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ASSOCIATIONS AMONG PRAGMATIC FUNCTIONS, LINGUISTIC STRESS, AND NATURAL PHONOLOGICAL PROCESSES IN SPEECH-DELAYED CHILDREN

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Pragmatic function and level of linguistic stress were studied as they relate to variability in phonological performance. Natural phonological process analysis was performed on the discourse topic and the discourse comment in the conversational speech of five speech-delayed children. Level of linguistic stress for discourse function was coded by trained judges. Results indicated that both the type of pragmatic function and the level of linguistic stress were associated with reduction in the occurrence of natural phonological processes.

Variability in phonological performance has been studied from a number of perspectives. The influence of phonetic context on speech sound production has been well documented (e.g., Gallagher & Shriner, 1975a, 1975b; Kent & Minifie, 1977). Syntactic variables also have been related to phonological performance in normal and speech-delayed children (Menyuk, 1969; Panagos, Quine, & Klich, 1979; Paul & Shriberg, 1982; Panagos, Kelleher, & Klich, Note 2). Linguistic stress, however, has not been studied as it relates specifically to phonological variability, and only a few studies have focused on the contribution of pragmatic factors.

The available data on pragmatic variables indicate

their importance for speech performance. For example, three studies in which the subjects thought they were not being understood suggest that informational demands influence phonological performance. Longhurst and Siegel (1973) studied the speech of normal-speaking adults attempting to be understood under adverse conditions. Each subject was instructed to provide listeners with information necessary to complete a specific task. Analysis of the subjects' speech indicated that speaking rate decreased and the information provided became more elaborate as the speakers sought to overcome obstacles in their attempt to be informative. Longhurst and Siegel noted that in order to be understood, speakers

used more effort and tried alternative speaking conventions, such as providing longer descriptions, speaking more slowly and using more redundant speech.

Gallagher (1977) examined the speech behaviors that occurred when normal-speaking children thought they were not being understood. During the collection of continuous speech samples, Gallagher and her associates intermittently asked individual children the question, "What?". As was the case in Longhurst and Siegel's investigation, the subjects frequently revised the linguistic form of their message, including phonetic revisions, when they thought they were not being understood.

Weiner and Ostrowski (1979) asked 15 speech-delayed preschoolers to name 45 pictures that contained their error sounds. Following each production the clinician asked the child, "Did you say (picture name)?" and then the clinician produced the picture name in one of three conditions. In the first condition the specific picture name was produced correctly; in a second condition the clinician gave an exact imitation of the child's error; in a third condition the clinician produced a misarticulation that was different from the child's error. Children responded by saying "yes (or no)" and "I said (picture name)." The frequency of sound errors decreased significantly when the clinician pretended to be uncertain of what the child said.

These few studies suggest that informational or pragmatic variables may be associated with sound production in normal speakers and in speech-delayed children. Chafe (1970) and Bates and MacWhinney (1979) described two pragmatic functions that typically carry unequal information values within an utterance. The *comment* is associated with the newest, most informative aspect and usually takes the form of the predicate in the utterance. The *topic* carries less information than the comment because it is information that has already been shared with the listener and is often associated with the subject of the utterance. This comment-topic distinction has also been described as a discourse rather than an utterance notion (Chafe, 1972; Li & Thompson, 1975; Keenan & Schieffelin, Note 1). The new information is the discourse comment; the discourse topic refers to the proposition(s) about which an individual is either providing or requesting new information (Keenan & Schieffelin, Note 1). The important feature of this expanded comment-topic definition is that it allows for two or more utterances to share the same discourse topic rather than specifying a new topic for each utterance. For children with delayed speech, differences in the informativeness of discourse comments and discourse topics could be one factor underlying variability of phonological performance.

Linguistic stress is another factor that may contribute to phonological variability. Öhman (1967) posited that an additional amount of physiological energy is expended throughout the speech system during production of stressed syllables, that is, that "extra effort" is used to obtain the desired articulatory target. Kent and Netsell (1971) used cinefluorography to study such changes in the supraglottal musculature during production of

stressed contrasts. They concluded that for both vowels and consonants, stress is associated with changes in the position of the tongue body "in the direction of the presumed articulatory target" (p. 42). According to Kent and Netsell, such data support the view that increases in stress are related to increases in the muscular activity of the peripheral speech mechanism.

