EFFECTS OF SYSTEMATIC TRAINING PROGRAMS ON THE GENERALIZATION OF NEW PHONEME RESPONSES ACROSS DIFFERENT POSITIONS IN WORDS

by 1264

SANDRA LEE RAYMORE

B. A., Western Washington State College, 1967

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF ARTS

Department of Speech

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1970

Approved by:

Bruce C. Flanagan

Major Professor

ACKNOWLEDGMENTS

The experiences one gathers in the process of thesis writing are numerous and varied. Many individuals have contributed to the learning experiences of this investigator. Unfortunately, neither time nor space allow adequate recognition of all of those who have directly or indirectly given their advice, encouragement, and support. The following acknowledgments, then, while directed to specific individuals, are also directed to those who must go unnamed.

Appreciation is expressed to members of the thesis committee: to Dr. James McLean for invaluable assistance in the generation, completion, and writing of the present investigation, to Dr. Druce Flanagan who provided guidance and support through his role as professor and thesis advisor, and to Dr. Joseph Spradlin for his advice on the reporting of research and functional analysis of behavior techniques. Acknowledgment is directed to Dr. Norma Bunton, Chairman of the Speech Department, for permitting off-campus research in the completion of thesis requirements and to the children and professional staff of Parsons State Hospital and Training Center for the opportunity to complete this research at that location.

Special thanks are extended also to Mary Schickel for the construction of several of the graphic presentations, to J. D. Sexton for his technical assistance, and to Mildred Jolly for typing the manuscript. To each of the above-named and to the unnamed goes an appreciation for patience, perseverance, and prudence.

A final, but nonetheless significant acknowledgment is made to J. M., D. B., G. M., and J. R., research participants, who contributed to the understanding and improvement of training procedures for other retarded children with articulation problems.

SLR

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

List of Tables

List of Tables (Continued)

List of Figures

Chapter I

Introduction to the Problem

Speech pathologists are concerned with the modification of speech and/or language behaviors which interfere with communication or which call attention to themselves because they deviate from cultural norms. A substantial percentage of speech pathologists' clinical subjects are those whose primary problems are articulation disorders. In these cases, the phonemes of the subjects' language are deviant because they are distorted in their production; substituted for by another phoneme of the subjects' language; or omitted from contexts in which they are phonologically required. In cases of articulation disorders, the speech pathologist must teach new phoneme responses to replace those which are deviant.

Procedures for Articulation Therapy

New phoneme responses are taught relatively effectively by speech pathologists. Using functional procedures which provide auditory, visual, and/or tactile cues about the desired response, the speech pathologist evokes approximations of these new responses from his client. The individual clinician's procedures vary slightly depending on the particular therapy method he follows. Most clinicians use the basic "stimulus method" of therapy derived from Travis' early work (1931). This method utilizes the auditory stimulus as its primary cue and is best represented in its general form in the procedures described by Van Riper (1963), Berry and Eisenson(1956) and Milisen (1954). The general procedures of the stimulus method also provide prominent visual cues about the placement of the various articulators as the desired phoneme is articulated. In other therapy methods, the procedures are directed more specifically to the tactile cues and physical manipulations which are most effective in evoking the desired new phoneme response. In this method, the work of Young and Hawk (1955) in developing the "moto-kinesthetic" method is most prominent.

Most speech pathologists combine the elements of both the stimulus method and the basic placement methods in developing the new, basic phoneme productions required for any particular client. Although there are significant differences in therapeutic styles among clinicians, the functional necessity of utilizing auditory, visual, and tactile cues to evoke the new responses makes all procedures basically similar. Most clinicians, therefore, will follow similar, if not identical, procedures to develop the new phoneme responses required. They will identify the most prominent features of the desired new response and arrange their stimulus cues to portray these features in optimum fashion. For example, if an /l/ sound is sought, clinicians will invariably emphasize visual cues because the placement of the tongue on the alveolus is a highly visible (and highly informative) cue for the client.

Similarly, the plosive quality of the /t/ or /k/ will direct almost all clinicians to tactile cues which demonstrate this "explosion." In each case, regardless of the basic method, speech pathologists will consistently present auditory models of the desired response so that the client can attempt to match the acoustic properties of the desired response.

In the development of new phoneme responses to replace deviant ones, therefore, speech pathologists tend to show at least relatively homogeneous features in their procedures. They also tend to be relatively specific in identifying their therapy goal and the functional procedures which will attain that goal effectively. Their procedures indicate that they identify specific features of the desired response; analyze the degree and type of deviancy from these features; and seek to provide the optimum stimulus cues to enable the client to produce that response.

In such therapy, however, the attainment of correct phoneme production is but the first step. If the therapy is to be judged successful, the new phoneme response attained in the clinical setting must "carry-over" to the client's spontaneous speech. This second goal is generally not attacked with the same degree of procedural specificity as is the response development goal. The specifics of the procedures used to attain this second goal are not as easily identified in the speech pathologist's procedures.

Speech pathologists often view carry-over in terms of its situational properties. For example, they often characterize carry-over as the extension of a correct articulation response from the clinical speech setting to another situational setting, such as school or home. Many of our techniques for attaining carry-over, therefore, are focused on situational factors. Van Riper (1963), for example, suggests the use of a "good speech chair" to aid the child in this transitional stage of generalization. He recommends that a certain chair in the home of the child be used in which the child is to be particularly cognizant of his speech. Girardeau and Spradlin (in press) suggest the use of a speech wrist-watch as a transfer device. The child is instructed to "practice good speech" while wearing the wrist-watch with the amount of time that the wrist-watch is worn gradually increased until it can be worn at all times. There are many other suggestions for incorporating special cues into non-clinic situations at home and school to help a child transfer a new phoneme response from the clinical to non-clinical situations. It is interesting (and significant), however, to realize that this clinic versus non-clinic situational dichotomy remains as the speech pathologist's primary specification of the carry-over process. The fact that speech pathologists frequently report problems in attaining such situational "carry-over" testifies to the functional deficiency of this view of the carry-over process. If, as seems to be the case, the speech pathologist often has operational difficulty with carry-over--the fact that his <u>specified</u> procedures for attaining it are limited to consideration of rather gross situational variables seems to call for some attention.

This attention seems best directed to the awareness that, although the procedures directed toward training carry-over of newly acquired phoneme responses are most often specified in terms of clinical versus non-clinical <u>situations</u>, speech pathologists are cognizant of the fact that other of their early clinical procedures are important to the carry-over process. The point here being that early procedures of a program of phoneme learning contain the potential to convey specific carry-over information. The nature and function of these other procedures important to the carry-over process, however, have not been specified, empirically tested, and/or analyzed.

Thus, speech pathologists incorporate "transition" procedures in which new phoneme responses are moved through various configurations of complexity, i.e., isolation, syllables, words, and sentences. They execute various procedures to move phoneme responses from imitative emission to more spontaneous types of production, i.e., reading, self-generated sentences, and controlled conversational sessions. All of these procedures are directed toward some eventual event of carry-over of the response being trained from these controlled clinical situations to non-controlled environmental situations. Generally, these procedures eventually attain such carry-over. Empirical quantification of the process by which this is accomplished, is lacking, however. Such data could be extremely helpful in understanding the process of carry-over and in improving the efficiency by which it is accomplished.

Functional Analysis of Carry-Over

The proliferation of operant principles into clinical and educational fields has provided a new impetus for functional analyses of the processes involved in speech modification and the procedures which are used to attain the process goals. This thrust has led to work in the functional analysis of the entire learning generalization process and, as one part of this process, into the analysis of phoneme response generalization.

For example, McLean and Spradlin, working from an operant model (1967), have suggested that the carry-over of newly learned phoneme responses to spontaneous speech might be productively viewed in terms of a stimulus control problem. In this view McLean and Spradlin (1967) take the position thatalthough carry-over is finally realized when new phoneme learning emerges in spontaneous speech, the learning process which enables this state might be analyzed for possible functional components and treated more as a series of tasks rather than in its Gestalt.

In their attempt to identify the possible components involved in the carry-over process, McLean and Spradlin (1967) noted that in the transition of correct phoneme responses from the early, imitative stimulus condition to spontaneous speech, the most objective quantifiable change is in the evoking stimulus rather than in the response. For example, the response on the initial /s/ in articulating the word /sʌn/ in imitation of an auditory-visual model is the same as the response when looking at the sky and saying /sʌn/, however, the evoking stimulus in the two situations is quite different. Thus, they suggest that one component of the "carry-over" of a correct phoneme response might be viewed as the generalization of a correct response from a stimulus condition in which the response is modeled (echoic) to another stimulus condition in which the response is cued, but not modeled (real object or picture). McLean and Spradlin's construct suggests, then, that quantification of the nature of the changes in the evoking stimulus will quantify one aspect of the nature of the generalization process.

In his experimental work on this hypothesis, McLean (1965) investigated the generalization of new phoneme responses produced in words evoked from stimulus conditions in which the response was modeled by the experimenter for imitation by the subject to stimulus conditions in which the response was evoked but not modeled, e.g., pictures. McLean found that there were constraints to conditioning imitation to non-imitation generalization, but that a systematic training program could overcome them. However, while investigating the generalization constraints between imitative and non-imitative conditioning, further constraints to phoneme response generalization even within the imitation-non-imitation conditioning became apparent. Specifically, McLean's data indicated that in order to attain carry-over of new phoneme responses, training programs must attend not only to the shift from imitative to non-imitative conditions, but also to the position of the response in words, (i.e., initial, medial, and final) and to generalization of newly learned phoneme responses to words which correctly required phonemes which were highly similar to the newly learned one.

McLean's research, then, indicated that the carry-over process in articulation might be productively investigated in terms of three specific types of generalization constraints within the process. If the constraints which are functional in the carry-over of articulation learning could be identified, isolated, and experimentally manipulated, more systematic procedures for phoneme generalization could be developed.

This study, therefore, was directed toward the further investigation of one of the areas of generalization - constraints identified in McLean's work - that of the generalization of new phoneme responses learned in the initial position of a word to their appropriate emission in the medial and final positions of words.

Chapter II

Review of the Literature and Statement of the Problem

The purpose of the present investigation was to evaluate the effect of a systematic shift of stimulus control on the across-position generalization of new phoneme responses with a population of mentally retarded children. The following discussion will review four areas of literature relevant to such an investigation: (1) behavior modification and stimulus control; (2) speech pathology procedures for attaining carry-over of new phoneme learning; (3) speech therapy with mentally retarded children; and (4) shift of stimulus control procedures in articulation therapy with mentally retarded. The second portion of this chapter will present a statement of the problem, hypothesis generated for the study, and research questions designed to prove or disprove the hypothesis.

Behavior Modification and Stimulus Control

Skinner (1957) has suggested that verbal behaviors do not occur at random; they occur in response to given stimulus situations. A response emitted when a stimulus is present and reinforced in the presence of that stimulus is gradually brought under the control of that stimulus.

Skinner reports (1966) that the genesis of the theory of stimulus control may be found in Thorndike's Law of Effect (1911) which states that

> Of several responses made to the same situation, those which are accompanied or closely followed by satisfaction to the animal will, other things being equal, be more firmly connected with the situation, so that, when it recurs, they will be more likely to recur; those which are accompanied or closely followed by discomfort to the animal will, other things being equal, have their connections with that situation weakened, so that, when it recurs, they will be less likely to occur. The greater the satisfaction or discomfort, the greater the strengthening or weakening of the bond. (Thorndike in Birney and Teevan (Ed.), 1961, p. 3).

A more recent application of Thorndike's Law of Effect to the theory of stimulus control is revealed in Skinner's three-term contingency of reinforcement (Skinner, 1957). Skinner contends that when a contingency relationship between a stimulus, a response, and a reinforcer prevails, an organism not only acquires the response which achieves reinforcement, but it becomes more likely to emit that response whenever the prior stimulus is present. He calls the process through which this comes about "stimulus discrimination." In the establishment of stimulus control, the following components, then, represent Skinner's three-term contingency as it applies to the process of stimulus discrimination: ". . . (1) a particular stimulus, called a discriminative stimulus, is the occasion in which (2) a particular response, (3) is followed by reinforcement, while other stimuli are the occasion for non-reinforcement . . . (Sloane and MacAulay, 1968, p. 11)." Mechner (1959) illustrates the three-term contingency schematically in the following manner:

$$S^D \longrightarrow R \longrightarrow S^R$$

S^D -- discriminative stimulus

R -- particular response

S^R -- reinforcement

Terrace (1966) indicates that the degree of stimulus control is determined by "the extent to which the value of an antecedent stimulus determines the probability of occurrence of a conditioned response." Stimulus control is, therefore, measured as a change in the probability of a response which occurs in the presence of a change in the stimulus value. As Terrace states, "The greater the change in response probability, the greater the degree of stimulus control . . . (p. 271)."

Stimulus Control of Verbal Responses

A verbal response may be emitted and reinforced and, therefore, be controlled in the presence of many types of stimuli. Delineation of some of the different types of stimuli which control verbal responses have been offered by Skinner (1957). In his description of these controlling conditions, he discusses, among others, the mand and tact. Skinner defined the mand as a ". . .verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation (pp. 35-36)." The defining characteristic of the mand is the unique relationship between the response and the reinforcement in that the response "specifies" its reinforcer. In this respect, the response "Turn-on the light" is a mand under the control of a stimulus condition of darkness. The deprivation imposed by darkness is satisfied by the specification of the reinforcement for the verbal command, i.e., the switching on of a light.

The tact, however, has a different type of relationship with the antecedent stimulus. It is defined by Skinner as a ". . . verbal operant in which a response [of a] given form is evoked (or at least strengthened) by a particular object or event or property of an object or event (pp. 82-83)." The controlling properties of the tact are the physical elements of the environment of the speaker. The most distinctive characteristic of the tact is that the response is specified by the discriminative stimulus. Thus, the response "table" is specified by the presence of a table. This control is developed and strengthened by consistently reinforcing the response in the presence of the one particular stimulus. Whereas, the mand "specifies" the reinforcer called for by the antecedent stimulus, the tact is "specified" by the antecedent stimulus itself. In both situations, the responses are evoked by the control of the antecedent stimulus.

In addition, Skinner (1957) points out that verbal responses also come under the control of textual, intraverbal, and echoic stimuli. He includes in the textual category, pictures and other symbol forms. In the second category of verbal stimuli, Skinner cites the control extended by antecedent stimuli presented by another person as intraverbal stimuli. Such stimuli may be relatively simple verbal chains which evoke certain responses, e.g., "At night I see the moon, in the daytime I see the (sun)." Intraverbals also include the verbal stimuli involved in interpersonal conversations, e.g., "How are you?", "Where are you going?".

All of these stimuli have some implication for the probability of the evokation of one verbal response over some other verbal response. The degree of control they attain depends on many factors. Certainly, the probability of evoking the word "clouds" is higher if the intraverbal stimulus is "The sky is filled with white, fluffy ______" than if the intraverbal stimulus is "What do you see outside today?" Similarly, the probability of certain responses can be made higher by the use of antecedent stimuli which evoke echoic or imitative verbal behavior. The unique characteristic of echoic behavior is defined by the point-to-point correspondence between the topographies of the evoking stimulus and the response. For example, the presentation of the manding stimulus "Say 'log'" would evoke the imitative response "log" and, in addition to precluding the evokation of any other response, would model the specific topography of the desired response. Skinner (1957) describes echoic behavior as one of the simplest forms of stimulus control of verbal behavior. Such simplicity implies a high probability of the occurrence of an appropriate verbal response. Peterson (1968) further attests to the power of imitation as an evoking stimulus for speech.

Stimulus Control in Speech Therapy Procedures

McLean (1965) and McLean and Spradlin (1967) have discussed the ways in which speech pathologists use stimulus control in their procedures to modify speech behavior. They note that speech pathologists utilize echoic stimuli to increase the probability of evoking specific topographies of speech responses. This point-to-point relationship between the stimulus and response topographies constitutes an imitative relationship and is basic in operant approaches to speech and language learning (Peterson, 1968; Sloane and MacAulay, 1968; Baer and Sherman, 1964). McLean and Spradlin (1967) also note that speech pathologists make extensive use of textual stimuli (pictures, written words), intraverbal stimuli, and the general tact condition to increase the probability that the responses produced by their clinical subjects are those which are appropriate to the class of speech responses which require modification. In this function, for example, the speech pathologist seeking to modify the /l/ phoneme response evokes words containing that particular phoneme by using echoic models, pictures, printed words, and/or intraverbal chains to evoke such words as lamp, light, and lock.

McLean (1965) also points out that generalization across various stimulus types may be a major factor in "carry-over" of new responses from training situations into spontaneous speech situations. He notes that the processes necessary for the shifting of a correct response from echoic stimuli to textual and intraverbal stimuli may be an important part of the process of the generalization of new behavior to novel situations. It is with regard to this process that this study will be most specifically pertinent.

Reinforcement in Establishing Stimulus Control

The discussion of stimulus control has, to this point, been directed toward consideration of the relationship between two of the three components of Skinner's three-term contingency: the stimulus and the response. The third component, the reinforcement, is an event or events which occur after the emission of a response. The reinforcement controls the rate by which the response occurs and, thus, increases or decreases the rate of responding.

There are four basic procedures for presenting and withdrawing reinforcers: positive reinforcement, negative reinforcement (removal of aversive stimulation), punishment I (removal of positive reinforcer), and punishment II (presentation of aversive stimulation). The method of reinforcement utilized in the stimulus shift program calls for the presentation of positive reinforcement. Brookshire (1967) defines positive reinforcement as

> . . .presentation of a positive reinforcer contingent upon emission of a specified response, with a resulting increase in the frequency of that response. Positive reinforcers are consequent events which function to increase the frequency of the response they follow (pp. 216-217).

It is important to note that the reinforcer is critical to the establishment of stimulus control. It is the reinforcement of a response only in the presence of the discriminative stimulus which imbues that stimulus with its controlling properties. Thus, the response "cat" is controlled by an appropriate cat stimulus because it has been reinforced in the presence of that stimulus and not reinforced when emitted in the presence of dog or cow stimuli.

This section has discussed the basic principles of stimulus control. Skinner's (1957) concepts regarding stimulus control of verbal behavior have been discussed in terms of his delineations of the functional nature of mand and tact control and echoic, textual, and intraverbal stimuli. McLean's (1965) and McLean and Spradlin's (1967) extension of stimulus control principles into speech therapy procedures have been introduced and their possible application in the functional analysis of "carry-over" goals on new phoneme learning has been suggested.

Speech Pathology Procedures for Attaining Carry-Over of New Phoneme Learning

Standard Procedures

Investigation of the literature in clinical speech pathology indicates that the primary methodological considerations of the carry-over process include three general procedures: 1) sequential development of the production of a new phoneme response through a configuration of response complexity (Van Riper, 1963; Johnson, Brown, Curtis, Edney, and Keaster, 1948); 2) establishment of some degree of "stabilization" and/or "automation" (Van Riper and Irwin, 1958); and 3) some consideration of the extending of the response into natural environmental situations through the use of "nucleus" situations which approximate the natural environmental milieu (Van Riper, 1963; Johnson, et al., 1948; and Van Riper and Irwin, 1958).

There are many interpretations of the salient factors in each of the three general procedures listed above and, therefore, many variations of the specific procedures used to implement them. The speech pathology literature, however, presents no base for these procedures either in terms of basic learning theory or in terms of an appropriate mass of experimental data.

Having their base in procedures developed by Travis (1931), standard speech pathology procedures which seek to attain carry-over appear to have an obvious foundation in the early learning theories of Thorndike (1911) who postulated the Law of Exercise:

> Any response to a situation will, other things being equal, be more strongly connected with the situation in proportion to the number of times it has been connected with *that situation* and to the average vigor and duration of those connections (Thorndike in Birney and Teevan (Ed.), 1961, p. 3).

Extension of Thorndike's work into more refined theories of instrumental conditioning by Hull (1943) and Spence (1953) yielded other specific postulates which could be applied to the attainment of carry-over. Such constructs as *habit strength and fractional* anticipatory goal responses appear closely related to the specific procedural methods of speech pathology which seek to evoke a new sound response consistently and to develop the new response through a series of fractionated response configurations.

In earlier sections of this Chapter, Thorndike's "Law of Effect" (Thorndike, 1911) was cited as being basic to later concepts about stimulus control as espoused by Skinner (1957). All in all, then, procedures in speech pathology, although rarely discussed in such terms by its own proponents, reflect obvious referents in S-R learning theories. Some discussion of these procedures, as they are described in the literature, show this base clearly.

