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The Effects of Training on the Development of Articulatory Target and Error Analysis Skills.

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THE EFFECTS OF TRAINING ON THE DEVELOPMENT OF ARTICULATORY TARGET AND ERROR ANALYSIS SKILLS

A Dissertation

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ABSTRACT

The articulatory target and error analysis skills of ninety-five college students who were not majoring in communicative disorders were studied to determine what type of training, if any, had an effect on their ability to evaluate and record phonological targets embedded in words and sentences. In addition, the relationship of subject characteristics (course grade, grade point average, and foreign language experience) and phonological variables (type of phoneme, type of productions, and type of error) to the analysis scores was studied.

The subjects' response data from the Pre- and Post Tests were assessed through analysis of variance with a 4x2x3 design (4 treatments: 2 experimental and 2 control; 2 tests: Pre-Post; and 3 levels: word, sentence, and total) to determine if statistically significant differences existed in target and error analysis scores.

The subjects were pre-tested and then assigned to one of four treatment groups. The experimental Group A received live voice or didactic training on target and error analysis skills, while experimental Group B received the same training except the mode of presentation was by videotape. The control subjects were randomly assigned to Group C_1 which had no training on phoneme analysis, however they received another exposure to the three-minute instructional tape on how to record correct and incorrect articulatory

production, or to Group C_2 which had no exposure to instructions so they had no analysis training. The subjects were then post-tested.

The results indicated that a significant difference existed among the subjects' performance in the four treatment groups, particularly between the training and control groups. Those subjects who had training improved significantly in their target and error analysis performances over those who did not have any instruction, particularly when the target phonemes were embedded in sentences. There was no statistically significant difference in the performances of the two experimental groups, the live voice group and the videotape group both made significant gains in their abilities to analyze articulatory targets and errors. This indicated that for target and error analysis training, videotape type teaching was as effective as live voice type instruction.

The analysis of the relationship of certain subject characteristics to subject scores indicated that students who had higher grade point averages and course grades, and foreign language experience in high school had a tendency to perform better on the phonetic analysis tasks than subjects with low grade point averages and course grades, and no foreign language experience. There were three phonological variables (type of phoneme, type of production, and type of error) that tended to relate to subject performance.

It appeared that students could more easily evaluate consonants as correct or incorrect targets, while instruction on vowel analysis was best carried out at the word level. The ability of students to evaluate correct productions as correct and error productions as error apparently depended on the length of utterance, with most subjects demonstrating a greater ability to evaluate errored productions at the word level on the Pre-Test Measure. However, on the Post-Test word measure, they performed better on correct analysis of correct items. For sentence stimuli, the Pre- and Post-Test results indicated that the subjects were better at analysis of correct items.

Evaluation of the type of error or misarticulation indicated that omission type errors had the highest level of correct analysis on words, while substitutions had the highest level of correct analysis at the sentence level. The greatest gains in Pre- to Post-Test performance were for distortion type errors.

In summary, the study indicated that videotape instruction was a valid instructional tool for teaching subjects to recognize and describe the production pattern of correct and errored phonemes.

The testing and training videotape programs are available from: Department of Communicative Disorders, University of Mississippi, University, MS 38677 or Instructional Resources Center, Louisiana State University, Baton Rouge,

LA 70803.

CHAPTER I

PROBLEM AND REVIEW OF THE LITERATURE

Introduction

Instructional technology, a rapidly developing professional area, has provided a systematic way of designing, developing, and evaluating the teaching and learning process (Morgan, 1978). The 1960's marked the acceptance of this technology for broad educational application. The utilization of instructional technology in varied professional fields of study has been partially due to the extensive technological advances of such instructional tools as television. The need for educational technologies in the professional preparation of speech-language pathologists and audiologists was publicly stated in 1963 at the Conference on Graduate Education sponsored by the American Speech and Hearing Association (Spriestersbach, 1963). However, a seventeen-year paucity of instructional publications in this profession would appear to indicate a lack of acceptance and utilization of the educational innovations in training speech, language, and hearing personnel.

The terms instructional technology and educational

technology imply a systems approach to the educational or learning process. Other terms used to describe this relatively new academic discipline are instructional systems development, instructional design, and even educational engineering (Tickton, 1970; Torkelson, 1977; Morgan, 1978). For the purpose of the subsequent literature review, the term instructional technology has been used.

The older, more traditional view of instructional technology implied the use of media, i.e., films and transparencies, for educational purposes, along with the teacher, textbook, and blackboards. A broader, more recent view of this discipline was proposed by the President's Commission on Instructional Technology:

> Instructional technology goes beyond any particular medium or device. In this sense, instructional technology is more than the sum of its parts. It is a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication, and employing a combination of human and non-human resources to bring about more effective instruction. The widespread acceptance and application of this broad definition belongs to the future. (Tickton, 1970, p. 7)

Others have defined instructional technology as a complex organization of men and machines, of ideas, or procedures, and of management -- a sequence of operations and a check on achievement (Heinich, 1968). The substance of this technology for twenty years has been to join the tools and knowledge of the fields of communication, management science, and behavioral science to focus on the problem of how stu-

dents learn and how teachers teach at all levels of education: elementary, secondary, and colleges/universities (Torkelson, 1977; Morgan, 1978; Pedone and Dirr, 1978).

Wittich and Schuller (1973) pointed out that the emphasis in instructional technology was then on the process by which learning could be improved. Systematic analysis of learner needs and development of strategies to meet these needs were inherent in the educational technologies. This article indicated that of the thousands of research studies in media-learning relationships carried out since 1955, one generalization was that, of the many different types of instructional media, educational television could accomplish significant increases in learning. Although many other tools, techniques and strategies have emerged and have been evaluated as important methods in the teaching/learning process, multiple references referred to television as the most thoroughly tested and researched teaching tool (Murphy & Gross, 1966; Breitenfeld, 1970; Torkelson, 1977; Sceiford, 1978).

Review of the Literature

Instructional television had its beginning in the mid-1950's, when it was used in the closed circuit mode for simultaneous viewing in multiple settings where large numbers of students could learn from an expert in the field. Television techniques for the teaching-learning process have been widely accepted by educators and have undergone numerous

technological advances (Winslow, 1970; Allen, 1971; Sceiford, 1978). The state of the art in educational television has been based on the electronic technological advances in instrumentation and extensive educational research of this tool as a positive learning device. Much of the research in instructional television has dealt with comparing the traditional teaching mode of didactic instruction with the use of videotaped or closed circuit television.

Breitenfeld (1970) reported that the basic research had repeatedly demonstrated that students could learn a variety of material through television-type instruction. Schramm's (1962) comprehensive analysis of evidence pointed out that there could no longer be any doubt that instructional television was, at least, as effective as didactic instruction. The majority of educational television research dealt with comparisons between the effectiveness of televised instruction and that of face-to-face teaching. The reviewed evidence indicated that there was no significant difference in the measured results of these two modes of instruction (Torkelson, 1977). In an extensive review of research evidence, Murphy and Gross (1966) reported that in 65 percent of the articles they reviewed, there was no significant difference in comparisons between televised and classroom teaching, while in 21 percent of the studies, the students learned significantly more from television than from classroom teaching. The remaining 14 percent of the studies

indicated that students learned more from classroom instruction than from television instruction.

The studies on media utilization indicated that one of the major post-secondary uses of instructional television was in the health-related professions (Carnegie Commission, 1972; Pedone & Dirr, 1978). Tickton (1970) reported the extensive use of television in medical education through the establishment of the networks for Continuing Medical Education and the Medical Television Networks. These networks have been major producers and distributors of videotapes in all areas of medical education (Lysought, 1965; Harris, 1966). The nursing and dental professions have begun to follow the lead of medical educators in the extensive use of television as a teaching tool for training health professions (Koch, 1968; Roth & Price, 1971).

In the last ten years, several reviews and summaries of instructional television research have emerged. Chu and Schramm (1967, 1977) in their investigation of educational media research reported the following conclusions: (1) individuals learned efficiently from instructional television; (2) repeated showings of a television program resulted in more learning; (3) problem-solving instruction on television was more effective than lecturing; (4) instructional television appeared to be equally effective with small and large viewing groups.

Wittich and Schuller (1973) reported that one of the

major advantages of instruction through television over didactics was repeatability. If student learning did not occur immediately, then the videotaped material could be played back as often as needed. Another reported advantage of television instruction over classroom type instruction was the applicability to individual or group instruction. Videotape instruction, when used over a period of time, was reported as more cost effective than repetitions of personal instruction.

In a related study, Gropper and Lumsdaine (1961) concluded from the research that interactive responding increased learning from television. When the television technique required the students to respond either verbally or in writing as a part of the instruction, the end result of learning was greater than when the student was passive during the televised experience.

According to the summary of research information by Tickton (1970), the technological advantages of television provided for access to equal education across diverse geographical areas by providing consistent learning experiences to everyone. He also concluded that television created more immediate learning when utilizing the principles of learning theory with emphasis on the use of immediate feedback. His diverse research conclusions implied that the broad application of educational television coupled with the explosive technological advances in hardware have led to the broad

acceptance of this instructional methodology.

During the years when major developments occurred in instructional technology, the young profession of speech-language pathology and audiology was coming of age, primarily because of the increased demands for the delivery of services, the creation of academic training programs, and the formation of a professional organization. The development of this profession and the emergence of educational technology in the training of clinicians would appear relevant to this study.

Speech-language pathology emerged as a professional entity in the United States in the mid-1920's (Paden, 1970). A review of the academic developments and the formation of the American Speech-Language-Hearing Association provides a perspective of the foundation of the profession, and thus an understanding for the relatively new focus on education and training needs.

Apparently, the first academic training of speech-language pathologists was directed by G. Hudson MaKeun, Professor of Defects of Speech at the College of Medicine at the University of Pennsylvania in 1897. However, the first earned degrees were doctorates granted in the 1920's. Sara Stinchfield-Hawks received her degree in 1922 from the University of Wisconsin under S. Blanton and R. West. In 1924 Lee Edward Travis earned his Ph.D. from the University of Iowa, with Carl Seashore initiating the program there. The instructional models for that new profession came from the

diverse training models in medicine, psychology, education, and speech. In 1925 there were six colleges or universities offering course work in speech correction (Wallace, 1954; Rieber & Rubaker, 1966; Paden, 1970, 1975a, 1975b; Bloodstein, 1979).

Another factor which marked the emergence of a profession to serve the communicatively handicapped and significantly influenced the education of its members was the formation of an organization devoted entirely to speech correction. Paden (1970) proposed that one reason for the formation of a separate professional organization away from the National Association of Teachers of Speech was the concern by the educators for the low level of knowledge and training among large numbers of practitioners. Many individuals engaged in the treatment of speech disorders had no formal training. In 1925 the American Speech Correction Association began with five members; it grew slowly for the first few years and by the mid-1930's was an established professional organization. In 1940 the organization began to evaluate the training of professionals, as evidenced by the appointment of the Committee on Education charged with the task of determining the kind and extent of education and professional training of speech correctionists in the United States. This was the first reported organized attempt to evaluate the educational processes in speech pathology (Spriestersbach, 1963; Paden, 1970, 1975a, 1975b).

Darley reported that in his opinion an important milestone in education and clinical training came in 1959, when the American Speech and Hearing Association established the American Board of Examiners in Speech Pathology and Audiology, which signaled the profession's determination to conduct an aggressive program of raising its standards and improving professional training. Another major milestone in the education and training of speech pathologists and audiologists was the 1963 Highland Park Conference on Graduate Education: Speech Pathology and Audiology. This was "the first extensive self-appraisal of graduate education in speech pathology and audiology by a representative group from the profession" (Spriestersbach, 1963, p. 1). Seventy of the one hundred professionals agreed to the following proposition:

> Whereas it is considered essential that the efficiency of graduate instruction be increased, RESOLVED that the application of every appropriate type of programmed learning and other modern instructional techniques be encouraged in both academic and clinical situations. (Spriestersbach, 1963, p. 89)

The efforts of the professional association to study, evaluate, and recommend educational direction slowly began to bring the attention of its members toward the need for instructional strategies in the training of speech-language pathologists and audiologists.

Several publications in the 1960's professional literature pointed to the potential utilization of instructional

technology, particularly of television, in the training of speech-language pathologists. These expository articles addressed some of the issues facing health science educators such as the rapid increase in student enrollment, the need for development of observational skills in clinicians, the need for consistency and standardization of training methods in the diverse geographical locals, and the desire for quality education. The publications suggested that academicians should look to other disciplines and professions for models of instructional improvement, particularly in reference to television, which was proposed as a solution to the educational needs of this profession (O'Neill & Peterson, 1964; Irwin & Krafchick, 1965; Kunze, 1967; Villareal & Lawrence, 1969).

A review of the literature indicated a paucity of research studies but yielded several other expository articles describing specific uses of instructional media in client management and clinical instruction. One of the most interesting applications of television to the modification of client behavior was proposed by Burkland (1967), who reported improving self-awareness of clients' articulatory errors through the use of visual and auditory feedback via television. Datiles (1977) proposed a similar method for fluency therapy.

Gordon (1960) reported the utilization of television for modification of articulatory skills in the classroom setting.

His article described procedures and techniques for the program. Diedrich's (1966) article explained various types of media and suggested applications for supervisory feedback, for parental observations, for teaching esophageal speech, and as a supplement to didactic lectures. O'Neill and Peterson (1964) discussed the rationale for and application of television to clinical instruction research information by videotaping therapy for supervisory and parental observation, clinician self-motivation, and also for the use of television in aural rehabilitation classes to practice lip reading. Another early study by Wood (1956) reported the use of television for teaching a course, "Introduction to Speech Correction," for university student consumption and for public education. This instructional application of the advancing technologies was explained in complete detail with recommendations for further utilization.

Ryan (1970) reported the results of a videotape questionnaire to 155 university training centers regarding utilization, equipment, needs assessment, and availability of tapes. The conclusion was that 47 percent of the respondents had videotape equipment while 12 percent planned to acquire it, and that very few centers had developed or catalogued tapes. The recommendations were that (1) local, regional, and national workshops on educational television instructional technology be instituted and that (2) the American Speech-Language-Hearing Association compile a directory of tapes and

act as a clearing house to encourage production and exchange of tapes.

Slosberg, Hawie, and Hartman (1976) briefly reported on a teaching program using computers. They suggested the use of computer based instruction to bridge the gap between conventional classroom teaching and clinical experience in the training of speech-language pathologists and audiologists. Levitt, Slosberg, Hawie, Mazer, and Rosenstein (1978) expressed the view that computer assisted instruction could provide experience to students in the diagnostic decision-making process by presenting simulated patients with a variety of audiological problems. They described the use of Computer Assisted Audiology Instruction, which was composed of a series of programs to augment textbooks and classroom instruction in diagnostic audiology.

An Exxon Education Foundation funded project provided information on faculty and student attitudes toward the utilization of videotapes in a clinical training program (Billeand, 1976). The conclusions indicated that the faculty noted improvement in student learning when video recordings were used in combination with classroom instruction. The student reactions were reported as very positive with recommendations for further utilizations, particularly in the assessment of the student clinician's performance in specific clinical situations.

The most recent expository report was by Oratio (1979),

who described the use of computer programs for analyzing the client-clinician interactive process of speech and hearing therapy sessions. He purported that computer assisted training allowed students a much more autonomous capacity through self-monitoring and self-supervision.

The focus of the very limited number of experimental instructional technology studies in speech-language pathology had a student training application and was concentrated in the areas of supervision and articulatory error analysis. Television has been the usual medium, particularly in the supervision studies while film, audiotapes, programmed instruction, and videotapes were employed to evaluate the articulatory error analysis skills of clinicians.

In the late 1960's and early 1970's, studies reviewed the utilization of television for self-confrontation as compared to other modes of supervision for effecting change in clinician behaviors. Johnson (1969) used videotaped segments of therapy sessions to develop a multidimensional scoring system for use in clinical observation. Irwin and Nickles (1970) reported on a tool for measuring supervisory judgments of clinician behaviors via videotape. In a similar study, Hall (1970) evaluated the effect of four different supervisory conditions on student clinician behaviors. The four types she evaluated were videotape feedback with supervisory interaction, videotape feedback without supervisory interaction, the traditional conference feedback, and the

control aspect of no supervisory feedback. She determined that videotape feedback with or without supervisory interaction was as effective a method for changing clinician behavior as the clinician-supervisor conference method. Generally, these studies indicated the usefulness of television for effecting positive changes in clinician behaviors with minimal supervisory interactions.

In a series of government sponsored research projects, Boone reported the development of techniques for videotape self-confrontation by clinicians. The results of these studies indicated a significant improvement in clinical skills when videotapes were compared to audiotape self-confrontation, supervisory conferences, and no feedback information (Boone & Goldberg, 1969; Boone & Stench, 1971; Boone & Prescott, 1972).

Of primary interest to the present investigation were the media studies concerned with the analysis of articulatory errors. The limited research in this area spanned forty years and involved varied types of instructional resources. One of the earliest works was by Henderson (1938), who studied the reliability of judges for recording speech sound errors when the stimuli were presented by three different methods. The misarticulations were given by live voice, face-to-face presentation, by audio tape-recordings, and by remote audio presentations which eliminated visual contact between the speaker and the judges. The results of the three different

presentation methods were analyzed as to agreement among judges in terms of correctness and incorrectness of responses, and agreement among judges in terms of specific analysis of responses. Henderson determined that the judges were more accurate in the correctness versus incorrectness discrimination task than in the analysis of the type of articulation error. She indicated that live voice and tape-recorded sessions produced a higher degree of judge reliability than error analysis via the microphone. However, in light of the limited number of subjects and judges the results of this study were questionable. The low reliability of judgments on specifying the type of misarticulation was important to the present investigation.