Other researchers have demonstrated that stressed syllables differ from those that are unstressed along three parameters: overall intensity (Fry, 1955; Lieberman, 1967; McClean & Tiffany, 1973); fundamental frequency (Gay, 1978; Lieberman, 1967); and duration (Fry, 1955; Oller, 1973; Weismer & Ingrisano, 1979). Among these three acoustic variables, the duration parameter is of particular interest in the present study. Klatt (1975) determined that an average stressed English vowel was 132 msec in duration, whereas unstressed vowels on the average were 70 msec in duration. Hence, stressed vowels are on the average 90% longer than unstressed vowels. Other researchers (Delattre, 1966; Lehiste, 1975; Parmenter & Treviño, 1935; Smith, 1978) also have reported duration increases for stressed vowels ranging from 37% to 90%, depending on the age of the subject, quality of the vowel, and type of speech sample. Few data are available on consonant duration as a function of stress. Based on data from one speaker's spontaneous reading, Umeda (1977) reported that the closure time or overall duration for some consonants (/p/, /b/, /f/) is longer following stressed vowels than following unstressed vowels. While there is reason to believe that these increases in phoneme duration may be learned linguistic behaviors rather than a function of physiological factors (Lehiste, 1970), they may have physiological consequences with implications for variability; that is, temporal factors may influence suprasegmental specification.

The literature also suggests that there are complex interrelationships among pragmatic and suprasegmental variables. Bolinger (1958) contended that the assignment of primary stress within an utterance is determined by the amount of information carried by a lexical item. He stated (1972) "accented words are points of information focus" (p. 633) and "the distribution of sentence accents is not determined by syntactic structure but by semantic and emotional highlighting" (p. 644). Umeda examined consonant durations in content words, which usually carry important information in the utterance, and in function words, which carry less information and are easy to guess from the context. Umeda found that in the word-initial stressed position, content words were as much as 40 msec longer than function words.

These findings on the amount of information carried by a lexical item and the degree of stress assigned that item may be associated with variability of phonological production in children. Data presented by Hornby and Hass (1970) indicate that preschool children stress the newest, most informative element of the utterance. Because stressed syllables appear to carry the main semantic/pragmatic content of the discourse, children as well as adults may articulate these lexical units with considerably more care than they do unstressed items.

The purpose of the present study was threefold. First, because of the difference in the degree of informativeness inherent in comments and topics, data were collected to determine whether children with delayed speech differ in their use of four natural phonological processes during spontaneous production of these two pragmatic functions. Second, the effect of two types of linguistic stress, independent of pragmatic function, on correct phoneme production was inspected. Third, the combined effect of pragmatic function and linguistic stress on natural phonological process was assessed. Overall, our purpose in this study was to test a hypothesis suggested in the previous literature review: Do speech-delayed children have fewer phonological simplifications when they produce new information (comments) with greater stress?

METHOD

Subjects

Subjects were five children (four boys, one girl) with delayed speech, who have been followed in a longitudinal study of natural process dissolution (Shriberg & Kwiatkowski, Note 3). Transcripts used for the present study were obtained from speech samples taken when the subjects were aged 4:9–6:7, with a mean age of 5:10. All children were attending preschool or elementary school and were receiving speech therapy at the time of sampling. None of the children presented any known oral-motor, hearing, or intellectual deficit, as determined by oral-peripheral examination, hearing screening, and teacher-clinician estimate, respectively.

Delayed speech has been proposed as a classificatory term by Shriberg and Kwiatkowski (1982). Essentially, children with delayed speech continue to use phonological processes characteristic of Stage III of speech development (Ingram, 1976) beyond expectations for their chronological age. In contrast, children with *residual articulation errors* have yet to complete their phonetic inventory, which is characteristic of Ingram's Stage IV. Neither term makes assumptions about etiological loci for so-called "functional" delay (Bankson, 1980). The term *natural process dissolution* follows from Stampe's (1973) conception of speech development. We currently favor a related view, that normal speech development and improvement in speech therapy reflect increasing cognitive constraints on speech output. The child's surface forms eventually match his or her assumedly adult-like underlying forms due to the dissolution of natural phonological processes. Precise description of dissolution within each process and eventual understanding of pragmatic factors that motivate dissolution are long-term research goals related to the present study.

