A Retrospective Study of Spontaneous Generalization in Speech-Delayed Children

Lawrence D. Shriberg and Joan Kwiatkowski

Programming for rapid generalization of target responses to spontaneous speech is perhaps the central goal of management. To determine whether any child or management factor was associated with generalization within a sample of preschool, speech-delayed children, a retrospective study of 73 case records was undertaken. Children had been given 14 different management programs over a period of 7 years of clinical research. Results suggest that age and error type may prove to be robust predictors of the potential for spontaneous generalization. Also, these data suggest that the inclusion of self-monitoring procedures may increase the probability of early spontaneous generalization of target sounds to continuous speech.

Children provided with speech management services may generalize newly acquired speech sounds to continuous speech in one of two ways. Some children demonstrate generalization to continuous speech without ever having direct training at this linguistic level, while other children require training at varying levels in various types of transfer of training programming for generalization to occur (e.g., Costello & Onstine, 1976; Diedrich & Bangert, 1980; Olswang & Bain, 1985; Wing & Heimgartner, 1973). Given the pragmatic importance of achieving rapid gains in intelligibility for preschool children with moderately to severely delayed speech, an eventual understanding of the nature and origin of factors underlying spontaneous generalization would seem to be a highly valued research goal.

Most of the available research on generalization has been focused on generalization to linguistic levels lower than spontaneous speech, using children whose speech sound errors consist only of /s/ or /r/ distortions or substitutions. Hence, few guidelines are available for increasing the probability of obtaining early spontaneous generalization to continuous speech with children who have more severely involved speech patterns. For example, Elbert, Shelton, and Arndt's (1967) classic finding that response generalization occurs within, but not across, phonetic class might not hold for children whose underlying segmental and word forms may be incomplete (e.g., Elbert, Dinnsen, & Powell, 1984; Gierut, 1985). Similarly, generalization effects potentially associated with the syllable position and phonetic context of the target sound in the training word (e.g., Elbert & McReynolds, 1975; 1978; McReynolds & Elbert, 1981) and with early acquisition rates (e.g., Diedrich & Bangert, 1980) may be different for school-aged children with residual /s/ and /r/

Lawrence D. Shriberg and Joan Kwiatkowski are in the Department of Communicative Disorders, University of Wisconsin-Madison, 1975 Willow Drive, Madison, WI 53705. Requests for reprints may be sent to this address.

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distortions compared to preschool children with more involved speech delays. Recent studies of the phonologic systems of young, moderately to severely involved children (e.g., Dunn & Davis, 1983; Grunwell, 1981; Hodson & Paden, 1981; Leonard, 1985; Shriberg, Kwiatkowski, Best, Hengst, & Terselic-Weber, 1986; Weiner & Wacker, 1982) demonstrate considerable heterogeneity in the distribution and topography of errors. These individual differences in error patterns suggest that predictive associations between specific phonologic factors and spontaneous generalization would necessarily be complex.

In the absence of literature on child, clinician, or programming variables that increase the probability of early spontaneous generalization for young speech-delayed children, clinicians who work with such children are likely to follow generally established programming principles. A sampling of such guidelines is provided in the following list adapted from research and suggestions by Dunn (1983), Engel and Groth (1976), Rockman and Elbert (1984), and Wing and Heimgartner (1973): (a) provide extensive practice on target behaviors, (b) train speech targets in all positions simultaneously, (c) schedule systematic movement from imitative to the spontaneous level within production practices, (d) use a variety of different words and teaching materials, (e) train simultaneously on more than one sound per sound class, (f) balance a short training list with a probe list to expose the child to more exemplars of the target behavior, (g) include self-monitoring and self-evaluation skills in the management program, (h) progress from continuous to intermittent reinforcement schedules, (i) train in different settings with different persons, and (j) involve parents in home practice. Controlled studies of the effectiveness of each of these suggestions, taken individually and in permuted combinations with children having different error patterns, would require an extensive research effort.

A useful preliminary to such a research effort is to review retrospective data on management outcomes, to identify which child or management variables might be associated with early generalization of speech targets to continuous speech. An available clinical database allowed the opportunity to pursue this approach. For findings of the type to be described in this report, nonsignificant associations between any independent variable and spontaneous generalization might be due to complex interactions that are uncontrolled in retrospective data. However, any independent variable that does turn out to be statistically associated with generalization, after appropriate additional analyses to remove potentially confounding variables, could suggest productive directions for controlled prospective studies.