Weiner (1963) studied the effectiveness of programmed instruction on the ability of individuals to judge articulation errors in conversational speech. Tape-recorded speech samples and a programmed text were used to provide subjects with articulation error analysis training utilizing immediate feedback after the analysis of speech sound error was recorded. The five experimental subjects were college students with no training in phonetics. These subjects were exposed to a ten-hour program to train them to judge and transcribe articulation errors. The tape-recorded instructional program consisted of 542 sentences with articulation errors mainly on the /s/ phoneme. A pre-post-test was devised to compare the judgments of the five experimental,

five control, and three sophisticated listeners. Weiner (1963) reported that after training, the experimental subjects exceeded the control subjects and the sophisticated listeners in their analysis of defective productions on error analysis for untrained sounds and trained sounds. On error analysis for untrained sounds, the sophisticated judges exceeded both the other groups, while the experimental group performed better than the control group. The researcher concluded that (1) the ability to discriminate and transcribe defectively articulated sounds occurring in conversational speech could be effectively taught to untrained subjects by programmed instructional techniques and (2) the use of programmed instruction techniques to teach student clinician discrimination and transcription of articulatory errors should be investigated further. The results of this study were questionable because of the limited number of subjects, the apparent lack of control for recording and listening conditions, and the absence of information on the complexity of articulation errors.

Irwin and Krafchick (1965) reported a study of the reliability of three different types of judges to record misarticulations of target consonants presented by an audio versus an audio-visual method. For this investigation, two alternate forms of a twenty-two-minute audio-visual film of six children with moderate to severe articulatory problems were produced. The stimulus material was two lists of 23 words

presented as single words, as phrases, and as "trios" of words. Fifty experienced clinicians, 50 graduating seniors in speech pathology, and 50 classroom teachers judged the target productions of the children as correct versus incorrect. The seniors and the clinicians were similar in their ability to judge errors and better than the teachers in identification of misarticulations. All three subject groups more accurately discriminated targets on the isolated word level than on the phrase level. The identifications using the audio-visual medium were more accurate than those which utilized only the audio signals. The results of this study were questionable in light of the imbalance of correct-incorrect items (Film A;68 percent correct, 32 percent incorrect; Film B;69 percent correct, 31 percent incorrect) which perhaps increased the score for the teachers who had no previous discrimination training.

In a follow-up study, Irwin (1970) reported utilizing one of the previously developed films to determine the consistency or intraobserver reliability of undergraduate majors in speech pathology for evaluating articulatory errors. The Test for Recognition of Misarticulations, Form A, was administered to 64 subjects on three different dates. The analysis of the results of this study indicated that undergraduate majors in speech pathology were relatively consistent in the way in which they evaluated articulatory productions. The highest level of agreement was in the evaluation of correct

productions (84 percent), with the least agreement on misarticulations (66 percent). The judges were more consistent in evaluating misarticulations at the word level than at the phrase or at the trios level. The highest intraobserver reliability occurred when speech sound productions were evaluated in words in which no misarticulations occurred. The results of this study could be questionable because of the high percentage of correct productions rather than misarticulations.

The only reference to utilization of the videotape mode in the training of articulatory error analysis skills was a study by Flynn (1970). This dissertation involved the development and evaluation of videotaped discrimination training utilizing immediate feedback. The 28 experimental subjects were divided into two groups for training; 14 of the subjects received live voice instruction while the other 14 subjects received videotape training. The control group had seven subjects who received no training. The /s/, /t/, and /r/ phonemes were the only target sounds included for analysis in the experiment. The author concluded from the pre-post-test data that the videotape medium was as effective as the live presentation for training subjects in discrimination tasks. According to Flynn, when the scores of the trained group were compared with the scores of the control group, it was obvious that the training program did have an effect upon the subject's ability to judge speech sound

production accurately in both the taped and the live situations. Flynn reported the following implications for further study: (1) the videotape medium for training discrimination skills warranted further investigation and (2) the use of immediate feedback procedures in discrimination training programs should be continued and expanded.

The apparent limitations of the Flynn study were the reduced number of tested phonemes and the subjects' binary response formats. With only three target phonemes, the listener had a very specific discrimination task which might not generalize to analysis of other defective phonemes. The subjects' judgments of target phonemes involved the simple discrimination task of determining correct versus incorrect production. In addition, Flynn did not indicate the nature of the articulatory errors utilized in the study.

In summary, it would appear that this profession has not made extensive use of instructional technologies if the paucity of published research articles represents the true utilization of educational television by this profession. The few specific training articles were general descriptions or applications of media, but the aspect of concern to this investigator was the very limited application of technologies for clinician training in the area of articulation problems. Because disorders of articulation occur most frequently in the communicatively disordered population, speech-language pathologists must be prepared to manage them (Bloodstein, 1979).

In addition, the few studies which involved articulatory error analysis training dealt only with a binary discrimination choice of correct-incorrect speech sound production. Practicing clinicians must go beyond simple binary discrimination in order to implement a feature therapy approach. In this age of accountability, clinicians must specifically describe the difference in actual and expected articulatory behaviors. There is a need for specific discrimination training and articulatory error response recording for clinicians.

In a pilot research project, this investigator developed and compared didactic and videotape instructional programs for training students to analyze articulatory errors (Appendix A). The results of the study indicated that subjects improved in their abilities to analyze sound errors on the word and sentence stimulus levels after exposure to articulation exercises which provided them with feedback regarding the appropriate response. There was not a statistically significant difference in the pre- and post-test performances of the two different instructional groups. From this pilot study, it was concluded that there is not a significant difference in the observational or analysis skills of students trained by the live voice and videotape methods. Further study of these instructional modes seemed warranted with the following modifications: (1) an increased number of subjects, (2) the addition of a control group, and (3) a

standardization of the Pre- and Post-Test measures.

Purpose

The purpose of this study was to determine:

(1) if there is a difference in the ability of students to recognize articulation errors with and without training;

(2) if there is a difference in the ability of students to recognize articulation errors based on type of training, that is, Didactic versus Videotape instruction;

(3) if there is a difference in the ability of students to recognize articulation errors based on the type of control, that is, Re-Instruction versus no Interaction;

(4) if students vary in their ability to analyze articulatory productions on the word versus the sentence level;

(5) if any of the following variables make a difference in a student's ability to analyze articulatory errors:

   a. grade point average
   b. grade in the course
   c. amount of foreign language experience
   d. course instructor
   e. training time

f. age

g. number of total college credit hours

h. race

i. sex

j. major vs. non-major

k. native language

l. class time

(6) if the following phonological variables have an effect on the analytical abilities of students;

a. vowels versus consonants versus diphthongs

b. correct versus error production

c. type of error production

CHAPTER II

PROCEDURES

Subjects

One hundred and ten undergraduate students enrolled in eight different sections of a Speech 1050 course at Louisiana State University during the Spring Semester, 1980, participated in this experiment.

Selection Criteria

The study was limited to those students who:

(1) according to their instructor had prior exposure to and could transcribe words using the International Phonetic Alphabet.

(2) demonstrated the ability to transcribe all test phonemes as presented on the Phonetic Competence.

(3) indicated on the Student Information Form no previous training in the transcription of speech of individuals having articulation errors.

(4) demonstrated adequate far point visual acuity using the standard targets from the Keystone Visual Survey Program.

(5) had normal hearing sensitivity as indicated by

passing a hearing screening test. The pure-tone test stimuli (octave intervals 250 through 8,000 Hz) were administered at 20 dB HL in a sound-treated booth. Any subject failing to hear more than one test tone in one ear was excluded from the study.

(6) demonstrated normal articulation while reading "My Grandfather" (Fairbanks, 1960) passage to a trained clinician.

The aforementioned selection criteria were utilized in order to insure a group of subjects who had a basic knowledge of the International Phonetic Alphabet and no visual and/or auditory problems that would impair their ability to use the information provided in the training program. There were 95 students who met the selection criteria and participated in all phases of the experiment.

Group Assignment

The subjects within each individual class were assigned by random draw to one of four different groups as shown in Table 1. The two Experimental Groups (Group A and B) were exposed to the word and sentence level phoneme analysis instructional program while the Control Groups (Group C_1 and C_2) had no analysis training. Treatment Group A, with 31 subjects, had Live Voice training in target and error analysis while Treatment Group B, with 33 subjects, had the same stimulus materials and training presented via videotape.

TABLE 1

Subject Group Assignments

Group Designation	Treatment	Number
Experimental		
A	Live Voice Instruction	31
B	Videotape Instruction	33
Control		
C_1	Reinstruction	18
C_2	No Interaction	16

Control Group C was split into two subgroups, with Subgroup C_1 viewing the videotaped instruction again while Subgroup C_2 had no information presented or interaction with the researcher. There were 18 students in C_1 and 16 subjects in C_2 for a total of 34 subjects in the control groups.

Stimulus Materials

The materials prepared for this experiment included student information and response forms (Appendices A, B, C, D, E, F, G, H, I, K, L), a videotaped phonetic transcription competency test, an instructional tape on error transcription, a Pre-Post-Test measure on videotape, and various types of training materials via Videotape or Live Voice presentation.

Competency Test

A seven-minute phonetic transcription competency test (Appendix C) required that the students record the appropriate phoneme symbols from a videotaped dictation of syllables which included all of the target phonemes utilized in the pre- and post-test stimuli. Nonsense syllables were used in order to assure the knowledge of the phonetic symbol without the benefit of contextual information. Each of the target phonemes was presented in at least three different syllables. To pass the Phonetic Competence, the subjects had to correctly record, at least once, the phonetic symbol

of each tested phoneme.

Instructions

The three-minute instructional videotape (Appendix J) provided an introduction to articulatory target and error analysis during which the investigator explained a procedure for recording the appropriate responses for the correct productions, substitution errors, distortion errors, and omission errors. Each type of response marking was demonstrated. An example word with a correctly produced target phoneme was presented and the subjects were instructed to place a check mark (✓) in the blanks when they evaluated the production as correct. For each type of misarticulation a word was presented in which the target phoneme was incorrectly produced. If the error was an omission, the subject was told to record minus (-). When the error was a substitution, the subject was instructed to record the phonetic symbol of the substituted phoneme. For the distortion errors the subject recorded an X. In addition, a legend of these response markings was included on each student response form for both testing and training.

Test and Training Items

The testing and training stimulus items contained 40 different target phonemes (25 consonant singles, five consonant clusters, 11 vowels, and four diphthongs) exposing students to the analysis of a variety of English sounds.

Correct and error productions of the tested phonemes were presented. Each of the three types of misarticulations occurred so that the subjects were exposed to the error productions typically heard in the communicative disordered population.

In this present study, as in past studies, subjects were exposed to four types of productions: correct productions, substitution errors, distortion errors, and omission errors. However, the difference was that this study required subjects to identify errors on a variety of consonants, vowels, diphthongs, and clusters, whereas in previous studies only one or three consonants were targeted. Another difference was that subjects in this study were required to specify the particular error pattern rather than indicate only that an error had occurred. The rationale for this descriptive approach was to provide practice in the development of skills in recognizing, analyzing, and describing error productions which were considered preparatory to using a feature approach to articulation therapy. Attention was given to phoneme selection based on frequency of occurrence of sounds in the English language and on the most frequently errored phonemes. A complete list of all target phonemes appears in Appendix M with the frequency of occurrence of each sound and the type of productions indicated. Traditionally used phonological inventories were the source of stimulus words and sentences. The rationale for using these tests was to

relate training to commercially available materials. The sources of the stimulus items were: The Templin-Darley Tests of Articulation (Templin and Darley, 1969), Goldman-Fristoe Articulation Test (Goldman and Fristoe, 1972), Arizona Articulation Proficiency Scale (Fudala, 1970), and Fisher-Logemann Test of Articulation (Fisher and Logemann, 1971).

Test

The Pre- and Post-Tests were the same videotaped presentation which included word tasks and sentence tasks. Two levels of test stimuli (word and sentence) were selected to determine if the subjects' articulatory error analysis abilities differed by length of stimuli. Test items were presented one time for listener analysis. The first ten words of the test had one target phoneme to be analyzed while the second ten stimuli of the word test contained two target phonemes. The word level test contained 19 errors of 30 target phoneme productions in 20 words on a 5:43 minute tape. The sentences each contained two target phonemes for subject analysis. The sentence level test was 8:09 minutes in length and included 28 error productions in 40 total target phonemes contained within 20 sentences. The Post-Test measure was administered within forty-eight hours of the Pre-Test in order to minimize the possibilities of students learning from factors other than the treatment procedures.

Training

Training words and sentences are identical for each treatment group varying only in mode of presentation (Didactic versus Videotape). The training program consisted of the following progressive analysis task:

(1) Level One (Consonant Error: Words) involved one consonant error per stimulus at the word level with two presentations of each stimulus word (10:49 minutes of tape time);

(2) Level Two (Vowel Error: Words) consisted of one vowel error at the word level with two presentations of each word (8:49 minutes of tape time);

(3) Level Three (Consonant and Vowel Error: Words) has two errors, consonant and/or vowel, at the word level with each word presented once (6:55 minutes of tape time);

(4) Level Four (Consonant and Vowel Error: Sentences) two errors, consonant and/or vowel, at the sentence level with one presentation of each sentence (8:26 minutes of tape time).

Response Time

After the presentation of each stimulus word or sentence a five to eight second pause occurred to allow the subjects time to record on the appropriate form their analysis of the production of the target phoneme(s). The length of response

time varied according to the complexity of the stimulus, that is, more time was allowed for recording errors in two instances: when the context was longer, as in the sentences, and when the subjects were required to analyze more than one phoneme.

Feedback Methods During Training

In order to provide the subjects with feedback regarding the appropriateness of their response, the following procedures were utilized. During the Videotape training sessions, the subjects first observed the investigator presenting the stimulus, after which a time interval was allotted for recording the response. The stimulus item was then repeated by the investigator while the example scoring form with the correct response was shown on the screen. For the Didactic training sessions, the investigator presented each stimulus item live voice, then allowed five to eight seconds for subjects to record their responses. The stimulus item was then repeated by the speaker while an example score form with the correct response was shown via an overhead projector. These procedures allowed the subjects to immediately verify the appropriateness of their responses.

Equipment

Production

The videotapes were recorded in the color studio of the

Media Services Center at the University of Mississippi, Oxford campus. Input and recording equipment were selected so as to control intensity and frequency response variables. Careful attention was given to the matching of system components as well as to environmental controls in order to assure the production of test stimuli free of distortion. The frequency response range of the equipment and tapes exceeded the frequency range of speech (60 Hz to 8,000 Hz) needed in order to assure clarity of phoneme production.

A condensor misrophone (Sony ECM - 50) which was placed 10 centimeters just in front of and below the mouth of the speaker provided the input signal for the recording of the tapes. The output of the microphone was coupled to an audiometer (Opamp Labs, Model 50-80) which provided the input signal to the videorecorder (Sony, Model VO 2850). The vocal effort input signal was monitored so as to insure that fluctuations remained within a relative 40 dB range on a VU meter. Videocassette tapes (Sony, Model KCA 30) were used to store all recorded messages.

Playback

The same videoplayer (Sony, Model VC 2800) and color monitor (Sony, Model KV 1911) were utilized for all video stimuli presentations. The frequency response range of this equipment exceeded the frequency range of speech.

Controls

The following variables were constant for all subjects: speaker, testing/training environment, playback equipment, and Pre- and Post-test time interval. The investigator presented all of the testing and training stimuli. The speaker monitored vocal effort by insuring that the needle on a VU meter remained within a relative 40 dB range. The live voice training stimuli were judged to be consistent for the three different sessions by three certified speech-language pathologists who monitored audiotape recordings of the sessions.

The environment for both testing and training was a sound-treated room so as to reduce extraneous noise and provide an environment conducive to listening. Each subject was seated within twelve feet of the stimulus source and had an appropriate viewing line. The same playback equipment was used throughout the experiment. There were 48 hours between the Pre- and Post-test measure for each subject. The participants were asked not to discuss the project with other subjects.

Presentation Procedures

The experimental procedures followed the format of pre-testing by class, individual screening just propr to small Treatment Group or Control Group sessions, and then post-

testing by class as shown in Table 2.

Pre-Treatment Activities

For each class participating in the research the investigator explained the purpose of the project and requested that each student complete the Subject Information Form and sign a statement volunteering for training outside of class. The Phonetic Competency Test was then administered to each class. The videotape entitled "Instructions on Error Analysis" was played in order to provide information relative to the analysis task. Time was alloted for questions.

Pre-Test forms for the word level and sentence level tasks were distributed. The examiner observed the class as each student recorded responses to the Pre-Test stimuli presented via videotape. As the Pre-Test forms were collected, each student drew a color-coded sheet to determine assignments to Experimental Groups A or B or Control Groups C_1 or C_2. The subjects then selected one of three times available for each treatment and control group. The Training Session Assignment Form (Appendix L) was marked to indicate the date, time, and place for screening and training. The pre-training sequence averaged forty-six minutes per class.

As the subjects arrived for the training session, their speech, vision, and hearing were screened on an individual basis by a trained examiner.

