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GENERALIZATION TO CONVERSATIONAL SPEECH

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Although changes in children's phonological systems due to treatment have been documented in single-word testing, changes in conversational speech are less well known. Single-word and conversation samples were analyzed for 10 phonologically disordered children, before and after treatment and 3 months later. Results suggest that for most of the children, there were system changes in both single words and in conversational speech. It appears that many phonologically disordered children are able to extend their correct production to conversation without direct treatment on spontaneous speech.

KEY WORDS: phonological, generalization, conversational speech, intervention, PCC

In clinical research it is important not only to demonstrate that behavior changes occur in controlled experimental conditions, but also to determine whether these behavior changes are maintained and extended to everyday functioning. Numerous studies have shown pre- and posttreatment changes in single word generalization probes for phonologically disordered children (e.g., Elbert & McReynolds, 1978; Gierut, Elbert, & Dinnsen, 1987; McReynolds & Bennett, 1972; Weiner, 1981). The extension of these changes into conversational speech is less well documented. However, correct production of error sounds in conversational speech is the ultimate goal of phonological remediation. Accurate production in connected speech would indicate that the child has integrated what has been learned about sound production and usage into his or her own phonological system.

Clinicians and researchers have long been interested in the topic of whether a child's production of sounds in single words (citation form) is the same as, or closely related to, production of sounds in connected speech (Dubois & Bernthal, 1978; Faircloth & Faircloth, 1970; Templin, 1948). The two tasks seem potentially quite different. The use of sounds in conversation appears to require a certain linguistic sophistication whereby the child must be able to store and retrieve the correct sound for production while attending to contextual demands as well as the pragmatic, syntactic, and morphological aspects of communication. The production of the single word in response to picture stimuli seems relatively simple in comparison. Thus, different responses to the two tasks might be expected.

During the last two decades, a great deal has been learned about children's ability to generalize. Research during this time has focused on the phonological system itself, that is, on patterns of errors across the system and change in error patterns due to treatment (e.g., Elbert & McReynolds, 1985; Gierut, Elbert, & Dinnsen, 1987; McReynolds & Bennett, 1972; McReynolds & Elbert, 1981; Weiner, 1981). Researchers have moved away from focusing on individual sounds in most investigations and yet have continued that focus when describing spontaneous speech (e.g., Fey & Stalker, 1986; Olswang & Bain, 1985; Shriberg & Kwiatkowski, 1987).

The intent of this investigation was to examine overall changes in the phonological systems of phonologically disordered children who had received treatment and to describe systemwide changes following treatment. In order to describe systemwide changes, all of the consonant sounds were examined, not just sounds targeted for treatment. If one subscribes to the view that children are actively engaged in the learning process, then it seems logical that learning a few new speech sounds has the potential for affecting the whole system. That is, children should be able to integrate new knowledge into an existing system and thereby alter the system itself. This view contrasts with a traditional non-cognitive/linguistic approach, in which changes are expected to occur treated sound by treated sound rather than across the system. This broader view encompasses overall system change and is based on research concerning generalization. Research literature on generalization has revealed that children learn more than what is directly taught. For instance, if a child is taught /s/ in one position, the child might generalize correct production not only to the taught position but also to other positions (Elbert & McReynolds, 1978; Rockman & Elbert, 1984), to the cognate sound /z/ (Elbert, Shelton, & Arndt, 1967), to other sounds with similar phonological features (Costello & Onstine, 1976, McReynolds & Bennett, 1972), or to other sounds affected by implicational relationships (Elbert, Dinnsen, & Powell, 1984).

In the present study, the overall phonological systems of 10 preschool children with multiple phonological errors were described and analyzed in two ways. The first method of description and analysis was based on single-word responses and the second on spontaneous speech. Both methods focused on the phonological system as a whole rather than on individual sounds. These data were obtained at three points in time: at the beginning and at the end of the treatment process, and 3 months after completion of treatment. The main purpose of this investigation was to examine the overall changes in the phonological system of phonologically disordered children

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by describing and analyzing changes in the phonological system shown in both single-word responses and conversational speech.

