Modifications of Classroom Speech Training Prompted by Systematic Inservice Education

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The CUNY Preservice-Inservice Training Project is designed to upgrade the skills of professionals providing speech services to hearing-impaired children. This staff development program has encouraged professionals to examine and modify existing speech programs in order to apply the suggested principles and practices for greater carryover of speech training. One school for the deaf has developed an interdepartmental speech program to incorporate individual tutoring sessions with daily classroom speech periods. Statistical analysis of speech evaluations indicated significant improvements in the phonetic-level targets practiced during those periods. In response to the need for additional materials and techniques to facilitate speech maintenance and carryover throughout the school day, an assessment procedure was developed to describe communication strategies, the auditory environment, and communication modes of teachers and students. This profile was used in a second school for the deaf to provide feedback to teachers for increased speech carryover. Preliminary results of a pilot study with this profile are discussed, and a theoretical model for carryover is suggested.

In our professional work with communication disorders in children, we often encounter "buzz words," terms used to indicate those conditions, treatments,

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or outcomes we perceive as ideal, including carryover, early identification, parent counseling, or mainstreaming. A term like *carryover,* used in reference to speech training in general (and, for our purposes, speech training of the hearing impaired in particular), is greeted with nods of agreement and approval by teachers of the hearing impaired, speech-language pathologists, and educational audiologists. In principle, the carryover of teaching and/or therapy activities into conversational speech is the major goal of their endeavors; in fact, like those other buzz words, it frequently falls far short of successful realization. In recent years, the challenges to professionals whose goals include carryover have been to *assimilate* a growing body of basic and applied research within the traditional domains of education of the hearing impaired and/or speech-language pathology and audiology, to *accommodate* the ever-broadening scope of normal speech and language development, and to *apply* this overwhelming body of knowledge to systematic and meaningful educational strategies for severely and profoundly hearing-impaired children. This challenge is compounded by the presence of additional complicating factors, such as multiple handicaps; later ages of identification and intervention; and the cultural, social, and emotional dimensions of a child's family. Moreover, the ultimate barrier against reaching the desired speech teaching goals may be erected by the professionals themselves. As Ling (1976) suggested:

> Failure to acquire useful speech will result if those in direct contact with the child do not consider acquisition of speech skills a worthwhile goal, lack the required teaching techniques, or have an inadequate understanding of the many variables which underlie speech development. (p. 9)

Traditionally, teachers of the hearing impaired had the primary responsibility for the speech training of their students (Bender, 1960). The development of speech departments in school programs for the hearing impaired, concurrent with the increase in orientation to a philosophy of total communication, has led to a gradual but significant decline in the speech teaching skills of classroom teachers (or confidence in those skills; see Hochberg, 1980). The responsibility for these activities was assumed by speech departments while classroom teachers focused greater attention on language development. Thus, with speech and auditory training considered to be separate school subjects, the incorporation of speech reception and production activities for carryover into content areas (e.g., mathematics, science, reading, etc.) has not been fully successful. The other side of this unfortunate coin is that speech-language pathologists have not necessarily received the training or practicum experience to prepare them adequately for providing effective speech services to this population.

These observations, presented here in a general way, were documented systematically through a needs assessment conducted by the Center for

Research in Speech and Hearing Sciences of the the City University of New York during the first year of its Preservice-Inservice Training Project. The needs assessment included task force meetings, site visits, a national survey of classroom teachers and speech-language pathologists working with hearing-impaired children, and a review of the literature (Hochberg, 1980; Hochberg, Levitt, & Osberger, 1980). The major conclusions drawn from these assessments were (a) that there was an urgent need for continuing education through inservice training for classroom teachers of the hearing impaired and speech-language pathologists, in combination with (b) modifications in pre-professional training programs, and (c) the need for these professions to work together at both preservice *and* inservice levels.

We have addressed these needs through the development of a consortium model of preservice and inservice training (Hochberg, Schmidt, Solomon, Schiavetti, Godsave, & Burgess, 1981). We define a consortium as a formal cooperative agreement among representatives of several constituent units for the purpose of achieving mutually desirable objectives through on-going collaboration and interaction. In our case, the constituent units include: (a) a laboratory facility doing research on speech of the hearing impaired and related issues, (b) a university with both a department of speech-language pathology and audiology and a teacher-training program in education of the hearing impaired, and (c) school programs providing services to hearing-impaired children. We have worked within this basic consortium concept during the past three years (Hochberg & Schmidt, in press), with one of the major goals being to demonstrate that systematic continuing education *can* have a significant impact on the skills and competencies of professionals responsible for speech training and ultimately on the speech reception and production skills of hearing-impaired students themselves.