Method

Subjects

Clinical records were reviewed for 73 children who had been referred to a University-affiliated Phonology Clinic from 1977–1984 for management of their speech delays of unknown origin. As shown in Table 1, this retrospective database included 18 girls and 55 boys who ranged in age from 2:9 to 9:6 with an average age at referral of 5:3. Average severity of involvement, as indicated by Percentage of

TABLE 1. Description of subjects, including severity of involvement values for 46 subjects on whom a percentage of consonants correct (*PCC*) in continuous speech (Shriberg & Kwiatkowski, 1982c) was available.

Variable	*n*	*M*	*SD*	*Range*
Age (yrs/mos.)				
Girls	18	5;1	1;4	3;0-7;1
Boys	55	5;4	1;5	2;9-9;6
All	73	5;3	1;4	2;9-9;6
Severity (PCC)				
Girls	12	71%	10.0	55%-86%
Boys	34	69%	9.3	53%-86%
All	46	70%	9.5	53%-86%

Consonants Correct (PCC) scores from a continuous speech sample (Shriberg & Kwiatkowski, 1982c) was 70%, with most children falling within 12 percentage points of the sample average. These values convert to an adjective description of mild-moderate to moderate-severe involvement and, hence, children in this study were similar to approximately 85% of preschool children seen for speech delays of unknown origin (Shriberg et al., 1986).

Coding Procedures

Selected information from the clinical management reports of the 73 children was coded by a research assistant, a master's level student in her last semester of training in speech pathology. The research assistant was unacquainted with both the database and the goals of the retrospective study. Coding of the clinical information was accomplished by means of a 42-item system developed for this purpose by the authors. Items were of two types, those that described individual children and those concerned with management objectives, programs, and outcomes. Coding procedures required either simply copying values recorded in the clinical folders or making categorical decisions from the available clinical reports. Because the content in the clinical records varied in degree of detail, only nonambiguous data were coded. As a result, missing data were frequent across the 42-item system. To assess factors potentially associated with early generalization, only data from the children's first semester of management were used. The average number of mangement sessions per child was 14, with a range of 8–19 sessions. These data reflect the large number of children, 59 (81%), who were seen for short, summer terms. All coding was completed within a 3-month period.

Records from 15 randomly selected children (17% of the data set) were recoded 6 weeks after the original coding to assess the intrajudge reliability for coding of the categorical decision items. The obtained item-level percentage of agreement was 98.4%.

TABLE 2. Phases and steps in the management programs.

Phase	*Steps*	*Target sound(s)*
1	1	Produce in isolation; imitation
	2	Produce in syllable; imitation
2	3	Produce in word; imitation
	4	Produce in word; spontaneous
	5	Produce in carrier phrase; imitation
	6	Produce in carrier phrase; spontaneous
	7	Produce in variable phrase; imitation
3	8	Produce in variable phrase; spontaneous
	9	Produce in continuous speech

Management Information

The 73 children had received management services from 40 masters-level student clinicians. Because the management services were provided in the context of an on-going research program (e.g., Shriberg & Kwiatkowski, 1982b), all clinicians were very closely supervised. Clinicians used experimental versions of 14 different management approaches or program types. Although these program types were experimental they were consistent with the types of programming that clinicians have used and continue to use with speech-delayed children. One, two, and three program types were used respectively with 35, 32, and 6 children. The actual number of speech sounds targeted in any one program type ranged from 4 to 92 [M = 28, SD = 28]. All but one program type emphasized production (i.e., output) practice; three emphasized both listening/discrimination (i.e., input) and output practice; and one program emphasized only input. There were no programs that emphasized throughput (i.e., procedures that consequated both a child's production and self-evaluation of that production (Shriberg & Kwiatkowski, 1982b). Training targets varied across programs and included specific phonemes, processes, and features with certain of the program types representing attempts to operationalize for management, linguistic targets that were proposed in the theoretical and applied literature in child phonology during the period in which each experimental program was used. Some programs used a stimulus-response framework for training while others were communication-centered. Within each of the program frameworks, specific arrangements for antecedent events (cues) and subsequent events (knowledge of results, reinforcers) were individualized for each child. Continuous reinforcement schedules were used with all children. Parent involvement in home practices was always included, beginning with word-spontaneous production practice (see Table 2).