Configuration Complexity. Most often, speech pathologists develop a new phoneme response through a configuration complexity which begins with the phoneme in isolation and moves it through configurations of nonsense-syllables, words, and sentences (Johnson, et al., 1948; *Van Riper, 1963; Van Riper and Irwin,* 1958). The rationale for this practice is most frequently expressed with the concept that therapy procedures dealing with the new phoneme in isolation from normal speech contexts minimize the interference from old (error) responses and, thus, increase the probability that a new response pattern can be emitted. Therapy procedures which move from training the phoneme in isolation to syllables, then, begin to re-introduce interference from phonemic neighbors and from nearer-to-normal configuration contexts. By evoking the new phoneme response in the face of such interference, the speech pathologist generally feels that he is executing a strengthening procedure for the new response. This strengthening in the face of increased interference from both old habit patterns and from increased response complexity, is also the goal of moving the new phoneme into word configurations and sentence-type responses. Thus, the speech pathologist begins evoking "key words" and putting the words in sentences to be produced by the subject (Van Riper, 1963; Johnson,et al., 1948; Van Riper and Irwin, 1958).

It is at this point that the speech pathologist believes that he has reached a state in which the strength of the new response can compete successfully with previous error response patterns. Most authorities in speech pathology infer that strengthening of a new response produces the concommitant weakening of the old response, again, in resonance with Thorndike's (1911) Law of Exercise.

At the word configuration level, then, the speech pathologist begins to anticipate that the competition between the error sound and the new correct response can begin to be modified in favor of the new response. He also believes that the sentence-type configuration can now begin to be extended as a successfully competing response with the earlier innappropriate response in normal environmental situations by using the procedure of evoking sentences in controlled situations which are analagous to more spontaneous speaking situations.

<u>Strengthening and Automation of New Responses</u>. Within the configuration procedures just described, speech pathologists seek the development of a new response in the face of increasing interference from response complexity, the old error response, and semantic complexity. Often, it is difficult to separate the various sources of the interference. The general implication within the literature is that competition from the habitual error response is increased as response configurations reach semantic significance because this is the level at which the old error response has been produced and reinforced over a period of time. The level at which semantic meaning is carried also is inferred to have higher interference capability because the adding of meaning to a response tends to distract

from the degree of concentration that a speaker can direct toward the smaller, less meaningful components of his speech configuration. Then, of course, utterences of semantic significance tend to reach higher degrees of length and phonemic complexity. This complexity tends to create greater difficulty in correct articulation of a phoneme than the configuration levels which call for simple nonsense syllables and/or simple words.

Within this move through configuration levels, then, speech pathologists work toward a point at which the forces which they feel interfere with a new response are overcome. They tend to believe that this goal is accomplished through a process in which a subject brings his speech under the more automatic controls of his kinesthetic and tactual senses in order to minimize the interference of semantic contexts and other sources of interference. Such terms as "semantic stabilization", "fixing the sound", and "automating" sound production are descriptive of these concepts of therapy (Van Riper, 1963; Van Riper, and Irwin, 1958).

Nucleus Situations. In addition to the development of new phoneme responses through a configuration of phonemic and semantic complexity and the attainment of a degree of stability and automation in such responses, speech pathologists generally work specifically to evoke the new responses in environmental situations away from the "clinical" situation in which the responses are initially learned and strengthened. In these procedures, for example, a "good speech chair" is designated in the home, with the child being instructed to attend to his articulation most carefully when he is in that chair (Van Riper, 1963). Similar situations are set-up in school, e.g., a reading class is imbued with extra cues to remind a child to produce his new sound response correctly. Assignments are given for a child to perform some special communication task and part of the assignment insists that he monitor his speech carefully for correct production of his newly-learned phoneme response. Such techniques are attempts to increase new response carry-over across situational constraints.

Recent Developments in Speech Pathology

With the theoretical and empirical bases for the most widely used procedures in articulation learning obviously based in S-R learning theory and instrumental conditioning as represented in the work of Thorndike (1911), Hull (1943) and Spence (1953), it is natural that this work and extensions of it in the work of Skinner, (1953; 1957) should have continued impact on the development of further procedures for such learning. This impact is highly visible in two current trends within the field of speech pathology.

The first trend is the emergence of new procedures for the acquisition of articulation responses based on operant conditioning paradigms. Mowrer, Baker, and Schutz (1968), McLean (1965), McReynolds (in press), among others, have reported such procedures.

The second trend which is evident is that of empirical investigation of the generalization characteristics of new articulation response learning. In this latter area, perhaps as important as generalization to new phoneme responses, is the nature of the constraints to such generalization.

Phoneme Generalization. Available studies of phoneme generalization are, interestingly, based on widely varying ideas about significant generalization parameters. For example, Winitz and Bellerose (1963) investigated the generalization of newly trained phoneme responses to other phonemes. They found high generalization to phonemes which were near the trained phoneme in terms of its distinctive features (Miller and Nicely, 1955) but not to phonemes more than two distinctive features different from the phoneme trained.

Shelton, Elbert and Arndt (1967) studied the generalization of training on one phoneme to other phonemes which were defective within their subjects' speech. Their data corroborated that of Winitz and Bellerose although it was not specifically designed or analyzed to do so. For example, they found that training on /s/ generalized as improved production of the /z/ but not on the /r/. This finding is consistent with the Winitz and Bellerose distinctive feature gradient.

McLean (1965) tested generalization of new phoneme learning of retarded children with regard to correct phoneme production in word positions other than that in which the phoneme was trained; across-phoneme boundries to the phoneme which, previous to the training, had been the error-response; and to untrained words in which the phoneme appeared. McLean's data indicated high generalization to phonemes similar to the trained phoneme in corroboration of Winitz and Bellerose's findings. His data also indicated that generalization of phonemes trained in the initial position did not generalize to untrained occurrences of that phoneme in the medial position in words, at least with retarded children. McLean also found that phoneme responses trained with his procedures did generalize to untrained words containing that phoneme in the same position in which it was trained.

Powell and McReynolds (1969) tested generalization of new phoneme learning and found that their subjects showed generalization of phoneme production from nonsnese syllables to words containing that phoneme. Their data also indicated that phoneme responses did generalize across changes in word position counter to McLean's findings. It should be noted, however, that data for the Powell and McReynolds study was obtained with subjects of normal intelligence in a program using the trained phoneme in isolation, nonsense syllables, and words while that of McLean was obtained with mentally retarded subjects in a program using only words.

The significance of these two trends is multi-dimensioned. Not only are they giving impetus to the development of improved procedures for the modification of deficient articulation behavior but they are bringing forth empirical data about the process of phoneme modification. This latter event will allow the end of the relatively gross consideration of "carry-over" within speech pathology procedures and will provide, instead, a body of empirical data which prescribes and defines the generalization of articulation learning across several critical constraints. Such data can be used to design intervention programs in articulation which have much greater efficiency and effectiveness than the current procedures.

Speech Therapy with Mentally Retarded Children

The subjects in the present investigation were drawn from a mentally retarded population. The following section will provide information regarding (1) characteristics of the articulation of mentally retarded children and (2) articulation therapy programs for mentally retarded children.

Characteristics of Speech

In a study designed to determine the articulatory deficiencies of mentally retarded individuals, Bangs (1942) examined the speech of subjects using 65 stimulus cards containing pictures of objects within the range of experience of the retarded individual. The results revealed that the subjects used in the study had substitutions which were similar to those of normal children with similar mental ages; however, the minor substitutions were different than those of normal children. Also, omissions were found to be ". . .one of the most significant characteristics of the articulatory errors found in the feeble-minded (p. 356)."

Schlanger (1958) in reference to his earlier work (1953) indicates that 55 to 66 percent of mentally retarded children have speech defects. In a study designed to evaluate speech defects in a hospital population, Schlanger tested 516 children over a five-year period. He concluded that neither the severity nor the type of speech problem was consistent within the population. However, 79 percent of the subjects had ". . .varying degrees of speech defectiveness in one or more speech areas (p. 102)."

According to Schiefelbusch (1963), ". . .57 to 72 percent of institutionalized mental defectives have speech defects (p. 3) . . ." with articulation and voice problems being the most prevalent. West, Ansberry and Carr (1957) state that the speech of the mentally retarded individual ". . .is characterized by phonetic lapses confusing to the auditor . . . (p. 402)."

From the above referents, it is clear that a large percentage of the individuals within a mentally retarded institutionalized population have speech problems and that a large number of these are articulation problems. It appears that therapeutic programs for individuals in these populations are an essential part of the habilitative efforts within such institutions.

Therapy

Wood (1964) comments ". . .a mentally retarded child has a reduced ability to learn adequately from any experience within his environment (p. 36)." She advocates drill and repetition as the basic core of therapy. Simple patterns involving few and concrete elements, are methods recommended by West, et al., (1957). Karlin and Strazzula (1952) agree with Wood that stimuli should be familiar and concrete.

Schlanger (1958) discusses characteristics of the learning ability of the retarded: ". . .reduced learning capacity, slow development, and problems of maladjustment (p. 298)." He advocated non-directive therapy, role-playing, games, and efforts to lessen the frustration of the individual.

Wilson (1966) designed a study to ". . .determine the efficacy of providing speech therapy to those mentally retarded individuals having articulation deviations (p. 423)." The investigator placed 415 speech deviant children into three groups: experimental, placebo and control. Over an experimental period of three years, the experimental group attended two one-half hour sessions of speech therapy a week where the Van Riper (1963) method of articulation therapy was used. The placebo group received non-phoneme oriented therapy in two half-hour sessions per week while the control group received no therapy during the experimental period. Results of the experiment indicated that the differences in the decrement of errors was not significant and concluded ". . .the approach to speech therapy commonly used in a public school setting . . . is of little value for the improvement of articulation for the retardate (p. 433)."

Sommers (1969) reported on an extensive program of articulation therapy for mentally retarded children in public schools. He concluded that articulation therapy with educable retarded children had definite benefits but cited an important problem in such therapy:

> . . . .the problem of carry-over, long recognized by speech therapists and others as one of the more challenging [problems] in the therapy process . . . . appeared to be a formidable [problem] for retarded subjects. The techniques used to facilitate the carry-over process in the present study were highly

> similar to those commonly used with children of normal ability. It is suggested that future research concerning the efficacy of articulation therapy for such children attempt to utilize a series of different types of carry-over activities at important junctures of the therapy process (p. 50).

It seems clear that mentally retarded children are not considered ideal candidates for articulation therapy by many authorities. It is also clear that standard techniques in therapy are not totally successful with retarded children. Carry-over is specifically cited (Sommers, 1969) as a difficult goal using standard procedures.

Shift of Stimulus Control Procedures in Articulation Therapy with Mentally Retarded

McLean (1965) designed a program of articulation therapy for retarded children utilizing an operant paradigm. The purpose of the study was to ". . .investigate articulation modification by an operant technique and to provide observations of the stimulus generalization of articulation responses (p. 217)." The program, emphasizing training of a specific phoneme in the initial position, was designed to bring the correct phoneme response under four different types of stimulus control. The rationale of this approach was to use the echoic stimulus condition to generate correct phoneme responding at high levels and to extend "carry-over" of the correct phoneme by shifting stimulus control to two types of textual stimuli (picture and grapheme) and to one type of intraverbal stimuli (an incomplete sentence to be completed by the subject).

Five mentally retarded male subjects, between the ages of eleven and thirteen years who were residents at the Parsons State Hospital and Training Center, participated in the study. All of the subjects had moderate to severe articulation disorders, but possessed adequate language skills for communication. On the basis of data collected on the Hejna articulation test, it was shown that the five subjects ". . .had articulation defects which were characterized by substitution errors." In addition, each subject was stimulable, i.e., able to imitate the experimenter's production of the phoneme to be trained in isolation. The response selected for modification consisted of a substitution error in articulation in the initial position of a word. One of the following phonemes was trained for each subject: /s/, /l/, /r/, and /tʃ/. The subjects were also demonstrated to be unable to correctly articulate the selected phoneme in the initial position in any of ten selected words when the words were evoked by picture, printed word or intraverbal stimulus presentations. The subjects, seen individually, five days a week for 15 to 20 minutes a day, were positively reinforced immediately after each correct response.

The four stimulus conditions involved in the study were designated as follows: S^1, echoic (auditory-visual stimulus); S^2, textual (picture stimulus); S^3, textual (printed word stimulus); and S^4, intraverbal (incomplete sentence). The procedure, involving the pairing and shifting of antecedent stimuli, was presented as follows:

1. S^1 -- audio-visual stimuli with performance criterion set at 50 percent correct phoneme production on each of four training blocks (one block consisted of 10 different words with the selected phoneme in the initial position). The subject was instructed to imitate the production of the stimulus word which was provided by the experimenter. Each correct response was reinforced by a token immediately after being evoked.
2. S^1S^2 -- the program shifted to a pairing of the auditory-visual stimulus with a picture stimulus until a criterion of 20 correct responses out of 20 attempts (equivalent to 100 percent on two blocks) was achieved. Each subject was instructed to imitate the production of the stimulus word as it was produced by the experimenter. Simultaneous with the occurrence of the auditory-visual model of the sound, the experimenter presented a picture of the stimulus word to the right of his mouth so that the subject would see and hear the word being articulated as well as see the pictorial representation of the word.

3. S^2 -- the program shifted to the presentation of picture stimuli alone. A criterion of 38 correct responses out of 40 attempts (95 percent correct on four blocks) was established for this condition. If, on any of the stimulus conditions, there occurred a downward trend in responding on four successive blocks, the previous stimulus condition was reinstated until the subject reached the criterion of that stimulus condition.
4. S^2S^3 -- the program shifted to a pairing of picture and written word stimuli with an established criterion of 20 attempts. The picture and the word were presented on the table directly in front of the subject.
5. S^3 -- the program shifted to a presentation of written word stimuli alone with a criterion of 38 correct responses out of 40 attempts.
6. S^3S^4 -- the program shifted to a pairing of written word and intraverbal stimuli with an established criterion of 20 correct responses out of 20 attempts. The stimulus consisted of an incomplete sentence in which the last word was omitted (intraverbal chain); the written stimulus was presented at the end of the intraverbal stimulus, the subject was instructed to respond by saying the word which was omitted from the intraverbal chain, using the training phoneme correctly.
7. S^4 -- the program shifted to intraverbal stimuli alone with a criterion of 38 correct responses out of 40 attempts.

The subjects were given three different types of tests during the training procedure to evaluate the effects of training: pre-training, intratraining probe, and post-training tests. The pre-training and post-training tests consisted of ". . .each subject's responses to the 10 training words in all four stimulus conditions (S^1, S^2, S^3, S^4) . . .(p. 40)." These tests were given before the training sequence began and immediately after the training sequence was completed. Reinforcement was not presented during the testing blocks. The unreinforced intra-training probe tests were given before the introduction of a new stimulus condition immediately after criterion had been met on the preceding stimulus condition.

After the training program had been terminated, each subject was given three generalization tests and one retention test. All three tests of stimulus generalization were given to each subject 24 hours after the completion of the stimulus shift training program and immediately after a subject was given the post-training tests. Using picture stimuli, the following tests were given: (1) New Item Generalization: five new word items in which the trained phoneme was in the initial position; (2) Overgeneralization: five new words which contained the formerly substituted phoneme in the initial position; and (3) Across-Position Generalization: five new words in which the trained phoneme was in the medial word position.

At the same time that the 24 hour test was given, and again one week later, the retention test was given. Each subject was to respond to picture stimuli of the original 10 training words. In addition, the subjects were given the New Item Generalization, Overgeneralization, and Across-Position Generalization tests using only the picture stimulus.

On the basis of the data gathered in this study, McLean concluded the following (pp. 105-106):

1. The principles and methods of descriptive behaviorism are appropriate for the study of variables controlling articulation change.
2. Articulation responses evoked by echoic stimuli and positively reinforced through a series of paired and single-stimulus conditions does effect efficient shifts in the stimulus control of the response.
3. Spontaneous generalization to new and untrained stimulus conditions were shown by procedures followed in this study.

4. Three of the four subjects were able to generalize to new words requiring the trained phoneme in the same word-position in which it was trained.
5. Three of the four subjects overgeneralized to new words which, when correctly produced, required the previously substituted phoneme.
6. The subjects did not generalize the trained phoneme to a word position different from that in which it was trained.
7. The responses and generalization patterns acquired in the stimulus shift training program are maintained at least over a short period of time.

The results obtained by McLean indicated that the trained articulation response generalized to new words in which the trained phoneme occurred in the trained position; the trained articulation response over-generalized to words containing the previously substituted phoneme; and the trained articulation response did not generalize to positions other than the position in which the response was trained. The results dealing with the inability of the mentally retarded subjects to generalize the trained phoneme response to word positions other than the initial position are the basis of the present investigation. While three of the four subjects who completed McLean's program were able to generalize the trained phoneme response to new words in the initial or trained position, none of the four subjects were able to generalize the correct phoneme response to new words in which the trained response was required in the medial position. It appears, then, that, with mentally retarded subjects at least, specific word position training is necessary in order to generalize the trained response to new words in the initial, medial, and final word positions. However, the influence of a stimulus shift program, which includes training of the correct phoneme in all three word positions, upon the generalization of correctly articulated phoneme responses is not known.

Statement of the Problem

As discussed in previous sections of this study, the trends in articulation therapy procedures are toward the development of more functionally defined procedures for training articulation responses and the empirical investigation of the generalization gradients of articulation learning.

Most of the new therapy procedures (Mowrer, Baker, and Schutz, 1968; Sloane and MacAuley, 1968; Garrett, 1965) emphasize systematic manipulation of various antecedent stimulus conditions. The specific variations in the nature and type of the stimuli used, constitute an important dependent variable in experimentation into new programs of therapy. Concommitantly, within such investigations of new therapy procedures, the generalization of the response learning which accrues, is an important factor in judging both the validity and the efficiency of these procedures.

The importance of this concurrent concern with both teaching paradigms and generalization effects of training appears most critical. In the past, as noted in an earlier section of this study, carry-over has been treated by speech pathologists as an event which comes as a last stage of articulation therapy. In the new procedures the process of carry-over is fractionated from the relatively gross situational dimensions previously used (clinic versus non-clinic situations) and viewed in terms of a number of specific generalization tasks which must be attained within the various stages of the therapy process. Thus, training procedures are developed not only to produce a new response, but also to produce the generalization of the new response to novel (untrained) situations which are deemed important to the general carry-over process.

The concept of stimulus control discussed previously has provided the theoretical and empirical base from which training paradigms can be generated. The extension from stimulus control constructs to stimulus generalization constructs, then, provides the theoretical and empirical base for investigation of new phoneme training and carry-over.

As McLean and Spradlin (1967) state, most articulation therapy procedures, both old and new, carry-out some training on a highly supportive stimulus-type such as echoic and extend this stimulus control of the correct response to other, less-supportive types of stimuli such as pictures. This change of stimulus control across different types of stimuli enhances the generalization of such responses to other, untrained stimuli through the process of stimulus generalization.

As stimulus control is developed and extended, and as stimulus generalizations are attained and measured, however, variables which function as constraints to such generalization become apparent. As such variables are identified, they must be included in the training paradigms so that their constraining effect can be attenuated and optimum and complete generalization attained.

The present study seeks to investigate one of the constraints to generalization observed in McLean's (1965) work with mentally retarded children. This constraint was evident in the inability of his subjects to generalize new phoneme responses learned in the initial position of words to untrained words which contained the phoneme in the medial position. Consistent with the perspective discussed above, variables deemed important to attaining what McLean called "across-position" generalization were identified and were incorporated in the shift of stimulus control training procedures he used.

The Problem

It was the purpose of this study, therefore, to investigate a modification of the shift of stimulus control procedures. The modifications were directed toward attaining better across-position generalization. Specifically, the modifications included two additional treatments for training the correct phoneme response in the medial and final positions. It was hypothesized that, since generalization gradients of initial-position learning to other word positions are low, correct responding in all three positions requires specific position training. Thus, at least with mentally retarded children, the key is not across-position generalization of initial-position training, but generalization of three-position training to untrained items.

