibit general syntactic delay, as indexed by their sentence structures. However, as in Pattern I, there is evidence in the transcripts of the effects of phonological simplification processes on certain morphophonemic forms. Again, those forms that require the addition of consonant segments to base stems are less often realized than are forms that simply change vowels. In Pattern II transcripts, phonetically complex morphemes at lower stages of otherwise age-appropriate syntax are likely to be absent.

Child 13 (CA: 64 mos.) serves as an example of Pattern II speech. He uses sentence structures that correspond

TABLE 4. Patterns of association between phonology and syntax and their proportion of occurrence in 30 children with delayed speech.

Patterns	SSS delayed re CA	Discrepancy in morphological use[a]	CR used[b] word-final position	Subjects classified n	%
I	Yes	Yes	–	9	30
II	No	Yes	–	6	20
III	Yes	No	–	11	36
IVa	No	No	No	2	7
IVb	No	No	Yes	2	7

Note. SSS = Sentence Structure Stage; CR = Cluster Reduction.
[a]One or more morphemes at or below the overall level of morphological production is less than 75% correct.
[b]Used more than twice.

to late Stage V to post-Stage V (expected age range: 41 to over 60 mos.; Miller, 1981). His use of articles and irregular past tense is consistently correct. However, third person singular, the other Stage V morpheme for which his transcript includes contexts, is never marked. Similarly, his use of the Stage II–III phonetically simple morphemes, *in, on,* and *-ing,* is correct 100% of the time. The plural marker, which adds a segment to the base word, however, is marked only 67% of the time.

Like Pattern I children, children in Pattern II seem to exhibit an interaction between phonological and syntactic production. That is, phonological constraints appear to operate on the realization of certain grammatical morphophonemes. Pattern I children's phonological simplifications are associated with morphophonemic delays even greater than their delays in sentence structures. For Pattern II children, these constraints indicate only a problem in productive morphology.

Pattern III. Eleven children (36%) whose transcripts can be classified as Pattern III have an overall delay in syntax. In contrast to Pattern I, however, their delays in grammatical morpheme realization are no greater than their delays in the other syntactic domains. That is, sentence structures and the use of the 14 grammatical morphemes are delayed with reference to age, but these syntactic parameters are consistent among themselves. These children may also evidence the natural processes of Final Consonant Deletion and Cluster Reduction, but their delays in production of grammatical forms can not be attributed solely to these phonological constraints. Phonological delay and syntactic delay are both present but appear to be noninteractive.

Child 2 (CA: 52 mos.) exemplifies Pattern III. His use of sentence structures is below age expectations (predicted age range: 32–49 mos.; Miller, 1981). He does use Cluster Reduction in his speech, yet his production of plural forms, such as *pigs,* is correct 100% of the time. This child is able to produce some complex morphophonemes at the same level as his overall syntactic development, even though the overall level represents a delay relative to his age.

Pattern IV. Four children (14%) initially classified as Pattern IV do not appear to have a syntactic delay in any area. Their production of grammatical morphemes is at the same age-appropriate level as their use of sentence structures.

Because children who evidence Final Consonant Deletion and Cluster Reduction might be expected to simplify at least some final segments of words, including morphophonemic segments, an additional question was asked to differentiate Pattern IVa transcripts from what was to become Pattern IVb. If in word final position a child used one or more of the six natural processes other than Final Consonant Deletion and Cluster Reduction, and if that child used these latter processes only rarely (less than three times in a speech sample), the transcript was classified as Pattern IVa. Note that the six processes other than Final Consonant Deletion and Cluster Reduction, such as Liquid Simplification (deletions or substitutions for /l/ and /r/) and Velar Fronting (t/k, d/g), would not be expected to affect morphological segments because /l/, /r/, /k/, and /g/ are not used as grammatical markers. Technically, Stopping (substitutions of stops for fricatives) does affect the realization of /s/ and /z/ phonemes, which are frequently used as grammatical markers (e.g., plurals, possessives, third person singular). However, unlike Final Consonant Deletion or Cluster Reduction—processes that remove phonemes from the word—Stopping of /s/ and /z/ by definition yields a stop, generally /t/ and /d/, respectively. These substitutions in a transcript can be read as evidence that a segment has been added to mark a grammatical morpheme. For example, the utterance [ʃud] in context can be glossed as *shoes.* The child in this case can be given credit for adding a plural marker even though that marker has been phonologically simplified. Note, however, that [ʃu] in a context requiring a plural does not provide evidence that the child has an underlying plural marker that underwent Final Consonant Deletion (although vowel length might allow this inference in some transcriptions). In this latter case, credit for use of plurals could not be given.