METHOD

Subjects

Ten phonologically disordered children, 5 girls and 5 boys ranging in age from 3:7 to 5:9 (years:months), served as subjects. These children produced a minimum of six sounds in error across three manner categories, as determined by performance on the Goldman-Fristoe Test of Articulation (Goldman & Fristoe, 1972), and scored within normal limits on all other tests, including hearing sensitivity/acuity and receptive vocabulary. These children were selected from a larger group of 40 subjects to represent a range of severity. They were randomly selected from subgroups of moderately to severely phonologically disordered children who had received phonological treatment. Table 1 provides information for the 10 subjects pertaining to age, sex, and scores on the Peabody Picture Vocabulary Test (Dunn & Dunn, 1981) and Goldman-Fristoe Test of Articulation. Table 1 also contains the specific sound and phonological context of each treatment target selected for each subject. The subject identification numbers reported in Table 1 are the same numbers assigned to the subjects in a previous report that examined the children's phonetic inventories prior to treatment (Dinnsen, Chin, Elbert, & Powell, 1990).

Speech Samples

Two types of speech samples were obtained: single word and conversational speech. These samples were obtained at three distinct points in time: pretreatment, posttreatment, and 3 months following completion of treatment.

Single-word sample. The single-word sample was elicited using a specially designed 306-item probe, which required the spontaneous naming of pictures in isolation (adapted from Gierut, 1985). This extensive list allowed examination of all English consonants in multiple responses (for instance, /s/ was sampled in 50 words).

Conversational analysis. Conversational speech samples were obtained during an interaction that lasted 5–7 min. The examiner used questions and comments to prompt verbalizations related to the stimulus materials, which included a children's picture book and a variety of plastic animals. To facilitate later glossing and transcribing of the sample, the examiner repeated the child's utterances. The speech samples were recorded on a Marantz PMD 340 or a Technics Panasonic audiocassette recorder in a quiet room. One hundred words selected from the larger sample, which had been phonetically transcribed, were analyzed.

Analysis. Both types of speech samples were analyzed using the metric "percentage of consonants correct" (PCC) as described by Shriberg and Kwiatkowski (1982). Although their procedure/protocol was designed to examine consonant sounds in connected speech, the measure was also applied in the present study to the single-word sample in order to obtain comparable scores. The percentage of consonants correct is determined by the formula:

$$\text{PCC score} = \frac{\text{number of consonants correct}}{\text{total number of consonants produced}} \times 100$$

In addition to the established procedures for calculating PCC, the following criteria were used to enhance the representativeness of the conversational samples (Shriberg & Kwiatkowski, 1985). The sample included at least 65 different words, with no more than three productions of any word. Each sample contained targeted consonants from all phoneme manner classes, so that the sample more closely represented the correct proportional distribution of sounds in the language (Shriberg & Kwiatkowski, 1982)

Reliability. An examiner and observer were present during the elicitation of the probe items used for the single-word sample. Transcribers were graduate students

TABLE 1. Subject's age, sex, scores on the Peabody Picture Vocabulary Test-Revised (PPVT-R), percentile scores on the Goldman-Fristoe Test of Articulation (GFTA), and the specific sound and context selected for treatment.

Subject	*Age*	*Sex*	*PPVT-R*	*GFTA*	*Treatment targets*
23	4:3	F	86	<1	b/_#, t/_#, d/V_V
4	3:7	M	108	<1	s/#_, k/#_, b/_#
36	5:9	M	88	<1	f/#_, n/_#, g/_#
11	3:10	M	114	<1	ʃ/#_, z/#_, f/#_
33	5:4	M	100	<1	k/#_, θ/#_, l/#_
8	3:9	F	85	<1	v/#_, θ/#_, k/#_
14	4:1	M	108	5	dʒ/V_V, v/#_, s/#_
34	5:5	F	114	<1	l/_#
12	3:11	F	102	6	z/V_V, ʃ/#_
17	4:3	F	93	4	t/_#

and/or certified speech-language pathologists. Each child's production of the target words was transcribed independently by both persons using the International Phonetic Alphabet with diacritics for narrow phonetic transcription. For an item to be scored as an agreement, all consonants in the word had to be realized with the same notation by both transcribers. All disagreements were reevaluated by the transcribers using the audiotape of the sample until 100% agreement was achieved.