Research Questions

From this hypothesis, the following general research question was devised: After the correct response has been trained in the initial position utilizing the procedure described by McLean, will specific training on the medial and final positions improve generalization of the response to all positions in new words? The general research question was used to generate three specific questions to be answered by this study. These questions are:

1. Will replication of McLean's shift of stimulus control procedures, applied to initial position training of a new phoneme with mentally retarded children, indicate low generalization to other positions in untrained words as did his study?
2. If low across-position generalization is again demonstrated as a result of initial position training, will additional application of the shift of stimulus control procedures, training new phonemes in the medial and final positions in words, increase generalization to these positions in untrained words?
3. If 100 percent levels of generalization of position learning are not attained from the training of each of the three word positions, will enforced responding to randomized presentations of occurrences of the phoneme in all three positions under a positive reinforcement contingency further improve the generalization to all positions in untrained words?

Chapter III

Procedures

The discussion of the procedures of the present investigation entails a detailed description of the selection of subjects, the experimental material, the experimental environment and equipment, the experimental method, tests for the effects of training, tests of generalization after training, retention tests and reliability.

Subjects

For this investigation, three male subjects and one female subject were selected from the population of residents at Parsons State Hospital and Training Center. They were selected from a group of residents who had been recommended by Speech and Hearing Department personnel for articulation therapy on the basis of screening tests given prior to the investigation. The following table (Table 1) lists the chronological age, mental age, intelligence quotient, measured intelligence and adaptive behavior levels for each of the four subjects.

TABLE 1

Subject Test Data

Subject	CA	MA	IQ
A	15-10	10-5	82
B	14-5	10-7	83
C	12-2	7-0	69
D	12-10	8-11	56
MEAN	13-10	9-5	72.5

Data for the mental ages and intelligence quotients were collected from results on the Peabody Picture Vocabulary Test, Form B, administered prior to the beginning of this study. While each subject demonstrated an adequate expressive ability for purposes of the present investigation, each subject also exhibited a need for articulation therapy. Each subject had been given hearing tests prior to selection for the investigation; each was found to have hearing thresholds within normal limits.

Each subject was required to meet specific criteria regarding the type of articulation error demonstrated. On the basis of results obtained on an articulation test using picture stimuli, the subjects met the following criteria for selection.

1. At least one phoneme defective in all three word positions on a picture articulation test of the phonemes /k/, /g/, /f/, /l/, /r/, /tʃ/, /s/, and /z/.
2. The ability to imitate correctly one or more of his defective phonemes in isolation after it had been presented as an auditory-visual stimulus model no more than five times by the experimenter.
3. Inability to produce the selected phoneme correctly in the initial, medial and final word positions in any of the selected training words when the words were evoked by picture or intraverbal stimuli.

The specific results of the articulation tests, as well as data regarding the above information, for each child are given in Appendix A. All subjects, had at least one articulation error which was characterized by substitution or omission errors in all three word positions. From the acquired data, one phoneme which met the criteria for selection was identified for each subject. Two subjects substituted /θ/ for /s/; one subject substituted /w/ for /l/; and one subject substituted /ts/ for /tʃ/.

All but one subject met the third criterion in that they were not able to articulate the selected phoneme correctly in training words presented in the form of picture stimuli. One subject, Subject A, inconsistently produced the /s/ phoneme correctly on the training words, but consistently was unable to correctly produce the /s/ in conversational speech. On this basis, he was included in the training program to observe the effects of training on such inconsistency.

Materials

On the basis of the phonemes selected for use in the study, materials were developed which met the following criteria:

1. Words used in the program must be nouns which are *picturable*, i.e., a simple line drawing representing the word which, when tested, would evoke the appropriate verbal response.
2. Words used in the program must contain (a) the selected phoneme in the initial position (10 words), (b) the selected phoneme in the medial position (5 words), and (c) the selected phoneme in the final position (5 words).

The training materials used in the program included:

1. S^1 -- A list of 10 different stimulus words in which the selected phoneme was in the initial position which were presented orally to the subjects for imitation.
2. S^2 -- Ten stimulus pictures of the same 10 words.
3. S^2S^3 -- Ten stimulus cards in which the picture of the stimulus word is on the right half of the card and the grapheme representation is on the left side.
4. S^3 -- Ten stimulus cards upon which the grapheme representation of the stimulus word was printed.

5. S^4 -- Ten intraverbal chains (short, incomplete sentences in which the last word was omitted; use of the appropriate training word with the selected phoneme in the appropriate position would complete the sentence).

Materials for generalization testing included a picture of five untrained stimulus words in which the trained phoneme was in the appropriate word position. Appendix B lists the stimulus words and intraverbal chains selected for the investigation for each subject.

Experimental Environment

Each subject was seen in a well-lit therapy room equipped with a two-way mirror. The subject was seated at a table to the immediate right of the experimenter facing a mirror. Throughout the training session, the experimenter was turned to face the subject so that the subject was exposed to a full-face presentation by the experimenter.

To the right of the subject was placed an Altec (model 682) microphone which was used in the audio recording of the therapy session. An Ampex (model 602) tape recorder (7 1/2 i.p.s.) was located to the experimenter's left.

Because of the nature of a particular phoneme substitution (/w/l/), all sessions with Subject C were video-taped, rather than audio-taped, for later reliability judgements. A Sony (model CV2000) video-recorder with a matching Sony camera were used with the audio portion being channeled through a Magnecord (model 1022) tape recorder. In addition, an Electro Voice Sound Spot Microphone (model 644) was used as well as a General Electric Weatherproof Floodlight (150-Par-Fl) to illuminate the mouth area of the subject in order to facilitate reliability judgements on the tongue elevation for /l/.

The reinforcer (a poker chip whose presentation was contingent upon a correct response) was delivered from a Gerbrands Poker Chip Dispenser (Model B). The dispenser was placed in a 12 x 9 x 4 inch clear plastic box lined with sponge rubber to eliminate the distracting noise of the poker chip hitting the plastic sides. The mechanism was operated by a switch held in the hand of the experimenter. The reinforcement box was placed to the left of the experimenter. Tokens received during each training session could be redeemed for items from the clinic store or pennies.

Experimental Method

Each subject was seen individually for approximately 30 minutes, five days a week. Because the completion of the experiment was based on the time at which each subject met the assigned criteria, the number of sessions needed to complete the assigned task was different for each subject. Throughout the training program, except during the testing sessions, each correct response made by a subject was followed by immediate reinforcement.

The training sequence developed by McLean "was designed to generate a new articulation response under one stimulus-type and then to shift this response to the control of three other stimulus-types in succession (p. 35)" with training words in which the selected phoneme was in the initial position. The present investigation was designed to follow the same procedure with the inclusion of four additional training steps, i.e., training of the selected phoneme in the (a) final position, (b) medial position, (c) medial-final randomization, and (d) initial-medial-final randomization.

The technique of training proposed by McLean was described generally in Chapter II; however, a brief description of the technique will follow to aid in the understanding of the additional treatments. Four stimulus conditions were presented by McLean; each stimulus condition represented a stimulus type with a specific criterion being established for each condition. When the criterion for each of the four conditions were met, the training sequence was terminated and considered complete. A description of the four stimulus conditions, their criteria, and methodology of application were described by McLean (pp. 36-40). The following represents, in part, the description provided by that experimenter:

Initial Position

Condition I. Each of ten training words were presented as auditory-visual models (S^1) to the subject by the examiner. The subject was instructed to repeat each word after the examiner. Correct responses received immediate positive reinforcement while incorrect responses did not. On the occasion of an incorrect response, the examiner moved on to the next stimulus item. When the subject reached a criterion of 50 percent on four successive blocks of 10 words each, Condition I was terminated.

Using the method of graphic description devised by Mechner (1959), McLean presented the following as a representation of Condition I:

$$S^1 \longrightarrow R \longrightarrow S^{R+}$$

S^1 represents the auditory-visual stimulus of Condition I, R represents the correct response, and S^{R+} represents the positive reinforcer.

Condition II. Using the same 10 audio-visual stimuli of the training words (S^1) of Condition I, the experimenter simultaneously presented 10 picture stimuli (S^2). On any one stimulus item, the subject was exposed to the auditory-visual stimulus as well as the pictorial stimulus. When the subject reached the criterion of 20 correct responses in 20 attempts, the use of paired stimuli was terminated. The auditory-visual stimulus was withdrawn and only the pictorial stimulus was presented. When the subject reached the criterion of 38 correct responses out of 40 attempts, the subject was considered prepared for the next treatment condition. McLean represented Condition II graphically in the following manner:

$$\left[\begin{matrix} S^1 \\ S^2 \end{matrix}\right. \longrightarrow R \longrightarrow S^{R+} \longrightarrow S^2 \longrightarrow R \longrightarrow S^{R+}$$

20 correct in 20   38 correct in 40

In *the event that a subject* showed a downward trend of correct responses on S^2 or any of the following treatment conditions, the experimenter reinstituted the previous stimulus condition until the subject met the criterion assigned for that condition. The previously unsuccessful stimulus condition was again presented with the appropriate criteria. When the criteria was met, the next stimulus condition was presented.

Condition III. The picture stimuli (S^2) and the printed grapheme (S^3) were paired until the subject had emitted 20 correct responses out of 20 attempts. When the criterion had been met, the picture stimulus was withdrawn and the printed grapheme was presented alone. The criterion to be achieved was 38 correct responses out of 40 attempts.

The graphic representation described by the experimenter appeared as follows for Condition III:

$$\left[\begin{matrix} S^2 \\ S^3 \end{matrix} \longrightarrow R \longrightarrow S^{R+} \right] \longrightarrow \left[S^3 \longrightarrow R \longrightarrow S^{R+} \right]$$

20 correct in 20   38 correct in 40

Condition IV. The printed grapheme (S^3) was paired with the intraverbal stimulus (S^4) until the subject reached the established criterion of 20 correct responses in 20 attempts. When the criterion had been established, the printed grapheme was withdrawn and the subject received only the intraverbal chain as a stimulus. When the criterion (38 correct responses in 40 attempts) was achieved, the training sequence was terminated.

McLean described Condition IV graphically in the following manner:

$$\left[\begin{matrix} S^3 \\ S^4 \end{matrix} \longrightarrow R \longrightarrow S^{R+} \right] \longrightarrow \left[S^4 \longrightarrow R \longrightarrow S^{R+} \right]$$

20 correct in 20   38 correct in 40

The training technique employed in the present investigation followed the same sequence as that described by McLean for the initial position. However, the subjects employed in the present experiment completed Conditions I, II, III, and IV for all three word positions (initial, final, and medial) and then began two randomized treatment conditions. The method of application in this study, then, followed the termination of training of the selected phoneme in the initial position in words, by training the same phoneme in the (a) final position, (b) medial position, (c) randomization of the training words with the phoneme in the medial and final positions, and (d) randomization of the training words with the phoneme in all three word positions. Figure 1 presents a graphic description of the training procedure. Positive reinforcement was presented immediately after the occurrence of a correct response. An incorrect response received no reinforcement and the experimenter presented the next stimulus item.

Detailed descriptions of the four treatments employed in this investigation after training on the initial position was terminated are given below. Their criteria and their procedural sequence are described in the following sections (refer to Figure 1 for specific order of presentation):

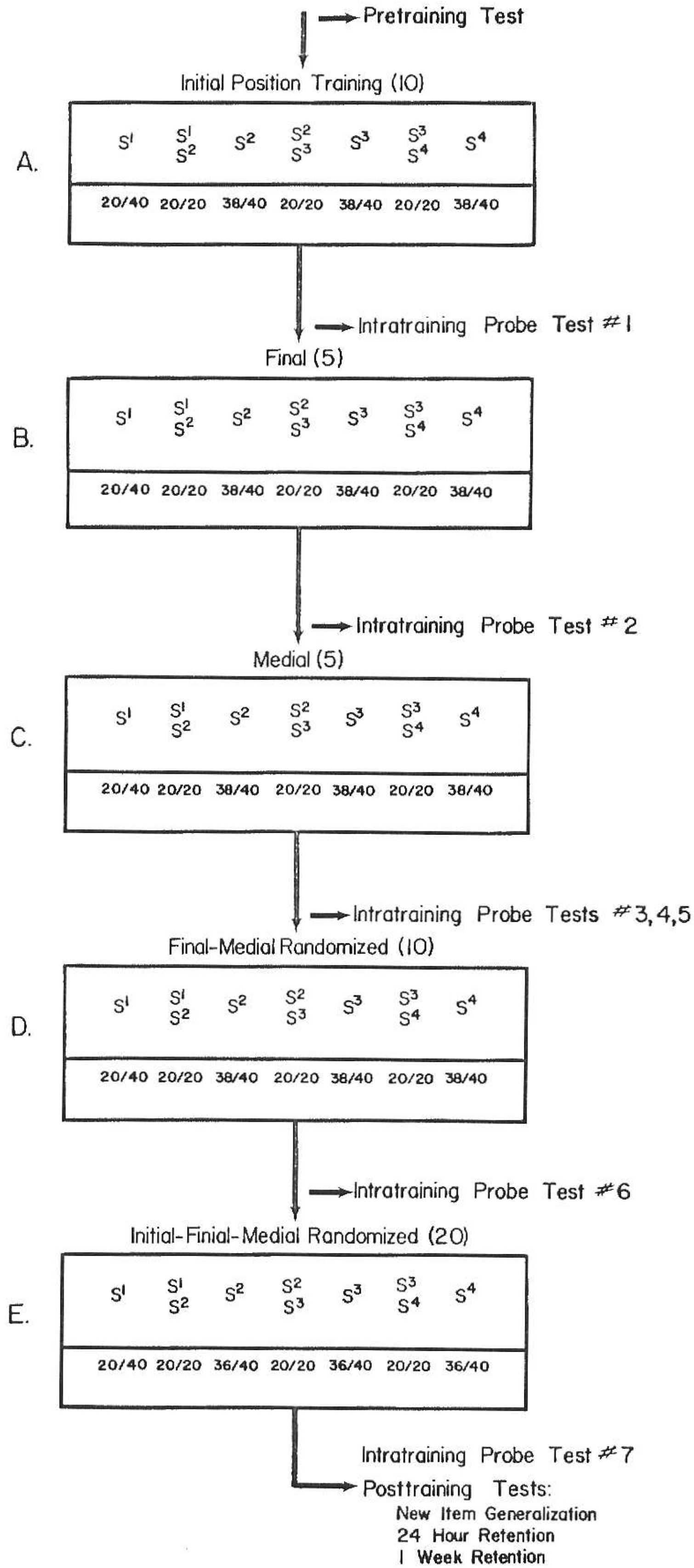
Final Position

Condition I. Five stimulus words (S^1) were presented to the subject by the experimenter. Upon the presentation of the auditory-visual stimulus, the subject was instructed to repeat the stimulus item after the experimenter. Each correct response was reinforced. When a criterion of 50 percent on four successive blocks of 10 words each was achieved, Condition I was terminated.

Condition II. The same five stimulus words employed in Condition I (S^1) were paired with corresponding pictures (S^2). As the experimenter presented the auditory-visual stimulus (S^1), she presented a picture (S^2) of the stimulus word to the left of her mouth. The subject was instructed to observe the

FIGURE 1

Sequence of Training with Relative Position of Testing Sequence Indicated



production of the stimulus item and the picture of the stimulus item and to repeat the word after the experimenter. When the subject met the selected criterion of 20 correct responses in 20 attempts, the auditory-visual stimulus was withdrawn and only the pictorial stimulus (S^2) was presented. Upon presentation of a picture, the subject was instructed to respond by naming the object pictured using the selected phoneme correctly. The criterion for presentation of S^2 was 38 correct responses out of 40 attempts. When the criterion was met, Condition II was terminated.

Condition III. The program shifted to include a pairing of the picture stimulus (S^2) with the grapheme (S^3). The two stimulus items were presented on one stimulus card. The subject was instructed to attend to the grapheme for five seconds while the presentation of the picture stimulus was delayed by covering it with a blank card. After the five second period, the blank card was withdrawn and the subject was exposed to both the picture and the grapheme for approximately two seconds. The picture stimulus was once again withdrawn and the subject was to attend to the grapheme for five more seconds. After five seconds, he was to make a verbal response. A correct response was to be made during a second five-second period. A correct response constituted (a) correct phoneme production, (b) temporal discrimination, and (c) correct grapheme identification. The criterion for this level was 20 correct responses out of 20 attempts. When this criterion had been met, only the grapheme (S^3) was presented; each grapheme was presented separately using different stimulus materials than those presented on the previous stimulus condition. Criterion for this training phase was 38 correct responses out of 40 attempts. When this criterion was met, Condition III was terminated.

Condition IV. The same five grapheme stimuli (S^3) were paired with five intraverbal chains (S^4). The experimenter instructed the subject to listen to a sentence in which the last word in the sentence was said to be missing. A printed word, the subject was told, would be shown to tell him what the missing word was. The subject was to name the missing word at the end of the incomplete sentence, using the printed word as a "cue" and using the selected training phoneme correctly. Criterion for the pairing of S^3 and S^4 was set at 20 correct responses out of 20 attempts. When the established criterion was met, the printed word stimulus was withdrawn and only the intraverbal chain (S^4) was presented. The subject was instructed to complete the chain. When the subject had achieved 38 correct responses out of 40 attempts, the training sequence for the final position was terminated.

Medial Position

An identical procedure that followed those procedures used in the training of the selected phoneme in the final position was employed in the training sequence of the medial position. The criteria and method of application were also the same. When the criteria employed in stimulus Condition IV were achieved, the training sequence for the medial position was terminated.

Medial and Final Position Randomization

Following the same procedure as that described above for the final position, the experimenter randomized the presentation of the five previously used training words with the selected phoneme in both the medial and final positions (total of ten words). The words were randomized to require differential responding on both medial and final positions. The same criteria and method of application were also employed.

Initial, Medial and Final Position Randomization

Again, utilizing the same training items and procedures, the subject was presented with twenty stimulus items randomized for phoneme position (10 words, initial position; 5 words, medial position; 5 words, final position). The criteria remained the same with the exception of a change from 38 to 36 correct responses out of 40 attempts on S^2, S^3, and S^4 stimulus conditions when training blocks included 20 items instead of 10 items.

Test for the Effects of Training

In order to examine each subject's unreinforced articulation responses prior to and following the training sequence, the following methods were used to allow an evaluation for the effects of training. Figure 2 illustrates the order of presentation.