The two children (7%) with age-appropriate syntax who rarely evidenced Final Consonant Deletion or Cluster Reduction are characterized as Pattern IVa. These children do not seem to evidence an interaction between their phonological delay and their normal syntax. Child 27 (CA: 83 mos.) provides an example of a Pattern IVa speaker. Her sentence structures are commensurate with late Stage V (expected age range: 41 to over 60 mos.; Miller, 1981). She never uses Final Consonant Deletion and reduces only one of her word-final clusters. Her use of all 14 grammatical morphemes is nearly 100% correct, including her use of plurals, regular past tense, and regular third person singular markers. The main processes she uses, Liquid Simplification and Palatal Fronting, do not interfere with her production of grammatical morphemes.

Two other children (7%) whose syntax was age-appropriate, but who evidenced some use of Cluster Reduction in final position were designated Pattern IVb. As

discussed previously, the use of Cluster Reduction would be expected to interfere with the realization of at least some morphophonemic segments. Yet for two subjects in this sample, this was not the case. That is, these children reduced some clusters at the ends of words but never when final clusters functioned as grammatical markers. (Because of limitations in the transcripts, we do not have evidence on the differential treatment of particular clusters in grammatical morphemes as opposed to monomorphemic contexts, e.g., [ks] in *books* vs. *box*.) These children's phonological behaviors interact with their syntax, but in a different way from that described for the other patterns. These children have "suppressed" their simplification processes in the morphemes in question (Stampe, 1973). This suppression may not be necessary to communicate semantic information, because grammatical morphemes are often redundant in context *(two books)* and the child has managed to communicate the meaning before without any marker *(mommy shoe)*. Some other morphemes, such as third person singular, are strictly syntactic and do not have any semantic value. Hence, simplification processes seem to be suppressed by these children primarily in cases where "getting it right" requires marking the grammatical relationship that is marked in the adult language. Smith (1973) made a similar point in his discussion of his son Amahl's realizations of /z/ (p. 67-70).

Child 9 (CA: 64 mos.) provides an example of a Pattern IVb transcript. His sentence structures are age-appropriate at post-Stage V (expected age range: 41 to over 60 mos.; Miller, 1981). He never uses Final Consonant Deletion, but he uses Cluster Reduction 50% of the time in nongrammatical contexts. Yet in the context of the grammatical morphemes, he never reduces final clusters. Each of the grammatical markers is correct nearly 100% of the time.

Proportion of Occurrence of Phonology/Syntax Interactions

The proportional data from the four major patterns can be combined in different ways to address several questions.

First, what proportion of these speech-delayed children also have delays in sentence structure use? Thirty percent of the sample display the pattern of interaction between phonological process use and productive syntax described as Pattern I. Moreover, an additional 36% of the sample were classified as Pattern III. Pattern III children have delayed syntax as well, but their phonological simplifying processes are not associated with an additional delay in morphology. Taken together, Patterns I and III account for 67% or two-thirds of the sample. This proportion estimates the population of speech-delayed children who also exhibit syntactic delays in the form of simplified sentence structures in spontaneous speech.

An alternative summary statistic addresses the question, What proportion of children have phonological delays that interact with the morphological component of syntax? Those classified as Pattern II, 20% of the sample, have age-appropriate syntax but delays in some grammatical morphemes. As pointed out in the discussion of the Pattern I children, these delays in morphology were deductively related to children's use of the phonological simplifying processes of Final Consonant Deletion and Cluster Reduction. The Pattern I and Pattern II proportions taken together yield a statistic of 50% or half the children in this sample whose productive use of some grammatical morphemes is limited because of phonological simplifying processes.

Finally, what percentage of children with phonological delay have no delays in either area of syntax, sentence structure or grammatical morphemes? The answer to this question is provided in the sum of Patterns IVa and IVb, which is 14%. Pattern IVa children, who comprise 7% of the sample, do not use phonological simplifying processes that would affect the realization of grammatical morphemes. Pattern IVb children (7%) do use these processes, but not when the consonant clusters serve as grammatical markers.