The conversational samples were transcribed independently from the audiotape by a graduate student and a certified speech-language pathologist. The transcription of each consonant was compared to determine whether the sound was scored as correct or incorrect. Disagreements were settled by a third independent transcriber.

Interjudge reliability of phonetically transcribed single words and conversational speech samples was calculated to determine accuracy in judging the child's productions of consonants. Mean agreement was 80% for the single-word responses and 93% for conversation. The lower percentage obtained for single-word responses generally resulted from disagreements involving diacritical markings.

Treatment

Treatment combined perceptual-motor and cognitive-linguistic strategies; that is, production of the target sound(s) was emphasized within minimal pair contrast training. One to three error sounds were targeted for treatment for each subject. These treatment targets are shown in Table 1. Probe lists containing 15 or 20 words for assessing each target sound were created in order to establish baseline performance and measure generalization during treatment. Treatment focused on contrasting the child's error with the target sound. The number of minimal pairs trained ranged from 3 to 10. Initially, the child's responses were imitative, and shaping procedures were used as needed to improve the child's production accuracy. Treatment progressed systematically through imitation and spontaneous production of single words, and reinforcement was decreased systematically. No direct treatment of connected speech was provided at any time.

When the child demonstrated generalization for a target sound, the next target sound was taught. For the purposes of this study, generalization was operationally defined as a 50-percentage-point increase over the mean baseline measures or accurate production of 90% of the words containing the target sound.

Results

Two general findings emerged from the analyses and are shown in Table 2. First, most subjects increased their scores on the Percent Consonant Correct metric for single-word responses in the posttreatment and follow-up analyses. Second, and importantly, subjects also increased their scores on the Percent Consonant Correct metric in conversational speech. Table 2 shows the mean scores of the 10 subjects for both the single-word responses and the conversational speech. The mean scores for the pretreatment, posttreatment, and follow-up analyses were 46%, 65%, and 72% respectively for the single words and 52%, 60%, and 72% respectively for conversational speech.

At posttest, most subjects had improved on both measures but showed slightly greater improvement in single words. At the follow-up point, the subjects continued to improve on both types of samples. These changes are illustrated in Figure 1.

Overall, most of the subjects in this study showed steady increase over time both in single-word test responses and in spontaneous conversational speech. Two forms of generalization appeared to be present. In one form, subjects generalized from a limited number of words targeted for treatment to the larger set of words used in the analysis. In the second form, generalization was from single words to conversational speech.

In order to determine whether there were significant changes on the subjects' scores across the three test times, the single-word and conversational speech data were

TABLE 2. Percent of Consonants Correct (PCC) in single words (SW) and conversational speech (CS) for 10 subjects at three points in time.

Subject no.	*Pretreatment(%)*		*Posttreatment(%)*		*Follow-up(%)*	
	SW	*CS*	*SW*	*CS*	*SW*	*CS*
23	21	32	34	35	46	63
4	23	27	24	33	22	38
36	29	47	54	48	78	71
11	41	40	65	55	69	71
33	48	56	79	80	83	83
8	51	68	77	75	82	77
14	54	59	74	58	83	72
34	59	65	78	69	82	86
12	67	58	87	83	93	92
17	70	65	79	66	81	69
M	46	52	65	60	72	72