Procedures

PHONOLOGICAL PROCESS ANALYSIS

Four 15-min continuous speech samples were

analyzed for each child. Speech samples had been recorded on a Nagra III audiotape recorder with an Electro Voice 601 microphone. Samples were obtained over an 18-month period, with an interval of approximately 4 months between each recording period. At each session, held in a speech clinic, the same examiner conversed with the child to obtain 110–150 spontaneous utterances. Conversation centered on home and school activities as well as activities suggested by toys and pictures.

All monosyllabic nouns, pronouns, and verbs from each transcript were phonetically transcribed and entered for coding if they contained one of nine singleton target phonemes: /f/, /v/, /s/, /z/, /ʃ/, /tʃ/, /dʒ/, /k/ or /g/. These phonemes were selected for analysis because each was in the variable stage of production for these children, defined as being produced correctly on 20–85% of occurrences. To control for structural and morphophonemic effects, words containing nontarget clusters or targets that carried morphological functions (e.g., plurality) were not included in the analysis. Across the five subjects the mean percentage of correct occurrence of the nine phonemes ranged from 46 to 78% with an overall mean of 62%.

A natural process analysis was performed on the 412 words (approximately 80 words per child) that met the above criteria, following a procedure described by Shriberg and Kwiatkowski (1980). The four natural phonological processes relevant for the nine phonemes of interest were Final Consonant Deletion, Stopping, Palatal Fronting and Velar Fronting. Complete coding rules and rationale are provided in Shriberg and Kwiatkowski (1980). Briefly, target words were coded as indicating one or more of the four phonological processes as follows: *Final Consonant Deletion* was coded if any one of the nine target phonemes was deleted in the final position of topics and comments, for example, [kæ] for *cat*. *Stopping* was coded if /f/, /v/, /s/, /z/, /ʃ/, /tʃ/, or /dʒ/ was replaced by any phonemic stop, for example, [tōp] for *soap*. *Palatal Fronting* was coded if /ʃ/, /tʃ/, or /dʒ/ was replaced by any more anterior phoneme, for example, [θu] for *shoe*. *Velar Fronting* was coded if /k/ or /g/ was replaced by /t/ or /d/, for example, [ti] for *key*.

Reliability assessment. The tape recorded speech samples had been phonetically transcribed for the Shriberg and Kwiatkowski study (Note 3) by a speech-language pathologist with considerable experience in narrow phonetic transcription. The transcriber was naive to all questions in the present study. To determine reliability for broad phonemic transcription of the words in the study, the first author phonetically transcribed 41 of the target words (9 topics, 32 comments) randomly selected from the transcripts of two of the five children. Whole-word agreement between the original transcriber and the first author for these 41 words (10% of the total sample) was 87%.

PRAGMATIC FUNCTION ANALYSIS

The first author and an experienced speech-language pathologist made independent judgments of the pragma-

tic function of each word in the discourse. Approximately 206 words were judged by each clinician. The pragmatic functions of interest in this paper were discourse topic and discourse comment. Crystal's (1980) definition of *discourse* as a "continuous stretch of (especially spoken) language larger than a sentence" (p. 114) was used to determine pragmatic function. Topics and comments were defined in relation to the discourse rather than the sentence (Keenan & Schieffelin, 1976). This decision was particularly appropriate because the children often did not use complete sentences. The *discourse topic*, in the present context, was defined as the presupposed or old information. The *discourse comment* was defined as the newest, most informative aspect of the discourse. For example, for one child who was talking about going different places the word *go* was a discourse topic in the sentence "I don't go on the bus." Going places remained the topic until the topic changed to the child's family. In the sentence "and we all go and eat breakfast" *we* became the discourse topic and *go* became a comment because it described what the family was doing. In the present study there was only one topic per discourse. Other words (nouns, pronouns, or verbs) produced within the discourse were considered comments on the topic. Seldom was the same word used as both a topic and a comment in the same sample, and there were no cases of repeated productions of a topic within the same discourse. Because children assumed rather than restated the discourse topic, only 19% or 79 of the target words were topics, whereas 81% or 333 target words were comments.