DISCUSSION

Prevalence of Syntactic Delay in Speech-Delayed Children

Consistent with previous studies, the current investigation also found that some children with delayed speech have delays in sentence complexity. Two-thirds (67%) of the sample, children classified as Patterns I and III, show syntactic delays that are independent of their phonological deficits. These results support earlier findings (Shriner et al., 1969; Van Demark & Mann, 1965; Williams et al., 1937) of moderate association between speech delays and delays in complexity of sentence structures in productive language. Although an additional 20% of the sample (those in Pattern II) have restricted use of morphological markers, their syntactic deficit appears to be directly attributable to phonological simplifications that delete and reduce those final consonants and consonant clusters that serve as morphophonemic segments. Hence apparent morphological delays in this latter 20% can be considered a product rather than a concomitant of their speech problem.

These data also provide information on whether specific morphophonemic delay occurs in children with developmental speech delay. The consistent agreement found in these speech samples between assigned SSS and OGM stage indicates that morphophonemic development appears to be proceeding in this population much as it does in normally speaking children. That is, children's acquisition of grammatical morphemes is generally consistent with sentence structure development. These data suggest that for speech-delayed children whose syntactic development is below age expectations, overall morphophonemic development will be no worse. Only on those markers that attach segments to base

words, such as plurals, possessives, and regular past tense, will some children (in this sample, 50% in Patterns I and II) perform below their general syntactic level.

In summary, these data support the notion that among children with speech delays 86% are likely also to have delays in productive syntax. Of the sample, 66% have syntactic delay attributable to phonological deficit, while an additional 20% have restricted use only of those morphophonemic segments that complicate the phonetic structure of words. For these latter children, it can be deduced that the additional delay is the direct outcome of phonological simplifications.

Effect of Syntactic Complexity on Phonological Production

If Panagos et al. (1979) were correct that grammatical complexity causes simplifications as a result of a general limitation in encoding capacity, the use of simplification processes should impair the realization of complex morphophonemes beyond any overall syntactic delay. Patterns I and II of the present typology (50%) support Panagos et al.'s claim. The performance of children with these patterns can be explained by the limited organizational capacity model. When demands for both phonological and syntactic complexity converge in grammatical morpheme production, these children do tend to simplify. Whether this simplification takes place at the syntactic or phonological level of encoding is, of course, unknown.

For children comprising the remaining 50% of the sample, however, other kinds of interactions appear to be taking place. Pattern III speech samples indicate a general delay, with no additional problems in encoding grammatical morphemes. If hierarchical complexity limits output, these children would be expected to be poorer in the realization of phonetically complex grammatical morphemes than in their use of sentence structures—as are their counterparts classified as Pattern I. Pattern III children, however, seem to find the resources to encode grammatical morphemes at the same level as their sentence structures. Although their overall delay in syntactic production may be the result of a system limited in encoding capacity, the exact points at which the system will simplify output are not easily predicted in terms of sentence or word complexity in free speech.

Pattern IVa and IVb children pose an even greater problem for the limited encoding capacity model of phonological disorders. These children do not provide evidence of syntactic delay or impairment of morphological realizations. The two children classified as Pattern IVb have adequate performance on grammatical morphemes despite the use of final cluster reduction in some nongrammatical contexts in the transcript.

These findings lead to the conclusion that while some speech-delayed children can be characterized as limited in encoding capacity for linguistic units (50% in this sample), this conception is not supported for all children with phonological disorders. Some children appear capable of making their surface forms for phonetically complex morphemes match their underlying level of syntactic competence. That is, these children seem to be able to upgrade their articulation when their grammatical competence requires it.

Age and Severity of Phonological Delay Considerations

Aram and Nation (1975) found chronological age to be related to the patterns of language disorders they obtained in a factor analytic study. Older children tended to have less involvement in the overall language system and to have deficits specific to phonology. As young children grew out of their language problems, articulation deficits appeared to be the last to resolve. Similarly, several of the studies cited earlier found that correlations between phonology and syntax measures tended to decrease with age. Results of the present study, in contrast, indicate that associations between phonological and syntactic performance do not covary with age.

One important difference in subject characteristics between the present study and other studies concerns severity of phonological delay. Earlier studies classified children based on articulation test performance. Any child showing a criterion number of errors or scoring more than 1 standard deviation below the mean for the test was considered disordered. This criterion could result in the inclusion of children with relatively mild articulation problems. The children in the current sample, however, were included on the basis of their use of one or more of the natural simplification processes described by Shriberg and Kwiatkowski (1980). This criterion results in the exclusion of children with only phonetic distortions, for example, dentalized /s/, derhotacized /r/. Assumedly, the phonemic level of phonological processing (phoneme deletions and/or phoneme substitutions) interacts more with syntactic demands than does lower-level phonetic processing. Support for this view is provided in recent studies by Cohen (1978), Lybolt (1979), and Mulroy and Hoffman (1979), which found that syntactic complexity has little effect on correct versus distorted sibilant production.