Pre-Training

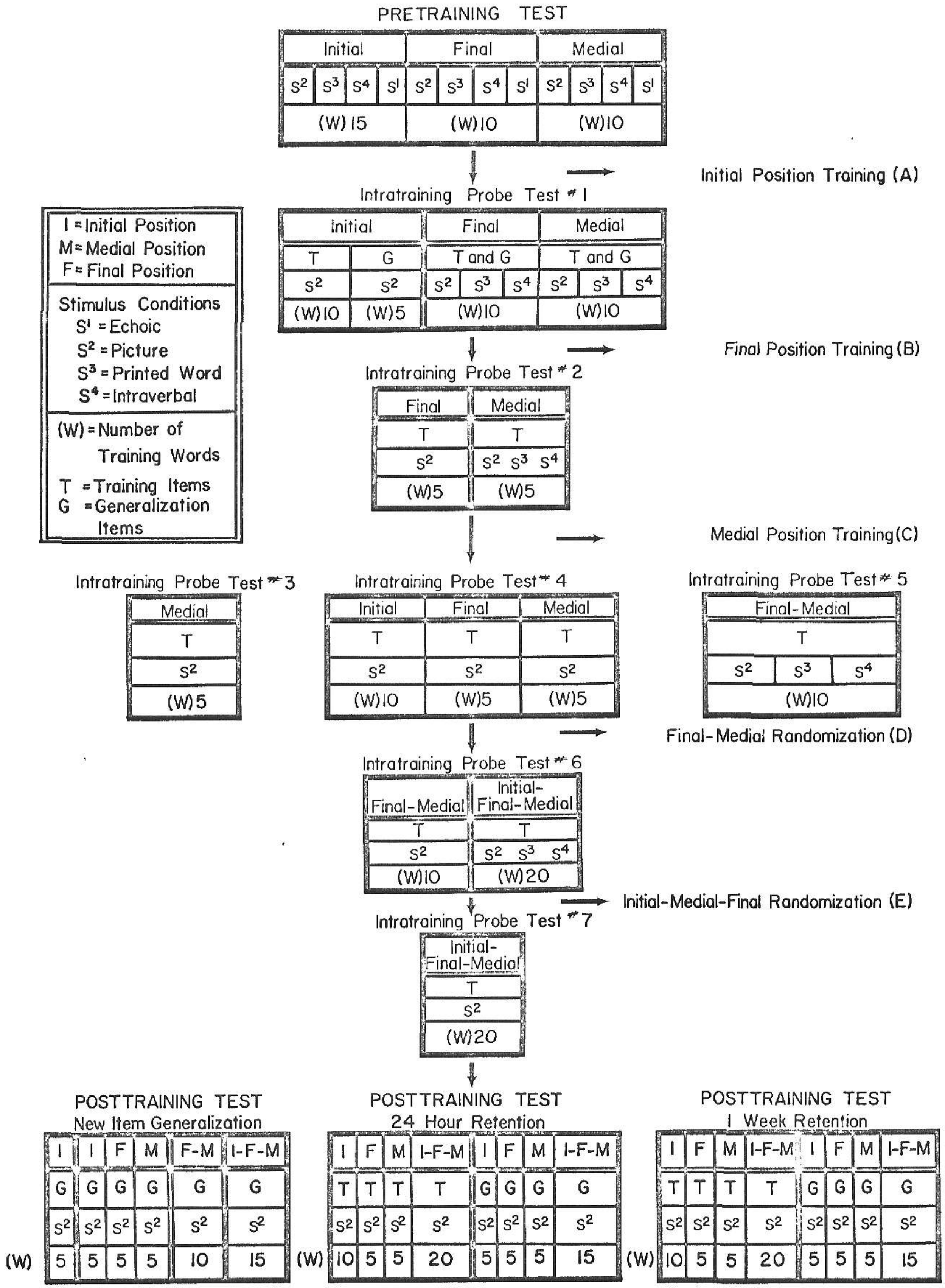
Baseline data were collected to determine the level of performance of each subject before the commencement of training. All four stimulus conditions were presented. To attenuate the effects of learning from the test situation presentation of the echoic stimulus, the stimulus conditions were presented in the following order: (a) S^2, (b) S^3, (c) S^4, and (d) S^1. The same order of word position presentation used during training was used during testing, i.e., (a) initial, (b) final, and (c) medial. The subject was then given training on all four stimulus conditions in the initial position.

Intratraining Probe Tests

After the completion of training on the initial position, intratraining probe tests were given, prior to training on each of the following: (a) final position, (b) medial position, (c) randomized final-medial positions, and (d) randomized initial-final-medial positions. Each intratraining probe test contained (1) test items to evaluate the effects of prior training where S^2 (picture) stimuli evoked test responses and (2) test items to evaluate the influence of prior training on across-position generalization using S^2, (picture), S^3 (printed word) and S^4 (intraverbal) stimuli.

FIGURE 2

Sequence of Testing with Relative Position of Training Sequence Indicated



Instructions were given for each stimulus condition and the evoked responses were recorded as being correct or incorrect. No reinforcement was given for correct responses. A comparison of the results of the two batteries of tests would describe the changes in articulation responses which occurred during the training program.

Tests of Generalization After Training

Two types of stimulus generalization testing were employed in the present investigation: New Item Generalization and Across-Postion Generalization. The New Item Generalization test was given to determine whether or not a subject was able to generalize or transfer the newly-acquired articulatory response to untrained stimuli. Picture stimuli (S^2) were used to evoke unreinforced responses from each subject immediately after the completion of the training program.

Twenty-four hours and again one week after the termination of the entire training program, Across-Position Generalization and New Item Generalization Tests were given. Using only picture stimuli (S^2), the generalization items were presented in the following word position order: (a) initial, (b) final, (c) medial, and (d) randomized presentation of initial, medial, and final word positions.

Reliability

Audio and visual recordings were used for intrajudge reliability. To establish intrajudge agreement the experimenter made post-session judgements of each session and made a comparison of those judgements with judgements made after the termination of the entire training and testing program.

Summary of Procedures

Four mentally retarded subjects whose speech was characterized by articulation errors were selected for this investigation. The subjects met specific criteria established by the experimenter regarding (a) at least one misarticulated phoneme in all three word positions, (b) ability to imitate the phoneme correctly in isolation, and (c) inability to produce a correctly articulated response of the selected phoneme in words in all three word positions.

The subjects were trained on four stimulus conditions: (1) S^1 -- echoic; (2) S^2 -- textual (picture); (3) S^3 -- textual (printed word); and (4) S^4 -- intraverbal. After being trained on the initial position, the subjects were trained on the (a) final position, (b) medial position, (c) randomized presentation of medial and final positions using the same stimulus conditions as those used in training for the initial position, and (d) randomized presentation of initial medial and final positions. When the criterion for a particular level was met, the next level of treatment was introduced. The program training sequence was terminated when all criteria on all levels were met. A positive reinforcer was presented for correct responses; no reinforcement was given for incorrect responses or for responses made during testing or probing.

The responses of the subjects were evaluated in terms of (a) pretraining test scores, (b) intratraining probe test scores, (c) new item generalization tests, and (d) across-postion generalization tests. All results were compared to determine the effectiveness of the training program.

In order to establish the reliability of the judgements made by the experimenter, audio and video tape recordings were made of each experimental session. Two post-session judgements of the tape recordings were made by the experimenter regarding the correctness of each articulated response. A comparison of the judgements made by the experimenter after the completion of each treatment with those made after the completion of the entire training program was used to establish intrajudge reliability.

Chapter IV

Results

The results of the present investigation are presented in the following sections: (a) Pretraining Test, (b) Analysis of Training Curves, (c) Posttraining Tests, (d) Generalization Tests, (e) Retention Tests, and (f) Reliability of Data.

Pretraining Test

Prior to the initiation of formal training, each subject was given a pretraining test to determine the number of correct responses made to the stimuli to be used during training and generalization testing. Verbal responses to pretraining test items were evoked by stimuli presented in the four stimulus conditions used during the training program: (a) echoic (S^1), (b) picture (S^2), (c) printed word (S^3), and (d) intraverbal (S^4). The same four stimulus conditions were presented in all three word positions. Table 2 illustrates the results of the pretraining test.

TABLE 2

Pretraining Test

Number of Correct Responses on Training and Generalization Items Prior to Training

Subject	Initial (15 items)				Final (10 items)				Medial (10 items)			
	$*S^1$	$*S^2$	$*S^3$	$*S^4$	S^1	S^2	S^3	S^4	S^1	S^2	S^3	S^4
A	6	5	5	3	4	1	1	3	7	5	3	4
B	7	1	1	0	0	0	0	1	1	0	0	2
C	5	0	0	0	3	0	0	0	6	0	0	0
D	3	0	0	0	0	0	0	1	0	0	0	1

$*S^1$ - echoic S^2 - picture S^3 - printed word S^4 - intraverbal

Initial Position

The data in Table 2 show that two of the subjects (C and D) were unable to produce a correct phoneme response to picture, printed word, and intraverbal stimuli. Subject A was able to produce 33 percent correct phoneme production to picture and printed word stimuli respectively and 20 percent correct phoneme production to intraverbal stimuli. While Subject A demonstrated a relatively high operant-level of responding during the pretraining test, he was unable to generalize the correct phoneme response to spontaneous conversation. Subject B was able to respond correctly to 6.6 percent of the picture and printed word stimuli and was unable to produce a correct response to intraverbal stimuli. All four subjects emitted correct phoneme responses to echoic stimuli (S^1) with the range of percentage of correct responses being from 20 to 46.6 percent. All subjects achieved higher scores on the echoic stimulus condition than on picture, printed word, and intraverbal stimulus conditions.

Final Position

Table 2 shows fewer correct responses for the final position than for the initial and medial positions for all four subjects. Three subjects (B, C, and D) were unable to make correct responses to picture and printed word stimuli; however, Subjects B and D were able to make one correct response to intraverbal stimuli while Subject C was unable to respond correctly to intraverbal stimuli. Subject A emitted correct responses to all four stimulus types with the largest percentage of correct phoneme responses being made to echoic stimuli. Subject C emitted three correct responses to echoic stimuli while Subjects B and D were unable to respond correctly in this stimulus condition.

Medial Position

A higher operant-level of responding was seen in the pretraining test for the medial position than for the final position as shown in Table 2. Again, three subjects (B, C, and D) were unable to produce correct responses to picture and printed word stimuli; Subjects B and D were able to respond correctly to at least one intraverbal stimulus while Subject C was not. As in previous position pretraining tests, Subject A responded at a relatively high operant-level in that he responded correctly to at least 30 percent of the evoking stimuli in all four stimulus conditions. Subjects B and C were able to emit correct responses to echoic stimuli while Subject D was unable to emit an appropriate imitative response.

The results of the pretraining test shown in Table 2 reveal a low operant-level of responding for Subjects B, C, and D. Subject A responded at a relatively high rate on the pretraining test, but was maintained in the program on the basis of (a) incorrect production of the selected training phoneme in at least 30 percent of all stimulus items and (b) inability to generalize the correct phoneme response to spontaneous conversation. Table 2 also demonstrates the influence exerted by echoic stimulus control and the relatively weaker control of the remaining stimulus conditions in the evokation of correct phoneme responses.

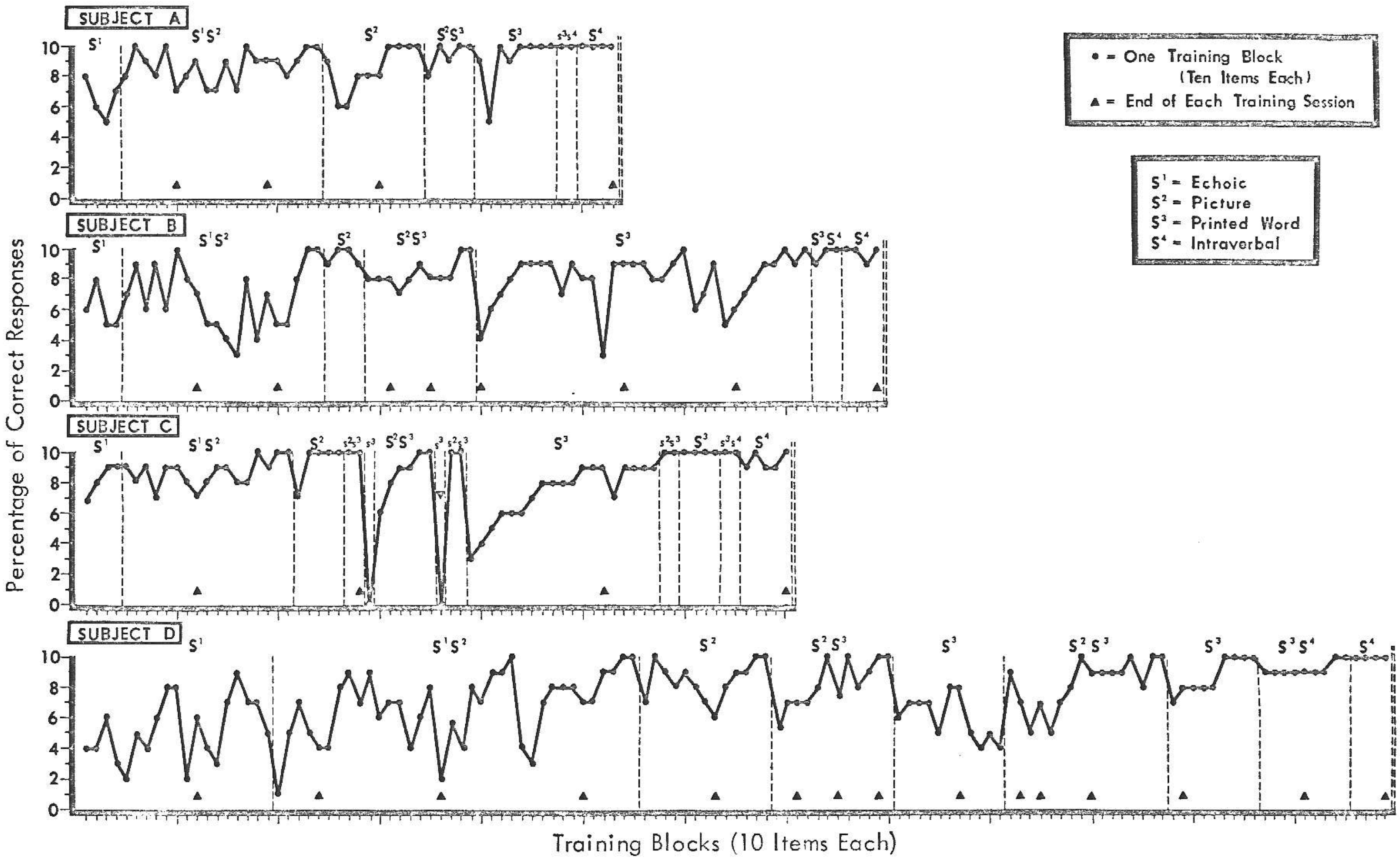
Analysis of Training Curves

Figure 3 demonstrates the rate of acquisition for all four subjects during training of the selected phoneme in the initial position while Figure 4 (Subjects A and B), Figure 5 (Subject C), and Figure 6 (Subject D) demonstrate the rate of acquisition for the experimental treatments under investigation in this study. Each figure shows (a) the percentage of correct responses in each training block, (b) the number of training blocks needed to attain criteria, and (c) the overall pattern of acquisition for each subject. Data for each acquisition curve were plotted from post-session judgements made by the experimenter.

Figure 3 begins with the first stimulus condition (echoic stimulus, S^1) with the selected phoneme response being trained in the initial position and Figures 4, 5, and 6 begin with the first stimulus condition (S^1) with the selected phoneme response being trained in the final word position. The termination of each stimulus condition, or the point at which each stimulus shift occurs, is noted by a single, broken line. When the criterion is achieved on *stimulus condition IV (intraverbal stimulus,* S^4*)*, the termination of the particular treatment is designated by a double, broken line.

FIGURE 3

Acquisition (Correct Responses) for Subjects A, B, C, and D for New Phoneme Training in Initial Position



Due to the unique characteristics of the acquisition curves for each subject, the following section will provide a detailed description of the pattern of acquisition for each subject as well as those characteristics which designate each training curve as being unique.

Training Curve for Subject A

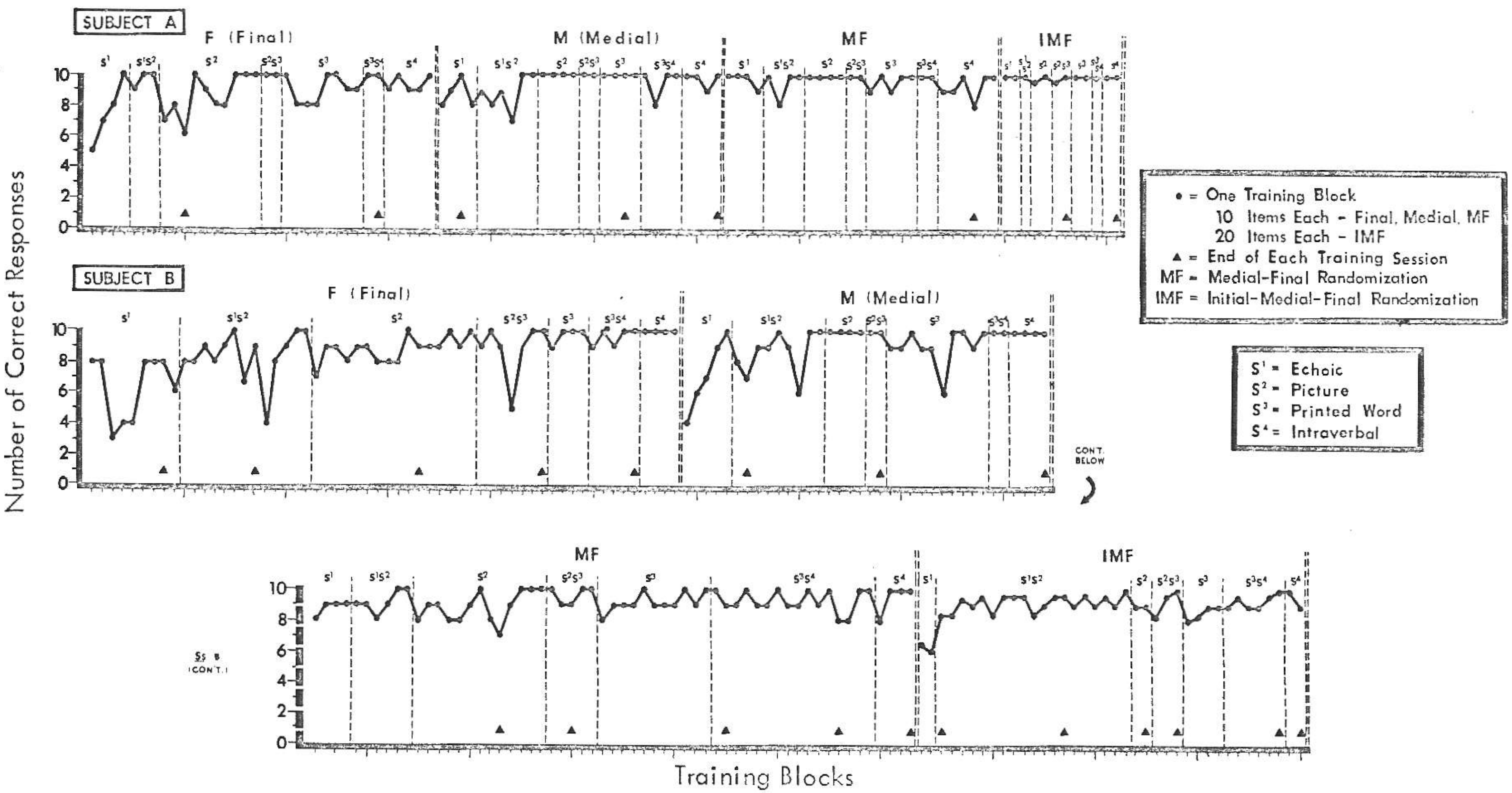
Subject A completed the entire training program after 154 training blocks. Close examination of the pattern of acquisition reveals that this subject (a) experienced more difficulty with the paired stimulus, $S^1 S^2$, and the shift from that stimulus condition to the S^2 stimulus condition in the initial, medial, and final positions than with later stimulus conditions in the randomization treatments, (b) required progressively fewer training blocks to meet the criteria on each successive position treatment, and (c) made progressively fewer errors on each successive position treatment.

Initial Position. Figure 3 shows that fifty-three training blocks were needed by this subject to acquire the /s/ phoneme in the initial position across four stimulus conditions. The minimum number of blocks possible for this treatment was 22. An analysis of the pattern of acquisition reveals that this subject met the criterion for the S^1 stimulus condition after the minimum number of trials (at least 50 percent correct responses on four successive training blocks). However, he required the presentation of twenty training blocks to meet criteria for the paired S^1S^2 stimulus condition where the minimum number of training blocks were two. The response pattern during this period of time was erratic until the criterion (20 correct responses out of 20 attempts) was met. As the latter stage of Condition II (S^2) was presented, the response pattern became more regular until Condition IV was initiated where Subject A met the criterion (38 correct responses out of 40 attempts) in the minimum number of trials.

Final Position. Figure 4 shows that thirty-four training blocks were needed to stabilize correct phoneme production in the final position with 22 blocks being the minimum number of blocks possible for this treatment. Training on the final position was shorter

FIGURE 4

Acquisition (Correct Responses) for Subjects A and B for New Phoneme Training in the Final, Medial, Medial-Final Randomization and Initial-Medial-Final Randomization Treatments



than that of the initial position in that the subject needed only seven blocks in both the S^1 (Condition I) and S^1S^2 (beginning of Condition II) stimulus conditions. However, the pattern of acquisition for the S^2 stimulus condition (latter half of Condition II where the echoic stimulus S^1 was withdrawn) was erratic and required ten training blocks, rather than four, to meet criterion. Again, as the acquisition pattern for the initial position indicates, after a period of relatively low and erratic responding in Conditions I and II, this subject met criteria on Condition IV in the minimum number of training blocks.