Regional Inservice Training

In order to reach this goal, a regional inservice training program was developed in which a fifteen-week course on topics related to speech of the hearing impaired was provided to six classroom teachers of the hearing impaired, two resource room teachers, and seven speech-language pathologists representing eight school programs in the New York City metropolitan area. This course prepared the 15 participants to return to their respective schools and provide inservice training to their staffs. As each school's representatives prepared to initiate training, project staff members assisted them to organize their respective inservice curricula and provided them with audiovisual materials to supplement the lectures and demonstrations. (See Hochberg, 1980, for more details regarding this component of the project.) Six of the eight school programs presented some form of inservice training, ranging in length from six weeks to the entire school year.

At the conclusion of this training, evaluations by the staffs who participated indicated a pressing need for more information of a practical nature and demonstrations of speech carryover activities to incorporate into classroom instruction. Another major point which emerged was the need for the school audiologists to take a more active role in this continuing education program. Although educational audiologists were not among those originally trained by us to present the inservice program, several topics are directly related to their services in school programs, including audiological assessment, amplification, speech reception, and auditory training. We suggested that the audiologist in each participating school could at the very least attend the inservice program, if not assist in the preparation and presentation of topics relevant to audiology.

Carryover Model

In order to address the issue of speech carryover in the classroom, a model of carryover activities is suggested here in Figure 1. This model is based on the work of Head (1979), as well as a review of earlier behavioral research and theory (e.g., Brookshire, 1967; Engel, Brandriet, Erickson, Gronhovd, & Gunderson, 1966; Fleming, 1971; Griffiths & Craighead, 1972; McLean, 1970; Powell & McReynolds, 1969; Shames, 1957; Winitz, 1975; Wright, Shelton, & Arndt, 1969) and practical suggestions (e.g., Hahn, 1961; Marquardt, 1959; Powers, 1971; Sutton, 1955) for carryover of articulation therapy with normally hearing children, as summarized by Mowrer (1971). This model focuses on the special carry-over needs and environments of hearing-impaired children, particularly at the second (classroom) level.

Two parallel hierarchies of carryover are identified, operating at three interacting levels. The *developmental* hierarchy involves the development of production and reception skills for individual phonemes and suprasegmental aspects of speech.The responsibility for this initial development often rests with the speech department of a school program and is realized through individual and group speech therapy activities. Carryover occurs in the developmental hierarchy when classroom or resource room teachers designate a period for practice and drill of the skills developed in therapy. As indicated by the two-way arrows connecting these two levels, a cooperative exchange between the teacher and the speech-language pathologist is essential for determining objectives and sharing progress as well as for the subsequent communication of this information to parents.

The *maintenance* hierarchy of Figure 1 involves: (a) the carryover of phonetic skills into meaningful language at the therapy level (Ling, 1976, 1978a), (b) incorporation of speech and auditory training objectives into classroom content lessons, and (c) generalization beyond these two settings