Clinical Implications

We can offer only preliminary comment on possible clinical implications of the four phonology/syntax patterns in children with delayed speech.

Children whose morphological performance shows no lag relative to sentence structure development (Patterns III, IVa, and IVb) should improve most efficiently in a comprehensive speech/language management program. As discussed, such children seem able to upgrade their phonetic accuracy to the level of their syntactic development. That development can be expanded through

remedial programming. Included as targets for phonological management should be forms with morphological markers at the same level as the child's sentence structures. In this way, both the competency base and the encoding capacity would be strengthened. However, this observation is not meant to suggest, as did Methany and Panagos (1978), that syntactic therapy alone will improve articulation for this group. It is hypothesized that remedial programs that attempt to expand sentence structures and provide practice in encoding grammatical morphemes would make use of the capacity these children already display for integrating their linguistic competencies and would help them maximize their performance.

For those children characterized by Pattern I and Pattern II performance, more traditional speech therapy techniques may be appropriate. Because these children do appear to be limited in general encoding capacity, their output would probably break down if they were to embed complex phonological targets in complex sentence frames. Although Pattern I children may require remedial programs for syntax, they will probably need to work on strengthening phonological production in less demanding contexts. For these children too, it may be appropriate to include as target forms those morphological markers at or below the child's general syntactic level. In this way, as articulation improves, morphological production can keep pace.

CONCLUSION

In summary, this study has examined relations between phonological and syntactic production in 30 speech-delayed children. We attempted to evaluate a theory of speech delay proposed by Panagos et al. (1979) that developmental speech delays are consequent to a general limitation in encoding capacity. Empirical support for the prevalence of at least four patterns of responses to complex encoding tasks leads us to conclude that the limited encoding capacity construct is not sufficient to explain developmental speech delays. A theoretical view that can account for all deficits observed in this clinical population has yet to emerge.

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REFERENCE NOTE

1. PAUL, R., CAMPBELL, T., & SHRIBERG, L. *Effects of linguistic variables on phonological simplifications in speech-delayed children.* Unpublished working paper, University of Wisconsin–Madison, 1979.

REFERENCES

ARAM, D., & NATION, J. Patterns of language behavior in children with developmental language disorders. *Journal of Speech and Hearing Research,* 1975, *18,* 229-241.

BANKSON, N. *Whatever happened to functional articulation disorders?* Paper presented at the American Speech-Language-Hearing Association Annual Convention, Detroit, 1980.

BEILIN, H. *Studies in the cognitive basis of language development.* New York: Academic Press, 1975.

BROWN, R. *A first language.* Cambridge, MA: Harvard University Press, 1973.

CAZDEN, C. The acquisition of noun and verb inflections. *Child Development,* 1968, 29, 433-438.

COHEN, G. *The effects of linguistic and cognitive variables on /s/ productions in children with inconsistent /s/ articulation.* Unpublished doctoral dissertation, Memphis State University, 1978.

DAVIS, E. The development of linguistic skills in twins, singletons with siblings, and only children from age five to ten years. *Institute of Child Welfare Monograph Series, No. 14.* Minneapolis: University of Minnesota Press, 1937.

DE VILLIERS, J., & DE VILLIERS, P. A cross-sectional study of the acquisition of grammatical morphemes. *Journal of Psycholinguistic Research,* 1973, *2,* 267-278.

DE VILLIERS, P., & DE VILLIERS, J. *Simplifying phonological processes in the one- and two-word stage.* Paper presented at the Boston University Conference on Child Language Development, 1978.

FAIRCLOTH, M., & FAIRCLOTH, S. An analysis of the articulatory behavior of a speech defective child in connected speech and isolated word responses. *Journal of Speech and Hearing Disorders,* 1970, 35, 51-61.

FROMKIN, V., & RODMAN, R. *An introduction to language.* New York: Holt, Rinehart & Winston, 1974.

HOOD, L., & LIGHTBOWN, P. What children do when asked to "Say what I say": Does elicited imitation measure linguistic knowledge? *Allied Health and Behavioral Sciences,* 1978, *1,* 195-214.

INGRAM, D. *Phonological disability in children.* New York: Elsevier, 1976.