Dependent Variables

The two dependent variables were target sounds that generalized to spontaneous speech and children who were defined as *generalizers*.

Target sounds included only error sounds that were directly trained. Each sound by position, cluster, and singleton counted as a separate speech target. The total number of speech targets across the 73 children was 440. This represented 60 different target sounds including different nasals, stops, fricatives, affricates, liquids, and two-element fricative and liquid clusters.

Performance on the 440 target sounds was tracked through the 9 program steps shown in Table 2. Not all program types included all program steps: Some programs consisted of practice only at the word level, while other programs included simultaneous practice at several program steps during the same session. For steps that were included in the program type used with each target, children spent 2–5 sessions at each step, averaging approximately 4 sessions per step.

To identify entry levels for training of each speech target, evocation level activities (2 steps) were termed *Phase 1,* Stabilization level activities (5 steps) were termed *Phase 2,* and Generalization level activities (2 steps) were termed *Phase 3.* Of the total of 440 target sounds that were trained for the 73 children, Phase 1 was the entry level for 374 target sounds and Phase 2 for another 66 sounds. There were no target sounds on which training began at Phase 3 or that ever were trained at Phase 3. However, speech performance at Step 9 of Phase 3 was routinely probed each week. These probes consisted of a 10-min, audio-taped, continuous speech sample obtained by the child's clinician in the clinic setting, using different stimulus materials from those used in training. Performance on target sounds in the taped sample had been scored by the child's clinician using a two-way, correct-incorrect scoring system. Scores were always validated by the supervisor of the child's management program (J. K.), who has extensive experience with both broad and narrow phonetic transcription (cf., Shriberg & Kwiatkowski, 1985; Shriberg, Kwiatkowski, & Hoffmann, 1984). Generalization of speech targets to continuous speech was also confirmed by records of parental report of similar generalization to the home.

Target sounds that were found on probes to be 80% correct or better in Step 9 of Phase 3 were considered to have generalized. If a child met this criterion on at least one target sound the child was coded as a generalizer. In the relatively brief, one semester periods of management described in this study, only 44 (10%) of the 440 target sounds spontaneously generalized, whereas 396 (90%) did not. Moreover, only 14 (19%) of the 73 children met the generalizer criterion, whereas 59 (81%) did not. Children classified as *generalizers* generalized on from 1 to 9 target sounds [$M = 3$; $SD = 2.4$] taught in the course of the one semester of management while also failing to generalize on from 1 to 8 target sounds [$M = 3$; $SD = 2.3$]. Only one child generalized all target sounds to spontaneous speech.

Independent Variables

A total of 11 independent variables was assembled from the coded data, including 5 child variables and 6 management variables. These variables were selected for study because of their potential relationship to generalization outcomes and because data were available for a sufficient number of the children.

Child variables were age, sex, severity of involvement (as indexed by percentage of consonants correct on referral), prior therapy status (had or had not received prior

therapy elsewhere), and possible etiology. Coding for the latter variable, which involved a provisional system described in Shriberg and Kwiatkowski (1982a), had been assigned by the authors, using available sources of intake and assessment data, including case history information, parent reports, school and physician records, audiologic-screening results, speech-language assessment results, and clinician and supervisor observations during assessment and management. Children who could not be assigned to one of the six provisional causal-background subgroups (hearing, speech production, language comprehension, language production, psychosocial inputs, psychosocial behaviors) were coded as *indeterminate*.

Management variables included type and word position of the target sound (Sound/Position), number of sessions spent on each target, type of management program, program entry level (see Table 2, first column), error type at the beginning of management (whether deletion, substitution or distortion) and teaching strategy or strategies used in the program. Of the 60 different target sounds, only those for which data were available for at least 15 children were included in the Sound/Position analysis in order to assure adequate data for meaningful comparison across target sounds. This restriction, for this analysis only, yielded data for the following eight target sounds (the number of children for whom the sound was targeted follows in parenthesis): s-initial (45), ʃ-initial (31), s-final (25), tʃ-initial (18), f-initial (18), k-initial (17), ʃ-final (16), and st-initial (16). Although 52 of the original 60 different speech targets were excluded from this analysis, only 6 children were excluded, one of whom was a generalizer.