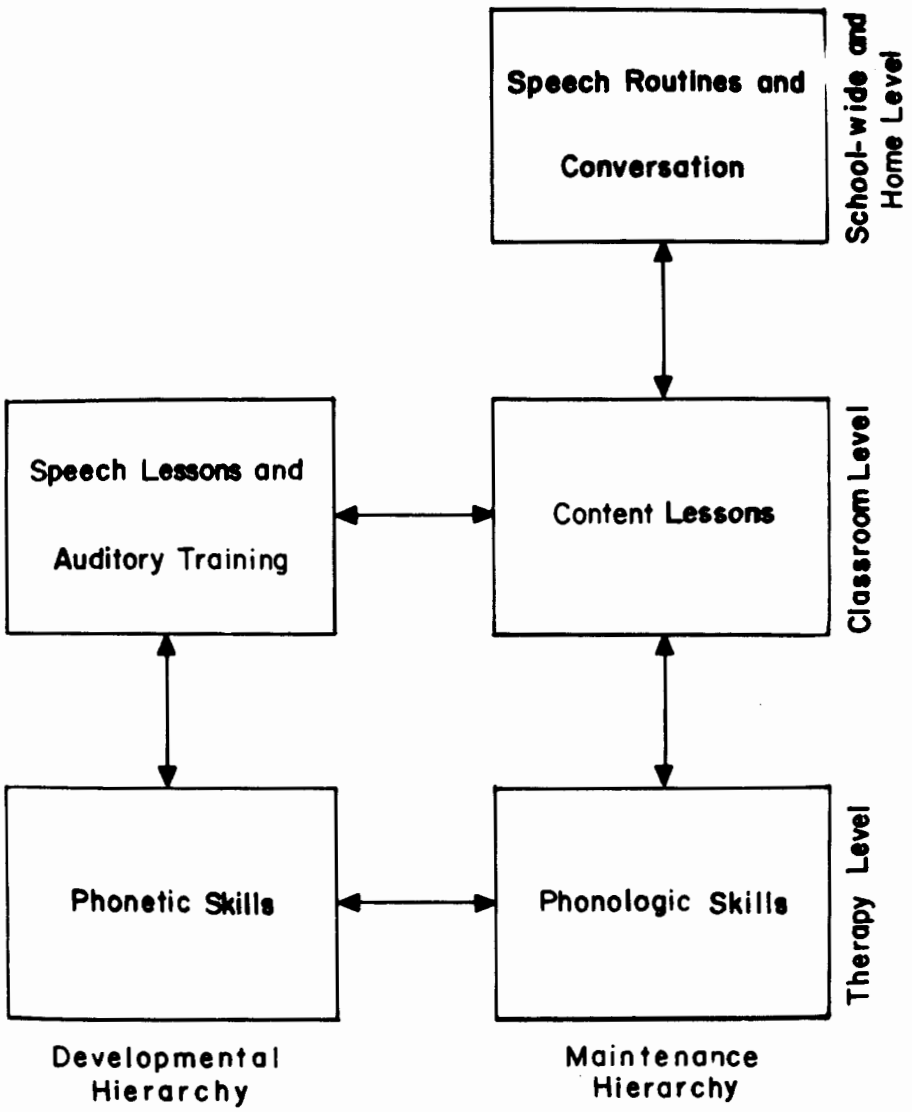

Figure 1. Carryover model. Two parallel hierarchies are suggested. The *developmental* hierarchy (left) involves systematic speech training in individual or group therapy carried over into classroom lessons specifically designed for speech and auditory training. The *maintenance* hierarchy is concerned with the retention and generalization of speech reception and production skills in meaningful language situations at the three levels indicated. Arrows indicate the interdependence of hierarchies and levels.

throughout the school and at home (Blackwell, in press). Again, the interaction between these three levels is essential as is the interaction between the development and maintenance hierarchies. Within our project, it is at the classroom level that increased attention has been addressed to generalize beyond the skills developed in therapy. That is, classroom teachers who have completed inservice training regarding speech of the hearing impaired have expressed their need for strategies to maximize opportunities for carryover, both developmentally and for maintenance of skills. We have worked with two day schools for the deaf to address this need, as follows:

1. In order to extend speech services from the development and remediation model of traditional speech therapy to include systematic carryover into the classroom, one school for the deaf began a daily program of speech drill in the classroom. A post hoc study of speech evaluations, comparing results from the traditional program with results following the initiation of the new program, is described below.
2. A profile for assessment of speech communication in the classroom was developed (Schmidt & Solomon, 1981) to facilitate the application of principles and techniques learned during the inservice training program to classroom maintenance of speech skills within content lessons. In a pilot study at a second school for the deaf, classroom teachers incorporated speech maintenance strategies which were suggested by this profile. Preliminary results of this study are discussed below.

CARRYOVER OF SPEECH THERAPY THROUGH CLASSROOM PRACTICE OF SPEECH TARGETS

The first effort to provide carryover within the developmental hierarchy (from the therapy level to the classroom level) occurred at St. Francis de Sales School for the Deaf (St. Francis) in Brooklyn, New York, where concurrent with the presentation of the inservice training program, the speech department initiated a new daily classroom speech period designed to familiarize classroom teachers with the speech skills ("targets") identified for each student.