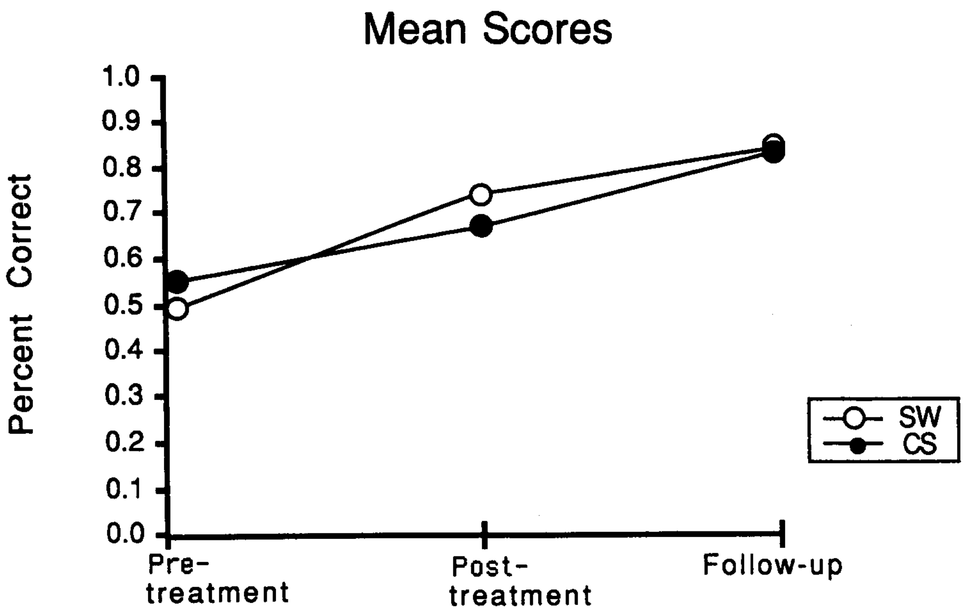

FIGURE 1. Mean percent consonants correct (PCC) for the 10 subjects at three points in time for single words (SW) and conversational speech (CS).

arcsin transformed and submitted to a repeated measured analysis of variance (ANOVA). For single-word productions, the ANOVA was significant, F (2, 29) = 36.2, $p <$ .0001. Multiple comparisons on the three test times were performed using Scheffé, and two of the three pairwise comparisons were found to be significant. The pretest scores were significantly lower than posttest, F (2, 29) = 16.99, $p < .05$, and follow-up scores, F (2, 29) = 34.25, $p < .05$; however, there was no significant difference between posttest and follow-up scores. For conversational speech, the ANOVA was also significant, F (2, 29) = 21.4, $p < .0001$, and again two of the three pairwise comparisons were significant. The pretest scores were significantly lower than follow-up, F (2, 29) = 21.2, $p < .05$, and posttest scores were significantly lower than follow-up, F (2, 29) = 7.5, $p < .05$. There was no significant difference between pretest and posttest scores. It appears that in single words the largest part of the change is embodied within the pretest and posttest scores, whereas in conversational speech the largest part of the change was embodied within the posttest and follow-up scores. The scores for single-word responses and conversational speech were collapsed across the three points in time and compared. The results indicated no significant difference between the scores on the two different samples.

Although the main purpose of this investigation was to examine overall changes in the phonological system, changes in the individual treatment targets were also examined. Table 3 presents the mean PCC scores for the combined treatment targets for each subject. These scores represent the small subset of sounds in specific contexts

TABLE 3. Mean Percent of Consonants Correct (PCC) in single words (SW) and conversational speech (CS) for the treatment targets.

Subject	*Pretreatment(%)*		*Posttreatment(%)*		*Follow-up(%)*	
no.	*SW*	*CS*	*SW*	*CS*	*SW*	*CS*
23	39	25	78	3	81	63
4	0	0	0	0	0	36
36	0	17	33	39	100	100
11	3	0	72	0	86	100
33	0	0	79	70	97	100
8	0	25	87	88	91	100
14	16	0	47	0	91	8
34	0	0	53	0	60	67
12	0	*	100	*	93	*
17	23	0	45	50	100	27
M	8	7	59	28	80	67

*No production attempts.

that were directly taught. For instance, for Subject 23, the single-word score is the mean percentage of correct productions of three sounds in three specific contexts (i.e., b/_#, t/_#, d/V_V).