Teaching strategies that were studied included Auditory Bombardment, Auditory Discrimination, Self-Evaluation, and Minimal Contrasts. Three of these strategies relate to the child's response; one describes a characteristic of the words selected as training stimuli. For Auditory Bombardment, the child listened as the clinician read a list of words containing the target sound (c.f., Hodson & Paden, 1983); for Auditory Discrimination, the child selected the pictured word that was said by the clinician, and; for Self-Evaluation, the child judged the accuracy of his/her response prior to explicit feedback from the clinician. For Minimal Contrasts, words that were maximally similar except for the target sound (e.g., *soap* vs. *hope*) were selected to contrast the target with the replacement sound. Three of the strategies, Auditory Bombardment, Auditory Discrimination, and Minimal Contrasts were a routine part of some program types and optionally included in all others. The fourth strategy, Self-Evaluation, was an optional element in all program types. Other teaching strategies used in virtually all the programs, such as providing the child with knowledge of results on the correctness of responses, were not studied.

Analyses

Regression analyses or other multivariate approaches were not appropriate for these data because of the limited sample size and the number of cells with missing data. One-way analyses of variance were calculated for the three independent variables of age, severity of involvement, and number of management sessions. Chi square (χ^2) tests of association were calculated for all other child and management variables that had adequate cell sizes. The dependent variable for each analysis was generalization status for either target sound or child, whichever was appropriate.

Results and Discussion

Results of the 11 statistical analyses are listed in Table 3. Among the first 5 child variables, the analyses for sex, provisional etiological category, severity of involvement, and prior therapy were not significantly associated with generalization outcome. The analyses for age reached statistical significance [F (1, 72) = 4.56; $p <$ .05] with the generalizers being an average of 11 months older than the nongeneralizing children. The mean age of the generalizers was 72 months, with a standard deviation of 20 months; nongeneralizing children averaged 61 months, with a standard deviation of 16 months. Implications of this finding are deferred to a later section.

Among the six management variables, those not significantly associated with generalization were the type and position of training target, the number of management sessions, the program type, and the program entry level. Two variables that were significantly associated with generalization were error type and teaching strategy. Figures 1 and 2 present a closer look at the findings for these two management variables.

Figure 1 is a display of the association between three error types—deletion, substitution, and distortion—and the percentage of target sounds characterized by these error types that generalized to continuous speech. Data on error type were available for 411 of the 440 target sounds. The statistically significant results of an analysis of these data [$\chi^2(2) = 20.01$; $p < .05$] indicated that a higher percentage of substitution errors eventually generalized, in comparison to generalization rates for deletion and distortion errors. These results are consistent with Elbert and McReynolds' (1978) generalization findings, in which children with consistent omission errors on sibilant clusters before training did not generalize as well to nontrained clusters as children with substitution errors before training.

Figure 2 contains generalization data for each of the four teaching strategies. Beginning with the upper left panel, inclusion of Auditory Bombardment in management programs was negatively associated with generalization [$\chi^2(1) =$ 17.21; $p < .05$]. When Auditory Bombardment activities were not included in management programs, 251 (85%) of the 294 targets did not spontaneously generalize to continuous speech, but 43 (15%) did. In contrast, when Auditory Bombardment was included in the management program, none of the 105 target sounds generalized. Additional analyses of the individual data for possible explanations for this finding were unrevealing. No child or management characteristics could be found that may have moderated this finding, such as the possibility that a higher proportion of severely involved children had been assigned to programs that included auditory bombardment activities. This strategy has been well described by Hodson and Paden (1983) and is widely used to increase children's awareness of sounds, possibly accompanied by subvocal rehearsal. We suspect that the statistically significant findings for this variable speak more to the complex interaction of child and management variables associated with generalization outcomes, than to the potential power of any one program strategy to inhibit generalization.

In Figure 2, upper right panel, for the 93 speech targets that did not include training stimuli containing Minimal Contrasts, 91 (98%) did not generalize and 2

TABLE 3. Summary of results for the 11 statistical analyses.

Question	*Association with generalization*	*F*	χ^2
1. Age	Generalizers older by average of 11 mos.	4.56[a]	
2. Sex	Not associated		<1.00
3. Possible etiology	Not associated		b
4. Severity of involvement	Not associated	<1.00	
5. Prior therapy	Not associated		2.37
6. Sound/Position	Not associated		b
7. Number of sessions on target	Not associated	<1.00	
8. Program type	Not associated		b
9. Program entry level	Not associated		b
10. Error type	Substitution errors more frequently generalized		20.01[a]
11. Strategy	Associated; see text		3.97–31.12[a]

[a]$p < .05$. Significance levels are provided only for values exceeding 1.00.
[b]Cell sizes were too small to test, but no means trends were observed.