LYBOLT, J. *Phonemic and morphophonemic productions in normal-speaking and speech-language-impaired children.* Paper presented at the Annual Convention of the American Speech-Language-Hearing Association, Atlanta, 1979.

MARQUARDT, T., & SAXMAN, J. Language comprehension and auditory discrimination in articulation deficient kindergarten children. *Journal of Speech and Hearing Research,* 1972, *15,* 382-389.

MENYUK, P. Comparison of grammar of children with functionally deviant and normal speech. *Journal of Speech and Hearing Research,* 1969, 7, 109-121.

MENYUK, P., & LOONEY, P. Relationships among components of the grammar in language disorder. *Journal of Speech and Hearing Research,* 1972, *15,* 395-407.

METHANY, N., & PANAGOS, J. Comparing the effects of articulation and syntax programs on syntax and articulation improvement. *Language, Speech, and Hearing Services in Schools,* 1978, *9,* 57-61.

MILLER, J. *Assessing children's language production: Experimental procedures.* Baltimore: University Park Press, 1981.

MILLER, J., & CHAPMAN, R. The relation between age and mean length of utterance in morphemes. *Journal of Speech and Hearing Research,* 1981, *24,* 154-161.

MOORE, T., & HARRIS, A. Language and thought in Piagetian theory. In L. Siegel & C. Brainard (Eds.), *Alternatives to Piaget.* New York: Academic Press, 1978.

MULROY, E., & HOFFMAN, P. *Effect of syntactic complexity upon /s/ misarticulation.* Paper presented at the Annual Convention of the American Speech-Language-Hearing Association, Atlanta, 1979.

PANAGOS, J. String complexity increases phonemic interference. *Perceptual and Motor Skills*, 1974, 38, 1219-1222.

PANAGOS, J., QUINE, M., & KLICH, R. Syntactic and phonological influences on children's articulation. *Journal of Speech and Hearing Research*, 1979, 22, 841-848.

SAXMAN, J., & MILLER, J. Short term memory and language skills in articulation deficient children. *Journal of Speech and Hearing Research*, 1973, *16*, 721-730.

SCHMAUCH, V., PANAGOS, J., & KLICH, R. Syntax influences the accuracy of consonant production in language-disordered children. *Journal of Communication Disorders*, 1978, *11*, 315-323.

SCHNEIDERMAN, N. A study of the relationship between articulation ability and language ability. *Journal of Speech and Hearing Disorders*, 1955, *20*, 359-364.

SHRIBERG, L., & KWIATKOWSKI, J. *Natural process analysis (NPA): A procedure for phonological analysis of continuous speech samples*. New York: Wiley & Sons, 1980.

SHRIBERG, L., & KWIATKOWSKI, J. Phonological disorders I: A diagnostic classification system. *Journal of Speech and Hearing Disorders*, 1982, *47*, 226-241.

SHRINER, T., HOLLOWAY, M., & DANILOFF, R. The relationship between articulation deficits and syntax in speech defective children. *Journal of Speech and Hearing Research*, 1969, *12*, 319-325.

SLOBIN, D. (Ed.). *The ontogenesis of grammar: A theoretical symposium*. New York: Academic Press, 1971.

SMITH, N. *The acquisition of phonology: A case study*. London: Cambridge University Press, 1973.

STAMPE, D. *A dissertation on natural phonology*. Unpublished doctoral dissertation, University of Chicago, 1973.

TEMPLIN, M. Certain language skills in children. *Institute of Child Welfare Monograph Series, No. 26*. Minneapolis: University of Minnesota Press, 1957.

VAN DEMARK, A., & MANN, M. Oral skills of children with defective articulation. *Journal of Speech and Hearing Research*, 1965, *8*, 409-419.

WHITACRE, I., LUPER, H., & POLLIO, H. General deficits in children with articulation problems. *Language and Speech*, 1970, *13*, 231-239.

WILLIAMS, A., MCFARLAND, M., & LITTLE, M. Development of language and vocabulary in young children. *University of Iowa Studies in Child Welfare*, 1937, *13*, 9-18.

WINITZ, H. Language skills of male and female kindergarten children. *Journal of Speech and Hearing Research*, 1959, 2, 377-386.

WINITZ, H. *Articulatory acquisition and behavior*. Englewood Cliffs, NJ: Prentice-Hall, 1969.

YEDINAK, J. A study of the linguistic functioning of children with articulation and reading disabilities. *Journal of Genetic Psychology*, 1949, *74*, 23-59.

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