Reliability assessment. From the original tapes 40 words were selected randomly for categorical assignment as part of the discourse topic or comment. Each word was categorized by the first author and an experienced language clinician. Interjudge agreement was 97%. For an estimate of intrajudge agreement, these same 40 words were categorized again by both clinicians at a later date. Intrajudge agreement for both clinicians was 93%.

STRESS TYPE ANALYSIS

To obtain ratings of linguistic stress, a tape containing 71 topics and 305 comments was constructed from 20 original tapes. Topics and comments were embedded in utterances ranging from two to nine words in length. All the words in the pragmatic analysis were included in this second (stress) analysis, with the exception of 36 single word utterances. Dubbing and editing of utterances containing these topics and comments from the original 20 tapes onto the experimental tape was accomplished by feeding the output of a Sony TC-270 audiotape recorder into a Crown 800 audiotape recorder.

Training Session. Two speech-language pathologists with experience in listening studies were trained to determine the type of stress used during production of topics and comments. During a 1-hour training session, definitions and examples of two types of stress were presented to each judge. The two stress classifications used were primary stress and nonprimary stress. *Primary*

stress was defined as the strongest word in a spoken utterance. Words produced with primary stress differed from words produced with nonprimary stress in one or all of the following suprasegmental characteristics: greater loudness, higher pitch, and increased length. *Nonprimary stress* was defined as any stress type that is not primary, including secondary, tertiary, and minimal stress types. A training tape consisting of 12 utterances, totaling 67 words, was presented individually to each judge. Judges were instructed to categorize each word in the 12 utterances as having primary or nonprimary stress. A word-by-word analysis of the 67 words judged for stress type by both judges yielded an interjudge agreement of 87%.

Listening session. Seven days following the training session, a listening session for both judges was held in a listening laboratory. The experimental tape was presented via a Sony ER-740 tape recorder that fed two listening booths equipped with Koss Pro 20 headphones. There were 376 utterances randomized and put into two groups. A written list of 188 utterances was prepared for each judge and served as a scoring sheet. Judgments were made individually, and each judge could listen to a given utterance up to three times before making a final decision.

Reliability assessment. During the listening session 50 utterances were presented twice to both judges to determine interjudge and intrajudge agreement for stress adjustments. These 50 utterances had been selected randomly from the total sample and placed in random order on the tape. Utterances consisted of 15 topics and 59 comments, respectively 21% and 19% of the utterances representing each pragmatic function. Intrajudge agreements were 94% and 96%. Interjudge agreement was 86%.

Data Reduction

The percentage of occurrence of Final Consonant Deletion, Stopping, Palatal Fronting, and Velar Fronting on all potential lexical items was calculated for each child. This was accomplished for each process by dividing the total number of process occurrences by the potential number of occurrences. Percentage of occurrence of each phonological process was then cross-tabulated with pragmatic function (topic and comment words) and stress type (primary, nonprimary). Because of the disproportionate number of topics and comments and the small number of subjects in this study, arc sine transformations (Kirk, 1968, p. 66) were used to normalize the sample variance for all statistical tests. For clarity, however, all figures are expressed in percentage values.

RESULTS

Pragmatic Function/Stress Type and Phonological Processes

Figure 1a shows the percentage of occurrence of the four natural phonological processes in comments and

topics across all five children. These data indicate that process usage occurred less frequently during production of comments than of topics ($t = 3.65, df = 4, p < .03$). Figure 1b shows the percentage of occurrence of natural phonological processes in words with primary stress compared to those with nonprimary stress. Percentage of occurrence of natural processes was descriptively lower in words produced with primary stress; the means difference approached statistical significance ($t = 2.61; df = 4, p < .06$).