TABLE 2

Outline of Subject Procedures

Pre-Treatment Sequence

1. Completion of subject information form
2. Phonetic competency testing
3. Instructions on target and error analysis
4. Pre-test at word and sentence level
5. Random draw for group assignment
6. Screen speech, hearing, and vision

Treatment Sequence

1. Subjects assigned to Experimental Groups A or B were exposed to identical training materials presented via live voice (Group A) or videotape (Group B)
2. Subjects assigned to Control Groups C_1 or C_2 had no formal training

Post-Treatment Sequence

1. Post-test at word and sentence level
2. Signed grade permission form

Training Groups Sequence

The training procedures varied only by mode of presentation. During the Live Voice instructional session, Group A subjects were seated in the sound-treated room within an appropriate vision line of the speaker. Response forms for Consonant Error: Words; Vowel Error: Words; Consonant and Vowel Error: Words; and Consonant and Vowel Error: Sentences were distributed. As the investigator presented each stimulus item, the participants recorded their analysis of the target productions. Feedback was provided via Live Voice and graphic representation of the appropriate written response. At the completion of the four training levels, the subjects were reminded of the Post-Test appointment during the next regular class session.

During the videotaped training sessions, the Group B participants were seated in the sound-treated room with attention to vision line and distance from the monitor. The videotape player and monitor were the same used for Pre- and Post-Testing. Each subject received the four response forms, viewed the tapes, responded, received feedback and were reminded of the Post-Test appointment during the next regular Speech 1050 class.

Control Group Sequence

The Control Groups, C_1 and C_2, were not exposed to the training materials constructed for the Live Voice and Video-

tape treatment groups. Subgroup C_1 was seated in the sound-treated room and viewed the videotape "Instructions on Error Analysis". The investigator then reminded the subjects that the Post-Test would occur in their next Speech 1050 class period. The subjects in Subgroup C_2 had no exposure to any training or instructional materials. These participants were reminded of the Post-Test time and dismissed.

Post-Training Sequence

The Post-Test was administered to each subject during the next regular class time. The test environment, seating arrangements, and equipment remained constant from the Pre- to the Post-Test. Test forms were distributed, the tapes played, and the forms collected. Each participant was asked to complete a Grade Permission Form which allowed the investigator to obtain the student's final grade in order to determine if the Pre-Test and Post-Test performances were correlated to the grade in the course.

Scoring

The nature of the expected response was established for the Pre- and Post-Tests and the Phonetic Competency by a panel of three certified speech-language pathologists who individually viewed and scored each videotaped activity. The three judges were in agreement on 65 of the 70 Pre-Post Test items. On the other five test items at least two of

the three judges agreed on the analysis of the target production. There was 100% agreement on expected responses for the phonetic competency.

Each subject's test forms were then scored by the investigator to differentiate between appropriate and inappropriate analyses. The actual subject responses on the Pre- and Post-Test measures and the appropriateness of the response were punched on computer cards. The Phonetic Competency correct score by consonant, vowel, diphthong, and clusters was entered. In addition, the following identifying information was coded on the computer card for each participant:

(1) identification number
(2) class time
(3) instructor
(4) treatment group
(5) training time
(6) sex
(7) age
(8) race
(9) grade point average
(10) grade in Speech 1050
(11) number of total college credits
(12) high school and college language experience
(13) native language
(14) major versus non-major

Analysis of Data

The Statistical Analysis System (SAS) (Barr, Goodnight, and Sall, 1979) computer program available through the Louisiana State University Computer Center was used to analyze all data.

The design used to study the subjects' ability to analyze articulatory productions before and after treatment was a 4x2x3 Analysis of Variance as shown in Table 3. The sources were four treatment groups (two experimental: Live Voice and Videotape and two control: No Interaction and Re-Instruction), two tests (Pre-Post) and three levels of test stimuli (word, sentence, and total test).

The relationships of subjects variables or characteristics and phonological variables on the students' ability to analyze target and error productions were derived using Pearson Product Moment Correlations.

TABLE 3

Analysis of Variance Design

Source	Degrees of Freedom
Treatment Groups	3
Time (Pre- to Post-Test)	1
Type of Stimulus (Word, Sentence, Total)	2
Time vs. Type	3
Group vs. Time	4
Group vs. Type	5
Group vs. Time vs. Type	6

CHAPTER III

RESULTS

Introduction

A description of the participants and their performance in this study is presented. Group characteristics of the subjects such as race, grade point average, and academic performance in the class are summarized. An analysis of both the Experimental and the Control Groups' performance on the Phonetic Competency Test is presented. The equality of Pre-Test scores among the Treatment Groups is analyzed. Pre- and Post-Test findings regarding target and error phoneme analysis abilities is discussed. The affect of certain subject and phonological variables on the Pre-Post-Test score is reported.

Summary of Subject Information

Subjects were 95 student volunteers enrolled in one of eight different sections of a basic speech course at Louisiana State University. Ninety-two percent of the individuals were female, and eight percent were male. The subjects were Caucasian (96%), black (3%), and Oriental (1%). A small percentage (9%) of the students were majors in the field of communicative disorders, while the remaining parti-

cipants (91%) were non-majors. Subjects' ages ranged from 17 years to 34 years, with a mean age of 19 years, 4 months.

Grade point averages (GPA) for 87 of the 95 subjects were obtained. These averages ranged from 1.2 to 4.0, with a mean of 2.6. Grade point averages were not available for eight of the subjects, as these individuals were in their first semester of enrollment at the University.

Class grades for 93 of the 95 students enrolled in Speech 1050 were made available to the examiner. The grades ranged from 0.0 (F) to 4.0 (A), with a mean grade of 2.7. The distribution of grades indicated that six percent of the individuals obtained an "F" (0.0) for the class; four percent obtained a "D" (1.0); 24 percent of the individuals achieved a "C" (2.0) in the class; 40 percent of the individuals received a "B" (3.0), and 26 percent of the subjects received an "A" (4.0) in the class.

The number of earned credits per subject concurrent with class enrollment was available for 89 percent of the subjects. This data revealed a range of from six college credit hours to 99 credit hours, with a mean of 36 credit hours.

Of interest to this study was the relationship between the amount of foreign language training and the participants performance on tests of articulatory error analysis. As a part of their high school curriculum, 58 percent of the participants' received one, two, or three years of training with one language. Five percent of the students had one

to three years of training in two or more foreign languages. The remaining 37 percent had no foreign language training in high school. Within the category of students having a single foreign language experience, 20 percent received one year, 26 percent two years, and 12 percent three or more years.

In addition, information concerning foreign language experience at the college level revealed that 75 percent of the participants received no foreign language, 6 percent had one semester, 11 percent had two semesters, and 8 percent had at least three semesters of foreign language training at the time of this study.

Phonetic Competency Test Analysis

Prior to the administration of Pre-Test stimuli, a 96-item Phonetic Competency Test was given in order to determine which subjects could accurately transcribe all phonetic symbols. This test consisted of 96 target phonemes which included 42 consonant items, 37 vowel items, 12 diphthong items, and 5 consonant cluster items. Table 4 shows that of the 96 items presented, on an average eighty items or 85 percent of the items were transcribed correctly. An inspection of the average transcription accuracy by phoneme type indicated that 38 of 42 consonant items, 29 of 37 vowel items, 9 of 12 diphthong items, and 5 of 5 cluster items were correct.

A correlation coefficient was then used to determine

TABLE 4

Phonetic Competency Test
Mean Correct Responses for Consonants,
Vowels, Diphthongs,Clusters, and Total Test

Type of Phoneme	Number	Phonetic Competency Mean Correct
Consonants	42	38.29
Vowels	37	29.32
Diphthongs	12	9.44
Clusters	5	4.93
Total	96	81.98

the relationships between the Phonetic Competency Test and the scores of the Pre-Test measure for all the subjects in the study. For the Pre-Test measure the coefficients were ($r = 0.62$, $P < 0.0001$) for the word portion, ($r = 0.65$, $P < 0.0001$) for the sentence section and ($r = 0.67$, $P < 0.0001$) for the total test. These results show a significant positive correlation between the two variables in question, that is those subjects having high Phonetic Competency Test scores also tended to have high scores on the Pre-Test measures.

Pre-Test Performance: Equality

In order to assess baseline behaviors, the two Experimental Groups (A-Didactic approach and B-Videotape approach) and the two Control Groups (C_1-Re-Instruction and C_2-No Interaction) were given the Phonetic Competency Test, the Articulatory Error Analysis Instructions, and then pre-tested on target and error recognition abilities in word, sentence, and total test contexts. Data in Table 5 reveals that the percentage of correct responses for each group was similar for both word and sentence tasks. However, it should be noted that Control Group C_2 (no interaction) performed slightly higher than the other three groups for word, sentence, and total test. T-Tests were used in order to determine the difference in Pre-Test means for word, sentence, and total test and the subjects' group assignment. The results of this analysis revealed that differences in word, sentence, and total Pre-Test performance among

TABLE 5

Pre-Test Percentage of Correct Responses
for Words, Sentences, and Total by Treatment
Group with Probability of Interactions Among Groups

Treatment Group	Word %	Word Probability	Sentence %	Sentence Probability	Total %	Total Probability
A	59.89		63.63		61.76	
B	61.44		61.83		61.64	
C_1	60.00		60.69		60.37	
C_2	67.08		64.69		65.89	
A vs B vs C_1		NS		NS		NS
A vs C_2		$P < 0.02$		NS		$P < 0.05$
B vs C_2		NS		NS		$P < 0.05$
C_1 vs C_2		$P < 0.04$		NS		$P < 0.02$

groups A, B, and C_1 were not significant. However, as shown in Table 5, there was a statistically significant difference in the Pre-Test scores between Experimental Group A and Control Group C_2 for words ($P < 0.02$) and total ($P < 0.05$); Experimental Group B and Control Group C_2 for total test performance ($P < 0.05$); and Control Group C_1 and Control Group C_2 for word level ($P < 0.04$) and total test ($P < 0.02$). These results indicated that the two Experimental Groups and Control Group C_1 performed in a similar fashion on words, sentences, and total Pre-Test scores. Control Group C_2, however, initially performed better than the other groups. This group, from the outset of the study, demonstrated an ability for target and error recognition that surpassed the baseline ability of the other three groups.

Correlates of Test Scores

Correlation type analyses were performed to determine which, if any, subject variables related to the participants' ability to transcribe phonetic symbols or to analyze articulatory target and error productions. The subject variables of final course grade, reported overall grade point average, and foreign language training were found to be related to several of the test measures. The variables of sex, major versus non-major, native language, and race were not evaluated due to the limited number of subjects in each group. The subject variables of course instructor, training time, age, and

class time, were not found to relate to any test measures.

Phonetic Competency Test Correlates

Two factors, final grade in the class and overall grade point average, as shown in Table 6, were found to be positively correlated to the subject's Phonetic Competency Test score, while the participants' previous foreign language training did not correlate to the test scores.

For the 93 subjects whose final course grade was available, the correlation coefficient to the phonetic transcription score was $r = 0.58$ ($P < 0.0001$). The correlation between the reported grade point average of 87 subjects and their Phonetic Competency Test score was $r = 0.23$ ($P < 0.04$). These findings suggested a tendency for the higher the class grade and/or overall grade point average, than the higher the expected score on the Phonetic Competency Test.

Pre-Test Correlates

The subject variables found to correlate to the Pre-Test scores were grade in course, overall grade point average, high school foreign language experience, and college foreign language experience. The information for these relationships are shown in Table 7. A significant positive correlation was found between the grade in the course and the Pre-Test score. The correlation coefficient for grade and score was $r = 0.50$ ($P < 0.0001$) for the word level, $r = 0.52$ ($P < 0.0001$) for the sentence level and $r = 0.54$ ($P < 0.0001$) for the total test score.

TABLE 6

Correlations of Phonetic Competency to Final Course Grade and Grade Point Average

	Final Course Grade	Grade Point Average
Correlation Coefficient	0.58	0.23
Probability	< 0.0001	< 0.04
Number	93	87

TABLE 7

Correlates of Pre-Test Scores to Grades and
Foreign Language Experience by Word, Sentence, and Total Test

	Final Course Grade			Grade Point Average		
	Word	Sentence	Total	Word	Sentence	Total
Correlation Coefficients	0.05	0.52	0.54	0.40	0.36	0.40
Probability	< 0.0001	<0.0001	<0.0001	<0.0001	<0.0005	<0.0001
Number	93	93	93	87	87	87

	High School Foreign Language			College Foreign Language		
	Word	Sentence	Total	Word	Sentence	Total
Correlation Coefficients	0.26	0.26	0.28	0.23	0.27	0.22
Probability	<0.0104	<0.0102	<0.0063	<0.0244	<0.979	<0.0355
Number	95	95	95	95	95	95

These findings suggested that there was a tendency for the grade in the course to increase as the subject's Pre-Test score increased, and that these trends were consistent for the word, the sentence, and the total test score.

A significant relationship also existed between the overall grade point average and the Pre-Test score. The coefficient for the word portion was $r = 0.40$ ($P < 0.0001$); $r = 0.36$ ($P < 0.0001$) for the sentences; and $r = 0.40$ ($P < 0.0001$) for the total test. These results suggested that there was a tendency toward the higher the grade point average, the better the subject performed on the Pre-Test score for words, sentence, and total.

The students' previous foreign language experiences also correlated to the Pre-Test score. The years of high school foreign language instruction were positively related to the Pre-Test performance with a coefficient of $r = 0.26$ ($P < 0.01$) for the word part, $r = 0.26$ ($P < 0.01$) for sentences, and $r = 0.28$ ($P < 0.01$) for the total test. The semesters of foreign language experience at the college level showed a tendency to positively correlate with the word and total Pre-Test scores. The correlation coefficient for college language experience and word portion Pre-Test score was $r = 0.23$ ($P < 0.02$) and for the total Pre-Test score was $r = 0.22$ ($P < 0.04$). The sentence Pre-Test score and college foreign language were not significantly correlated and yielded a coefficient of $r = 0.17$ ($P < 0.10$). These findings indicated that exposure to a foreign

language in high school more positively correlated with performance on tasks involving speech sound differentiation than did similar types of exposure at the college level.

Post-Test Correlates

As in the Pre-Test, the variables found to relate to the Post-Test score were grade in course, reported overall grade point average, high school foreign language experience, and college foreign language experience. Table 8 contains the correlation coefficients for these factors.

A positive correlation was found between the grade in the course and the Post-Test score. The coefficient was $r = 0.51$ ($P < 0.001$) for words; $r = 0.42$ ($P < 0.001$) for sentences; and $r = 0.48$ ($P < 0.0001$) for total test. These findings suggested that as the grade in the course increased, there was a tendency for the Post-Test score to increase and that these trends were consistent for word level, sentence level, and total score.

The correlation coefficient for the overall grade point average and the word portion Post-Test was $r = 0.27$ ($P < 0.01$); for the sentence level was $r = 0.24$ ($P < 0.03$); and for the total was $r = 0.27$ ($P < 0.01$). These indicated a tendency toward a positive correlation between reported overall grade point average and the students' performance on the Post-Test.

The students' foreign language instruction also related positively to the Post-Test scores. The correlation coefficient

TABLE 8

Correlates of Post-Test Scores to Grades and
Foreign Language Experience by Word, Sentence, and Total Test

	Final Course Grade			Grade Point Average		
	Word	Sentence	Total	Word	Sentence	Total
Correlation Coefficients	0.51	0.42	0.48	0.27	0.24	0.27
Probability	<0.0001	<0.0001	<0.0001	<0.0126	<0.0271	<0.0130
Number	93	93	93	87	87	87

	High School Foreign Language			College Foreign Language		
	Word	Sentence	Total	Word	Sentence	Total
Correlation Coefficients	0.24	0.21	0.24	0.27	0.17	0.24
Probability	<0.0178	<0.0446	<0.0208	<0.0076	<0.0970	<0.0219
Number	95	95	95	95	95	95

for years of high school language experience and performance on the word Post-Test was $r = 0.24$ ($P < 0.02$); on the sentence Post-Test $r = 0.21$ ($P < 0.04$); and on the total Post-Test $r = 0.24$ ($P < 0.02$). These findings again suggested that exposure to a foreign language in high school tended to positively correlate with performance on tasks involving speech sound discrimination.

The semesters of college level foreign language instruction were related to the word and total Post-Test scores. For the word Post-Test score, the coefficient was $r = 0.27$ ($P < 0.01$). The total Post-Test score coefficient was $r = 0.23$ ($P < 0.02$). The sentence Post-Test score and college foreign language instruction were not significantly related with a coefficient of $r = 0.17$ ($P < 0.10$). These results indicated that training in a foreign language tended to relate to a better performance on tasks involving articulatory target and error analysis.

Target and Error Recognition Abilities

The ability of the subjects to recognize the appropriateness of phonological targets as correct or error productions prior to and following training or no training is discussed in the following section. Two groups of subjects (Group A and B) received training in detecting articulation errors through either a Didactic approach (Group A) or through the use of Videotape recordings (Group B). Groups C_1 and C_2 received no actual training and/or feedback on analysis of

articulatory errors. Group C_1 viewed the instruction on analyzing errors again while Group C_2 had no interaction with the investigator or materials. The display of data in Table 9 indicates the mean percentage Pre- and Post-Test scores and the percentage improvement by treatment groups. Statistically significant Pre- to Post-Test gains are indicated. The analysis of variance tables with significant F values are in Appendices N, O, and P.