St. Francis has endorsed a total communication philosophy since 1973, and the speech program followed what may be termed a traditional or multisensory syllable unit method (Calvert & Silverman, 1975). Speech training was provided for each child twice weekly (20-40 minutes per session) by state-certified, speech-language pathologists. In September, 1979, the speech program was restructured to include two new components: (a) mandatory participation for teaching staff in the inservice program described above with voluntary attendance by speech staff, supervisors, and specialists; and (b) designation of the first period of each school day as a speech period.

Speech targets were established by the speech-language pathologists, who

administered phonetic and phonologic evaluations (Ling, 1976). After the targets were determined, the speech staff and the classroom teachers worked systematically on these targets during the traditional individualized therapy sessions and the new classrooom speech periods, respectively. During the classroom speech periods, speech staff members were available to work with classroom teachers if questions regarding speech production or remediation strategies were encountered. A record-keeping system was developed by modifying the *Cumulative Record of Speech Skill Acquisition* (Ling, 1978b; also Martello, in press).

Assessment of Evaluation Results

Annual administration of the phonetic level evaluation (Ling, 1976) at the beginning and end of each school year, and use of the record book yielded short-term longitudinal data on the growth of phonetic level speech skills of the students at St. Francis. A post hoc study using a one-group, before-after design (Matheson, Bruce, & Beauchamp, 1978) was undertaken to collect and analyze these data to consider the effectiveness of the additional effort related to speech activities.

Subjects. Twenty-nine students (10 females and 19 males) in the Upper Department of the school (students aged 10 to 14) were selected arbitrarily because of the availability of pre- and post-test data for at least two consecutive years. In the initial year of testing (Fall, 1978), the age range of these subjects was from 10 years 10 months to 14 years 0 months, with a mean age of 12.2 years. Unaided three-frequency (500-2000 Hz) pure-tone averages (PTAs) in the better ear ranged from 82 to 128 dB hearing threshold level (HTL) with a mean of 101 dB HTL.

Other pertinent information was obtained from the students' school records. Among the 29 subjects were one visually impaired student, one with orthopedic problems, one with perceptual problems, and two identified as educably mentally impaired based on scores on the WISC. These scores ranged from 58 to 124, with a mean score of 93.4. Four of the students have deaf parents, and eight students come from monolingual Spanish-speaking homes.

Instrument. The phonetic level evaluation (Ling, 1976) was administered to all 29 students at least four times (Fall, 1978; Spring, 1979; Fall, 1979; Spring, 1980), and a fifth time (Fall, 1980) to 21 of the 29 students. (The other eight students graduated in the Spring of 1980.)

The phonetic level evaluation reflects the sequential hierarchy suggested by Ling (1976) for the development of phonetic level skills. Thus, suprasegmental skills are tested first, followed by four levels or "steps" of vowels, four steps of consonants, and five steps each for word-initial and word-final blends. For the vowels and consonants, a child's skills are assessed for (a) production of the phoneme in a single syllable, (b) repetition at a rate of three per second,

(c) alternation with another phoneme at the same rate, and (d) production with a range of pitch. A check ($\surd$) is used to indicate consistent production, a plus (+) denotes inconsistent production, and a minus (-) indicates inability to produce the phoneme.

Results. A total of 70 response items were identified, drawn from the suprasegmental skills (vocalization, duration, intensity, pitch) and the "Step 1" vowels (/a/, /i/, /u/, /aʊ/, /aɪ/) and consonants (/b/ or /p/, /w/, /f/ or /v/, /θ/ or /ð/, /h/, /m/) for which there were complete assessment data for all subjects, even though many of the students had targets selected from the more advanced steps. For the purpose of analysis, a value of 3 points was given for each check (for mastery of a skill), 2 points for each plus (for inconsistent production of a phoneme), and 1 point for each minus (inability to produce a phoneme). The lowest possible score (all items minus) was 70 and the highest (all items checked) was 210.

Two analyses of variance (ANOVA) were used to examine several factors of the speech evaluation results. The first ANOVA (Table 1) included three factors: (a) effect of training (pre- and post-training), (b) year of training (first and second year), and (c) subject (N=29). A factor on differences among testers was not included. An examination of main effects suggested that: (a) the overall effect of training led to significant improvements in test scores; (b) there was a significant improvement in test scores between the first year of training (traditional speech therapy) and the second year (speech therapy plus inservice training and classroom speech periods); and (c) there were significant individual differences among subjects.