Medial Position. Only 28 training blocks were needed on this treatment which had a possible minimum of 22 blocks. A comparatively high level of responding was shown on the S^1 and S^1S^2 stimulus conditions for the medial position. The criterion for S^1 was met after the presentation of the minimum number of training blocks and only six training blocks (minimum of two) were needed on the paired presentation of the S^1S^2 stimulus condition to meet the specified criterion. Training for the remainder of the medial position treatment was relatively short compared to that of the previous treatments. At only one point (S^3S^4 -- paired presentation of picture grapheme) did this subject require the presentation of additional training blocks beyond the minimum number required to demonstrate criterion and, thus, terminate training on this treatment.

Randomization of Medial-Final Positions. This high level of responding continued throughout the remainder of the training program. Only 27 training blocks (minimum of 22 training blocks) were needed for the whole of the randomized medial-final treatment, indicating that fewer blocks were needed to meet criteria for each stimulus condition on this treatment than on previous treatments.

Randomization of Initial-Medial-Final Positions. On the last treatment, randomization of training items in all three word positions, only eleven training blocks (minimum of ten training blocks) were needed to meet criteria on all seven phases of the training program. The level of responding was very high and regular. It is evident that Subject A progressively decreased the number of training items needed to meet criteria as he progressed through the program.

The over-all level of responding throughout the training program for this subject was relatively high as was anticipated due to high pretraining test scores. At no time did the percentage of correct responses fall below 50 percent. The training program was completed in twelve half-hour training sessions.

From the above discussion, it can be seen that, for Subject A, (a) relatively few training sessions were needed to reach criteria, (b) the pairing of S^1 and S^2 stimuli and the shifting of stimulus control to S^2 in the initial, medial, and final positions required more training, (c) each successive treatment required fewer training blocks to meet criteria, and (d) a higher level of responding was seen with each successive treatment.

Training Curve for Subject B

Subject B required 270 training blocks to terminate the stimulus shift program. A study of the acquisition curve reveals that (a) until the commencement of the medial-final randomization treatment, the pattern of responding was comparatively low and erratic, (b) fewer training blocks were needed for training on the medial position with the largest number of training blocks needed being for the initial position, and (c) fewer errors were made on the randomized treatments than on the treatments for individual word positions.

Initial Position. Figure 3 shows that Subject B required 79 training blocks to meet criteria for use of the /s/ phoneme in the initial position. The minimum number of training blocks needed for this treatment was 22. Close examination of the training curve for this subject reveals low and erratic responding in all of the seven phases of this treatment. In only three of the seven phases (S^1, S^2, and S^4) did Subject B complete training with the minimum number of training blocks. On the first phase, S^1, four out of four training blocks were needed to meet the criterion; however, on the second phase, S^1S^2, twenty, rather than two, training blocks were needed to achieve criterion. The third phase of the program, S^2, required four training blocks to meet criterion and this subject required only four. The rate of responding for the fourth and fifth phases was again low and erratic, e.g., eleven (minimum of two) training blocks were necessary to achieve criterion on the fourth phase (S^2S^3) and thirty-three, rather than four, training blocks were required to meet criterion on the fifth phase (S^3). The rates of responding were much higher on the sixth and seventh phases in that only one additional training block was needed to achieve criteria and terminate training on this treatment.

Final Position. Figure 4 shows fifty-eight training blocks were needed by this subject to complete training on the final position. A pattern of low and erratic responding continued until the initiation of the last three phases of the program. The subject required nine (minimum of four) training blocks to meet criterion on S^1; thirteen, (minimum of two) training blocks, on the paired S^1S^2 condition; sixteen, (minimum of four) on the S^2 stimulus condition phase; and seven (minimum of two) on the paired presentation of S^2S^3. Only thirteen training blocks were needed to demonstrate criteria in the remaining training phases and terminate the treatment. The minimum possible for this treatment section was ten blocks.

Medial Position. Fewer training blocks were needed to complete this treatment than any of the other treatments; only 35, with a possible minimum of 22, training blocks were needed. In addition, the response pattern was comparatively more regular and higher. Analysis of the acquisition curve for this treatment shows the acquisition of the /s/ phoneme in the medial position occurring after five, rather than the minimum of four, blocks on the first phase, S^1. Two of the remaining six training phases appear to have caused difficulty to the subject in that nine, rather than the minimum of two, training blocks were needed to achieve criterion on the second phase (paired presentation of S^1S^2) and ten, rather than the minimum of four, training blocks were necessary to demonstrate criterion on the fifth phase (S^3). Only the minimum number of training blocks were needed on the following phases or stimulus conditions on this treatment: S^2, S^2S^3, S^3S^4, and S^4. Training was terminated when criterion was reached on the last training phase.

Randomization of Medial-Final Positions. The response pattern for this treatment indicates a comparatively long training period. Figure 4 shows that 58 training blocks were needed to reach criterion. The minimum number of four training blocks were needed for the first stimulus condition (S^1) while the paired S^1S^2 stimulus condition required six, rather than the minimum of two, training blocks. Thirteen, rather than the minimum of four, blocks were necessary to reach criterion on S^2 and five blocks, rather than the minimum of two, were needed for the combined treatment, S^2S^3. Seven more than the required number were needed for S^3 while the paired presentation of S^3S^4 required 16 training blocks rather than two. The minimum number of four blocks was needed to achieve criterion on the last phase and to terminate the treatment.

Randomization of Initial-Medial-Final Positions. The last treatment of the training program required 37 training blocks, rather than the 11 minimum. Again, as in the previous randomized treatment, the rate of responding was high and more regular. While the criterion was met with the minimum of training blocks for the first stimulus condition, this subject required eighteen more than the minimum number of training blocks needed to meet criterion on the paired presentation S^1S^2. Two words ("scales" and "mattress") were difficult for the subject throughout the program and they continued to retard her progress until the termination of the program. The minimum number of training blocks were needed for the third phase (S^2) while only two more than the minimum were needed for the fourth phase (S^2S^3). Only 12 additional blocks were needed to complete the program compared to a minimum of five. The major portion of the seven extra blocks were needed for the paired presentation of the S^3S^4 stimulus condition. The entire program was terminated after the completion of the last phase.

The overall level of responding for this subject was characterized by a great deal of inconsistency over the 27 half-hour sessions needed to complete the program. The previous discussion revealed (a) a low and erratic response pattern for the first three treatments, (b) training on the medial position required fewer training blocks than on all other position treatments, and (c) a higher rate of responding and fewer errors were revealed on the randomized treatments.

Training Curve for Subject C

A total of 276 training blocks were needed by this subject to terminate the program. Because of the nature of the misarticulation ([w/l]), all sessions were video-taped. An analysis of the acquisition pattern for Subject C reveals that: (a) with the exception of the medial position treatment, the number of training blocks needed to achieve criterion grew progressively smaller, (b) the level of responding was higher for the last two phases of each treatment than for the first five phases on all treatments, and (c) the responses made in the first five phases of each treatment were erratic in nature.

Initial Position. The number of training blocks necessary to demonstrate criteria for this treatment was 70, rather than a minimum of 22 (Figure 3). While the first phase, or S^1 stimulus condition, required only the minimum number of training blocks to achieve criterion, 17, rather than the two minimum, were needed for the second phase (paired presentation of S^1S^2). The third (S^2) and fourth (S^2S^3) phases required only one training block more than the minimum. However, this subject was unable to identify any of the grapheme stimuli (S^3), and required the re-instatement of the previous stimulus condition, the paired presentation of S^2S^3. Acquisition was comparatively slower here, requiring six training blocks rather than the two minimum. Once again the S^3 stimulus condition was presented, but, again, Subject C was unable to identify any of the graphemes (S^3). The paired S^2S^3 stimulus condition was then reinstituted a second time where criterion was met with the minimum number of training blocks. The third presentation of the S^3 stimulus condition produced a steadily increasing rate of responding up to a score of 90 percent. To achieve the necessary criterion (38 correct responses out of 40 attempts), the S^2S^3 stimulus condition was reinstituted for the third and last time, after which 100 percent correct responding on the S^3 stimulus condition was demonstrated. This high rate of responding continued until the termination of the treatment with only one training block more than the minimum being required to reach criteria on the remaining training phases.

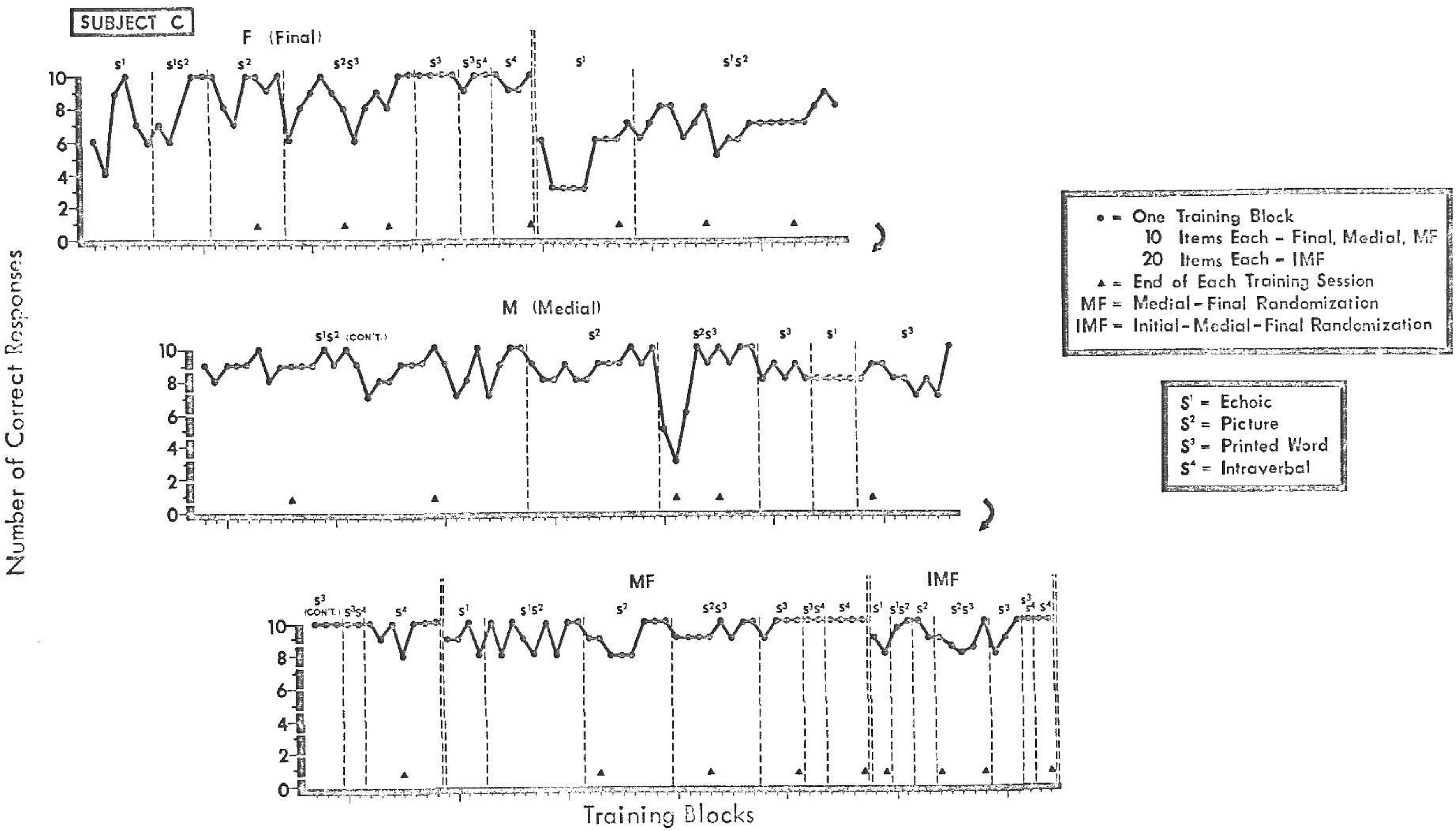
Final Position. Figure 5 shows that 40 training blocks were needed to complete this treatment. While the pattern of acquisition for the first four phases or stimulus conditions was erratic, the last three phases were very high and regular. The number of training blocks required to demonstrate criteria exceeded the minimum possible number by 18. Subject C experienced more difficulty with the paired presentation of S^2S^3 than with any of the other six phases.

Medial Position. A total of 108 training blocks were needed to complete this treatment. A majority of these blocks (49) were needed to achieve criterion on the S^1S^2 stimulus condition. Two of the five training words ("umbrella" and "valentine") were expecially difficult for this subject, necessitating repetition of stimuli until appropriate responses were made. The pattern of responding was erratic until the initiation of the paired S^3S^4 stimulus condition. The minimum number of training blocks (two) terminated that phase and three more than the minimum were needed to demonstrate criterion on the seventh phase and terminate the treatment.

Randomization of Medial-Final Positions. Only 38 training blocks, rather than the minimum of 22, were needed to complete training of this first randomized treatment. While the response pattern was somewhat erratic, it was also comparatively higher than that of the previous treatments. The criterion was met with the minimum number of training blocks on the S^1 phase and nine blocks were necessary to achieve criterion on the second phase, S^1S^2. Only four more than the minimum number of training blocks were needed to demonstrate criterion on the S^2 stimulus condition with six more than the minimum being required on the paired presentation of S^2S^3. The minimum number of training blocks were needed to complete the remaining three phases of this treatment and demonstrate criteria to terminate the treatment.

FIGURE 5

Acquisition (Correct Responses) for Subject C for New Phoneme Training in Final, Medial, Medial-Final Randomization, and Initial-Medial-Final Randomization Treatments



Randomization of Initial-Medial-Final Positions. Only 17 training blocks, rather than the minimum of 11, were needed to terminate this treatment. As in the previous treatment, the response pattern of the first five phases was erratic, but high. Those phases requiring more than the minimum number of training blocks were the paired presentation of S^1S^2 (two, rather than one, training blocks were needed); the paired presentation of S^2S^3 (five, rather than one, training blocks were needed); and S^3 (three, rather than two, training blocks were needed). Only the minimum number of training blocks were needed to complete the last two phases, thereby attaining criteria and terminating the program.

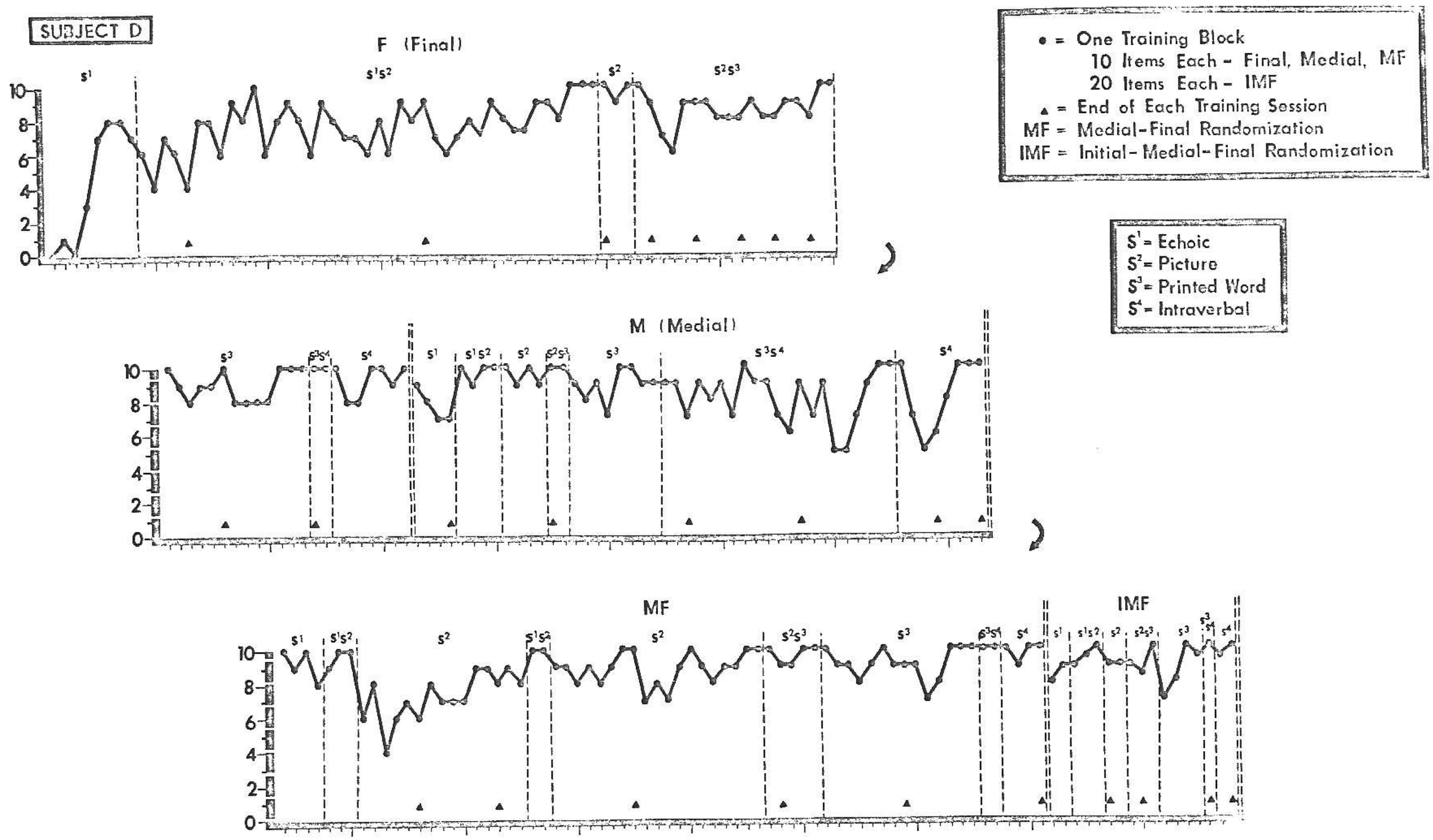
The above discussion, then, has shown that (a) the number of training blocks progressively decreased with the presentation of each treatment with the exception of the treatment for the medial position (b) the level of responding was consistently higher on the last two phases or stimulus conditions on all five treatments, and (c) the response pattern of each of the first five phases on all five treatments was erratic, becoming more regular on the last two phases. Subject C completed the entire program in a total of 27 one-half-hour sessions.

Training Curve for Subject D

Subject D completed the training program after 401 training blocks. An analysis of this subject's pattern of acquisition reveals the following: (a) low and erratic responding for the initial and medial position treatments and, while the response pattern was comparatively high, erratic responding for the final, randomized medial-final, and randomized initial-final-medial position treatments, (b) the response pattern was most erratic for the S^1 and S^1S^2 stimulus conditions in the initial and final position treatments and for the S^2 and S^3 stimulus conditions for the randomized medial-final position treatment; while the S^3S^4 and S^4 stimulus conditions were the least erratic for the initial, final, randomized final-medial, and randomized initial-final-medial position treatments, and (c) comparatively long periods before criteria was demonstrated on all but the randomized

FIGURE 6

Acquisition (Correct Responses) for Subject D for New Phoneme Training in Final, Medial, Medial-Final Randomization, and Initial-Medial-Final Randomization Treatments



initial-final-medial position treatments with the number of training blocks progressively decreasing with the exception of the randomized medial-final position treatment where a seven block increase from the previous treatment was demonstrated.

Initial Position. Figure 6 shows that a total of 128 training blocks were required to achieve criteria on this first treatment. This was 106 blocks more than the minimum possible number of blocks. Very low and erratic responding was shown on the S^1 stimulus condition (15 beyond the minimum of four training blocks were needed to demonstrate criterion) and the paired S^1S^2 stimulus condition (36 rather than the minimum of two training blocks were needed). The response rate ranged from 20 to 80 percent on the first training phase and from 10 to 100 percent on the paired S^1S^2 stimulus condition. However, the response rate and regularity increased markedly on the following two stimulus conditions where 13, rather than the minimum of four training blocks were needed to achieve criterion on the S^2 stimulus condition (range of responses from 60 to 100 percent). The erratic and comparatively low response rate returned for the S^3 stimulus condition; therefore, the previous stimulus condition, the pairing of S^2S^3, was reinstituted. The erratic response rate continued on this phase for six blocks, then became more regular until criterion was demonstrated after a total of 16 (with two the minimum) training blocks in the S^3 stimulus condition. From this point on, the response rate was high and regular. Only nine training blocks were needed to demonstrate criterion on the S^3 stimulus condition; nine training blocks were needed for the paired S^3S^4 stimulus condition; and the minimum number of blocks was needed for the last condition (S^4) to demonstrate criterion and terminate training on this treatment.