A comparison of the mean scores in Tables 2 and 3 is also revealing. Although the overall single-word PCC (65%) and treated single-word PCC (59%) at posttreatment are similar, the overall conversational PCC and treated conversational PCC at posttreatment show a greater disparity (60% vs. 28%). It appears that treated sounds may contribute to improvement more in single words than in conversational speech for this small subset of the data.

The scores in Table 3 show that the subjects began with very low percentages correct in both single words and conversational speech and showed increases on both measures over time. These changes on the treatment targets across time for the single words and conversational speech data were arcsin transformed and submitted to a repeated measures analysis of variance (ANOVA). For single-word productions, the ANOVA was significant, $F\ (2, 29) = 21.3$, $p < .0001$. Multiple comparisons on the three test times were performed using Scheffé, and two of the three pairwise comparisons were found to be significant. The pretest scores were significantly lower than posttest, $F\ (2, 29) = 8.55$, $p < .05$, and follow-up scores, $F(2, 29) = 20.71$, $p < .05$. For conversational speech, the ANOVA was also significant, $F(2, 26) = 13.26$, $p < .0004$, and again two of the pairwise comparisons were significant. The pretest scores were lower than follow-up, $F\ (2, 26) = 12.42$, $p < .05$, and posttest scores were lower than follow-up, $F\ (2, 26) = 6.53$, $p < .05$. In single words, the largest part of the change was embodied within the pretest and posttest scores, whereas in conversation the largest part of the change was embodied within posttest and follow-up scores. These results on a subset of items mirror the results from the overall scores.

Discussion

The results of this study demonstrated that many children do generalize correct sound production to conversational speech without direct treatment on conversational speech. The fact that this happens would seem to indicate that some crucial learning has taken place. The improvement noted in single words and in spontaneous speech was across the entire phonological system, not only to isolated sounds. Thus, there are indications that children learned more than simply new production skills.

When correct sound production and usage are extended into conversational speech, it would appear that the correct forms are now stored and ready for retrieval on demand. Sound productions are learned to the extent that the knowledge can withstand other potential distractions on the system that might arise from pragmatic or syntactic demands.

There are strong indications in the data that learning continued beyond treatment; that is, the subjects continued to improve during the 3 months following treatment. This continued change provides some additional insight into children's learning patterns. It appears that changes in single-word productions are accompanied by similar changes in conversational speech. Changes did not cease at the end of treatment but continued. This supports the hypothesis that children are actively engaged in the learning process.

Despite the positive aspects of the results, some limitations in generalization should be noted for these subjects. For most subjects, some speech problems continued to exist even at the follow-up point, as evidenced by less-than-perfect scores at that time. These results are descriptive in nature, not explanatory. Factors that influence generalization to single words or conversation require experimental investigation.

The notion that children do not readily generalize to conversation from single-word (or minimal pair) treatment seems to have begun with clinician concern about "carryover." Anecdotal accounts are legion concerning children who can produce a word in the clinic room but misproduce the same word as they walk out the door. Indeed, this is the problem addressed by two recent studies of school-age children (Koegel, Koegel, & Ingham, 1986; Koegel, Koegel, Van Voy, & Costello Ingham, 1988). One might speculate that school-age children with only one or two sounds in error form a large, but special, subpopulation of phonological disorders. These children have phonological systems that are basically intact and intelligible. Communication is unimpaired, and thus the "need" to change is less crucial than it is for the more unintelligible children with multiple errors and less well-developed phonological systems. The perceived need to communicate, even if it is not at an entirely conscious level, may help to account for the differences in generalization between subgroups.

The issue concerning the necessity for direct treatment of conversational speech is far from resolved. Further research seems indicated in at least two areas: the subject characteristics of children who do and do not generalize to conversation and the treatment procedures provided.

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