Table 1

Analysis of Variance: Phonetic Level Evaluations

Source of Variation	Degrees of Freedom	Mean Squares	F-ratio	Level of Significance
Pre/post Training (T)	1	23016.85938	314.569	0.001
Year of Training (Y)	1	3487.03442	47.657	0.001
TY Interaction	1	417.24121	5.702	0.023
Subjects (S)	28	2216.42627	30.292	0.001
TS Interaction	28	128.68318	1.759	0.071
YS Interaction	28	85.46304	1.168	0.342
TYS Interaction	28	73.16951		

The TY interaction (effect of training and year of test) was also significant ($p<.023$) and indicated that although there was improvement in both years, the effect of training was greater in the second year, as shown in Table 2.

Table 2
Improvements in Phonetic Level Evaluations
for Year 1 and Year 2

	Pre-training[a]	Post-training[a]	Improvement
Year 1	151.4	175.7	24.3 points
Year 2	158.5	190.5	32.0 points

[a]Numbers are interaction means.

The second ANOVA (Table 3) examined the extent of the reductions in scores which may be attributable to summer vacations from school. Three factors were considered: (a) effect of a break in training (pre- and post-summer vacation), (b) the year of the break (first and second summer), and (c) subjects (N=21). As before, all three main effects were highly significant ($p<.001$): (a) there was a significant reduction in test scores between the beginning and the end of the summer vacations; (b) there was a significant improvement in test scores for the second year (implementation of new speech activities); and (c) there were significant intersubject differences.

Table 3
Analysis of Variance: Reductions in Phonetic Level
Evaluation Scores

Source of Variation	Degrees of Freedom	Mean Squares	F-ratio	Level of Significance
Summer Gap (G)	1	2508.10693	28.892	0.001
Year of Gap (Y)	1	11363.43750	130.903	0.001
GY Interaction	1	1078.58325	12.425	0.002
Subjects (S)	20	2282.97974	26.299	0.001
GS Interaction	20	56.28214	0.648	0.830
YS Interaction	20	138.36546	1.594	0.153
GYS Interaction	20	86.80832		

Table 4
Changes in Phonetic Level Evaluations
after Summer 1 and Summer 2

	Pre-summer[a]	Post-summer[a]	Change in Performance
Year 1	173.0	154.9	-18.1 points
Year 2	189.0	185.3	- 3.7 points

[a]Numbers are interaction means.

There was also significant interaction($p<.002$) between the break in training and the year of testing; i.e., the change in performance was significantly less after the second summer break in training, as shown in Table 4.

Discussion

Statistically significant improvements on phonetic level evaluations occurred during both years of testing, with greater improvements occurring in the second year, which may be attributable to the implementation of inservice training and the newly scheduled daily classroom speech periods. There is no procedure which can determine if the 32-point mean improvement in second-year scores is clinically or educationally more significant than the 24-point mean improvement noted for the first year (Figure 2). One confounding variable in the analysis of second-year data is a ceiling effect observed in five students who were consistently producing all Step 1 items (thus scoring the maximum 210 points) and had moved on to more advanced phonetic level skills. It is possible that the difference between the two years would have been substantially greater if additional vowel and consonant steps had been included in this analysis.

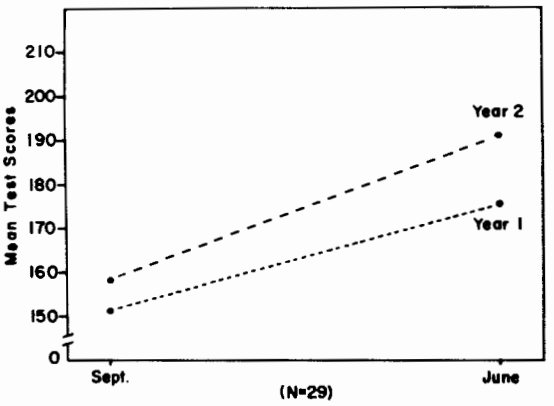

Figure 2. Mean test scores on phonetic level evaluations in September and June for first and second years of training. (Linear growth is presumed, although rate of growth was not examined.