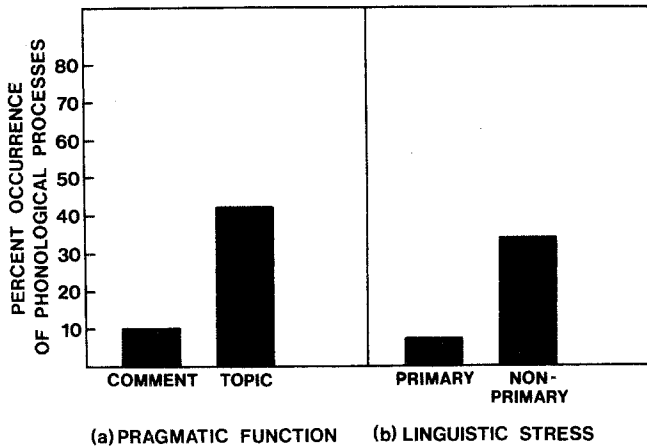


FIGURE 1. Percent occurrence of four natural phonological processes in five speech-delayed children (a) by pragmatic function and (b) by linguistic stress.

Associations among Pragmatic Function, Stress Type, and Phonological Processes

Group data. A repeated-measures t test (Kirk, 1968, p. 74) was used to test the main hypothesis of differences in the proportion of phonological process occurrence among the four pairwise comparisons. An alpha level of .05 (two-tailed) was originally selected as the criterion for statistical significance. Because there were four a priori contrasts of interest, a family-wise alpha level was calculated by dividing the original value of .05 by the number of contrasts. This resulted in a statistical criterion of $p < .01$ (two-tailed). A t value of 3.05 ($df = 12$) was needed to reach statistical significance at the .01 level. As indicated in Figure 2, mean differences for three of the four contrasts exceeded this value. The first two contrasts indicate that natural phonological processes occurred significantly less often when both comments ($t = 4.86$) and topics ($t = 3.79$) were produced with primary stress. The next contrast indicates that natural phonological processes occurred significantly less often on comments than topics ($t = 3.07$) for words produced with primary stress. The final contrast indicates the same trend as the previous one, but differences in group means failed to reach statistical significance ($t = 1.99$).

Child and process data. Figure 3 is a presentation of data for each of the five children. For all children, natural processes occurred least often on words pro-

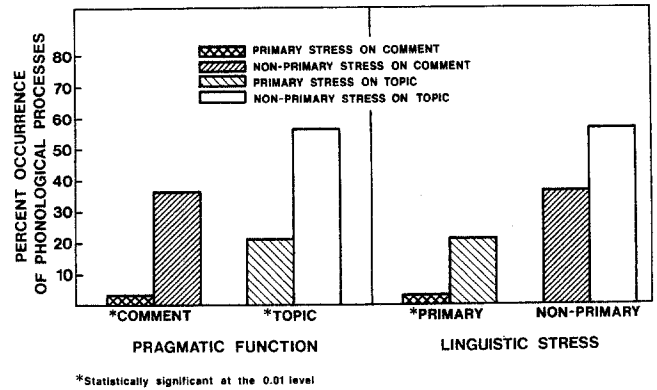


FIGURE 2. Associations among pragmatic function, linguistic stress, and natural phonological processes in five speech-delayed children. The left panel illustrates the data by pragmatic function; the right panel illustrates the same data by linguistic stress. Statistically significant contrasts are marked with an asterisk.

duced with primary stress. Figure 4 is a display of data for each of the four natural processes. For all natural processes, simplifications were proportionally least frequent on words produced with primary stress.

Summary

In this sample of speech-delayed children, natural phonological processes occurred proportionally less often during production of comments (10%) than topics (42%), and process occurrence was less frequent in words produced with primary stress (7%) than words

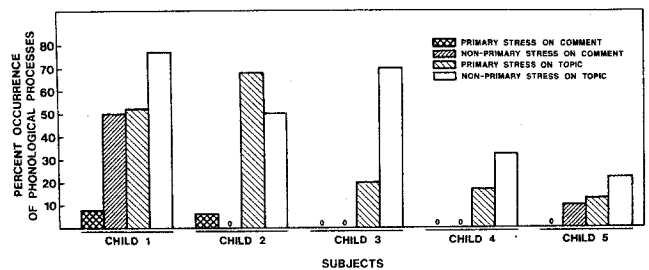


FIGURE 3. Percent occurrence of four natural phonological processes for each of five speech-delayed children.