Training versus Control Groups

For the purpose of this discussion, Groups A and B are grouped together as the training or Experimental Groups. Groups C_1 and C_2 are discussed as the Control Groups.

Training. Mean percentage correct scores for the Experimental Groups (Groups A and B) shown in Table 9 are as follows: for the total score, this group improved by 20.13 percent following the treatment, with a pre-treatment mean correct of 62.62 percent and a post-treatment mean of 82.75 percent. For the word score, this group improved by 25.72 with the pre-treatment mean score for this measurement of 59.56 percent, and post-treatment mean of 85.28 percent. A 14.55 percent improvement was noted at the sentence level for the two experimental groups with a pre-treatment score of 65.68 percent and a post-treatment score of 82.23 percent. These two training groups showed statistically significant improvement ($P < 0.001$) from their Pre-Test to Post-Test scores for analysis of articulatory targets and errors for words, sentences,

TABLE 9

Target and Error Recognition by Mean Percentage Correct and Percentage Improvement from Pre- to Post-Test for Words, Sentences, and Total by Treatment/Control Group

Treatment Group	WORD Pre-Test %s	WORD Post-Test %s	WORD Improvement %s	SENTENCE Pre-Test %s	SENTENCE Post-Test %s	SENTENCE Improvement %s	TOTAL TEST Pre-Test %s	TOTAL TEST Post-Test %s	TOTAL TEST Improvement %s
A	58.80	85.92	27.12***	67.18	81.22	14.04***	62.99	83.57	20.58***
B	60.32	84.64	24.32***	64.18	79.23	15.05***	62.25	81.93	19.68***
A + B	59.56	85.28	25.72***	65.68	82.23	14.55***	62.62	82.57	20.13***
C_1	57.70	78.98	21.18***	63.96	76.79	13.03***	60.83	77.88	17.05***
C_2	67.66	78.27	10.06*	67.71	75.41	7.70*	67.77	76.84	9.18*
$C_1 + C_2$	62.66	78.63	15.97**	65.84	76.10	10.26**	64.25	77.36	13.11**

* P <.05
** P <.01
*** P <.001

and total test.

Control. Groups C_1 and C_2 (Re-Instruction or No Interaction groups) improved 13.11 percent in their ability to recognize articulatory targets and errors for the total test, as shown in Table 9. Their mean score for the total test for pre-treatment was 64.25 percent correct with a post-treatment mean score of 77.36 percent. At the word level, an improvement of 15.97 percent for the control groups was noted. The mean pre-treatment score at this level was 62.66 percent with a post-treatment mean score of 78.63 percent. The difference between pre- and post-treatment scores for analysis at the sentence level revealed an improvement of 10.26 percent. Pre-treatment sentence mean score for the two groups was 65.84 percent, and the post-treatment mean score was 76.10 percent. The Control Groups showed statistically significant improvement ($P < 0.01$) in their ability to analyze articulatory targets and errors from the Pre- to Post-Test for words, sentences, and total test.

Summary and Comparison. These data indicated that both the Experimental Groups and the Control Groups improved in their ability to analyze articulatory targets and errors. However, when the Experimental Groups (A + B) are compared to the Control Groups ($C_1 + C_2$) for Pre- to Post-Test gains there was a statistically significant difference between those groups with training and those groups without training for the total test scores ($F = 7.95$; $df = 1$; $P < 0.01$) and sentence

scores ($F = 4.10$; $df = 1$; $P < 0.05$). There was not a statistically sigificant difference ($F = 1.12$; $df = 1$; $P < 0.29$) for the word level performance between the Treatment and the Control Groups. In summary, the groups with training (Live Voice or Videotape) made significantly greater gains in articulatory target and error analysis at the sentence and total test level than the Control Groups, which indicated that the difference in scores for training or no training occurred at the sentence level.

Didactic Group

Group A achieved an improvement of 20.58 percent (total score) following treatment, having a pre-treatment mean score of 62.99 percent and a post-treatment mean score of 83.57 percent. A 27.12 percent improvement was achieved at the word level (pre-treatment mean score, 58.80 percent, post-treatment mean score, 85.92 percent); while an improvement of 14.04 percent was obtained between a pre-treatment mean score of 68.18 percent and a post-treatment mean score of 81.22 percent at the sentence level. The improvements at the word, sentence, and total test from the Pre- to the Post-Test measures were statistically significant ($P < 0.0001$). This suggests that subjects who were exposed to Live Voice instruction showed significant improvement in their articulatory target and error analysis abilities. The greatest amount of change occurred at the word level.

Videotape Group

Group B improved by 19.68 percent in target and error recognition ability following Videotape training, with a total Pre-Test mean score of 62.25 percent and a Post-Test mean score of 81.93 percent.

At the word level, a pre-treatment mean score of 60.32 percent and a post-treatment mean score of 84.64 percent resulted in an improvement of 24.32 percent. Group B improved by 15.05 percent in analysis at the sentence level, with a pre-treatment mean score of 64.18 percent and a post-treatment mean score of 79.23 percent.

The subjects in Group B demonstrated significant ($P < 0.0001$) change in their Pre- to Post-Test scores at the word, sentence, and total test levels. This indicated that Videotape trained subjects showed a significant improvement in their ability to recognize articulatory targets and errors with the greatest improvement at the word level.

Re-Instruction Group

Group C_1 improved in their overall ability to detect errors by 17.05 percent, having a pre-treatment mean score of 60.83 percent, and a post-treatment mean score of 77.88 percent. A difference of 21.18 percent was achieved between pre- and post-treatment scores of 57.70 percent and 78.98 percent, respectively, at the word level. At the sentence level, an initial mean score of 63.96 percent was obtained,

with a post-treatment mean score of 76.79 percent, yielding an improvement of 13.03 percent.

These subjects who had no training but were exposed to the Articulatory Error Analysis Instruction for a second time made a significant ($P < 0.001$) improvement in their target and error analysis scores at the word, sentence, and total test level. Their greatest improvement occurred at the word level of analysis.

No Interaction Group

The subjects of Group C_2 (no interaction) received a pre-treatment mean score of 67.66 percent overall and performed with a mean of 76.84 percent accuracy following treatment, improving by 9.18 percent which was significant ($P < 0.001$). At the word level, a pre-treatment mean score of 67.61 percent was achieved, with a post-treatment mean score of 78.27 percent, resulting in a significant improvement of 10.66 percent ($P < 0.01$). An improvement of 7.7 percent was noted at the sentence level which was significant ($P < 0.003$). The subjects achieved a pre-treatment mean score of 67.71 percent for this measure, and a Post-Test mean score of 75.41 percent. These results indicated that subjects who took an articulatory target and error analysis test for a second time scored better than they did the first time. Although the percentage of improvement was about the same for all test levels, the subjects did better on word level analysis on the second testing.

Summary on Target and Error Recognition. The subjects showed significant improvement in their ability to recognize articulatory targets and errors for the word, the sentence, and the total test level regardless of exposure or no exposure to training. That is, the subjects improved their analysis score by retaking the test.

However, Treatment Groups A (Live Voice) and B (Videotape) and Control C_1 (re-instruction) showed a greater improvement in Pre-Post-Test mean scores for words, sentences, and total test than did the Control Group C_2 (no interaction) subjects. Further, by evaluating actual percentage gains, it was apparent that training by Live Voice (Group A) and by Videotape (Group B) produced a higher percentage improvement in correct analysis from the Pre- to Post-Test measures than did re-instruction (Group C_1), and no interaction (Group C_2).

Phonological Correlates

Evaluation of the stimulus items yielded three phonological variables which apparently related to the subjects' ability to correctly analyze the stimulus productions. The variables are type of phoneme: consonant versus vowel; type of production: correct versus error; and type of error: omission, distortion, or substitution.

Consonant versus Vowel

In Table 10, the mean percentage correct analysis of

TABLE 10

Phonological Variables: Consonants versus Vowels; Mean Percentage Correct and Mean Percentage Improvement for Words, Sentences, and Total by Treatment/Control Group

	Treatment Groups	CONSONANTS Pre-Test %s	CONSONANTS Post-Test %s	CONSONANTS Improvement %s	VOWELS Pre-Test %s	VOWELS Post-Test %s	VOWELS Improvement %s
WORD	A	67.20	87.46	20.26***	47.31	79.57	32.26***
	B	66.30	84.44	18.14***	52.60	81.11	28.52***
	C_1	66.00	81.17	14.50*	44.44	79.51	29.63***
	C_2	70.49	74.07	5.12	60.42	72.22	11.80
SENTENCE	A	65.19	82.93	17.74***	60.70	72.73	12.03*
	B	66.53	81.94	15.41**	51.82	67.88	16.06**
	C_1	64.35	79.63	15.28*	53.03	64.14	11.11
	C_2	67.71	75.78	8.07	63.07	64.20	1.13
TOTAL TEST	A	66.20	85.19	18.99***	54.01	76.15	22.14***
	B	66.41	83.19	16.78**	52.21	74.49	22.28***
	C_1	65.51	80.40	14.89*	48.74	69.11	20.36**
	C_2	69.10	77.65	8.55	61.74	68.21	6.47

* P < .05
** P < .01
*** P < .001

consonants and vowels are displayed by type of treatment and by Pre- and Post-Test at the word level, sentence level, and total test scores. The percentage of improvement in the mean score from Pre- to Post-Test are shown.

Didactic Group A: Word. The subjects who received Live Voice training scored a mean percentage correct of 67.20 on consonant items on the Pre-Test and an 87.46 percent on the Post-Test, yielding a 20.26 percent improvement in consonant analysis after training which is statistically significant ($P < 0.0002$). On the vowel items Group A exhibited a 47.31 mean percentage correct response on the Pre-Test with an improvement to 79.57 percent after training. This yielded a 32.26 percent improvement which was a statistically significant ($P < 0.0001$) gain. The improvement at the word level was greater for vowels than for consonants although Live Voice training produced a significant improvement on both consonant and vowel target analysis.

Didactic Group A: Sentences. The traditionally trained subjects scored a mean of 65.19 percent on consonant items on the Pre-Test sentences and an 82.93 percent on the Post-Test. The improvement from pre- to post-analysis of consonants in sentences by Group A was 17.74 percent which is statistically significant ($P < 0.001$). For the vowel items at the sentence level, Group A had a 60.70 percent on the Pre-Test and a 72.73 percent on the Post-Test which yielded a 12.03 percent improvement which was statistically signifi-

cant ($P < 0.02$). The gain in Pre- to Post-Test performance was greater for consonants than for vowels when these were embedded in longer utterances such as sentences.

Didactic Group A: Total. The mean percentage score for the total Pre-Test consonants by subjects in Group A was 66.20 while the Post-Test score was 85.17 yielding an 18.99 percent improvement in performance. The subjects' ability to analyze consonants after training was improved. This improvement was statistically significant ($P < 0.0001$). The vowel Pre-Test score was 54.01 percent while the Post-Test score, after training, was 76.15 percent yielding a 22.14 percent increase. The improvement was significant ($P < 0.0001$). This implied that when Pre- and Post-Test averages for words and sentences are compared for consonants versus vowels under Didactic training, improvement was shown for both types of phonemes, however, the percentage of improvement was slightly better for vowels.

Videotape Group B: Word. The subjects who received the Videotape training scored a mean correct of 66.30 percent for consonant items on the Pre-Test and a 84.44 percent on the Post-Test yielding an 18.14 percent improvement in consonant analysis after training. The gain was statistically significant ($P < 0.0001$). The vowel item score for this treatment group was 52.60 percent on the Pre-Test with an 81.11 percent on the Post-Test. A 28.52 percent improvement was noted. This change was statistically significant ($P < 0.0001$).

The improvement at the word level from pre- to post-measures was greater for vowels than for consonants although the Videotape training produced a significant improvement in both consonant and vowel target and error analysis.

Videotape Group B: Sentence. The videotaped-trained subjects scored a 66.53 mean percent correct of consonants on the Pre-Test and improved to 81.94 percent for the Post-Test. This yielded a 15.41 percent improvement which was statistically significant ($P < 0.003$). The vowel change was from 51.82 percent on the Pre-Test to 67.88 percent on the Post-Test. The 16.06 percent improvement was statistically significant ($P < 0.002$). This indicated that the Pre- to Post-Test gain was significant for consonants and vowels at the sentence level with videotape instruction. However, the percentage improvement for vowel analysis was slightly greater than for consonant analysis.

Videotape Group B: Total: The mean percentage score for the total Pre-Test consonants by subjects in Group B was 66.41. The Post-Test was 83.19 percent. This group showed a statistically significant ($P < 0.001$) gain with a 66.78 percent improvement. For the vowel items on the total test, Group B had 52.21 percent on the Pre-Test and 74.79 percent on the Post-Test yielding a 22.28 percent improvement on vowel analysis. This change was statistically significant ($P < 0.0001$). This indicated that when Pre- and Post-Test averages for words and sentences are compared for consonants

versus vowels under Videotape training, improvement was shown for both types of phonemes. However, the percentage of improvement was slightly greater for vowels.

Control Group C_1: Word. The subjects who received no training (re-instruction only) scored a mean correct of 66.67 percent on the consonant items on the Pre-Test and an 81.17 percent on the Post-Test. The percent of improvement was 14.50 which was statistically significant ($P < 0.04$). On the vowel items, Group C_1 exhibited a 44.44 percent on the Pre-Test items and a 79.51 percent on the Post-Test. The 29.63 percent improvement was statistically significant ($P < 0.0001$). The improvement at the word level from pre- to post-measures was better for vowels than for consonants although both phonological variables showed improvement when the subjects were re-exposed to Instructions on Articulatory Error Analysis.

Control Group C_1: Sentence. The Group C_1 subjects scored a mean percentage of 64.35 percent on the Pre-Test consonants in sentences. The Post-Test score was 79.63 percent. The improvement from Pre- to Post-Test analysis of consonants in sentences by Group C_1 was 15.28 percent which was statistically significant ($P < 0.02$). For the vowel items at the sentence level, Group C_1 had a 53.03 percent Post-Test score which yielded an 11.11 percent improvement which was not a significant improvement ($P < 0.10$). These results indicated that the Pre- to Post-Test gain at the sentence level

was significant for consonants but not for vowels when the subjects were exposed to re-instruction.

Control Group C_1: Total. The mean percentage score for the total Pre-Test consonants by subjects in Group C_1 was 65.51 percent while the Post-Test score was 80.40 percent yielding 14.89 percent improvement in performance. The subjects' ability to analyze consonants was statistically better on the Post-Test ($P < 0.02$). The vowel Pre-Test score was 48.74 percent. On the Post-Test the subjects in this group correctly analyzed 69.11 percent of the vowels. The 20.36 percent improvement was statistically significant ($P < 0.001$). This indicated that when the Pre- and Post-Test averages for words and sentences were compared for consonants versus vowels with participants having re-instruction that improvement was shown for both types of phonemes. The percentage of improvement was greater for vowels.

Control Group C_2: Word. The subjects who received no re-instruction or training scored a mean correct of 70.49 percent on consonant items on the Pre-Test and a 74.07 percent on the Post-Test yielding a 5.12 percent improvement. The change in consonant analysis was not significant for words ($P < 0.23$). The vowel item score for this control group was 60.42 on the Pre-Test with a 72.22 percent on the Post-Test. The 11.80 percent improvement in vowel analysis was not statistically significant ($P < 0.12$). These results indicated that without training or re-instruction the

participants did not significantly improve in their ability to analyze either consonants or vowels items.

Control Group C_2: Sentences. The control group of subjects scored a 67.71 mean percent correct for analysis of consonants in sentences on the Pre-Test and improved to 75.78 percent on the Post-Test. This 8.07 percent improvement in consonant analysis score was not statistically significant ($P < 0.26$). The vowel analysis change was from 63.07 percent on the Pre-Test to 64.20 percent on the Post-Test yielding a 1.13 percent improvement. Control Group C_2 subjects did not show a statistically significant improvement in their ability to analyze vowel sounds from the Pre- to the Post-Test ($P < 0.87$). These results indicated that without training or re-instruction subjects do not improve in their ability to analyze either consonants or vowel items.

Control Group C_2: Total. The mean percentage score for the total Pre-Test consonants for subjects in Group C_2 was 69.10 percent with a Post-Test score of 77.65 percent yielding an 8.55 percent improvement which was not statistically significant ($P < 0.19$). The Vowel Pre-Test score was 61.74 percent with a Post-Test score of 68.21 percent. The 6.47 percent improvement in vowel analysis was not statistically significant ($P < 0.32$). The lack of significant improvement in consonant and vowel analysis from the Pre- to Post-Test indicated that without training or re-instruction, subjects did not improve in their ability to analyze phonemes.

Summary of Consonant versus Vowel. In summary, training by the Didactic or Videotape method improved the subjects' ability to analyze both consonants and vowels. At the word level and total test level the experimental subjects improved more in vowel analysis while in sentences Group A (Didactic) improved more in consonant analysis and Group B (Videotape) improved more in vowel analysis. Control Group C_1, who had re-instruction, improved their score for consonants and vowels but especially vowels for words and total test. This Control Group improved only in consonant analysis at the sentence level. Group C_2, who had no training or re-instruction, did not significantly improve their scores for analysis of consonants or vowels at any level.