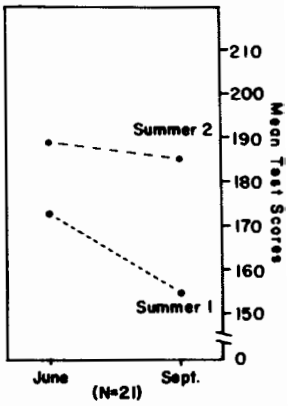

Figure 3. Mean test scores on phonetic level evaluations in June and September for first and second summer breaks in training.

An interesting finding is the ANOVA of the reduction in scores after the three-month summer vacations (Figure 3). The first summer drop of an average of 18.1 points, after gaining an average of 24.3 points during the previous school year, is not dissimilar to that observed by Nittrouer, Devan, and Boothroyd (1976) in an auditory training study with students in the same

age range (10 years to 12 years 2 months). They found that students' scores on several measures of speech perception returned almost to baseline after a seven-month gap in training.

The more intriguing finding then occurred after the second summer when the mean reduction in scores was only 3.7 points. An examination of the raw data revealed that among the 21 students in this group, only nine had an actual reduction in scores after the second summer ($\bar{X}$=-12.78 points), while five students had no difference in scores, and seven actually improved their scores after the summer ($\bar{X}$=+5.28 points). Despite the statistical finding of significant intersubject differences, there appeared to be no *systematic* differences among students which would account for the reduction, retention, or improvement in scores after the second summer. That is, no similarities were noted in terms of the ages of the students, their better-ear hearing thresholds, the presence of additional handicaps, the hearing status or dominant language of their parents, or their intelligence as measured by the WISC. For example, the two students identified by the school as educably mentally impaired had the largest reduction in points after the second summer. However, this finding was not consistent with the performance of these two students during the two years of training and after the first summer when excellent progress and average reductions, respectively, were noted.

This inconsistency suggests that the internal validity was affected in some way by the design of this study and by the presence of other uncontrollable variables (Campbell & Stanley, 1963). For example, the school population was not randomly sampled. Also, in addition to the speech program at school, other speech-related events, which Campbell and Stanley termed effects of history, occurred between measures. Over the course of this two-year period, the maturation of subjects also may have had an effect on the evaluation results. However, because speech evaluations are a normal part of the school experience for hearing-impaired children, the effects of testing with the same instrument was not felt to be a detrimental factor. It is encouraging to note that despite, or perhaps because of, such variables as maturity and history in addition to staff development and training, improvements could be observed in this older population of children for whom speech training is often a negative experience.

These data are for phonetic level evaluations only; phonologic assessments and speech reception skills have not been examined to the same extent at St. Francis, although Ling has begun to report results of phonologic assessments (Ling, 1980), as well as the effects of breaks in training at the phonologic level (Ling & Shitrit, 1980). Further analysis of progress in speech training, similar to that reported by Osberger, Johnstone, Swarts, and Levitt (1978) and Osberger (in press), needs to be undertaken with the already-established, record-keeping system used at the school. This might yield more information about individual differences among students.

CARRYOVER OF SPEECH SKILLS AFTER ASSESSMENT OF SPEECH COMMUNICATION IN CLASSROOM CONTENT LESSONS

In an effort to improve speech carryover at the classroom level of the maintenance hierarchy (Figure 1), a second study was conducted to assess the capacity of an observational instrument (Schmidt & Solomon, 1981) designed to yield information about the nature and amount of speech interactions occurring in classrooms for hearing-impaired children. This instrument was developed to identify objectives for direct interaction and intervention with teachers regarding speech in their classrooms. Before project staff members provided such assistance regarding the interactions themselves, the general speech communication environment in classrooms was assessed in a variety of areas. The contents of the profile (summarized in Table 5) were based on our inservice training curriculum; information gained from the authors' training programs and teaching experiences; and input from researchers, university faculty, supervisors, and classroom teachers.