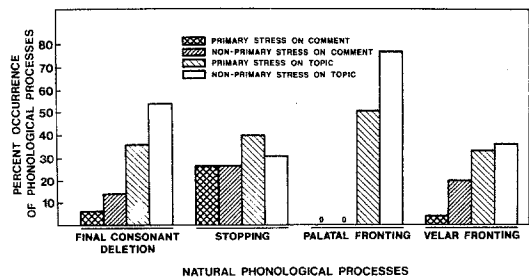


FIGURE 4. Associations among pragmatic function and linguistic stress for each of four natural phonological processes for five speech-delayed children.

produced with nonprimary stress (34%). Analysis of the combined effects of pragmatic function and stress type on natural phonological process occurrence indicated that when both comments and topics were produced with primary stress, fewer simplifications occurred (3% and 21%, respectively) than when these pragmatic functions were produced with nonprimary stress (36% and 56%, respectively). This trend was consistent in the grouped data, at the level of individual children, and for all four natural phonological processes.

DISCUSSION

These findings support the position that pragmatic and stress variables are associated significantly with phonological performance. For general theories of speech production, these data suggest that such variables, along with syntactic and semantic variables, are important inputs to organization plans for speech (e.g., Kozhevnikov & Chistovitch, 1965).

For theories of normal and delayed acquisition of speech, these data raise many questions which could not be tested with this small data set. One question is whether these data might be viewed as evidence for Stampe's (1973) notions concerning the eventual "suppression" of natural phonological processes. Stampe's view of phonological development posits that limiting, ordering, and suppression of phonological processes occur as children eventually use the surface forms of the adult ambient language. Stampe argues that children have the correct underlying forms, as indeed our subjects seemed to because their surface forms were not always reduced (i.e., 20-85% correct was an entrance requirement). Stampe did not deal explicitly with the question, What variables motivate these mechanisms in phonological development? We could speculate that pragmatic concerns (i.e., the need to be informative) and stress parameters (i.e., changes in intensity, frequency, and/or duration) provide this source of interpersonal motivation and physiological impetus for eventual suppression of phonological processes. A strong test of this interpretation, one not possible in this data set, would be to calculate precisely where each phonological simplification occurred in relation to children's baseline frequency of occurrence of simplification. For example, for children who almost always delete final consonants, what percentage of final consonant inclusions occur on words that are comments or on words with primary stress? Support for the psychological reality of the suppression hypothesis would require that those few lexical items that were articulated correctly were important pragmatically (comments) or said with primary stress.

Another provoking question concerns the influence of intensity, frequency, and durational components on phonological process occurrence. For children of this age, we might speculate that the duration component might be of paramount interest. Increased durations reported for normal children's and adults' phonemes in stressed syllables (Smith, 1978) and in words carrying

greater information (Umeda, 1977) suggest testable hypotheses. One possibility is that increased durational values for stressed/informative words place timing constraints on segmental specification. Thus, increased durational values for stressed words may motivate selection of a phoneme that accommodates the required temporal constraints. During production of the stressed word *dog*, for example, the lengthened vowel before the final voiced obstruent may impel a closed syllable in order to realize the organizational time plan for the syllable. If *dog* is unstressed, an open syllable may be sufficient. Such questions may be explored readily in appropriate natural speech samples and in experimental protocols containing tokens not available in the present data set. Ideally, an analysis might inspect the same lexical item said in each of the four pragmatic/stress categories.

It should be emphasized that a number of other linguistic variables may have been interactive in these data. Bates and MacWhinney (1979) presented a variety of grammatical components that are associated with topic-comment and linguistic stress functions. This list includes aspects of lexical selection, sentence embedding, and word order, among others. Furthermore, the location of the target word in the sentence has also been closely related to the marking of certain pragmatic forms and the assignment of linguistic stress. Finally, as Kent and Netsell (1971) noted, various types of stress (e.g., lexical, emphatic, sentence, and phrase) may have different effects on speech production. Combinations of these linguistic components, as well as such articulatory variables as phonetic context, could be associated with differential phonological simplification of underlying forms that are marked pragmatically as topics or are unstressed.

Until appropriate studies yield data on questions discussed in this paper, clinical practice with speech-delayed children will continue in the search for effective ways to implement pragmatic and suprasegmental variables in management programming. We suspect that pragmatic and stress influences are major components underlying both spontaneous self-correction and successful management techniques.

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Associations among Pragmatic Functions, Linguistic Stress, and Natural Phonological Processes in Speech-Delayed Children

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