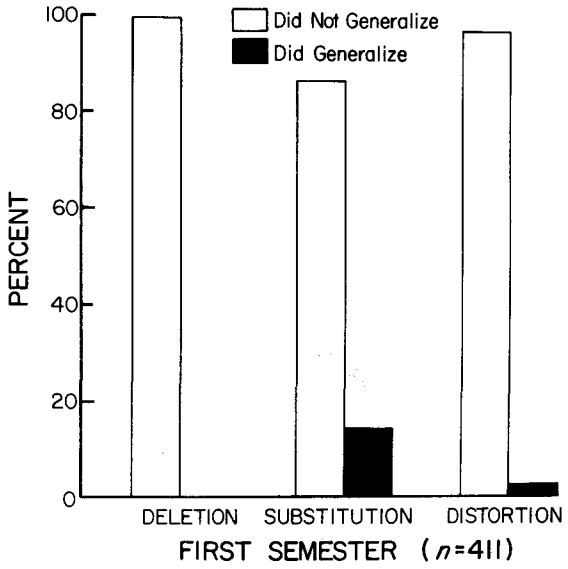

FIGURE 1. Generalization of target sounds by pretraining error type.

(2%) did. When Minimal Contrasts were included, 97 (89%) of the 109 targets did not generalize and 12 (11%) did (Figure 2). These differences in generalization outcomes were statistically significant [$\chi^2(1) = 6.11$; $p < .05$]. Many variants of minimal contrast strategies have been proposed during the period since these retrospective data were collected. Although the magnitude of the clinical gains associated with this strategy was not large in the present findings, development and use of minimally contrasted stimuli in pragmatically oriented communication management approaches has been of continuing interest (e.g., Blache, 1982; Ferrier & Davis, 1973; Weiner, 1982).

In Figure 2, lower left panel, for the 42 speech targets for which Auditory Discrimination was not included as a strategy, no target sound generalized to spontaneous speech, whereas when it was included, 82 (91%) did not generalize and 8 (9%) did generalize [$\chi^2(1) = 3.97$; $p < .05$]. Discussions of auditory discrimination activities in intervention have appeared in numerous forms in the clinical literature (e.g., Locke, 1983; Monnin, 1984; Winitz, 1984). As with the findings for Auditory Bombardment and Minimal Contrasts, it is difficult to interpret the significance of these marginally significant differences in generalization outcomes, given the many child and management variables that were interactive in these data.

The lower right panel in Figure 2 displays the generalization outcomes for the 229 speech targets for which Self-Evaluation was not included and the relatively equal and large number of target sounds (200) for which it was included. When Self-Evaluation was not included in the management program, 223 (97%) target

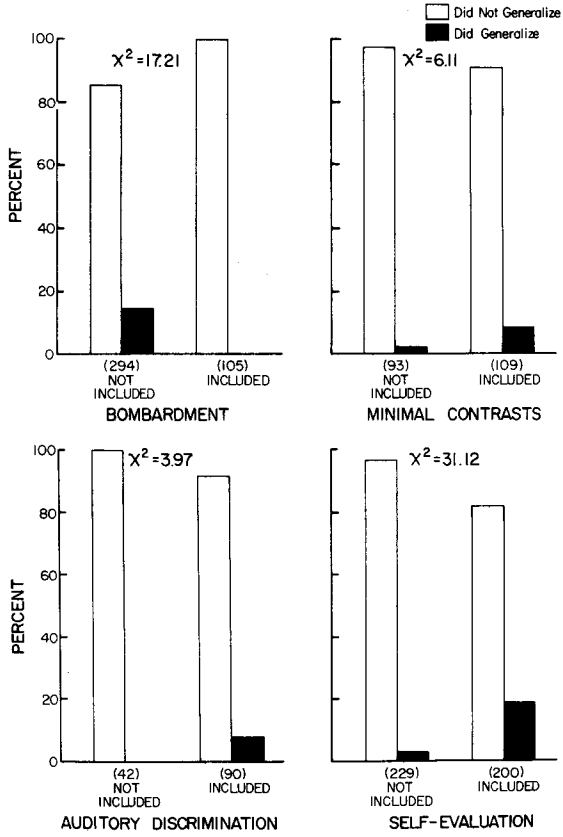

FIGURE 2. Generalization of target sounds by management strategy.

sounds did not generalize and 6 (3%) did generalize. When Self-Evaluation was included, 162 (81%) target sounds did not generalize and 38 (19%) did generalize to continuous speech. Both the statistical findings [$\chi^2(1) = 31.12$; $p < .05$] and the clinical effect size appear to meet the requirement suggested at the outset of this paper of a potentially powerful variable that warrants controlled study. Several additional analyses and literature considerations support this conclusion.