Table 5

Summary of Assessment Items for
Profile of Speech Communication in the Classroom

I.	Auditory Environment
	A. Personal hearing aids
	B. Classroom amplification equipment
	C. Acoustical treatment of classroom
	D. Internal noise of classroom
II.	Teacher Variables
	A. Use of amplification
	B. Classroom arrangement and environment
	C. Awareness of speechreading needs of students
III.	Communication Modes
	A. Teacher only
	B. Teacher-student interaction (teacher-initiated)
	C. Student-teacher interaction (student-initiated)
	D. Teacher facilitation of student-student interaction
	E. Student-student interaction

A pilot study was conducted with ten volunteers from among the classroom teachers at St. Joseph's School for the Deaf, Bronx, New York, another day school espousing the total communication philosophy which has participated in the inservice training program described above. During this study, project staff used the profile to record pre- and post-interaction observations and found it to be a good source for objectives for a series of four weekly

classroom interactions and conference periods with each teacher.

The preliminary results of these activities indicated that even with only a limited number of contacts with individual teachers, gains could be made in several areas pertinent to the maintenance of speech skills in classroom-teaching situations. These areas included: (a) use and maintenance of classroom amplification systems, (b) expectations for students' simultaneous use of speech with signed English, (c) awareness and incorporation of levels of intervention (Calvert & Silverman, 1975) for speech correction and maintenance, (d) opportunities and expectations for modification of speech after such intervention, and (e) auditory training activities.

In summary, the profile proved to be a useful and suitable qualitative tool for determining the communication strategies and modes used in self-contained classrooms for hearing-impaired children. Information gained from the profile enabled the project staff to establish objectives for teachers pertaining to improving speech intervention and observing characteristics of speech communication in their classrooms. Although the profile did not yield quantitative data that could be analyzed statistically (Schmidt, Solomon, & Hochberg, in preparation), general trends and patterns of improvement or lack of improvement in specific areas were apparent. On the basis of several preliminary observations and field tests, we believe that this instrument can facilitate a supervisor's determination of the communication strategies employed within a classroom and delineate areas to be strengthened. The profile also provides positive feedback for teachers about the strategies and skills being used in their classrooms.

CONCLUSIONS

In the two studies described above, classroom teachers and speech-language pathologists working together with researchers have been successful in their attempts to combine theoretical information pertaining to speech reception and production by hearing-impaired children with practical applications of speech-training techniques to achieve various levels of carryover. The ANOVA results for phonetic level evaluations suggested that a systematic, long-term, inservice education program (St. Francis continued the original one-year program through a second year) combined with a well-organized and supported classroom speech period can lead to carryover within the developmental hierarchy suggested here.

Furthermore, the preliminary results of the pilot study with the profile of speech communication in the classroom were very gratifying with the occurrence of observable increases and improvements in opportunities and expectations for speech production during other class lessons. Based on these studies and other feedback we have received, we are now in the process of revising and expanding our inservice curriculum and exploring additional means of increasing carryover at the classroom level. These endeavors will

continue at both the inservice and preservice levels, with increased attention to the participation of educational audiologists in the continuing education process.

Support staff in school programs for hearing-impaired children have recognized the importance of speech reception and production and their roles in the speech carryover task. In addition to the obvious role of speech-language pathologists, educational audiologists also can make an important contribution to the process of staff development. As mentioned above, our original model of inservice training did not include audiologists as primary inservice providers because they are not yet widely trained and employed in educational settings; but it is obvious that they can play a key role in inservice training regarding amplification, audiological assessment, and auditory development and training. Ross and Calvert (1977) provided a comprehensive description of the potential responsibilities of educational audiologists, which included not only specifications for clinical services in educational settings but also suggestions for organizing auditory skill development programs and the role of the audiologist in the continuing education process.

This implies that the preparation and training of professionals will provide the necessary foundation for audiologists in educational settings to perform such activities, as well as to provide inservice training about the activities to other staff members. However, just as the disciplines of education of the hearing impaired and speech-language pathology need exposure to relevant aspects of each profession as well as to audiology, audiology training programs also must emphasize more interdisciplinary participation in the preparation of educational audiologists. With such training, the educational audiologist will be able to extend audiological services beyond the prevalent nature of clinical services in a school setting and thereby develop a comprehensive auditory program which complements the speech program and classroom instruction. As a result of the coordinated efforts of classroom teachers, speech-language pathologists, and educational audiologists, we believe that carryover of speech reception and production skills can move from the ideal toward reality for hearing-impaired children.

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