Final Position. A reduction in the number of training blocks needed to demonstrate criterion was shown by Subject D on this treatment; 111 training blocks (17 blocks fewer than on the previous treatment) were needed to terminate training for the final position. This was 89 blocks beyond the minimum possible number of blocks. Training on this treatment was interrupted by a two week leave for the subject. In training completed before the leave, the response pattern was very low and erratic for the S^1 stimulus condition (responses ranged from 0 to 80 percent) but, due to the nature of the criterion (50% on four blocks), only three more than the minimum number of training blocks were necessary to demonstrate readiness for the initiation of the next stimulus condition phase. Erratic responding over a long period of time (40 blocks rather than the possible minimum of two) was characteristic of the pattern of acquisition for the paired S^1S^2 stimulus condition. However, when criterion was demonstrated and the S^2 stimulus condition was initiated, only the minimum number of training blocks were necessary. It was during the next phase (paired S^2S^3 stimulus condition) that training was interrupted for two weeks. Upon the return of the subject, the first phase of the treatment (S^1) was reinstituted as a review. Again the response pattern was erratic (from 30 to 90 percent response range) but only three more training blocks than the minimum were necessary to achieve the criterion. The response pattern became more regular when the paired S^1S^2 stimulus condition was initiated; only three more than the minimum number of training blocks were needed to demonstrate criterion and move to the next phase, S^2, where the minimum number of training blocks were needed to achieve criterion. While the number of training blocks needed to reach the criterion for the paired S^2S^3 stimulus condition exceeded the minimum by sixteen blocks, the response pattern was comparatively more regular. The same is true of the S^3 stimulus condition where only ten more than the minimum number of training blocks were needed to achieve criterion. The paired S^3S^4 condition criterion was reached with only the minimum number of training blocks and three training blocks more than the minimum were needed to demonstrate criterion on the S^4 stimulus condition and terminate the treatment.

Medial Position. Another reduction in the number of training blocks necessary to demonstrate criteria was again shown in that Subject D required only 69 blocks to terminate this treatment (42 less than the previous treatment). Training for the medial position was again interrupted by an additional one week leave for the subject. Up to the point of departure, the response pattern was comparatively high and regular with a total of only six more than the minimum number of training blocks being needed to achieve criteria on the S^1, S^1S^2, S^2, S^2S^3, and S^3 stimulus conditions. Training had been initiated on the paired S^3S^4 stimulus condition prior to the departure of the subject; upon his return, this condition was presented to the subject and a progressive reduction in the number of correct responses was demonstrated due to an inability to respond to the grapheme (S^3). Because the learning breakdown had occurred at the grapheme level, it was decided to return to the paired presentation of the grapheme and picture in order to reinstate the grapheme in the repertoire of Subject D. The paired S^2S^3 stimulus condition (picture and grapheme) was again presented until criterion was achieved; five more than the minimum number of training blocks were needed to demonstrate readiness for the presentation of the S^3 stimulus condition alone. Only four more than the minimum number of training blocks were necessary to reach criterion and shift to the pairing of the S^3S^4 stimulus condition. The pattern of acquisition for this phase of training was again erratic and comparatively long in duration; sixteen more than the minimum number of training blocks with a response range of from 50 to 100 percent illustrate length and irregularity of this phase. Four more than the minimum were needed to demonstrate criterion on the last stimulus condition (S^4) with the range of responses again being from 50 to 100 percent.

Randomization of Medial-Final Positions. The relative instability of the response in the medial position was made evident in this combined randomization treatment; 76 training blocks were needed to complete this section of the program, an increase of seven training blocks over the previous treatment. While the response pattern was high (only one training block more than the minimum was necessary) for the S^1 and paired S^1S^2 stimulus conditions, responses to the S^2 stimulus condition (withdrawal of the echoic stimulus) were comparatively low and erratic. With a range of response rates from 40 to 90 percent, the subject met criterion for a return of the S^1S^2 stimulus condition (paired presentation of the echoic and pictorial stimuli). Upon return of the echoic stimulus, criterion was attained immediately. The S^2 (picture only) stimulus condition was then reinstituted and the criterion was reached after nineteen training blocks. Training on the paired S^2S^3 stimulus condition was relatively short with only three more than the minimum number of training blocks being necessary to demonstrate criterion. However, when the pictorial stimulus was withdrawn and only the grapheme (S^3) was presented, the response pattern again became erratic with criterion not being demonstrated until after ten more than the minimum number of training blocks were completed. Subject D reached criterion with only the minimum number of training blocks on the paired S^3S^4 and S^4 stimulus conditions to terminate training on this treatment.

Randomization of Initial-Final-Medial Positions. Only 17 training blocks were needed to establish criteria on the final treatment of the training program by Subject D. This was only six beyond the minimum possible blocks for this treatment. At only one point did the response rate fall below 80 percent which occurred on the S^3 stimulus condition. On the first training block of this phase, a score of 70 percent was achieved, followed by scores of 80, 100, and 95 percent. From the acquisition pattern of this treatment, it can be seen that the correct phoneme response (/tʃ/) did indeed stablize and did occur at a relatively high and regular rate until the termination of the treatment and the program.

The previous discussion has covered the following points regarding the pattern of acquisition for Subject D: (a) the pattern of acquisition was essentially erratic with

(b) the initial phases being the most erratic and the terminating phases being the least erratic, and (c) a comparatively large number of training blocks were necessary to reach the criteria on all but the last treatment with the number of training blocks decreasing with the initiation of each new treatment with the exception of the medial position treatment. Forty-one training sessions were needed to complete the entire training program.

Intratraining Probe Tests

For purposes of the present investigation, two types of intratraining probe tests were devised: (a) to measure the effects of training on a treatment immediately after the termination of training by evaluating the number of correct responses to picture stimuli and (b) to measure the effect of preceeding treatments on succeeding treatments using picture, printed word, and intraverbal stimuli to evoke phoneme responses. The following tables, then, will demonstrate the effect of prior training on across-position generalization as well as the effectiveness of training on each treatment. A response was considered correct if the training phoneme was articulated correctly in the word position being tested.

Intratraining Probe Test 1

The first intratraining probe test was given (a) after the completion of training in the initial position and (b) prior to training on the final position. Its purpose was two fold: (1) to determine the effectiveness of prior training using those picture stimuli which were previously used to evoke phoneme responses in the initial position and (2) to determine the effectiveness of initial position training on the emission of correct phoneme responses to picture, word, and intraverbal stimuli in the untrained medial and final positions. Table 3 demonstrates the results of this first test.

Initial Position. From the data shown in Table 3, it can be seen that after training was terminated on the initial position (Subtest A), two subjects (A and B) responded correctly to 90 percent of the initial position pictured stimuli and two (C and D) responded correctly to 100 percent of the pictured stimuli. However, the data shown in Subtest B show a relatively low level of generalization to other word positions which have not been trained. The percentage of correctly generalized responses ranged from 0 percent (Subjects B and D) to 30 percent (Subject A).

TABLE 3

Intratraining Probe Test 1

Correct Phoneme Responses to the Initial Position Training Words at the Completion of Initial Position Training (Subtest A) and Correct Phoneme Responses to Untrained Final and Medial Position Words After Initial Position Training (Subtest B)

Subjects	Subtest A	Subtest B					
	Initial (10 items)	Final (10 items)			Medial (10 items)		
	S^2	S^2	S^3	S^4	S^2	S^3	S^4
A	9	0	2	3	3	5	5
B	9	0	0	0	0	0	0
C	10	0	0	0	2	1	0
D	10	0	0	0	0	0	0

Subtest B of this intratraining probe test and subsequent intratraining tests probed correct phoneme responses to untrained picture (S^2), printed word (S^3), and intraverbal (S^4) stimulus conditions. The S^2 stimulus condition reflected generalization trends in other stimulus conditions adequately enough to serve as the referrent for discussion. Therefore, the following analysis will be centered primarily on a discussion of the number of correctly generalized phoneme responses to S^2 stimuli.

Final Position. Subject A was the only subject who correctly articulated the target phoneme in the final position. A comparison of the S^2 (picture) scores with the S^2 scores obtained on the pretraining test demonstrate the following for each subject: (a) Subject A: loss of one correct response to a zero response level (although the percentage of correct responses remained the same over the three stimulus conditions); (b) Subject B: maintenance of a zero response level (although the loss of one correct response occurred on S^4); (c) Subject C: maintenance of a zero response level; and (d) Subject D: maintenance of a zero response level (although the loss of one correct response occurred on S^4). It can be seen, then, that training in the initial position did not significantly increase the generalization ability of any of the four subjects. In fact, correct phoneme production in the untrained final position decreased from baseline levels after initial position training.

Medial Position. Two subjects (A and C) emitted correct phoneme responses in the medial position to picture stimuli. However, comparison of these scores with those of the pretraining test revealed the following for each subject: (a) Subject A: gain of one correct response across the three stimulus conditions; (b) Subject B: loss of two correct responses; (c) Subject C: increase of three correct responses across the three stimulus conditions; and (d) loss of one correct response across the three stimulus conditions. It can be seen that only Subjects A and C gained more than was lost in the medial position across all stimulus conditions as a result of training on the initial position with the largest percentage of correct responding being only 20 percent for Subject C.

It does not appear that correct phoneme production in the medial and final word positions is adequately effected by training in the initial position. These results corroborate the results obtained by McLean (1965) in that the trained initial position phoneme responses did not generalize to the untrained medial word position for any of the four subjects involved in that study.

Intratraining Probe Test 2

After completion of the above tests, the first experimental treatment, phoneme training on the final position, was initiated. Each subject was exposed to the same seven stimulus conditions and criteria as in the initial word position treatment. After the completion of the training program on the final position, Intratraining Probe Test 2 (Subtests A and B) was given; Table 4 demonstrates the effectiveness of training on the final word position and the influence of this training on across-position generalization to the medial word position in untrained words.

TABLE 4

Intratraining Probe Test 2

Correct Phoneme Responses to the Final Position Training Words at the Completion of Final Position Training (Subtest A) and Correct Phoneme Responses to Untrained Medial Position Words after Final Position Training (Subtest B)

Subjects	Subtest A	Subtest B		
	Final (5 items)	Medial (5 items)		
	S^2	S^2	S^3	S^4
A	5	4	4	4
B	5	1	0	2
C	5	0	0	2
D	5	0	0	0

Final Position. The results of Subtest A, shown in Table 4, clearly demonstrate the effectiveness of training in the final position for all four subjects in that each subject used the training phoneme correctly in 100 percent of the posttraining test stimuli. Compared with the results of Intratraining Probe Test 1, Subtest B, each subject increased his rate of correct responding by 100 percent.

Medial Position. A comparison of the results shown in Table 3, Subtest B, with those shown in Table 4, Subtest B, reveals that the percentage of across-position generalization to the medial position after training on the initial and final position treatments increased for Subjects A, B, and C and remained the same for Subject D. Subject A increased the total percentage of correct responses from 43 percent (13 out of 30) after initial position training only (Table 3, Subtest B) to 80 percent (12 out of 15) after training on the initial and final positions (Table 4, Subtest B) and Subject B increased the number of correct responses from 0 percent (0 out of 30) after training on initial position only to 20 percent (3 out of 15) after initial and final position training. Subject C increased the number of correct responses from 10 percent (3 out of 30) to 13 percent (2 out of 15). Subject D was unable to generalize the trained phoneme response to the medial position either preceding or following training on the final position. It is clear, then, that training on both the initial and final position does not generate exceptionally high generalization to the medial position occurrence of the trained phoneme in untrained words in three of the four subjects.

Training on the medial position, the second experimental treatment, was initiated after the completion of the second intratraining probe test. Again each subject met criteria on the seven stimulus conditions of the stimulus shift program and was then given the following three intratraining probe tests: Test 3: to measure the effects of training in the medial position, Test 4: to measure the effects of training on each independent position treatment, and Test 5: to measure the effects of independent position training on a randomized presentation of medial-final stimuli.

Intratraining Probe Test 3

The effects of training in the medial position as demonstrated by intratraining Probe Test 3 are shown in Table 5. It can be seen that all four subjects achieved scores of 100 percent in response to picture stimuli used during training. These scores, compared with those shown in Table 3 (Subtest B) and Table 4 (Subtest B), demonstrate a marked increase in correct phoneme production in the medial position for all subjects.

TABLE 5

Intratraining Probe Test 3

Correct Phoneme Responses to the Medial Position Training Words at the Completion of Medial Position Training

Subjects	Medial (5 items)
	S^2
A	5
B	5
C	5
D	5

Intratraining Probe Test 4

Intratraining Probe Test 4 was given 15 minutes after results were obtained on Intratraining Probe Test 3. The purpose of this test was to determine what effect independent position training had on preceeding position treatments. Using those picture stimuli which had previously been used in training, the unreinforced responses made by each subject to the training-test stimuli were compiled for each word position. The resultant scores are shown in Table 6.

TABLE 6

Intratraining Probe Test 4

Correct Phoneme Responses to Training Words at the Completion of Training All Three Independent Word Positions

Subjects	Initial (10 items)	Final (5 items)	Medial (5 items)
	S^2	S^2	S^2
A	10	5	5
B	9	3	5
C	10	5	5
D	2	3	5

It can be seen that after successive position training, correct phoneme production on previous word positions decreased for two of the four subjects (Subjects B and D). Subject A increased the percentage of correct responses from 95 to 100 percent, while Subject C maintained 100 percent correct phoneme production. Subject B maintained the number of correct responses in the initial position and demonstrated a 40 percent loss in correct phoneme responding in the final position. Subject D demonstrated an 80 percent decrement in correct phoneme production in the initial position and a loss of 40 percent in the final position.

All four subjects achieved 100 percent correct phoneme production in the medial position, the most recently trained position. It might be assumed from these results that the correct production of the training phoneme in the initial and final positions had not stabilized for two subjects and that training on succeeding positions for these two subjects interfered with the correct production of the response in preceeding word positions.

Intratraining Probe Test 5

The influence of independent word position training on the correct production of the trained phoneme in a randomized presentation of stimuli in the medial and final positions is shown in Table 7.

TABLE 7

Intratraining Probe Test 5

Correct Phoneme Responses After Completion of Training on Independent Word Positions to a Randomized Presentation of Final and Medial Position Training Words

Subjects	Randomized Final-Medial (10 items)		
	S^2	S^3	S^4
A	10	9	10
B	9	7	10
C	7	5	8
D	9	6	8

The results shown in Table 7 indicate that none of the subjects was able to correctly discriminate between word positions and/or produce the trained phoneme in 100 percent of the test items, but Subject A achieved a score of 97 percent, making only one error in response to a printed word stimulus. Subject B responded correctly to almost 87 percent of the test stimuli with the majority of errors being made in response to printed word stimuli. The lowest percentage of correct responses were made by Subject C whose total percentage of correct responses was 70 percent with the majority of errors being made in response to printed word stimuli. Relatively fewer correct responses were also made by Subject D to the printed word, with the percentage of total correct responses being 73 percent.

Most of the errors made on Intratraining Probe Test 5 were made in response to stimuli in which the correct response was in the final position. In addition, the majority of errors were made in response to printed word stimuli rather than the echoic or intraverbal stimuli.

Intratraining Probe Test 6

After the completion of Intratraining Probe Test 5, the third experimental treatment, randomization of training items in the final and medial positions, was presented to each subject. Following the completion of the seven training phases, or stimulus conditions, the sixth intratraining probe test was given to each subject. The results of this test are shown in Table 8.

The results shown in Table 8, Subtest A, reveal that, immediately after training on the randomized medial-final treatment, two subjects (A and D) responded correctly to 100 percent of the training picture stimuli while the remaining two subjects (B and C) responded correctly to 90 percent of the test stimuli. Only Subjects C and D experienced a change in the number of correct responses as is shown in a comparison with the results of Table 7. Subject C increased his score by two correct responses while Subject D increased his score by one. The scores of Subjects A and B remained the same.

TABLE 8

Intratraining Probe Test 6

Correct Phoneme Responses to Randomized Final and Medial Position Training Words at the Completion of Randomized Training (Subtest A) and Correct Phoneme Responses to Randomized Initial, Final, and Medial Position Training Words after Randomized Final and Medial Position Training (Subtest B)

Subjects	Subtest A	Subtest B		
	Randomized F-M (10 items)	Randomized Initial-Final-Medial (20 items)		
	S^2	S^2	S^3	S^4
A	10	20	19	19
B	9	19	17	18
C	9	9	10	13
D	10	12	11	15

When the training items from all three word positions were randomized for Subtest B, the scores ranged from 97 percent correct (Subject A) to 53 percent correct (Subject C). The majority of items missed were those requiring the trained phoneme in the initial position. Subject A emitted only two errors, one in response to a printed word stimulus and the other, to an intraverbal stimulus. Subject B, with a total correct production score of 90 percent, emitted 50 percent of the errors in response to the printed word. Subject C, responding correctly to only 53 percent of the test stimuli, emitted the majority of the incorrect responses to picture and printed word stimuli. The number of correct phoneme responses was slightly higher for Subject D in that 63 percent of the total number of responses were correct. The majority of this subject's errors, like those of the other subjects', was in response to the printed word.

The results in Table 8, Subtest B, as noted above, reveal that the majority of errors made by each subject were made in response to printed word stimuli and, for two subjects, in the initial position. It appears that the training which occurred after the first presentation of the initial position training items in some way affected the retention of correct phoneme production in the initial position on all three stimulus conditions.

Intratraining Probe Test 7

Training items for the randomized initial-medial-final treatment, the fourth experimental treatment, were presented immediately after Intratraining Probe Test 6. After the criteria were met on each of the seven stimulus conditions, the seventh and last, intra-training probe was presented. Table 9 reveals the results of this test.

TABLE 9

Intratraining Probe Test 7

Correct Phoneme Responses to Randomized Initial, Final, and Medial Training Words After Completion of Three Position Randomized Training

Subjects	Test A IMF* (20 items) S^2
A	20
B	20
C	20
D	20

*IMF refers to the randomized presentation of training items in the initial, medial and final word positions.

The results in Table 9 indicate that the trained phoneme response had been acquired and stabilized in all three word positions for all four subjects. Prior to training on the last treatment (Table 6, Subtest B) Subject A responded correctly to all pictured test items; Subject B erred on one picture test item; Subject C emitted a total of 11 incorrect responses to all three stimulus presentations; and Subject D, 12 incorrect responses. It can be seen, then, that with the exception of Subject A, training on this last randomization treatment was an important factor in the acquisition of the trained phoneme response in all three word positions.

Posttraining Test: New-Item Generalization

Tests to evaluate new-item generalization were given to each subject (a) 15 minutes after the completion of training on the initial position (Subtest A), (b) after all three independent treatments (Subtest B), (c) after the medial-final randomization treatment (Subtest C), and (d) after the initial-medial-final randomization treatment (Subtest D). These tests were used to demonstrate the ability of each subject to generalize the trained phoneme response to previously untrained items presented in the form of picture stimuli. Items for the new-item generalization tests were chosen on the basis of the responses made by each subject on items used during the collection of baseline data. The criterion for selection of new-item stimuli was that the subject must have been able to identify the picture stimulus but also must have misarticulated the training phoneme. The results of the tests for new-item generalization are shown in Table 10.

The following discussion of Table 10 will be divided into four sections according to the point at which the new-item generalization test was given. The test was given after training on (a) the initial position treatment (Subtest A), (b) the independent position treatments (Subtest B), (c) the randomized medial-final treatment (Subtest C), and (d) the randomized initial-medial-final treatment (Subtest D).

TABLE 10

Posttraining Test: New-Item Generalization

Correct Phoneme Responses to Untrained Words After Completion of Training in Initial Position (Subtest A), After Completion of Training in All Three Independent Word Positions (Subtest B), After Completion of Training in Randomized Final and Medial Word Positions (Subtest C), and Completion of Training of Randomized Initial, Final, and Medial Word Positions (Subtest D)

Subjects	Subtest A	Subtest B			Subtest C	Subtest D
	Initial 5 items	Initial 5 items	Final 5 items	Medial 5 items	F-M 10 items	I-F-M 15 items
	S^2	S^2	S^2	S^2	S^2	S^2
A	5	5	4	5	10	15
B	0	4	5	1	9	11
C	4	4	1	4	9	13
D	5	2	5	5	10	14

Initial Position (Subtest A)

After training was terminated on the initial position, two subjects (A and D) were able to correctly articulate the trained phoneme in all five of the untrained new-item test words when evoked by picture stimuli. Subject C was able to emit four out of five responses correctly while Subject B was unable to generalize the trained phoneme to any of the new items. The trained phoneme appeared in the initial position of the untrained words.