First, the large number of sounds involved in the Self-Evaluation contrast and the controls imposed by the coding procedure suggest that the finding is functionally related to child and management variables. That is, it seems clear from the differences associated with the Self-Evaluation variable, that this finding cannot be discounted as an example of the kind of unexplained spontaneous generalization that occurs in some speech-delayed children (e.g., Olswang & Bain, 1985).

Second, although statistically significant effects were found for each of the other three teaching strategies, subsequent analyses indicated that these findings may

have been due to their association with the self-evaluation strategy used in the same program. Generalization outcomes were calculated when each of the four strategies was the only strategy used in the management program (i.e., none of the other three strategies was included during the semester). Auditory Discrimination was never the only strategy, so a generalization percentage could not be calculated. For Minimal Contrasts, which was the only strategy used with 12 speech targets and Auditory Bombardment, which was the only strategy used with 50 targets, generalization was 0% and 2%, respectively. In contrast, for the 93 targets for which Self-Evaluation was the only strategy used in the program, 18 (19%) of the targets generalized.

Third, because the specific self-evaluation techniques used by clinicians for children who did and did not generalize could not reliably be reconstructed, speculation about the content of effective strategies cannot be proposed. Variants of self-evaluation procedures crossing many theoretical views of intervention have appeared in the clinical literature. In Shriberg and Kwiatkowski (1982b) these differing conceptions were subsumed under a cover term, Type C programs. The central feature of Type C programs is that a child is consequated for correct evaluation of his or her own outputs. Such programs contrast with Type A programs, which consequate a child's identification, discrimination, or monitoring responses to external sources of linguistic input, and Type B programs, which use external sources to consequate the child's speech output. For example, many traditional Type C programs recommend that children undertake immediate self-evaluation of correct/incorrect speech forms (e.g., Engel & Groth, 1976), while variations on long-term self-evaluation procedures involving charting behaviors in a variety of situations have been proposed in behaviorally-oriented intervention views (e.g., Diedrich, 1971; Koegel, Koegel, & Costello-Ingham, 1986). Ruscello and Shelton (1979) suggest self-evaluation techniques that emphasize proprioceptive cues, tactile cues, and cognitive processes involved in speech-motor planning. Finally, more recently appearing variants of self-evaluation strategies stress their use in pragmatically valid contexts, such as having the child try to evaluate and correct phonologic errors when a listener signals misunderstanding (e.g., Hagood & Dunn, 1985; Leach, 1984; Spinelli & McCoughey-Nisenbaum, 1984; Weiner & Ostrowski, 1977). Hence, self-evaluation processes appear to be central concepts within diverse theoretical views of normal speech development and, in the present context, within approaches to and explications of successful intervention.

Fourth, the data suggest that age may moderate the relationship of self-evaluation procedures to spontaneous generalization. Self-evaluation, as operationalized in the many ways suggested above, requires a child to have obtained a certain level of metalinguistic awareness that may be approximately correlated with age. Because age is a macrovariable that indexes development in cognitive, sensorimotor, and pragmatic domains, the relative success of self-evaluation procedures that invoke processes in one or another of these domains may, in part, be a function of a child's individual growth and development in the requisite ability domain. In the present data, children with whom self-evaluation activities were used ranged in age from 50 to 109 months. Of the children who did spontaneously generalize at least one target sound to continuous speech, none was below 60 months of age.

Fifth, the data do not suggest that the efficacy of self-evaluation to facilitate generalization is associated with severity of speech delay as indicated by Percentage of Consonants Correct (PCC). There was no statistically significant difference between the average PCCs of generalizers and nongeneralizers whose training included Self-Evaluation [F (1, 20) = .41 $p > .05$]. Furthermore, clinicians' decisions to include a self-evaluation strategy in the child's management program was not determined by severity of speech delay. PCCs for children for whom Self-Evaluation was included ranged from 54% to 86% [M = 72; SD = 9.8], while for children for whom self-evaluation was not included, PCCs ranged from 53% to 86% [M = 68; SD = 9.2]. Mean differences in PCC scores were not statistically significant [F (1, 44) = 1.72 $p > .05$].