Correct versus Error

This section analyzes the subjects' ability to identify a correct stimulus as correct and an incorrect stimulus or error stimulus as an error. It has been hypothesized that the subjects' ability to discriminate between correct and incorrect phonetic productions was affected by the variability of the stimuli; that is, itwas easier to identify correct stimulus as correct than itwas to identify an incorrect stimulus as an error. Since the percentage of incorrect items was greater than the percentage of correct items, the task of choosing the appropriate response was more difficult for this test than for previous studies cited in which there was a

higher percentage of correct stimuli for subjects to analyze.

Table 11 presents the data for correct versus incorrect stimulus items by type of treatment for word, sentence, and total test scores.

Didactic Group A: Word. The subjects who received Live Voice training scored a mean percentage correct of 56.45 on correct items on the Pre-Test and an 88.71 on the Post-Test, yielding a 32.26 percent improvement on analysis of correct items which was statistically significant ($P < 0.0001$). On the errored items, Group A exhibited a 59.29 mean percentage score on the Pre-Test with an improvement to 74.75 percent after training. This yielded a 22 percent improvement which was a statistically significant gain ($P < 0.0001$). The subjects improved in their ability to analyze both correct and incorrect stimulus presentations at the word level with a greater improvement for analysis of correct stimuli.

Didactic Group A: Sentence. The traditionally trained subjects scored a mean of 75.07 percent on correct items on the Pre-Test sentences and 87.68 percent on the Post-Test sentences. The improvement from pre- to post-analysis of correct responses in sentences was 12.61 percent which was statistically significant ($P < 0.01$). For the errored items at the sentence level, Group A had a mean of 59.29 percent on the Pre-Test and a 74.75 percent on the Post-Test which yielded a 15.46 percent improvement which was statistically significant ($P < 0.002$). The gain in Pre- to Post-Test

TABLE 11

Phonological Variable: Correct versus Error Productions by Mean Percentage and Percentage Improvement from Pre- to Post-Test for Words, Sentences, and Total Test by Treatment/Control Group

	Treatment Groups	CORRECT PRODUCTION Pre-Test %s	Post-Test %s	Improvement %s	ERROR PRODUCTION Pre-Test %s	Post-Test %s	Improvement %s
WORD	A	56.45	88.71	32.26***	61.14	83.14	22.00***
	B	57.92	87.92	30.00***	62.73	81.36	18.63**
	C_1	52.78	79.17	26.39**	62.63	78.79	16.16*
	C_2	68.75	81.25	12.50	66.48	75.28	8.83
SENTENCE	A	75.07	87.68	12.61**	59.29	74.75	15.46**
	B	69.39	84.55	15.16**	58.97	73.91	14.94**
	C_1	71.21	83.84	12.63*	56.70	69.73	13.03*
	C_2	74.43	84.66	10.23	60.99	66.16	5.17
TOTAL TEST	A	65.76	88.20	22.44***	60.22	78.94	18.72***
	B	63.66	86.23	22.57***	60.85	77.64	16.79***
	C_1	61.99	81.50	19.51**	59.67	74.26	14.59*
	C_2	71.59	82.95	11.36	63.73	70.72	6.99

.* P < .05
** P < .01
*** P < .001

analysis performance was greater for the errored productions than for the correct items at the sentence level.

Didactic Group A: Total. The mean percentage score for the total Pre-Test correct responses by subjects in the Live Voice group was 65.76. The Post-Test mean score was 85.20 yielding a 22.44 percent improvement in performance from the Pre- to Post-Test measures which was statistically significant ($P < 0.0001$). The error Pre-Test total mean correct score was 60.22 percent. The Post-Test score was 78.94. The 18.72 percent improvement on analysis of error productions from the pre- to post-measure was statistically significant ($P < 0.0001$). This implied that when Pre- and Post-Test averages for words and sentences are compared for correct versus incorrect stimuli, under training, improvement was shown for both types of productions. The percentage of improvement was slightly better for correctly produced stimulus items.

Videotape Group B: Word. The subjects who received the Videotape training scored a mean correct of 57.92 percent on correct items on the Pre-Test and a 87.92 percent on the Post-Test yielding an 30.00 percent improvement in correct analysis after training. The gain was statistically significant ($P < 0.0001$). The error item score for this treatment group was 62.73 percent on the Pre-Test with an 81.36 percent on the Post-Test. An 18.63 percent improvement was noted. This change was statistically significant ($P < 0.001$). The improvement at the word level from pre- to post-measures was

greater for correct items than for error items, although the Videotape training produced a significant improvement in both correct and error analysis.

Videotape Group B: Sentence. The Videotape trained subjects scored a 69.39 mean percent for correct items on the Pre-Test and improved to 84.55 percent for the Post-Test. This yielded a 15.16 percent improvement which was statistically significant ($P < 0.003$). The improvement on the recognition score for errors was from 58.97 percent on the Pre-Test to 73.91 percent on the Post-Test. The 14.94 percent improvement was statistically significant ($P < 0.003$). This indicated that the Pre- to Post-Test gain was significant for correct and error productions at the sentence level with Videotape type instruction. However, the percentage improvement for correct analysis was slightly greater than for error analysis.

Videotape Group B: Total. The mean percentage score for the total Pre-Test correctness by subjects in Group B was 63.66. The Post-Test was 86.23 percent. This group showed a statistically significant ($P < 0.001$) gain with a 22.59 percent improvement. For the error items on the total test Group B had 60.88 percent on the Pre-Test and 77.64 percent on the Post-Test yielding a 16.79 percent improvement on error analysis. This change was statistically significant ($P < 0.0004$). This indicated that when Pre- and Post-Test averages for words and sentences are compared for correct

versus errors under Videotape training improvement was shown for both types of productions. However, the percentage of improvement was slightly greater for correct productions.

Control Group C_1: Word. The subjects who received no training (re-instruction only) scored a mean correct of 52.78 percent on the correct items on the Pre-Test and a 79.17 percent on the Post-Test. The percent of improvement was 26.39 which was statistically significant ($P < 0.0002$). On the error items Group C_1 exhibited a 62.63 percent on the Pre-Test items and 78.79 percent on the Post-Test. The 16.16 percent improvement was statistically significant ($P < 0.02$). The improvement at the word level from pre- to post-measures was better for correct items than for error items although improvement was shown for both types of productions when the subjects were re-exposed to Articulatory Error Analysis Instruction.

Control Group C_1: Sentence. The Group C_1 subjects scored a mean percentage of 71.21 percent on the Pre-Test correct in sentences. The Post-Test score was 83.84 percent. The improvement from Pre- to Post-Test analysis of items in sentences by Group C_1 was 12.63 percent which was statistically significant ($P < 0.05$). For the error type items at the sentence level, Group C_1 had a 56.70 percent Pre-Test and a 69.73 percent Post-Test score which yielded a 13.03 percent improvement which was a significant improvement ($P < 0.04$). These results indicated that the Pre- to Post-Test gain at

the sentence level was significant for error type items when the subjects were exposed to re-instruction.

Control Group C_1: Total. The mean percentage score for the total Pre-Test analysis of correct items by subjects in Group C_1 was 61.99 percent while the Post-Test score was 81.50 yielding 19.51 percent improvement in performance. The subjects' ability to analyze correct items was significantly better on the Post-Test ($P < 0.002$). The error Pre-Test score was 59.17 percent. On the Post-Test the subjects in this group correctly analyzed 74.26 percent of the error productions. The 14.59 percent improvement was statistically significant ($P < 0.02$). This indicated that when the Pre- and Post-Test averages for words and sentences are compared for correct items versus error items the participants having re-instruction showed improvement for both types of productions. The percentage of improvement was greater for correct items.

Control Group C_2: Word. The subjects who received no re-instruction or training scored a mean percent correct of 68.75 percent on correct items on the Pre-Test and a 81.25 percent on the Post-Test yielding a 12.5 percent improvement. The change in correct analysis was not significant for words ($P < 0.09$). The error item score for this control group was 66.48 percent on the Pre-Test with a 75.28 percent on the Post-Test. The 8.83 percent improvement in error analysis was not statistically significant ($P < 0.24$). These results indicated that without training or re-instruction the

participants did not significantly improve in their ability to analyze either correct or error items.

Control Group C_2: Sentence. The No Interaction Control Group of subjects scored a 74.43 mean percent correct for analysis of correctness in sentences on the Pre-Test and improved to 84.66 percent on the Post-Test. This 10.23 percent improvement in correct analysis score was not statistically significant ($P < 0.14$). The error analysis change was from 60.99 percent on the Pre-test to 66.16 percent on the Post-Test yielding a 5.17 percent improvement. Control Group C_2 subjects did not show a statistically significant improvement in the ability to analyze error sounds from the Pre- to the Post-Test ($P < 0.45$). These results indicated that without training or re-instruction, subjects did not improve in their ability to analyze either correct or error items.

Control Group C_2: Total. The mean percentage score for the correct items on the total Pre-Test for subjects in Group C_2 was 71.59 percent with a Post-Test score of 82.95 percent yielding an 11.36 percent improvement which was not statistically significant ($P < 0.08$). The error Pre-Test score was 63.73 percent with a Post-Test score of 70.72 percent. The 6.99 percent improvement in error analysis was not statistically significant ($P < 0.28$). The lack of significant improvement in correct and error analysis from the Pre- to Post-Test indicated that without training or re-instruction subjects did not improve in their ability to analyze phonemes.

Summary of Correct versus Error. In summary, the subjects in Groups A, B, and C_1 demonstrated a statistically significant improvement in Pre- and Post-Test analysis of correctly produced stimulus items and incorrectly produced stimulus items. The improvement was greater for the correct item analysis on words and total test for the three groups. At the sentence level, the Videotape Group (B) performed better in the analysis of correct items while the Didactic (A) and Re-Instruction (C_1) Groups showed a greater improvement on error production analysis. The Control Group (C_2) who had no re-instruction or interaction showed no significant gains in their ability to analyze correct or error productions in words, sentences, or total test. That was, training and re-instruction produced greater improvement in learning to analyze correct or incorrect productions.

Type of Error: Omission versus Distortion versus Substitution

In Table 12, the mean percentage correct analysis of omissions, distortions, and substitutions is displayed by type of treatment/control for the Pre- and Post-Test at the word level, at the sentence level, and for the total test. The percentage of improvement in mean scores from the Pre- to Post-Test measures are shown with the statistically significant improvements noted.

Didactic Group A: Word. The subjects who received Live Voice training scored a mean percentage correct of 86.56

TABLE 12

Phonological Variable: Omission versus Distortion versus Substitution Type Errors; Mean Percentage Correct and Percentage Improvement for Words, Sentences, and Total Test by Treatment/Control Group

	Treatment Group	OMISSION ERRORS Pre-Test %s	OMISSION ERRORS Post-Test %s	OMISSION ERRORS Improvement %s	DISTORTION ERRORS Pre-Test %s	DISTORTION ERRORS Post-Test %s	DISTORTION ERRORS Improvement %s	SUBSTITUTION ERRORS Pre-Test %s	SUBSTITUTION ERRORS Post-Test %s	SUBSTITUTION ERRORS Improvement %s
WORDS	A	86.56	92.47	5.91	46.77	88.71	41.94***	67.05	79.26	12.21*
	B	84.44	90.56	6.12	51.67	88.33	36.66***	65.24	80.48	15.24**
	C_1	88.89	93.52	4.63	47.22	83.33	36.11***	66.67	75.00	8.33
	C_2	79.17	85.42	6.25	65.63	75.00	9.37	64.73	74.56	9.83
SENTENCES	A	55.48	73.55	18.07**	37.63	79.57	41.94***	63.29	74.35	11.06
	B	51.33	73.33	22.00**	50.00	81.11	31.11***	62.06	73.02	10.96
	C_1	54.54	71.11	16.67	38.89	62.96	24.07**	59.79	70.37	10.58
	C_2	62.50	70.00	7.50	56.25	60.42	4.17	61.31	66.07	4.76
TOTAL TEST	A	71.02	83.01	11.99*	42.20	84.14	41.94***	65.17	76.80	11.63*
	B	67.89	81.94	14.05*	50.83	84.72	33.89***	63.65	76.75	13.10*
	C_1	71.67	82.31	10.64	43.06	73.15	30.09***	63.23	72.69	9.46
	C_2	70.83	77.71	6.88	60.94	67.71	6.77	63.02	70.31	7.29

* P < .05
** P < .01
*** P < .001

on omission type errors for the Pre-Test and a 92.47 percent on the Post-Test, yielding a 5.91 improvement which was not statistically significant ($P < 0.32$). On the distortion type errors, this group had a mean Pre-Test score of 46.77 percent with an improvement to 88.71 percent on the Post-Test. This improvement of 41.94 percent was significant ($P < 0.0001$). When a substitution type error occurred, the Live Voice participants had a Pre-Test mean score of 67.05 percent and a Post-Test score of 79.26 percent yielding a 12.21 percent improvement which was significant ($P < 0.04$). These data indicated that before training of the three error types, it was easiest for subjects in Group A to recognize omission type errors followed by substitutions then distortions. Consequently, as a result of training the amount of improvement between Pre- and Post-Test performance was greater for distortion errors than substitutions or omissions.

Didactic Group A: Sentence. The traditionally trained subjects scored a mean percentage correct of 55.48 for Pre-Test analysis of omission type errors. After training they improved to 73.55 percent which yielded an 18.07 percent change which was statistically significant ($P < 0.003$). If the error was a distortion, the Pre-Test score was 37.63 percent with a 41.94 percent improvement to the Post-Test score of 79.57. This learning from the Pre- and Post-Test was statistically significant ($P < 0.0001$). The 11.09 percent improvement from a Pre-Test mean score of 63.29 percent to the Post-Test mean

score of 74.35 percent was not significant ($P < 0.13$). These results indicated that when errors are embedded in sentences, substitutions seemed to be easier to recognize than omissions and then next distortions. After training (Live Voice), the ability to recognize distortions in sentences was the highest. The greatest improvement from Pre- to Post-Test performance was in recognizing distortion type errors followed by omission errors and then substitution errors.

Didactic Group A: Total. When the averages for the word and sentence tasks were combined the mean percentage correct for omission errors was 71.02 for the Pre-Test. After Live Voice training, the mean score improved to 83.01 percent which was an 11.99 percent increase which was statistically significant ($P < 0.04$). For the distortion type error analysis, Group A scored a mean score on the Pre-Test of 42.20 percent and 84.14 percent on the Post-Test. The 41.94 percent improvement was statistically significant ($P < 0.0001$). The Pre-Test substitution mean score was 65.17 percent with an 11.63 percent improvement to the Post-Test score of 76.80 percent. This change was statistically significant ($P < 0.04$). These results suggested that for total test scores the Live Voice training produced significant improvement from Pre- to Post-Test scores for all types of articulatory errors. Prior to and after training, the omission errors had the highest level of correct analysis. The greatest improvement score occurred on the analysis of distortion type errors.

Videotape Group B: Word. The subjects who received Videotape training scored a mean correct of 84.44 percent on the Pre-Test omission items. On the Post-Test, their score improved by 6.12 percent to 90.56 percent which was not a statistically significant gain ($P<0.31$). For the distortion type errors, these subjects had a Pre-Test mean score of 51.67 percent, a Post-Test mean score of 88.31, yielding a 36.66 percent improvement which was significant ($P < 0.0001$). The substitution error Pre-Test score was 65.24 percent while the Post-Test was 80.48 percent indicating a 15.24 percent improvement. The pre- to post-change was statistically significant ($P < 0.01$). These results indicated that the greatest improvement in error analysis at the word level for individuals who had Videotape training was for distortion type errors than for substitution errors, followed by omission errors. The least gains in improvement occurred on omission errors since this type of error production had a high percentage of correct analysis on the Pre-Test.

Videotape Group B: Sentence. When the omission type error items occurred in sentences, the Videotape group achieved a mean correct score of 51.33 percent on the Pre-Test and a 73.33 percent on the Post-Test. The percentage of improvement was 22 percent and was significant ($P < 0.003$). When the analysis involved distortion errors, this group posted a 50.00 percent mean score on the Pre-Test and a 81.11 percent on the Post-Test. A 31.11 percent improvement

in distortion error analysis in sentences occurred which was statistically significant ($P < 0.0001$). These same subjects achieved a Pre-Test mean score of 62.06 percent and a Post-Test mean score of 73.02 percent for substitution errors. The 10.96 percent improvement in substitution error analysis was not significant ($P < 0.14$). These results indicated that subjects trained by videotape improved significantly in their ability to analyze omission and distortion type errors with the largest gain occurring on distorted items when the error was embedded in a sentence. Prior to training, of the three error types, it was easiest for these subjects to recognize substitutions. After training these subjects correctly analyzed distortion type errors more frequently than substitutions and omissions.

Videotape Group B: Tota.. The 67.89 percent Pre-Test omission error mean score improved to 81.94 percent after training for subjects in Group B. The 14.05 percent improvement was significant ($P < 0.02$). The Videotape participants initially scored a 50.83 percent on distortion errors but showed a 33.89 percent gain by scoring 84.72 percent on the Post-Test. This change was significant ($P < 0.0001$). The analysis of substitution errors yielded a 63.65 percent on the Pre-Test and a 76.75 percent on the Post-Test. The improvement score was 13.10 percent which was significant ($P < 0.03$). These results indicated that on the total test the Videotape group showed significant improvement in their

abilities to correctly analyze all types of errors. Their greatest improvement score occurred on the distortion type errors.