Independent Positions (Subtest B)

After training was completed on the independent position treatments (after the termination of training for the medial position), a second test of new-item generalization was given using the same untrained items that were used in the first test. Out of the 15 items used for this test (five words in each word position), Subject A emitted only one incorrect response (final position); Subject B emitted one incorrect response in the initial position and four in the medial position. Subject C emitted a total of six incorrect generalized responses with the majority being in the final position and Subject D emitted only three incorrect responses all of which were in the initial position.

It is interesting to compare the number of correct responses made in the initial position prior to training on the medial and final positions (Table 10, Subtest A) with those made after the completion of training on all three positions (Table 10, Subtest B). Subject A maintained a high level of responding while Subject B increased the number of correct responses from zero to four, demonstrating the effectiveness of training for this subject. Subject C maintained the same number of correct responses while Subject D decreased the number of correct responses by three. It appears that new-item (trained-untrained) generalization was not as severely affected by succeeding training as was across-position generalization.

Randomized Final-Medial Positions (Subtest C)

The pictured stimuli used for this test were the same as those used for the above test for the medial and final positions, however, the items were randomized to counter-balance the effects of order. A high operant-level of responding was seen for all subjects. Subjects A and D responded correctly to all of the new items while Subjects B and C each correctly emitted nine of ten new-item generalization responses. Again, Subject D responded at a high operant-level when he had performed at a comparatively low level during the collection of pretraining and intratraining probe data. Subjects A, B, and C all showed an increase in the number of correct responses after the randomized treatment from test scores obtained after training on the independent treatments (Subtest B). Subject D maintained the same high level of responding.

Randomized Initial-Final-Medial Positions (Subtest D)

With the addition of initial position picture stimuli to the randomized medial-final picture stimuli and the randomization of these test stimuli, data for the last new-item generalization test were collected. The level of responding, while as high or higher than on previous tests, was varied for this test. Subject A maintained the high level of responding and used the trained phoneme correctly on all 15 items; Subject D also responded at a high operant-level, erring on only one of the test items. Subjects B and C both increased their scores over those received on the new-item generalization test given after each word position treatment (Subtest B). While Subjects B and C did not achieve as high a level of responding as did Subjects A and D, the increase in the number of correct responses is significant nonetheless.

The results shown in Table 10 have demonstrated a maintenance of, or increase in, the number of correctly generalized new-item responses during the course of the training program. A sustained level of high responding was seen with Subject A while Subjects B, C, and D increased their ability to generalize their respective training phonemes to previously untrained stimuli.

Posttraining Test: Retention

The purpose of the retention tests was to evaluate the extent of each subject's ability to recall correct production of the trained phoneme in response to picture stimuli with the trained phoneme in the initial, medial, final, and randomized initial-medial-final positions after a given period of time with no training. Each test evaluated the responses of each subject to training stimuli, then, 15 minutes later, new-item (untrained) generalization stimuli. Two retention tests were given to each subject; one was given 24 hours after the termination of the training program (Table 11) and the other was given one week after the termination of training (Table 12).

Twenty-Four Hour Retention

The results in Table 11 reveal a comparatively high level of retention for each subject 24 hours after training. Subject A retained correct production of the trained

TABLE II

Posttraining Test: 24 Hour Retention

Correct Phoneme Responses to Trained and Untrained Words in the Initial, Final, Medial, and Randomized Initial-Final-Medial Word Positions 24 Hours After the Completion of Training

	Trained Words				Generalization (Untrained) Words			
Subjects	Initial 10 items	Final 5 items	Medial 5 items	I-F-M 20 items	Initial 5 items	Final 5 items	Medial 5 items	I-F-M 15 items
	s^2	s^2	s^2	s^2	s^2	s^2	s^2	s^2
A	10	5	5	20	5	5	5	15
B	10	4	5	20	5	4	4	12
C	10	5	5	20	5	4	3	12
D	10	5	3	20	5	5	5	15

phoneme to all 70 training and new-item (untrained) generalization test stimuli. Subject B, however, was unable to emit correct phoneme production on six of the test items with the majority of these errors being made to new-item (untrained) generalization stimuli in the following positions: *final position (1 error), medial position (1 error) and in the randomized* initial-medial-final positions (3 errors). A high level of correct responding was demonstrated by Subject C on the training test items, but one error was made to stimuli in the final position, two in the medial position and three in the randomized presentation of new-item (untrained) generalization test stimuli. Subject D, however, made two errors (medial position) *to the training test stimuli and responded appropriately to all of the new-item* (untrained) generalization test stimuli.

The overall level of responding was high for training and new-item (untrained) generalization test stimuli presented 24 hours after the termination of training. The percent of correct responses to all items ranged from 100 percent (Subject A) to 91.5 percent (Subjects B and C). However, the same is not true for responses made to test items one week after the termination of training. The results of these tests are shown in Table 12.

TABLE 12

Posttraining Test: One Week Retention

Correct Phoneme Responses to Trained and Untrained Words in the Initial, Final, Medial, and Randomized Initial-Final-Medial Word Positions One Week After the Completion of Training

Subjects	Trained Words				Generalization (Untrained) Words			
	Initial 10 items	Final 5 items	Medial 5 items	I-F-M 20 items	Initial 5 items	Final 5 items	Medial 5 items	I-F-M 15 items
	S^2	S^2	S^2	S^2	S^2	S^2	S^2	S^2
A	10	5	5	20	5	5	5	15
B	10	5	5	20	5	5	4	14
C	9	4	4	18	4	4	2	11
D	10	5	5	19	5	5	5	14

<u>One Week Retention</u>

The results shown in Table 12 compared with those shown in Table 11 reveal a change in retention for all but one subject (A) who maintained 100 percent correct responding on both retention tests. While Subject B made six incorrect responses to test items 24 hours after training, only two errors were made one week later; both errors were made to new-item (untrained) generalization test stimuli with one error being made in the medial position and the other being made in the randomized presentation. Subject C, however, made a substantial drop in the number of correct phoneme productions; six errors were made on the 24 hour test and 14 errors were made on the one week test. The number of errors made by Subject D remained the same on both tests, but the word position in which the errors were made was different. It can be seen that the two errors made on the 24 hour retention test were made in the medial position during the training item test. However, one week later, no errors were made in each of the two randomized treatments.

Table 12, then, shows (a) maintenance of the correct phoneme response by Subject A, (b) an increase in the number of correct phoneme responses by Subject B, (c) a decrease in the number of correct phoneme responses by Subjects C, and (d) a maintenance in the number of errors made but change in the test items missed by Subject D. The range of correct responses was from 100 percent (Subject A) to 85.3 percent (Subject B). While this range of responses is lower than that demonstrated on the previous test of retention, it is relatively high when compared to the results obtained on the Pretraining Test (Table 2).

Reliability of Data

"Reliability refers to the self-consistency of a measurement, usually expressed in terms of the degree of agreement . . . between two sets of measurements or two independent observers (Auer, p. 155)." For the purposes of the present investigation, one of the above mentioned measures of reliability were used; intrajudge reliability was used to determine the percentage of agreement between two sets of post-session measurements made by the investigator in the present study.

To determine intrajudge reliability two sets of recorded responses made by the investigator were compared for percentage of agreement. The first set of recorded responses were post-session judgements made after each subject had completed training on each treatment of the program. Judgements were made from audio tape recordings for three subjects (Subjects A, B, and D) and audio-video recordings for one subject (Subject C). Both sets of recordings were made during the actual training sessions.

The second set of recorded responses were made after each subject had completed the entire training program. The same audio and audio-video tapes were used for the second set of judgements as were used for the first set.

The following sections of the training program were used for the establishment of reliability: pretraining test, those training blocks where training criteria were met, intra-training probe tests and generalization tests, and those posttraining and generalization test responses made immediately, 24 hours, and one week after the termination of training. A total of 1520 responses were judged for each subject. The percentage of agreement was determined by comparing the two sets of recorded responses and computing the number of disagreements for each subject. The number of disagreements (X) were then divided by the number of items being judged (1520). The resultant number (X^1) was then subtracted from 100 percent to determine the percentage of intrajudge reliability (R): $\frac{X}{1520} = X^1$, $100\% - X^1 = R$. Table 13 shows the percentage of intrajudge agreement for each subject and the mean percentage of intrajudge agreement.

The results shown in Table 13 reveal a high percentage of agreement between the two sets of measurements by the investigator. This high percentage of agreement establishes the reliability of the investigator as a judge of the responses made by each subject in the present investigation.

It can be seen that the lowest percentage of agreement (93.62%) occurred for the responses made by Subject A. The responses made by this subject during training were made with only a short latency period between the stimulus presentation and response, making the resultant period of judgement and recording of each response relatively short. In addition, a large percentage of the disagreement occurred on the pretraining test where the /ʃ/s/ substitution was less easily discriminated due to the close proximity of the substituted phoneme /ʃ/ to the correct phoneme /s/.

TABLE 13

Intrajudge Reliability
Percentage of Agreement Between Two Post-Session Judgements by The Experimenter

Subject	Number of Responses Judged	Number of Disagreements	Percentage of Agreement	Type of Judgement
A	1520	97	93.62	Auditory
B	1520	59	96.12	Auditory
C	1520	39	97.43	Auditory-Visual
D	1520	47	96.91	Auditory
	6080	242	96.02	-

It is interesting to note that the highest percentage of agreement occurred on the judgements of responses made by Subject C. Due to the acoustic similarities between the substituted phoneme /w/ and the phoneme selected for training /l/, each training session for this subject was video-taped. The intrajudge measurements, then, for Subject C were made on the basis of both auditory and visual cues, where place of articulation could be observed, rather than on the basis of only auditory cues as was the case for the judged responses of Subjects A, B, and D.

Summary of Results

Summary of Training

All four subjects selected for the present investigation reached criteria on all five training treatments used in the present investigation. Each subject demonstrated periods of erratic responding during the early stages of treatment with a more regular pattern emerging as the treatment sequence progressed and was terminated.

There was a general trend of reduction in number of training blocks needed to terminate a particular treatment as training progressed. Thus, there appeared to be generalization of training effects within treatments. As might be anticipated, a long training period indicated a low level of responding while a short period of training indicated a high operant-level of responding.

Summary of Intratraining Probe Tests

Seven intratraining probe tests were given to each subject. Results of the first test, given after training was completed in the initial position, validated the results cited by McLean (1965): all four subjects were unable to generalize the trained phoneme response to the untrained medial and final positions. In fact, a comparison of the results of the first test with pretraining test data indicated that training in the initial position interfered to some degree with previously low levels of correct phoneme production in the medial and final positions.

Results of the second intratraining probe test, given after training in the final position, revealed a slight increase in correct responding in the untrained medial position over previously recorded levels for three subjects (A, B, and C) while Subject D maintained a zero level of responding. The third intratraining probe test demonstrated the acquisition of the trained phoneme in the medial position after specific training for all four subjects.

The fourth intratraining probe test was given after training had been completed on the independent word position treatments, e.g., after training had terminated in the medial position. The results of this test indicated that, while Subjects A and C maintained high levels of responding, Subjects B and D each demonstrated a decrease in correct phoneme responding. It was apparent that after successive training, previously correct phoneme responding decreased for two subjects (B and D).

Results of the fifth intratraining probe test, given prior to the final-medial randomization treatment, indicated unstable correct responses in the final position, caused apparently by training in the medial position, and a predominance of errors in response to grapheme (printed word, S^3) stimuli. After discriminative training for this first randomized treatment, results of the sixth intratraining probe test indicated a maintenance of correct response levels by Subjects A and B and a slight increase in response levels by Subjects C and D. This test also evaluated responses to training items in a randomized presentation of stimuli in all three word positions. Results revealed a majority of errors made in response to grapheme (printed word, S^3) stimuli. Also, two subjects (C and D) made more errors in the initial position than in the other two word positions. Further, it was apparent that successive training was followed by decreased correct responding in the initial position in the picture, grapheme, and intraverbal stimulus conditions.

The seventh intratraining probe test revealed that discriminative training in the initial-final-medial randomization treatment had stabilized the trained phoneme response in all three word positions for all four subjects. It can be concluded, on the basis of these results, that such randomization training is an important factor in across-position phoneme acquisition.

Summary of New-Item Generalization Tests

Four tests to evaluate the generalization of phoneme responses from trained to untrained items were given. The first test, given after training on the initial position, revealed high generalization scores for three subjects (A, C, and D) with Subject B being unable to generalize the recently trained phoneme to any of the new-item (untrained) stimuli.

A second test for new-item (trained-untrained) generalization was given after training had terminated on the medial position. Fairly high levels of generalized responses to untrained items were evidenced by all four subjects to words in all three word positions. It appeared that new-item (trained-untrained) generalization was not as impaired as a result of successive word position training as was across-position phoneme acquisition.

The third test, given after completion of the final-medial randomization treatment, revealed increased levels of correct responding for Subjects A, B, and C with Subject D maintaining the high level of responding shown on the previous test. After training had terminated on the initial-final-medial randomization treatment, the fourth new-item (trained-untrained) generalization test was given. Again, Subjects A, B, and C demonstrated increased levels of responding over the second test with Subject D maintaining the high level of responding shown on that test.

Summary of Retention Tests

Each retention test evaluated retention of correct responding to training and generalization stimuli. The first test was given 24 hours after the termination of training and the second, one week after the termination of training. The results of the 24 hour retention test revealed an overall high operant level of responding for the four subjects on the training and new-item (trained-untrained) generalization stimuli.

Results of the one week retention test revealed that Subjects A and D had maintained high levels of responding, Subject B increased the level of responding by 5.7 percent, and Subject C decreased the level of responding by 11.4 percent. These results were slightly lower than those obtained on the 24 hour retention test, but when compared to pretraining test data, were still at a high operant level.

Summary of Intrajudge Reliability

A total of 1520 responses for each subject were judged by the investigator. Post-session judgements were made (a) at the termination of each treatment sequence and (b) at the termination of the entire training program. Audio judgements were made for Subjects A, B, and D and audio-visual judgements were made for Subject C. The mean percentage of agreement for intrajudge reliability was 96.02 percent. The high level of agreement established the investigator as a reliable judge for the purposes of the present investigation.

Summary of General Results

The data for this study in across-position and new-item (trained-untrained) generalization revealed that all four subjects were able to produce the trained phoneme in all three word positions and were able to generalize the trained phoneme response to untrained stimuli at the conclusion of training.

It was apparent that generalization occurred within each treatment sequence indicated by a reduction of training blocks needed to demonstrate criteria with each successive treatment.

Test results showing across-position generalization indicated a general trend of variant responding on previous training items following each successive independent word position treatment sequence. These trends were manifested in relatively unstable phoneme responses. Randomization of phoneme position in training items appeared to counteract this trend and stabilize the emission of the trained phoneme. This trend of instability did not appear to be as obvious with regard to new-item (trained-untrained) generalization. The ability of each subject to generalize correct phoneme production to untrained words appeared to be increased or maintained as the training progressed.

Results of retention tests, given 24 hours and one week after the completion of training, illustrated the stabilized condition of the phoneme responses by high, though slightly reduced after one week, levels of responding. Marked increases in phoneme responding were made evident by comparison of retention test scores with pretraining test scores.

Intrajudge reliability, made on the basis of two post-session judgements, was found to be high for all four subjects being trained.

Chapter 5

Discussion

Previous consideration has been given to the point that carry-over, or the generalization of a newly-learned phoneme response to untrained contexts, is the criterion by which a speech pathologist measures the success of therapy. The process of generalization, however, has been treated rather grossly in that speech pathologists have viewed generalization with respect to clinic versus non-clinic procedures, or more generally, in terms of its situational properties. While it appears that speech pathologists are aware of the importance of the early phases of phoneme training and their relationship to the carry-over process, they have been unable to specify the constraints involved in such a process resulting basically in a reliance on chance effectiveness of procedures. While the need is readily apparent, little has been done to specify and empirically quantify the generalization constraints and the influence of training procedures with respect to these constraints.

The extension of the principles of S-R learning theory generated by Thorndike (1911), Hull (1943), and Spence (1953) into operant conditioning principles by Skinner (1953, 1957) has provided speech pathologists with a systematic approach for specifying and empirically quantifying measurements of articulation behavior. Recent investigators (McReynolds, in press; Mowrer, Baker, and Schutz, 1968; McLean, 1965) have applied these systematic procedures to training programs concerned with the acquisition of articulation responses and the effects of these programs on specific generalization gradients.

Specific to this study was work by McLean (1965) investigating articulation modification through the use of a systematic program of shifting stimulus control and observing the effects of such a procedure on certain generalization gradients. On the basis of the collected data, McLean concluded that the systematic shift of stimulus control procedure was (a) effective in training a particular phoneme response in the initial position, (b) effective in attaining the generalization of the trained phoneme to untrained words with the trained phoneme in the initial position, (c) ineffective in attaining the generalization of the trained phoneme to the untrained medial word position, and (d) inappropriately effective in attaining the over-generalization of the trained phoneme response to words requiring the previously substituted phoneme.

It was the purpose of the present investigation to observe the effects of training a specific phoneme response in all three position treatments and to observe the effects of this independent word position training on generalization of the trained phoneme response to untrained words. The hypothesis for this study, then, might be expressed in the concept that, since McLean's study had shown that generalization gradients of initial-position learning were low, correct phoneme responding in all three word positions requires specific position training. Thus, at least with mentally retarded children, the key is not across-position generalization of initial-position training, but generalization of across-position training to untrained items.

The principal findings of the present investigation provide support for the hypothesis that specific word-position training is required in order to attain high levels of generalized phoneme responding in all three word positions for mentally retarded children. The discussion of these findings will be presented in terms of the following: (a) training program, (b) retention, (c) secondary findings, (d) experimental problems, (e) summary, (f) conclusions, and (g) further research.

Training Program

This study demonstrated the effectiveness of specific word position training in the acquisition of correct phoneme responding to trained and untrained words in initial, medial, and final word positions for mentally retarded children. The following discussion will deal specifically with three points within the training program to show the effects of training as the program progressed: (a) Initial-Position Training, (b) Independent Word-

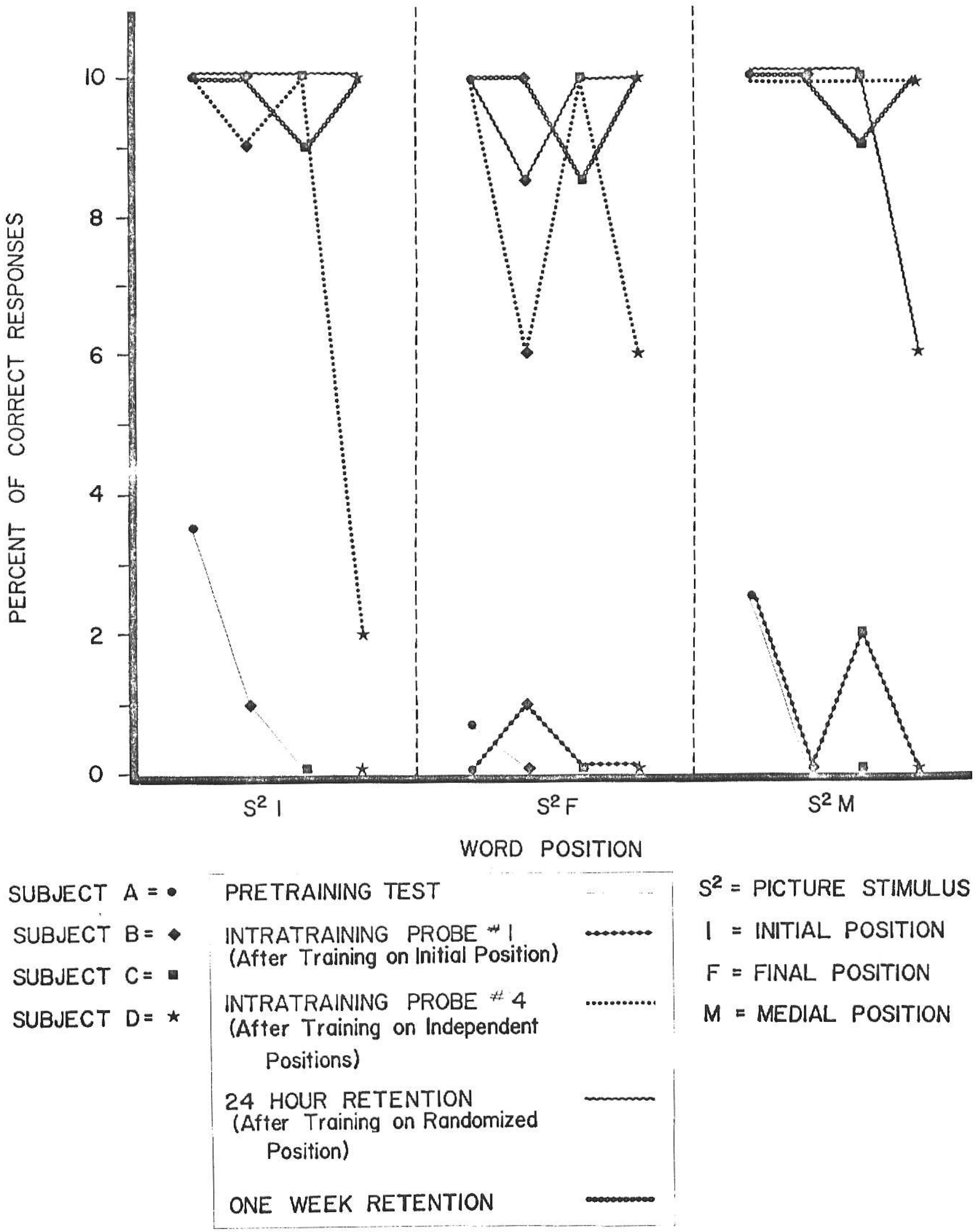
Position Training, and (c) Randomized Training. Figure 7 demonstrates the levels of correct responding for all four subjects at these points. For purposes of the illustration of the differing levels of responding, the S^2 stimulus condition was considered to be representative of the overall level of responding for each subject in Figure 7. The discussion will demonstrate any deviations from the level represented by the S^2 stimulus condition.