Finally, these retrospective data did not allow for analyses of possible phase- or step-related aspects of self-evaluation procedures. It could not be determined exactly when in the management program a self-evaluation strategy had been implemented and how frequently it had been used both within and across management sessions. Differences in both the type of self-evaluation strategy, as discussed above, and their relative use at different program steps, may be critical to their potential as facilitators of spontaneous generalization to continuous speech.

Conclusions

Among 11 child and management variables that were coded for retrospective study, only child age, error type, and self-evaluation strategies have emerged as potentially productive variables for controlled prospective study. For clinical purposes, age and error type may prove to be robust predictors of the potential for early spontaneous generalization in speech-delayed children. For continued clinical research and practice, variants of self-evaluation procedures may prove to be an effective component in the intervention plan.

As suggested at the outset of this report, the objective of rapid speech normalization for preschool children with significant speech delays is a valued research goal and a clinical task that increasingly is becoming the responsibility of persons working in the public school environment. The dependent variable derived for this study, early spontaneous generalization to continuous speech, may serve as a useful outcome criterion against which emerging intervention programs may be compared. The fact that in a relatively short period of time, some children did generalize to this level suggests the potential effectiveness that programs for young, speech-delayed children may someday routinely obtain.

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REFERENCES

BLACHE, S. (1982). Minimal word pairs and distinctive feature training. In M. Crary (Ed.), *Phonological intervention: Concepts and procedures* (pp. 61–69). San Diego: College-Hill Press.

COSTELLO, J., & ONSTINE, J. M. (1976). The modification of multiple articulation errors based on distinctive feature theory. *Journal of Speech and Hearing Disorders, 41,* 199–215.

DIEDRICH, W. (1971). Procedures for counting and charting a target phoneme. *Language, Speech, and Hearing Services in the Schools, 5,* 18–32.

DIEDRICH, W., & BANGERT, J. (1980). *Articulation learning.* San Diego: College-Hill Press.

DUNN, C. (1983). A framework for generalization in disordered phonology. *Journal of Childhood Communication Disorders, 7,* 46–58.

DUNN, C., & DAVIS, B. (1983). Phonological process occurrence in phonological disordered children. *Applied Psycholinguistics, 4,* 187–207.

ELBERT, M., DINNSEN, D. A., & POWELL, T. W. (1984). On the prediction of phonologic generalization learning patterns. *Journal of Speech and Hearing Disorders, 49,* 309–317.

ELBERT, M., & MCREYNOLDS, L. V. (1975). Transfer of /r/ across contexts. *Journal of Speech and Hearing Disorders, 40,* 380–387.

ELBERT, M., & MCREYNOLDS, L. V. (1978). An experimental analysis of misarticulating children's generalization. *Journal of Speech and Hearing Research, 21,* 136–150.

ELBERT, M., SHELTON, R. L., & ARNDT, W. B. (1967). A task for evaluation of articulation change. I. Development of methodology. *Journal of Speech and Hearing Research, 10,* 281–289.

ENGEL, P., & GROTH, L. (1976). Case studies of the effects on carry-over of reinforcing post-articulation responses based on feedback. *Language, Speech, and Hearing Services in the Schools, 7,* 93–101.

FERRIER, E., & DAVIS, M. (1973). A lexical approach to the remediation of final sound omissions. *Journal of Speech and Hearing Disorders, 38,* 126–130.

GIERUT, J. (1985). *On the relationship between phonological knowledge and generalization learning in misarticulating children.* Unpublished doctoral dissertation, Indiana University-Bloomington.

GRUNWELL, P. (1981). *The nature of phonological disability in children.* New York: Academic Press.

HAGOOD, L., & DUNN, C. (1985). *Self-monitoring in phonological acquisition.* Paper presented at the Child Phonology Meeting, Purdue University, Bloomington.

HODSON, B., & PADEN, E. (1981). Phonological processes which characterize unintelligible and intelligible speech in early childhood. *Journal of Speech and Hearing Disorders, 46,* 369–373.

HODSON, B., & PADEN, E. (1983). *Targeting intelligible speech: A phonological approach to remediation.* San Diego: College-Hill Press.