Control Group C_1: Word. The subjects who received no training (re-instruction only) scored a Pre-Test mean correct score of 88.89 percent and a Post-Test score of 93.52 percent. The 4.63 percent improvement was not significant ($P < 0.65$). For the distortion type error analysis the mean score was 47.22 percent for the Pre-Test and 83.33 percent for the Post-Test. The 36.11 percent improvement was significant ($P < 0.0001$). The subjects had a Pre-Test score of 66.67 percent for the substitution errors and a Post-Test score of 75 percent yielding an 8.33 percent improvement which was not significant ($P < 0.28$). This implied that at the word level the subjects who had re-instruction improved only on analysis of distortion errors. Before re-instruction, of the three error types, it was easiest for these subjects to correctly analyze omission type errors, then substitutions, followed by distortions. After re-instruction this group demonstrated the highest level of analysis on omission errors in words.

Control Group C_1: Sentence. The Group C_1 subjects scored a mean percentage of 54.44 on the Pre-Test omission type errors in sentences. The Post-Test score was 71.11 percent yielding a 16.67 percent increase which was not significant ($P < 0.09$). For distortion errors in sentences the improvement was 24.07 percent from 38.89 percent to 62.96

percent. This change was significant ($P < 0.01$). The Pre-Test score for substitutions was 59.79 percent with a Post-Test score of 70.37 percent. The 10.58 percent improvement was not statistically significant ($P < 0.27$). These results indicated that for sentence level stimuli, the Control Group C_1 showed the greatest improvement on the distortion type errors. On the Pre-Test these subjects demonstrated a higher level of correct analysis on substitution type errors, followed by omissions and then distortions. After re-instruction the subjects' analysis of omission errors was higher with substitutions and distortions following in that order.

Control Group C_1: Total. The mean percentage score for the total Pre-Test omission errors by subjects in Group C_1 was 71.67 while the Post-Test score was 82.31 yielding a 10.64 percent improvement in performance. The improvement score was not statistically significant ($P < 0.12$). The distortion Pre-Test mean score was 43.06 percent. On the Post-Test the subjects improved to 73.15 percent. This 30.09 percent improvement was statistically significant ($P < 0.0001$). For substitution type errors the Pre-Test score was 63.23 percent while the Post-Test score was 72.69 percent yielding a non-significant improvement of 9.46 percent ($P < 0.21$). This indicated that when the Pre- and Post-Test average for words and sentences were compared for omissions, distortions, and substitutions for participants with only re-instruction type

contact, significant improvement was shown only on distortion type errors.

Control Group C_2: Word. The subjects who received no re-instruction or training scored a mean percent correct of 79.17 on omission items on the Pre-Test and an 85.42 percent on the Post-Test yielding a non-significant improvement of 6.25 percent ($P < 0.45$). The distortion error Pre-Test score was 65.63 percent with a 75.00 percent Post-Test score. The 9.37 percent improvement on the distortion errors was not significant ($P < 0.26$). For the substitution errors these subjects had a mean score of 64.73 percent on the Pre-Test and a 74.56 percent Post-Test. The 9.83 percent change was not significant ($P < 0.23$). These results indicated that without training or re-instruction the participants did not significantly improve in their ability to analyze omission, distortion, or substitution type phoneme errors. The Pre- and Post-Test results indicated that these subjects demonstrated error analysis best on omissions followed by distortions and then substitutions.

Control Group C_2: Sentence. This control group of subjects scored a mean percentage of 62.5 on the Pre-Test on omission errors. Their Post-Test score was 70.00 percent yielding a 7.50 percent improvement which was not significant ($P < 0.47$). The distortion Pre-Test mean score was 56.25 percent and the Post-Test was 60.42 percent. The 4.17 percent improvement was not significant ($P < 0.69$). A 61.31 percent

mean score was achieved on the Pre-Test with a 66.07 percent on the Post-Test. This 4.76 percent change was not significant ($P < 0.64$). These findings suggested that without training or re-instruction there was no significant change from the Pre-Test to Post-Test. For both Pre- and Post-Test measures at the sentence level, these subjects were best able to evaluate omissions, substitutions, and distortions, in that order.

Control Group C_2: Total. The mean percentage score for the total Pre-Test omission errors for subjects in Group C_2 was 70.83 percent with a Post-Test score of 77.71 percent yielding a 6.88 percent improvement which was not statistically significant ($P < 0.39$). The distortion Pre-Test mean score was 60.94 percent with a Post-Test score of 67.71 percent. The 6.77 percent improvement in distortion type errors was not significant ($P < 0.40$). For the substitution errors the Pre-Test mean score was 63.02 percent while the Post-Test score was 70.31 percent. There was not a significant difference from Pre- to Post-Test scores for substitutions ($P < 0.36$). These results indicated that when no instruction or training was provided, the subjects did not show significant improvement in the analysis of omissions, distortions, or substitutions. The analysis pattern for the Pre- and Post-Test indicated that these subjects demonstrated the highest level of analysis on omission errors, followed by substitutions and then distortions.

Summary of Type of Error. In summary, the results suggested that subjects who received training or re-instruction showed the highest gains from Pre- to Post-Test scores on distortion type errors for the word, sentence, and total test levels. It appeared that certain types of errors, particularly distortions and substitutions, were easier to train at the word level while omission errors were easier to train at the sentence level. At the word level, omission errors had the highest level of recognition for all subjects on both the Pre- and Post-Test measures. There was no such pattern for the sentence level presentations. For the total test, the omission errors had a higher level of recognition on the Pre-Test for all subjects while on the Post-Test the omissions were easiest for those subjects in the control groups while the distortions had a higher mean percent correct for the experimental groups. The results also indicated that on the total test the experimental subjects (didactic and videotape) showed more improvement in Pre- and Post-Test scores than did the subjects in the control groups (re-instruction and no interaction).

Item Analysis

An evaluation of the appropriateness of the analysis of stimulus productions indicated that certain items were easier for subjects to evaluate correctly while others were more difficult for the subjects.

Pre-Test: Easiest Items

At the word level of the Pre-Test item number 10 (-/k - coats) was correctly evaluated by all of the subjects. Item number 17 (-/p - patty) was correctly evaluated by 93.68 percent of the subjects. Both of these items were consonants with an omission type error pattern.

For the Sentence Pre-Test the item with the highest correct evaluation was number 21 (d/d_3 - George) which 96.84 percent of the students correctly analyzed. Ninety percent or more of the participants correctly evaluated items number seven (-/g - big), item 20 (w/r - right), item 23 (w/r - like), and item 34 (t/f - far). Three of these items which the subjects found as the easiest were consonants with substitution type errors.

Post-Test: Easiest Items

On the Post-Test word level, the highest correct item was number 10 (-/k - coats) as it was for the Pre-Test. Nine other items had a 95 percent or better correct analysis. Eight of those items were consonants and two were vowels.

On the Post-Test sentences, item number seven (-/g - big) was correctly analyzed by all of the subjects. Ninety-five percent or more of the subjects correctly analyzed five other items which were also consonant productions.

Pre-Test: Hardest Items

For the Pre-Test words, the most difficult items were

numbers three (ɹ//ə - brother) and 12 (ɹ//ʊ - looked) with only 25.26 percent of the participants correctly analyzing these productions. Both of these were vowel productions.

On the Pre-Test sentences, the most difficult items were number 37 (ui/ɔI - Roy's) with only 13.68 percent of the subjects correctly analyzing it; item number 17 (ɛ/ɝ - burr) with a 16.84 percent correctness; and item number 40 (I/æ - that) with a 14.74 percent correct evaluation. These items were vowel and diphthong type productions.

Post-Test: Hardest Items

The Post-Test word items which were most difficult for the subjects were item 12 (u/U - looked) with only 34.73 percent correct analysis and item 14 (j/l - hill) with a 43.16 percent correct analysis.

For the Post-Test sentences, the items which had the lowest percent of correct analysis were the same difficult items in the Pre-Test sentence section. Item number 40 (I/æ- that) was the most difficult with only 18.95 percent of the students correctly analyzing the vowel error. The others were item number 37 (ui/ɔI- Roy's) with a 22.11 percent correct evaluation and item 17 (ɛ/ɝ - burr) with only 29.47 percent of the participants obtaining a correct evaluation.

In summary, these results indicated that more vowel items than consonant items were consistently harder for the subjects to evaluate correctly. At the word level, items 12

(u/ʊ - looked) and 14 (j/l - hi<u>ll</u>) remained difficult from the Pre- to Post-Test while item 10 (-/k - <u>c</u>oat) was the easiest item for the subjects on the Pre- and Post-Test. For sentence level stimulus items, the easiest analyses were items seven (-/g - bi<u>g</u>), 21 d/d_3 - <u>G</u>eorge), 23 (w/l - <u>l</u>ike), and 34 t/f - <u>f</u>ar), with the most difficult items remaining the same from the Pre- and Post-Test which were numbers 17 (ɛ/ɝ - bu<u>rr</u>), 37 (ui/ɔI - Ro<u>y</u>'s), and 40 (I/æ - th<u>a</u>t).

CHAPTER IV

CONCLUSIONS

Introduction

The conclusions of this experiment are presented to answer the following questions:

(1) Was there a difference in the ability of students, with and without training, to recognize articulation errors?

(2) Was there a difference in the ability of students to recognize articulation errors based on the type of training, that is, Didactic versus Videotape instruction?

(3) Was there a difference in the ability of students to recognize articulation errors based on the type of control, that is Re-Instruction versus No Interaction?

(4) Was there a variation in the subjects' ability to analyze articulatory productions on the word versus the sentence level;

(5) Did any of the following variables make a difference in a student's ability to analyze articulatory errors?

a. grade point average

b. grade in Speech 1050

c. amount of foreign language experience

(6) Did the following phonological variables have an effect on the analysis abilities of students?

a. vowels versus consonants

b. correct versus error production

c. type of error production

Articulatory Target and Error Recognition: With and Without Training

Both the Experimental Groups (A-Live Voice training and B-Videotape training) and Control Groups (C_1-Re-Instruction and C_2-No Interaction) improved in their abilities to correctly analyze articulatory target and errors from the Pre-Test to the Post-Test. This improvement was assumed to be a factor of training and/or exposure to the analysis task. A significant difference between those subjects who had training and those who did not was evident for sentence Pre- to Post-Test analysis and for the total Pre-Test to Post-Test scores. This difference was not significant at the word level for Pre- to Post-Test measures. The assumption then was that as the production unit became longer with the target sound more embedded, the importance of training (Live Voice and Videotape) for target and error recognition increased significantly.

Training clinicians to recognize errors in sentence level production becomes more important as speech-language

pathologists move toward evaluating phoneme productions embedded in multiple word utterances such as in connected speech samples rather than the traditional single word testing mode.

Articulatory Target and Error Recognition: Didactic versus Videotape Training

Group A (Live Voice) subjects and Group B (Videotape) subjects made significant gains in their ability to analyze articulatory targets and errors with no difference in performance between the groups. When presenting the same instructional stimuli equal numbers of times by Didactic or Videotape, there did not appear to be a difference in learning gains by the participants. The implications of this are that the development and utilization of Videotape training programs can provide the student clinician with single and/or multiple exposures to calibrated learning materials which are likely to provide long-term benefits in terms of instructional time and cost savings. These recorded programs provide individual and group access to a master teacher for single or multiple training times (depending on the learner's need), without the demands of the instructor's time.

Articulatory Target and Error Recognition: Re-Instruction versus No Interaction

The subjects in the Control Group C_1 viewed the three-minute instructional tape entitled Articulatory Error Analysis

Instruction, took the Pre-Test then later viewed the instructional tape again and then took the Post-Test at their next class meeting. The Control Group C_2 subjects viewed the instructional tape, took the Pre-Test, then took the Post-Test at their next regular class. As evidenced by the Pre-Test mean percentage scores (Table 2), the subjects in Control Group C_2 started off with higher articulatory analysis scores than the subjects in Control Group C_1, suggesting that the two Control Groups might not have been homogeneous.

The subjects in both Control Groups demonstrated statistically significant improvement in their abilities to recognize targets and errors at the word, sentence, and total test levels. Subjects in Control Group C_2 (no interaction) started off higher in target and error analysis but, without the advantage of re-instruction before the Post-Test, their improvement in speech sound analysis was not as great as the Control Group C_1 subjects who had the advantage of re-instruction. Perhaps the nature of the information given Control Group C_1 caused improvement in target and error analysis because it prepared the subjects to focus on the task.

Articulatory Target and Error Recognition: Words versus Sentences

There was a difference in target and error analysis for the word task and the sentence task. The Pre-Test sentence mean percent correct scores were higher for all four groups than the word scores which indicated that subjects demonstrated

better target and error analysis when the sounds were embedded in longer utterances. The gains made from the pre- to post-scores were significant on both the word level and the sentence level for all groups. The Post-Test scores for all groups were higher for words than for sentences. Apparently, for initial exposure, contextual clues seemed to facilitate correct identification of targets and errors. However, for shorter utterances, repeated exposures and/or training seemed to improve recognition.

Subject Variables Related to Target and Error Analysis

Grades

It was observed that both overall grade point average and course grade related to the subjects' abilities to analyze articulatory targets and errors. Students who had higher grades in the class performed better on the Pre- and Post-Test measures than did students who had lower overall grades and a lower course grade. This implied that students' overall grade point averages and grades in a basic speech course may be predictive of their articulatory target and error analysis abilities. Knowing this, instructors could predict which students might perform better on phonetic analysis tasks and which students would need more training in target and error analysis.

Foreign Language Experience

Of interest was the relationship between time and

degree of exposure to a foreign language and Pre- and Post-Test performance. These results suggested that those students having had experience with a foreign language in high school are likely to perform better on tasks requiring phonetic discrimination than do students having had such experiences later in a college level course or students having had no foreign language training. Apparently those students with foreign language experience develop discrimination skills that allowed them to perform better on error analysis. This implied that student clinicians with a foreign language experience in high school could be expected to perform better on target and error analysis tasks before and after training.

Phonological Variables and Target and Error Analysis

The three phonological variables found to have an affect on the students' ability to make a correct analysis of the targets were: (1) type of phoneme: consonants versus vowels; (2) type of production: correct versus error; and (3) type of error: omission versus distortion versus substitution.

Type of Phoneme: Consonants versus Vowels

A review of the results indicated that on the whole, vowel type phonemes are more difficult for subjects to analyze than are consonants.

At the word level all groups performed better on the Pre-Test vowels than on the consonants. The training and

Control Groups made gains in word level vowel and consonant analysis on the Post-Test with the highest improvement scores for vowels; however, consonant type targets still had a higher correct analysis than vowels. At the sentence level, all groups performed better on Pre-Test for consonants than vowels and the percentage improvement was greater for consonants than vowels for all groups. The Treatment Groups (A and B) showed more significant gains in consonant analysis than the control groups (C_1 and C_2). Apparently, in shorter units such as words, vowels were more of a problem to evaluate but can be taught at this level better than in sentences. The implication was that students can more easily evaluate consonants and that vowel recognition can best be taught in words.

Type of Production: Correct versus Error

The ability of students to appropriately evaluate correct productions as correct and error productions as errors apparently depends on the length of the utterance, i.e., words versus sentences. At the word level, subjects in Groups A, B, and C_1 demonstrated a greater ability on the Pre-Test to correctly evaluate the errored productions than the correct items. However, on the Post-Test, the trend for all groups was toward a higher mean percent correct analysis on the correctly produced items with the highest percent improvement occurring on those targets which were correctly produced. For sentences, the Pre-Test showing for

all groups was better on correct items than on incorrect items, and the Post-Test results followed the same trend.

When the type of production was summed across treatments versus controls, the greatest proportionate gains were made by Treatment Groups (A and B). This suggests that analysis of both errored and correct productions can be trained effectively.

Type of Error: Omission versus Distortion versus Substitution

The length of the utterance apparently relates to the students' ability to correctly analyze certain types of errors. The omission type errors in words had the highest level of recognition for all groups on the Pre- and Post-Test. The subjects found the distortion errors most difficult to evaluate on the Pre-Test words but on the whole made the greatest gains on this type of error analysis. When considering training of error analysis, all types of errors can be taught effectively at the word level with the greatest gains occurring on distortions.

When the sound was embedded in a longer utterance the pattern of performance was slightly altered. Prior to training, students found substitutions easier to identify followed by omissions and then distortions. Following training, the greatest gains at the sentence level tended to be on distortion type error analysis. Apparently all types of

error analysis can be taught at the sentence level but distortions show a greater gain.

Summary Conclusion

It can be concluded from this study that Videotape instruction was as effective as Live Voice instruction for training Sophomore level college students, who were not majoring in communicative disorders, to analyze articulatory target and error productions. This study demonstrated that television was a valid instructional tool for teaching subjects to recognize and describe the target and error pattern for a variety of phonemes while previous studies had demonstrated this on only a limited number of phonemes. It was observed that the subject variables of overall gradepoint average, course grade, and previous foreign language training may be predictive of a student's ability to analyze target and error productions. Results from this study indicated that for some phonological variables, Videotape training was superior to Didactic training in teaching discrimination abilities, for example, the subjects trained by television improved more on sentence level analysis than did the other groups and vowel analysis at the sentence level was best taught by television.

The advantages of Videotape instruction over Didactic instruction for training articulatory error analysis skills are:

(1) Videotape allows for repeated instruction for

individuals or groups without repeated involvement of teaching personnel.

(2) Television offers equal access to educational materials and tasks so that consistent learning experiences can be offered to clinicians regardless of their locale.

(3) Videotaped instructional programs can aid clinicians in developing and maintaining observational skills by establishing calibration for a known established standard.

Implications for Further Study

The Videotape medium for training articulatory error discrimination skills should be studied further as it applies to student clinicians with various levels of training and to determine if repeated viewing increases learning; if training with or without feedback produces greater learning; and if students generalize their videotaped learned analysis skills to other stimuli materials such as actual client speech samples.

The testing and training videotape programs are available from:

Department of Communicative Disorders
University of Mississippi
University, MS 38677

and

Instructional Resources Center
Louisiana State University
Baton Rouge, LA 70803

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APPENDIX A

Pilot Study

Report of Pilot Study

Title: The Development of Clinical Skills in the Analysis of Articulatory Errors

Introduction

Speech pathology has been defined by Perkins (1971) and others as an applied behavioral science. The responsibility of this scientific profession is the habilitation or rehabilitation of communicatively handicapped individuals. As a behavioral scientist, the speech-language pathologist must be an astute observer of human behaviors.

Nation and Aram (1978) point out that the clinician must possess knowledge and professional skills in the areas of "tool presentation, response observation and recording, and interpersonal interactions."

The academic and clinical training of the speech-language pathologist should provide the individual with skills in systematic observation and recording of behaviors. There should be some method of calibrating the inter-clinician and intra-clinician's communication.

In this writer's opinion, one of the major problems facing our rapidly growing profession is the lack of proven training and educational models for preparation of speech-language pathologists. ASHA has provided training programs with curriculum and clinical practicum guidelines but no

training strategies. Our profession must begin to develop in the area of instructional technology if efficient and precise scientists are going to be trained and maintained.

The process of human communication is very complex and can be impaired by a multitude of variables. One of the most frequently occurring types of communicative disorders is a phonological or articulatory handicap. The practicing speech and language clinician is constantly involved in the management of articulatory disorders. Effective treatment of articulatory problems must begin with appropriate analysis and description of the phonological deficits. Every clinician must possess accurate articulatory analysis skills.

The academic and clinical training programs in speech-language pathology do not have proven instructional methods for teaching students skills in the observation and analysis of articulatory errors. For twelve years this writer has been actively involved in the academic and clinical preparation of speech-language pathologists and audiologists. It is time that the training strategies be standardized and tested.

Purpose

The speech and language clinician must have sufficient observation analysis skills to accurately evaluate and record client behaviors. One observational skill frequently needed by speech-language pathologists involves articulatory error analysis.

The intent of this pilot study was to compare two instructional methods utilized in training students to analyze phonological errors. The traditional classroom Live Voice teaching technique was compared to a Videotape program of instruction.

In order to meet the above objective a secondary purpose of this project became the development of instructional procedures, videotapes, and response forms.

The pilot study aided the researcher in determining variables which needed to be controlled in further studies of this type.

Procedures

1. Selectively reviewed the literature in the fields of Speech-Language Pathology and Instructional Technology to determine:
   a. Availability of instructional aids for clinician training of articulatory error analysis.
   b. Present trends in articulatory testing and error analysis.
2. Reviewed presently used articulatory evaluation instruments.
3. Developed standard procedures for Live Voice Pre-Test and Post-Test measures and the appropriate forms as follows:

   PT 1 - Pre-Test measure of phonemes at the word level.

PT 2 - Pre-Test measure of phonemes at the sentence level.

PT 3 - Post-Test measure of phonemes at the word level.

PT 4 - Post-Test measure of phonemes at the sentence level.

4. Prepared a set of standard Live Voice instructional procedures and forms for clinician development of articulatory error analysis skills. The student was given an analysis opportunity then immediate auditory and visual feedback was provided for self-evaluation. The levels of instruction are as follows:

CE 1 - Consonant Error Analysis, Word Level

Twenty-five words from published, phonological inventories containing single consonant errors were produced by an adult model. The clinician was given two opportunities to observe the error. An appropriate amount of response time was provided before the third production was accompanied by visual and auditory feedback.

VE 1 - Vowel Error Analysis, Word Level

Twenty-five vowel error words were presented twice for student analysis. The third production was provided for feedback. An adult model was used.

CV 1 - Multiple Phoneme Errors, Word Level

The student had two opportunities to analyze 25 words with vowel and consonant errors. Immediate feedback followed.

CE 2 - Multiple Phoneme Errors, Word Level

Only one monitoring opportunity was provided for the 25 words with multiple consonant errors. Feedback followed each error.

CV 2 - Multiple Phoneme Errors, Sentence Level

The student had one opportunity to analyze the 41 consonant and vowel errors in sentences with feedback.

CE 4 - Multiple Consonant Errors, Sentence Level

Twenty sentences from the Templin-Darley Tests of Articulation were presented once with feedback information following each sentence.

5. Developed 3/4 inch cassette video-tapes based on the above mentioned instructional procedures. The training procedures involved varying levels of stimulus complexity in regard to type and number of phonemes to be analyzed per word or sentence and the number of stimulus presentations.
6. Three graduate students in communicative disorders evaluated the training tapes for clarity of instruction and presentation and adequacy of student response time. Tape CVE 3 was eliminated because the students reported inadequate time to record the phoneme errors.
7. Fifteen students enrolled in CD 301 (Articulation Disorders) at Ole Miss with no previous training in articulatory error analysis and who could pass a basic competency in phonetic transcription were randomly assigned to one of two treatment groups. The students completed

a Student Information Form.

8. Three expert judges and all subjects were pre-tested using a Live Voice presentation of PT 1 and PT 2.
9. Over an eight-day time span the subjects were exposed to their treatment (articulation training) in groups either by Live Voice or by Videotape..
10. Three expert judges and all subjects were post-tested using a Live Voice presentation of PT 3 and PT 4.
11. The expected or correct responses on all Pre-Test and Post-Test measures were determined by analysis of inter-judge response agreement. Two of the three judges had to indicate the same response or the item was deleted.
12. The subjects' proportion of correct responses were statistically analyzed to determine if the performance of the Live Voice group was better than the performance of the Videotape group..

Results and Conclusions

Each subject's scores were reported in proportion of correct responses. The Pre-Test and Post-Test measures did not have an equal number of possible responses because items had to be deleted when there was no inter-judge agreement on the articulatory error. PT 1 = 30 (no deletions; PT 2 = 37 (3 deletions); PT 3 = 27 (2 deletions); PT 4 = 35 (5 deletions).

The data was analyzed according to treatment group and

subtest performance on the Pre-Test and Post-Test measures. For group comparisons the data was reported in mean proportion correct and difference (improvement or regression) in mean proportion correct for the Pre-Tests and Post-Tests.

In Table 1 the summary of each subject's performance was divided by type of treatment and subtest (word and sentence) of the Pre-Test and Post-Test measures.

An analysis of individual scores as displayed in Table 2 indicated that the subjects as a whole improved in their ability to analyze articulatory errors based on the higher mean proportion correct from the Pre-Test and Post-Test measures.

The individual subject performances were analyzed further by considering Pre-Test and Post-Test changes for the word subtests and the sentence subtests. By comparing each subject's scores for the PT 1 (words) to the PT 3 (words) and for PT 2 (sentences) to PT 4 (sentences), it was found that all subjects except two showed an improvement after training. Subject 1 in the Live Voice Group and Subject 3 in the Tape Group did not show positive change.

Table 3 summarizes the mean proportion of correct responses for each treatment group by subtest for the Pre-Test and Post-Test measures. Further evaluation of this data indicated that the Live Voice group showed an improvement of their Pre-Test to Post-Test performance by 10.015. Table 4 indicated a 14.62 improvement in performance on the Post-Test

measure over the Pre-Test for the tape group. The Live Voice group performed better than the tape group by 4.395. This was not a statistically significant difference.

In Table 5, the grouped subjects' scores are compared for the similar tasks (Pre-Test and Post-Test tasks) at the word level. The Live Voice group showed the greatest improvement in analysis of articulation errors at the word level. The tape group improved equally on the word tasks and the sentence tasks.

The results of this pilot study implied that students do improve their ability to analyze articulatory errors on the words and sentence level after exposure to articulation exercises which provided them with feedback regarding the appropriate articulatory analysis response. Students were better observers of articulatory behaviors after exposure to training.

The performances of the Live Voice and tape groups was slightly different but not to a statistically significant degree. From this pilot study it was concluded that there is not a significant difference in the observation or analysis skills of students trained by the two different instructional modes of Live Voice and Videotape.

Further study of these methods seemed warranted particularly with an increased number of subjects and the addition of a control group with no training in observation skills.

Other conclusions are that the tape method was more

economical in regard to long term considerations and could be used for group and individual instruction. The tape method of training would lead to consistency in the learning mode with utilization on a broader basis. Live Voice instructional modes are not easily standardized from one presenter to the next and do not lend flexibility to the instructional format.

Recommendations

The pilot project provided insight into the many variables that could affect the results of further experimental studies in this area. Continued study of the techniques for developing articulatory error analysis skills in student clinicians seems warranted due to the lack of standardized instructional methods. The lack of inter-clinician and intra-clinician reliability on phoneme error analysis tasks was an additional reason for further study of instructional methods.

The following recommendations need to be considered before further experimentation:

1. The Pre-Test and Post-Test measures should be standardized through Videotape presentation rather than Live Voice.
2. Five to seven expert judges should determine the articulatory error patterns on the Pre-Test and Post-Test measures. Inter-judge reliability should

be higher when providing unlimited viewing of the test tapes.

3. The number of subjects should be increased to approximately sixteen per treatment group.
4. Subjects should be randomly assigned to treatment groups with equal distribution in regard to overall grade point average.
5. The five treatment groups should include:
   a. Group Live Voice presentation of training program.
   b. Group Videotape presentation of training program.
   c. Individual multiple access to Videotape program.
   d. No exposure to the training program.
   e. Exposure to traditional classroom techniques for training articulatory errors.
6. Further standardization of the Live Voice training procedures through the use of transparencies and an overhead projector to provide the feedback regarding error analysis.
7. Modification of scoring forms to include subject identification number, and summary information such as number correct.
8. Further statistical analysis utilizing analysis of variance considering the following sources:

a. groups

b. subjects within groups

c. time (Pre- and Post-Test measures)

d. group by time interaction

9. An analysis by type into error and sound should provide insights into patterns of difficult error analysis.

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TABLE 1

Proportion Correct by Subject, by Test, by Group

	Pre-Tests		Post-Tests	
Live Voice Group	Word PT 1	Sentence PT 2	Word PT 3	Sentence PT 4
Subject #1	76.67	91.89	81.48	91.43
Subject #2	56.67	75.68	66.67	82.86
Subject #3	33.33	51.35	66.67	80.00
Subject #4	76.67	70.27	88.89	91.43
Subject #5	63.33	75.68	92.59	80.00
Subject #6	20.00	48.65	81.48	82.86
Subject #7	70.00	59.46	66.67	82.86
Mean Proportion Correct	56.67	67.57	77.78	84.49

	Pre-Tests		Post-Tests	
Tape Group	Word PT 1	Sentence PT 2	Word PT 3	Sentence PT 4
Subject #1	60.00	64.86	74.07	91.43
Subject #2	60.00	48.65	70.37	74.29
Subject #3	93.33	89.19	88.89	77.14
Subject #4	83.33	72.97	85.19	82.86
Subject #5	83.33	78.38	92.59	91.43
Subject #6	46.67	54.05	74.07	74.29
Subject #7	46.67	56.76	88.89	88.57
Subject #8	70.00	86.49	88.89	85.71
Mean $\bar{x}$	67.92	68.92	82.87	83.21

TABLE 2

Proportion Correct by Subtest and Group

Live Voice Group	PT 1	PT 3	Difference	PT 2	PT 4	Difference
1	76.67	81.48	+ 4.81	91.89	91.43	- .46
2	56.67	66.67	+10.00	75.68	82.86	+ 7.00
3	33.33	66.67	+33.34	51.35	80.00	+28.65
4	76.67	88.89	+12.22	70.27	91.43	+21.16
5	63.33	92.59	+29.26	75.68	80.00	+ 4.32
6	20.00	81.48	+61.48	48.65	82.86	+34.21
7	70.00	66.67	- 3.33	59.46	82.86	+23.40

Tape Group	PT 1	PT 3	Difference	PT 2	PT 4	Difference
1	60.00	74.07	+14.07	64.86	91.43	+26.57
2	60.00	70.37	+10.37	48.65	74.29	+25.64
3	93.33	88.89	- 4.44	89.19	77.14	-12.05
4	83.33	85.19	+ 1.86	72.97	82.86	+ 9.89
5	83.33	92.59	+ 9.26	78.38	91.43	+13.05
6	46.67	74.07	+27.40	54.05	74.29	+20.24
7	46.67	88.89	+42.22	56.76	88.57	+17.53
8	70.00	88.89	+18.89	86.49	85.71	+ .78

TABLE 3

Mean Proportion Correct by Group and by Subject Test

	Pre-Test		Post-Test	
	PT 1	PT 2	PT 3	PT 4
Live Voice	56.67	67.57	77.78	84.49
Tape Group	67.92	68.92	82.87	83.21

TABLE 4

Mean Proportion Correct by Group for Pre- and Post-Test with Porportion Improved

	Pre-Test	Post-Test	Improved
Live Voice	62.12	81.135	19.015
Tape Group	68.42	83.040	14.620
		Difference	4.395

TABLE 5

Mean Proportion Correct by Subject for Equal Forms

	Pre-Test		Post-Test		Improved
Live Voice	PT 1	56.67	PT 3	77.78	21.11
	PT 2	67.57	PT 4	84.49	16.92
Tape	PT 1	67.92	PT 3	82.87	14.95
	PT 2	68.92	PT 4	83.21	14.29

APPENDIX B

Subject Information Form

Subject Information Form Speech 1050 - Class Days _____

Date: _____ Class Time _____

Name: _____ LSU ID#: _____

Local Telephone #: _____

Birthdate: _____ Age: _____

Overall Grade Point: _____ Number of academic hours completed: _____

Previous experience with phonetics:

High School - Yes No Describe: _____

College - Yes No Describe: _____

Foreign Language Experience:

Language spoken at home if not English _____

Academic Courses - (Specify language and years of study)

High School _____

College _____

Permission Statement:

I, _____, understand that I have
Name
volunteered for a research project involving phonetic transcription. I agree to spend one hour outside of class in a training session. It is my understanding that the scores I obtain will be confidential and identified only by a code.

_____ _____
Signature Date

Do not write below this line

Hearing Screening: ___ Pass ___ Retest Treatment
Vision Screening: ___ Pass ___ Retest Group _____
Speech Screening: ___ Pass ___ Retest
Phonetic Competency: ___ Pass ___ Retest

Scores	Form	#Correct	%age	Difference Score Word	Sentence
Pretest words	____	____	____		
Pretest sentences	____	____	____	____#	____#
Posttest words	____	____	____		
Posttest sentences	____	____	____	____%age	____%age

APPENDIX C

Phonetic Competency

Respondee Name: _____ Date: _____

Phonetic Competency

Instructions: Write in phonetics the nonsense syllables dictated from the videotape.

CV	VC	CCV Clusters
1. / /	1. / /	1. / /
2. / /	2. / /	2. / /
3. / /	3. / /	3. / /
4. / /	4. / /	4. / /
5. / /	5. / /	5. / /
6. / /	6. / /	
7. / /	7. / /	
8. / /	8. / /	
9. / /	9. / /	VCV
10. / /	10. / /	1. / /
11. / /	11. / /	2. / /
12. / /	12. / /	
13. / /	13. / /	
14. / /	14. / /	
15. / /	15. / /	
16. / /	16. / /	
17. / /	17. / /	
18. / /	18. / /	
19. / /	19. / /	
20. / /	20. / /	

APPENDIX D

Pre-Post-Test Word Level

PT 1 ANSWER SHEET PRE-POST-TEST WORD LEVEL Order #____

Respondee Name: _____ Date: _____

Words

1.	today	_____/t	I
2.	girls	_____/g	I
3.	brother	_____/ð	M
4.	half	_____/f	F
5.	push	_____/ʃ	F
6.	me	_____/m	I
7.	book	_____/ʊ	M
8.	asked	_____/æ	I
9.	out	_____/t	F
10.	coats	_____/k	I
11.	looked	_____/l	I
12.		_____/ʊ	M
13.	hill	_____/ɪ	M
14.		_____/l	F
15.	watching	_____/w	I
16.		_____/ŋ	F
17.	patty	_____/p	I
18.		_____/d	M
19.	closed	_____/kl	I
20.		_____/zd	F
21.	she	_____/ʃ	I
22.		_____/i	F
23.	church	_____/ɝ	M
24.		_____/tʃ	F
25.	sewed	_____/s	I
26.		_____/o	M
27.	television	_____/v	M
28.		_____/n	F
29.	black	_____/bl	I
30.		_____/ɹ	M

KEY
√ = correct
X = distortion
- = omission
w/r = substitution

Total Correct_____

Percentage Correct_____

APPENDIX E

Pre-Post-Test Sentence Level

PT 2 ANSWER SHEET PRE-POST-TEST SENTENCE LEVEL Order #___

Respondent: _____ Date: _____

/m, n/	1.	Nancy found some /m fine /n hangers.
/ð, w/	2.	Their father /ð /w wouldn't bathe.
/s/	3.	/s Sonya sewed six dresses /s.
/g/	4.	The /g girls wore big /g hats.
/p, ə /	5.	Please keep /p the paper /ə doll.
/ɪ /	6.	Give a little /ɪ of this /ɪ to him.
/r, o/	7.	The /r rose was /o old.
/ɔ /	8.	He was sad because /ɔ he was caught /ɔ.
/ɝ , k/	9.	The burr /ɝ was in the /k cat's fur.
/aɪ , r/	10.	/aɪ I found the /r right side.
/dʒ , sk/	11.	/dʒ George went to /sk school.
/l, d/	12.	I /l like the red /d apple.
/θ, z/	13.	We /θ thought he said /z zero.
/t, b/	14.	The two /t telephones are /b busy.
/eɪ , v/	15.	The /eɪ baby rolled /v over.
/u, k/	16.	I have a /u wool /k coat.