KOEGEL, L. K., KOEGEL, R. L., & COSTELLO INGHAM, J. (1986). Programming rapid generalization of correct articulation through self-monitoring procedures. *Journal of Speech and Hearing Disorders, 51,* 24–32.

LEACH, E. (1984). Correcting misarticulations by the use of semantic conflict. In H. Winitz (Ed.), *Treating articulation disorders: For clinicians by clinicians* (pp. 153–160). Baltimore: University Park Press.

LEONARD, L. (1985). Unusual and subtle phonological behavior in the speech of phonologically disordered children. *Journal of Speech and Hearing Disorders, 50,* 4–13.

LOCKE, J. (1983). Treatment of speech perception problems. In W. H. Perkins (Ed.), *Phonologic-Articulatory Disorders* (pp. 17–20). New York: Thieme-Stratton.

MCREYNOLDS, L., & ELBERT, M. (1981). Generalization of correct articulation in clusters. *Applied Psycholinguistics, 2,* 119–132.

MONNIN, L. (1984). Speech sound discrimination testing and training: Why? Why not? In H. Winitz (Ed.), *Treating articulation disorders: For clinicians by clinicians* (pp. 1–20). Baltimore: University Park Press.

OLSWANG, L. B., & BAIN, B. A. (1985). The natural occurrence of generalization during

articulation treatment. *Journal of Communication Disorders, 18,* 109–129.
ROCKMAN, B., & ELBERT, M. (1984). Generalization in articulation training. In H. Winitz (Ed.), *Treating articulation disorders: For clinicians by clinicians* (pp. 131–151). Baltimore: University Park Press.
RUSCELLO, D. M., & SHELTON, R. L. (1979). Planning and self-assessment in articulatory training. *Journal of Speech and Hearing Disorders, 44,* 504–512.
SHRIBERG, L., & KWIATKOWSKI, J. (1982a). Phonological disorders I: A diagnostic classification system. *Journal of Speech and Hearing Disorders, 47,* 226–241.
SHRIBERG, L., & KWIATKOWSKI, J. (1982b). Phonological disorders II: A conceptual framework for management. *Journal of Speech and Hearing Disorders, 47,* 242–256.
SHRIBERG, L., & KWIATKOWSKI, J. (1982c). Phonological disorders III: A severity metric. *Journal of Speech and Hearing Disorders, 47,* 256–270.
SHRIBERG, L., & KWIATKOWSKI, J. (1985). Continuous speech sampling for phonologic analyses of speech-delayed children. *Journal of Speech and Hearing Disorders, 50,* 323–334.
SHRIBERG, L., KWIATKOWSKI, J., & HOFFMANN, K. (1984). A procedure for phonetic transcription by consensus. *Journal of Speech and Hearing Research, 27,* 456–465.
SHRIBERG, L., KWIATKOWSKI, J., BEST, S., HENGST, J., & TERSELIC-WEBER, B. (1986). Characteristics of children with phonologic disorders of unknown origin. *Journal of Speech and Hearing Disorders, 51,* 140–161.
SPINELLI, F., & MCCOUGHEY-NISENBAUM, J. (1984). *Phonologically impaired preschoolers' responses to two types of clarification requests.* Paper presented at the Annual Convention of the American Speech-Language-Hearing Association, San Francisco.
WEINER, F. (1982). Pragmatic treatment for phonologic disability: Rationale and procedures. *Seminars in Speech, Language, and Hearing, 3,* 138–148.
WEINER, F. & OSTROWSKI, A. (1977). *Listener uncertainty and variability of sound production.* Paper presented at the Annual Convention of the American Speech-Language-Hearing Association, Chicago.
WEINER, F., & WACKER, R. (1982). The development of phonology in unintelligible speakers. In N. Lass (Ed.), *Speech and language: Advances in basic research and practice* (Vol. 4) (pp. 51–125). New York: Academic Press.
WING, D., & HEIMGARTNER, L. (1973). Articulation carry-over procedure implemented by parents. *Language, Speech and Hearing Services in the Schools, 4,* 182–195.
WINITZ, H. (1984). Auditory considerations in articulatory training. In H. Winitz (Ed.), *Treating articulation disorders: For clinicians by clinicians* (pp. 21–50). Baltimore: University Park Press.

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Lawrence D. Shriberg, and Joan Kwiatkowski
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