/i, f/	17.	Don't leap/i too far/f.
/u, j/	18.	Sue/u left yesterday/j.
/ɔɪ , gr/	19.	Roy/ɔɪ's house is green/gr.
/s, æ/	20.	See/s that/æ he leaves.

KEY
✓ = correct
X = distortion
- = omission
w/r = substitution

Total Correct_____

Percentage Correct_____

APPENDIX F

Consonant Error Analysis: Word Level

CE 1 Respondee Name _____

ANSWER SHEET Date _____

Consonant Error Analysis: Word Level

Item #	Answer Target Phoneme	Position	Stimulus Word
p. 1	w /r	I	rabbit
p. 2	___/g	F	dog
p. 3	___/s	I	sue
p. 4	___/ʃ	M	brushes

1.	leaf	I	___/l
2.	valentine	I	___/v
3.	wagon	M	___/g
4.	mouse	F	___/s
5.	pencil	I	___/p
6.	knife	F	___/f
7.	engine	M	___/d_3
8.	cat	I	___/k
9.	pipe	F	___/p
10.	matches	M	___/tʃ
11.	thumb	I	___/θ
12.	red	I	___/r
13.	smooth	F	___/ð
14.	scissors	M	___/z
15.	horse	I	___/h
16.	boat	F	___/t
17.	arrow	M	___/r
18.	broom	F	___/m
19.	door	I	___/d
20.	onions	M	___/j
21.	moon	F	___/n
22.	tub	F	___/b
23.	ties	F	___/z
24.	telephone	M	___/f
25.	shoe	I	___/ʃ

KEY
✓ = correct
X = distortion
- = omission
w/r = substitution

APPENDIX G

Vowel Error Analysis: Word Level

VE 1 Respondee Name _____

ANSWER SHEET Date _____

Vowel Error Analysis: Word Level

Item #	Answer Target Phoneme	Position	Stimulus Word
p. 1	___/ə	F	mother
p. 2	___/i	M	meat
p. 3	___/ɔ I	F	toy

1.	feet	M	___/i
2.	pin	M	___/I
3.	bed	M	___/ɛ
4.	bat	M	___/æ
5.	gun	M	___/ʌ
6.	mother	F	___/ɝ
7.	clock	M	___/ɑ
8.	ball	M	___/ɔ
9.	book	M	___/ʊ
10.	blue	F	___/u
11.	cone	M	___/o ʊ
12.	house	M	___/ɑʊ
13.	cake	M	___/eI
14.	pie	F	___/ɑ I
15.	boy	F	___/ɔI
16.	bird	M	___/ ɝ
17.	tiger	M	___/ɑI
18.	arm	I	___/a
19.	meat	M	___/i
20.	brother	F	___/ɚ
21.	opinion	I	___/o
22.	ate	I	___/e
23.	soda	F	___/ɐ
24.	music	M	___/ju
25.	moon	M	___/u

KEY
✓ = correct
X = distortion
- = omission
/ = substitution

APPENDIX H

Consonant and Vowel Error Analysis: Word Level

CVE 1 Respondee Name _____

ANSWER SHEET Date _____

Consonant and Vowel Error Analysis: Word Level

Item #	Answer Target Phoneme	Position	Stimulus Word
p. 1	___/ ð	I	th at
p. 2	___/ æ	M	
p. 3	___/st	I	st eps
p. 4	___/ ɛ	M	

1.	wagon	I	____/w
2.		M	____/ ɵ
3.	comb	M	____/o ʊ
4.		F	____/m
5.	cow	I	____/k
6.		F	____/ aʊ
7.	bathtub	M	____/ æ
8.		F	____/b
9.	gun	I	____/g
10.		M	____/ ʌ
11.	doll	I	____/d
12.		M	____/a
13.	pig	I	____/p
14.		M	____/I
15.	ladder	I	____/l
16.		F	____/ ɚ
17.	watch	M	____/ a
18.		F	____/t ʃ
19.	bird	M	____/ ɝ
20.		F	____/d
21.	nose	M	____/o
22.		F	____/z
23.	tree	I	____/tr
24.		F	____/i
25.	airplane	M	____/pl

KEY
✓ = correct
X = distortion
- = omission
w/r = substitution

APPENDIX I

Consonant and Vowel Error Analysis: Sentence Level

CVE 2 Respondee Name _____

ANSWER SHEET Date _____

Consonant and Vowel Error Analysis: Sentence Level

			KEY
		__/u-p1 __/ɔ -p2 __/k-p3	√ = correct
/u,ɔ,k/p1		Ruth caught a cold.	X = distortion
		__/l-p4 __/i-p5 __/p-p6	- = omission
/l,i,p/p2		Let me keep a little	w/r = substitution
		__/m-1 __/oʊ-2	
/m, oʊ/	1.	May I comb your hair?	
		__/g-4 __/ɔ -5 __/g-6	
/g,ɔ /	2.	The girl lost her dog.	
		__/n-7 __/ʌ -8	
/n, ʌ/	3.	I did not have fun at the game.	
		u/ -9 __/u-10	
/ʊ ,u,l/	4.	Look at the clock. You will be late	
		for school. __/l-11	
		ɜ/ -9 __/d -13 ɚ/ -14	
/ɝ ,dʒ,ɚ/	5.	The bird jumped across the ladder.	
		__/p-15 __/I-16 __/i-17 __/p-18	
/p,I,i/	6.	Peter, did you see my cap?	
		__/b-19 __/æ-20 __/b-21	
/b,æ /	7.	The baby's pan is in the tub.	
		__/aI-22 __/f-23 __.f-24	
/aI,f/	8.	Mike has a funny laugh.	
		__/s-25 __/aʊ-26	
/s,aʊ /	9.	The sun is shining on the house.	
		__/st-27 __/ð -28	
/st,ð /	10.	Stop! You missed the best one.	
		__/s-29 __/z-30 __/s-31 __/z-32	
/s,z/	11.	Suzie sewed zippers on two new	
		__/s-33 __/z-34 __/s-35	
		dresses at Bessie's house.	
		__/w-36 __/r-37 __/l-38 __/r-39	
/w,r,l/	12.	We rode with Lucy around the	
		tall __/l-40 __/w-41 tower.	

APPENDIX J

Articulatory Error Analysis Instruction: Script

Articulatory Error Analysis Instructions

Narrator: Gloria D. Kellum

The purpose of this tape is to train you in a method of recording speech sound errors, which are called misarticulations of speech sound errors. A misarticulation is simply when an individual misses a sound or produces a phoneme wrong. Listen to some examples of misarticulations of the /r/ phoneme in the word rabbit: "wabbit", "abbit", "xabbit", "wərabbit". Here is how you record each one of those misarticulations or sound errors in the word rabbit. As you see, for the first, if I were to say "wabbit" put a (w/r), secondly, "abbit" an omission of the /r/ (-/r) or perhaps "xabbit," (x/r) is a distortion. And then lastly, "wərabbit", (wə /r) is an addition. The types of misarticulations that you will find are, first, a substitution which is the use of a standard sound in place of standard sound. When you're recording this, you simply indicate the phoneme that was used in place of the target phoneme. For example, in the word "soap", if the person were to say "toap/soap" you record (t/s) which indicates a substitution. The next type of misarticulation is an omission, which simply has the sound left out. For example, if you were to say "oap/soap" you put a -/s and this is an omission error. The next type of misarticulation is a distortion. A distortion error is when the person uses a non-standard sound in place of a standard sound. A

nonstandard sound is one not common to the English language. It is indicated by a (x) and then the target phoneme. For example, in "soap", if the person were to say "xoap" you would write (x/s) to indicate a distortion. The fourth type of misarticulation is an addition error. This is the use of two or more phonemes in place of one. For example, in "soap" if the person were to say "tsoap" this is an addition and you record it by (ts/s).

For vowel errors, use the same type of markings. For example, in the target word "seat" if you're evaluating the [i] phoneme, the person says "sxt", this is a distortion type error; you record it by x/i. This is a distortion.

For clusters or blend errors use the same type of markings. For example, in the /bl/ cluster in "blue" if the person were to say "bue/blue" you'd write a (b/bl); this is a substitution error. Then when you are ready to score the misarticulations, first look for the target phoneme; the one you are to listen for and are to evaluate is always underlined. Then listen, and record the type of misarticulation using the marking as indicated previously. Thank you.

APPENDIX K

Grade Permission Form

PERMISSION FORM FOR SPEECH 1050 GRADE RELEASE

I, _____, give permission to Gloria D. Kellum to obtain my final semester grade in Speech 1050 after May 15, 1980. I understand that this information will be used in a research project and that my grade will never be identified by name or I.D. #.

_____
Signed

_____
Date

_____
LSU I.D. #

_____
Class day and time--Instructor

APPENDIX L

Training Session Assignment Form

SPEECH 1050 STUDENTS LUCK NUMBER: LSU ID #

Thanks for agreeing to come for a one-hour training session on Wednesday, April 30, 1980 or Thursday, May 1, 1980. You are in GROUP C. Please sign up for the time you wish to come for the training which will involve activities very similar to what we did in class today. Circle the time you signed up for so you will remember when to come. When it is your training time, come back to this same room; if you can, please come a few minutes early.

Reasons to come:
1. Learn more about phonetics.
2. Have a chance to win the door prize for each class. Bring this slip which has your luck number on it and we will draw the winner. You have to come to the training in order to have a chance to win.
3. Help an LSU student find a better way to teach phonetic analysis skills.

TRAINING TIMES: (Circle the one you sign up for)

Wednesday, April 30, 1980
5:00 P.M.
9:00 P.M.
Thursday, May 1, 1980
10:30 A.M.
3:30 P.M.

COME BACK TO THE SAME ROOM AT YOUR TRAINING TIME AND BE SURE TO COME TO CLASS ON FRIDAY WHEN WE WILL COMPLETE THE PROJECT.

APPENDIX M

Summary of Phonological Variables

Pre- and Post-Test

Summary of Phonological Variables, Pre- and Post-Test

PHONEME TYPE

Consonant Sounds	Word Frequency	Sentence Frequency	Total	Vowel Sounds	Word Frequency	Sentence Frequency	Total
n	1	1	2	I	1	2	3
t	2	1	3	e	1	0	1
d	1	1	2	æ	2	1	3
s	2	3	5	i	1	1	2
r	0	2	2	ə	0	1	1
m	1	1	2	ɔ	0	2	2
ð	0	2	2	ɝ	1	2	3
k	1	1	2	u	1	1	2
l	2	1	3	ʊ	1	1	2
g	1	2	3	o	1	1	2
z	0	1	1	Diphthong			
ŋ	1	0	1	ə I	0	1	1
b	0	1	1	e I	0	1	1
p	1	1	1	aʊ	1	0	1
v	1	1	2	ɔ I	1	1	2
f	1	1	2	clusters			
θ	0	1	1	kl	1	0	1
ʃ	2	0	2	bl	1	0	1
dʒ	0	1	1	gr	0	1	1
j	0	1	1	sk	0	1	1
ʧ	1	0	1	zd	1	0	1

TYPE OF PRODUCTION

	Total #	# Correct	# Errors	Type of Error		
				Omissions	Distortions	Substitutions
Words						
Consonants	18	4	14	5	2	7
Vowels	9	7	2	0	1	1
Diphthongs	0	0	0	0	0	0
Clusters	3	0	3	0	0	3
Total	30	11	19	5	3	11
Sentences						
Consonants	24	3	21	5	2	14
Vowels	11	8	3	0	1	2
Diphthongs	3	1	2	0	0	2
Clusters	2	0	2	0	0	2
Total	40	12	28	5	3	20
TOTAL TEST	70	23	47	10	6	31

APPENDIX N

Analysis of Variance by Treatment and Time at the Word Level

Analysis of Variance by Treatment
and Time at the Word Level

Sources of Variation	df	Sums of Squares	F	P
Treatment	3	0.02249363	0.79	NS
Time (Pre to Post)	1	1.53467476	162.39	0.0001
Treatment by Time	3	0.12324761	4.35	0.0067
Training vs Control	1	0.01054848	1.12	NS
Didactic vs. Videotape	1	0.00000118	0.00	NS
$Control_1$ vs $Control_2$	1	0.01088440	1.15	NS
Error	91	7.94832749	-	-

APPENDIX O

Analysis of Variance by Treatment and Time at the Sentence Level

Analysis of Variance by Treatment
and Time at the Sentence Level

Sources of Variation	df	Sums of Squares	F	P
Treatment	3	0.03940961	3.58	0.0169
Time (Pre to Post)	1	0.65788457	179.09	0.0001
Treatment by Time	3	0.04349106	3.95	0.0108
Training vs Control	1	0.02921662	7.95	0.0059
Didactic vs Videotape	1	0.00814525	2.22	NS
$Control_1$ vs $Control_2$	1	0.00112796	0.31	NS
Error	91	5.46542434	-	-

APPENDIX P

Analysis of Variance by Treatment and Time for the Total Test

Analysis of Variance by Treatment
and Time for the Total Test

Source of Variation	df	Sums of Squares	F	P
Treatment	3	0.026530	1.93	NS
Time (Pre to Post)	1	1.050544	229.85	0.0001
Treatment by Time	3	0.076637	5.59	0.0016
Training vs Control	1	0.018719	4.10	0.0459
Didactic vs Videotape	1	0.001987	0.43	NS
$Control_1$ vs $Control_2$	1	0.004755	1.04	NS
Error	91	6.415926	-	-

VITA

Gloria Dodwell Kellum, Doctoral Candidate, Louisiana State University, Baton Rouge, Louisiana; Assistant Professor, University of Mississippi, Oxford, Mississippi.

Date of Birth:
February 27, 1943

Family:
Husband: Jerrol Lynn Kellum
Children: Karen Kate (Birth: 7-30-70)
Kerrolyn Kelly (Birth: 7-6-73)

Education:
B.S., Louisiana State University, 1965, Speech Therapy
M.A., Louisiana State University, 1967, Speech Pathology and Audiology

Employment:
Instructor, Department of Speech and Theatre, University of Mississippi, 1966-1969

Assistant Professor, Department of Communicative Disorders, University of Mississippi, 1969-present

Professional Organizations:
American Speech-Language-Hearing Association (1966)
American Cleft Palate Association (1968)
Mississippi Speech and Hearing Association (1966)

Honors:
Outstanding Teacher Award, University of Mississippi, 1975
Outstanding Young Women of America, 1966, 1968, 1975, 1979
Fellow, American Speech-Language-Hearing Association, 1979

Professional Service:
American Speech-Language-Hearing Association
Legislative Councilor from Mississippi, 1976-1979, 1980-1983.
Mississippi Speech and Hearing Association
Vice President, 1967-1969
President, 1970-1972
Executive Board, 1967-present

Publications and Presentations:

Blackbourn, B. and Kellum, G. The Role of the Speech Pathologist and Audiologist (videotape), University of Mississippi Media Services Center (1974).

Crowe, T. and Kellum, G. Human Communications and Its Disorders: Fluency (videotape), University of Mississippi Media Services Center.

Crowe, T. and Kellum, G. (Editors) Human Communication and Its Disorders. In Progress.

Kellum, G. Articulatory Error Analysis (videotape), University of Mississippi Media Services Center 1978. A three part series of training tapes.

Kellum, G. Auditory Discrimination: Test Re-Test Reliability. Paper presented at the Annual Convention of the Southern Speech Association, Little Rock, Ark., 1968.

Kellum, G. and Crowe, T. Interactive Videotape Therapy (videotape), University of Mississippi, Communications and Resource Center.

Kellum, T. and Crowe, T. Interactive Videotape Therapy with Adult Stutterers. Videotape forum presented at the Annual Convention of the American Speech-Language-Hearing Association, Detroit, 1980.

Kellum, G., Crowe, T., and Chow, J. Effects of Stimulus Complexity on Verbal Responses of Stuttering Children. Paper presented at the Annual Convention of the American Speech-Language-Hearing Association, Detroit, 1980.

EXAMINATION AND THESIS REPORT

Candidate: GLORIA DODWELL KELLUM

Major Field: SPEECH

Title of Thesis: THE EFFECTS OF TRAINING ON THE DEVELOPMENT OF ARTICULATORY TARGET AND ERROR ANALYSIS SKILLS

Approved:

Cornelia A. Hudson
Major Professor and Chairman

James D. Ingraham
Dean of the Graduate School

EXAMINING COMMITTEE:

Stuart D. Gilmore

Albert J. Jetty

Kenneth L. Koonce

Charlie W. Roberts

Date of Examination: FEBRUARY 20, 1981