Initial Position Training. The lower portion of Figure 7 demonstrates the low level of correct response emission by each subject on (a) a pretraining test and (b) Intratraining Probe Test #1 after training on the initial position. As Figure 7 shows, the results of the pretraining test indicated low operant levels of responding for Subjects B, C, and D in response to picture, printed word, and intraverbal stimuli presented in all three word positions. Subject A responded at a higher operant level than did the other subjects but was inconsistent in correct phoneme production in both test situations and spontaneous speech and, for this reason, was maintained in the study. All four subjects were able to emit correct responses to echoic stimuli in the initial position. This was not the case for the final and medial positions, however. Only two subjects (A and C) emitted correct phoneme responses to echoic stimuli in the final position while three subjects (A, B, and C) made appropriate phoneme responses to echoic stimuli in the medial position. It is interesting to note that while Subjects B and D were unable to emit appropriate responses to echoic stimuli in the final position and Subject D, unable to do so in the medial position, all three subjects were able to emit correct phoneme responses to intraverbal stimuli.

Seven intratraining probe tests were given to each subject to evaluate the effects of previous training and to measure the effects of the previous training on untrained treatments. The first test, given after training on the initial position, showed low rates of responding on the final and medial positions demonstrating the inability of all four subjects to

FIGURE 7

Percentage of Correct Phoneme Responses to Picture Stimuli in All Three Word Positions for Subjects A, B, C, and D During Various Phases of Training



generalize correct phoneme production to untrained word positions. The observed low generalization gradient after initial-position phoneme learning supports McLean's findings (1965) as well as the first portion of the hypothesis under investigation here. It seems apparent that a program of specific position training must be initiated in order to attain correct phoneme production in all three word positions.

Independent Word-Position Training. The next treatment of the training program reinforced correct phoneme responses to words with the trained phoneme in the final word position. An intratraining probe test (#2), given at the completion of training on this treatment, showed no increase in generalized levels of responding to the untrained medial position for any of the four subjects. It became apparent that generalization of trained phonemes to untrained word positions would not occur and that, if medial position phoneme acquisition was to be attained, direct application of training in the untrained position was necessary.

Each subject, then, was given specific phoneme training in the medial word position. After the completion of this third treatment, three intratraining probe tests (#3, 4, 5) were given. Results of Intratraining Probe Test 3 showed the acquisition of the training phoneme in the medial position for all four subjects.

Combined results of Intratraining Probe Tests 1, 2, and 3 revealed that, immediately after training on each word position, the trained phoneme response in the most recently trained position was successfully trained. The basis for this conclusion was the high operant levels of responding emitted by each subject to the previously trained picture stimuli. Intratraining Probe Test 4 (see Figure 7), however, demonstrated that after training had terminated on all three independent word position treatments, two subjects (B and D) were unable to maintain the previously emitted high response rates in all word positions. In the initial position, Subject D experienced a loss of 80 percent correct responding while Subjects A, B, and C all maintained or increased their levels of responding. Final position responding, while high for Subjects A and C, showed Subjects B and D each experiencing a 40 percent loss in correct responding. It was apparent that correct phoneme production in the initial and final word positions for two subjects decreased following training in the successive training segments. Medial position responding was at the 100 percent correct phoneme response level for all four subjects. This high rate of responding is most likely attributed to the recent completion of training on that position with no interference from intervening training to create a disturbance in the high response levels. Since medial word position training had interfered with previously correct phoneme production in the initial and final positions, it must be assumed that, after specific word position training, correct phoneme production had not stabilized for Subjects B and D, even though they had demonstrated criteria to terminate training at the time of each particular treatment termination.

After the completion of Intratraining Probe Test 4, a test was given to each subject to observe the effects of independent word position training on generalization to untrained words with the training phoneme in all three word positions. Results of this test revealed relatively high operant levels of responding to untrained words in all three word positions for only Subject A. Subjects B, C, and D demonstrated varying levels of responding to untrained words for the three word positions demonstrating inconsistent use of the trained phoneme on untrained items. It was apparent that while independent word position training did enhance the generalization of the trained phoneme to untrained items, the presence of varied levels of responding for three of the four subjects appeared to indicate that the trained phoneme had not stabilized.

From these results, it can be seen that (a) generalization of trained phoneme responses to the untrained medial word position does not increase or improve after specific training on the initial and final word positions, that (b) independent word position training in each successive word position is sometimes followed by decreases in previously trained responses in other word position(s), indicating unstable phoneme responses, and that (c) independent word position training enhances across-position phoneme responding to untrained words, but that, generally, the responses, across all three word positions, are inconsistent. The presence of improved, but unstable, correct phoneme response rates to trained and untrained stimuli has indicated a need for further training.

Randomized Training. To stabilize phoneme generalization to untrained words in all three word positions, two randomized treatments were included in the training program. Prior to the commencement of the medial-final randomization, first of the two randomized treatments, the last portion of Intratraining Probe Test #5 was given. Results of this test revealed relatively unstable final position responding and that the grapheme stimulus condition (S^3) was the most difficult stimulus condition to which a correct phoneme response could be made. This was particularly true of Subjects B, C, and D who were unable to read prior to the study. The effects of training on this first randomized treatment, as shown by the sixth intratraining probe test, did change the response levels of Subjects A and B to picture stimuli but only slightly increased correct phoneme production for Subjects C and D.

When *initial position training items* were included in the medial-final randomization, a subtest of the sixth intratraining probe test revealed a loss of correct initial position phoneme responses for Subjects C and D with all four subjects being unable to correctly emit high levels of discriminative phoneme responding in the initial position to picture, printed word, and intraverbal stimuli. The effects of the last training sequence, a randomized presentation of previously trained stimuli in all three word positions, were shown in the seventh intratraining probe test. Here, it was clearly shown that responses for all four subjects had stabilized in that each subject was able to emit differential phoneme responses in all three word positions.

Training on the two randomized treatments shown by new-item (trained to untrained) generalization were shown to improve trained-untrained generalization for all four subjects.

Prior to the randomized training, a range of 20 to 100 percent correct responses was demonstrated while an increased range of 73.3 to 100 percent was indicated after the termination of the last randomized treatment. It is apparent that while independent position training is sometimes followed by decreases in correct phoneme responding to previously trained positions, such training is often followed by increases in the level of correct production to untrained words in trained positions.

These data have shown, therefore, that across-position generalization is relatively low in a population of retarded children. The problem of phoneme acquisition in all three word positions for such a population cannot be dealt with in terms of generalization of one, or even two learned positions. Consistent use of a new phoneme appears to require specific across-position phoneme training which includes not only training in each word position, but additional training using a randomized presentation of stimuli in all three word positions to implement differential correct phoneme responding.

Retention Tests

Two retention tests were given: each included independent and randomized stimuli for training and new item (trained-untrained) generalization items. Results of the first test, given 24 hours after training was terminated, revealed overall high operant levels of responding for all four subjects on trained and untrained items. While 100 percent correct responding to randomized trained stimuli was maintained over the 24 hour period for all four subjects, the effects of no training were slightly different with respect to generalization. Subject A maintained 100 percent correct responding while Subject D increased his response level from 93.3 percent to 100 percent and Subject B demonstrated an increase from 73.3 to 80 percent. Subject C dropped slightly over the 24 hour period from 86.6 to 80 percent.

One week later, the second retention test was given using the same stimuli as the 24 hour test. Overall results of this test were slightly lower than on the previous test.

With regard to training retention, Subjects A and B maintained 100 percent reponse levels during the presentation of randomized stimuli. Subject C reduced his response level from 100 to 90 percent correct responding and Subject D, from 100 to 95 percent. Responses to randomized trained-untrained generalization stimuli were varied. Subject A maintained 100 percent correct responding, while Subject B increased her levels of responding from 80 to 93.3 percent. Subjects C and D each evidenced slight decrements over the one-week period, with Subject C dropping from 80 to 73.3 percent and Subject D from 100 to 93.3 percent. While these scores are lower, overall, than those obtained on the 24 hour test, a marked improvement in articulation performance from pretraining test data was evidenced for all four subjects.

Secondary Findings

While these data have shown that the generalization gradients for across-position generalization from independent position training were low and that randomized position treatments are relatively effective in attaining appropriate generalization to untrained items, two other generalization constraints appeared to be functional within each of the five treatments: (a) generalization of trained responses from highly supportive stimuli to low-supportive stimuli and (b) generalization of trained responses to later phases of each treatment. The generalization of trained responses from high topographic support for the new response (echoic stimuli) to stimuli containing no support for the topography of the response (picture) appeared to be initially difficult for all four subjects, not only in the initial position training sequence, but in each successive training sequence or treatment as well. However, generally, the number of training blocks needed to reach criteria during each support to non-support phase in successive treatments decreased. Such a trend perhaps suggests an acquisition and subsequent generalization of the training procedure itself to later training sequences. Thus, while each subject experienced characteristically low and erratic periods of responding during the initial shift from stimulus conditions of support to non-support in all five treatments of the training program, the length of training needed to meet criteria for the first shift from supporting to non-supporting stimuli in each subsequent treatment decreased. In someways, this supports a hypothesis that each new position is a novel learning task.

The second generalization gradient mentioned above, that of generalization from the earlier phases of each training treatment or sequence to later phases was generally demonstrated by all four subjects. This trend was made evident by the fact that (a) fewer training blocks were needed to demonstrate criteria on the later phases or stimulus conditions than were needed on the earlier phases and (b) the number of training blocks needed for each subsequent treatment was lower than it had been on previous treatments. This trend was most evident in the acquisition curves for Subjects A and B. Both subjects required progressively fewer blocks in each training sequence or phase. Subject C deviated slightly from this general trend in that more training blocks were needed in the medial position treatment. This increase in needed training occurred due to the inability of Subject C to produce the /l/ phoneme in two words, "umbrella" and "valentine". Repeated training was needed to stabilize correct phoneme production in these two words thereby increasing the number of training blocks and disrupting the general downward trend. However, the decreasing trials trend was resumed as soon as the next treatment, randomization of initial-medial-final words, was commenced. The same interrupted pattern was observed for Subject D who experienced the increment rather than decrement of training blocks on the medial-final randomization treatment. The specific cause of the interruption cannot be directly related to any one variable. It is suggested, however, that a likely cause might be the fact that this Subject was reacting to the excessive need for repetition and was merely becoming "battle-weary."

Experimental Problems

While the data yielded informative results regarding across-position generalization, the training and testing procedures brought forth problems worthy of consideration. These problems are: (1) a need for a more efficient, less time-consuming training procedure, (2) a need for more detailed experimentation with the grapheme stimulus, and (3) a need for a more efficient system of probing and testing. With regard to the first problem, that of a more efficient training procedure, the present training program required from three weeks (Subject A) to two and one-half months (Subject D) of subject participation. The complexity of the program and the timing and presentation of probe and test items were contributing factors in the length of time needed to complete training. It appears that a more efficient training program might be developed.

With regard to the second problem, that of grapheme training, a considerable amount of training time was needed to assure (a) correct phoneme production and (b) recognition of the grapheme. In a pre-study analysis it was found that when the presentation of the grapheme was paired with the picture, a subject tended to attend more to the picture than to the grapheme. When the subject met the specified criteria for the paired picture-grapheme stimulus condition and the picture support was withdrawn, the subject experienced an inability to identify the grapheme. To counteract such an occurrence, a five-second hold was initiated in the presence of only the grapheme during the paired presentation. Such a procedure appeared to aid the transfer of correct responding to only the grapheme but it tended to increase the amount of time spent by the subject on the grapheme which had already been a time-consuming, slower-moving portion of the training procedure. A more precise procedure is needed, one that would insure phoneme-grapheme learning in the least amount of time.

The third problem mentioned above was that of a need for a more efficient probe and test procedure. As can be seen in the procedure section, the probe and test procedure was quite involved and lengthy. The experimenter was forced to follow a detailed checklist to ensure consistency in procedures. In addition, such a procedure dictated a large amount of handling of materials which increased the training and testing time beyond expectations. The use of probing techniques is a necessary part of any training program, however, a more efficient method must be considered to allow the clinician to attend to subject responding and other essential parts of the training program.

In addition, a problem in testing techniques was made evident with regard to new-item (trained-untrained) generalization. Stimuli to test the ability of each subject to make generalized phoneme responses were selected from pretraining test stimuli. As training and testing progressed, the same new-item (untrained) test stimuli were used to elicit generalized phoneme responses. At the conclusion of training and testing, each subject had been exposed to the new item (untrained) stimuli six times. While correct responses were not reinforced, there is some question as to how much learning had occurred as a result of the repeated presentations of the same new-item (untrained) stimuli.

The data provided in this study have shown the importance of specific word position training in the acquisition of correct phoneme responding in all three word positions. Further, it has been shown that a procedure which allows for differential word position responding to a randomized presentation is necessary for retention of such trained and generalized responses.

Further data has provided additional information regarding an improved ability to generalize responses to untrained items although a more reliable method of new-item testing is indicated. Also, it appears that the retention of correct responses to grapheme stimuli is adversely affected perhaps by succeeding training.

Summary

McLean (1965) developed a systematized program of shifting stimulus control designed to modify articulation disorders. The program was based on the "stimulus method" of Travis (1931), the auditory stimulation techniques of Milisen (1954), Van Riper (1963) and Berry and Eisenson (1956), and the behavior modification techniques of Skinner (1953, 1957). McLean's study was developed to determine what effects a systematized program of specific phoneme training would have on phoneme response acquisition and generalization. One of the results of the McLean study revealed that subjects were unable to generalize a trained phoneme response to word positions other than the particular word position in which it was trained. It was felt that an extension of McLean's shifting stimulus program, which included specific word position training, would enhance across-position phoneme learning.

The purpose of the present investigation was to determine if specific training in all three word positions would result in a high rate of across-position phoneme learning. The hypothesis to be examined was presented in the following manner: Since McLean's study had shown that training in the initial position did not result in generalization to medial and final positions, correct phoneme responding in all three word positions requires specific position training. Thus, at least with mentally retarded children, the key is not across-position generalization of initial-position training, but generalization of across-position training to untrained items.

The experimental program designed to investigate the hypothesis followed the same basic procedure as that of McLean. Four mentally retarded subjects were given specific phoneme training in a program using the pairing and shifting of echoic (verbal imitation), picture-textual (picture), grapheme-textual (printed word), and intraverbal (incomplete sentence) stimulus conditions. The program was extended past that of McLean in that the subjects were given training in the initial, final, and medial word positions, with additional differential training with stimuli being presented in randomized medial-final and initial-medial-final treatments.

In order to assess the progress of each subject the following testing and probing sequence was developed. Prior to training all subjects were presented all training and test stimuli to determine the baseline of articulatory behavior. During specific points in training, seven intratraining probe tests were given to determine the effects of previous training and the influence of the previous training on generalization to untrained positions and/or words. After the entire training program was completed, three posttraining tests were given: (a) immediately after training: new-item generalization, (b) 24 hours after training: training and new-item generalization, and (c) one week after training: training and new-item generalization.

Results of the training program supported the hypothesis. Training on the initial position revealed little across-position generalization for all four subjects. Independent word position training was then given with the following results after termination of medial position training: (a) a loss of correct responding for two of the four subjects in the initial and final word positions and (b) enhanced, but inconsistent, responding to untrained items in all three positions for three of the four experimental subjects. These results indicated relatively unstable phoneme response levels which, in turn, indicated a need for further training. After training was terminated on two randomized word-position treatments, where differential responding was reinforced, all four subjects were able to produce the trained phoneme in all three word positions to trained and untrained words at high response levels. These levels were generally maintained over the 24 hour and one week periods when retention tests were given. It can be seen, then, that a systematized presentation of shifting stimuli in a program of specific word position training which includes treatments which require differential word position responding, such as that presented in this study, is effective in the attainment of across-position phoneme learning and new-item (trained-untrained) generalization.

Conclusions

The results demonstrated in this study, then, would appear to support the following conclusions:

1. A training program which includes not only specific phoneme training in all three word positions, but also randomized presentations of stimuli

in all three word positions, increases and stabilizes the level of responding to trained and untrained items. At the termination of the training program under investigation in this study, all four subjects demonstrated these high levels of responding indicating stabilized phoneme acquisition. Relatively high levels were maintained over the 24 hour and one week retention periods.

2. A training program which includes specific phoneme training in all three word positions increases the level of responding to untrained words with the trained phoneme in all three positions, but the level of responding was still inconsistent and varied in that none of the four subjects attained 100 percent levels of generalization to untrained words.

3. A training program which includes specific phoneme training in all three word positions may be followed by decreased correct phoneme responding on previously trained positions. Two of the four subjects in this study experienced lower operant levels of responding on previously trained initial and final word positions after being trained on all three independent word positions.

4. Use of the shift of stimulus control procedures in initial position training of phoneme responses with mentally retarded children indicated low generalization to other word positions for all four experimental subjects.

Recommendations for Further Research

In order to facilitate further research on the modification of articulation disorders, the following areas are recommended:

1. Additional research into a more efficient training program are indicated. Specific consideration should be given to (a) the effects of different criteria with regard to the S^1 (echoic) stimulus condition, (b) the effects of the elimination of pairing of picture-word and/or word-intraverbal stimulus conditions, (c) the effects of incorporating generalization procedures into one main program rather than the present five-step program, and (d) the effects of one three-position randomization without the use of previous two-position randomization training.
2. Additional research which seeks to establish the relevancy of the following with respect to retention are indicated: (a) Does the extra exposure to stimuli necessitated by grapheme training positively effect retention? (b) Is a long period of training more effective than a short period of training with respect to retention? (c) Is "errorless" discrimination training (Terrace, 1966) more effective with regard to retention than is training which allows for the making of errors as in the present program?
3. Additional research which seeks to compare the effectiveness of therapist-produced stimuli as opposed to an automated procedure are indicated. The systematic nature of the method used in the present investigation lends itself to the use of automated procedures, however, no attempts have been made to establish the validity and reliability of such a procedure.

REFERENCES

Auer, J. Jeffery, An introduction to research in speech. New York: Harper and Brothers, 1959.

Baer, D. and Sherman, J. Journal of Experimental Child Psychology, 1964, 1, 37. Cited by Lovaas, et al., Science, 1966, 151, 705-707.

Bangs, Jack L. A clinical analysis of the articulatory defects of the feeble-minded. Journal of Speech and Hearing Disorders, 1942, 7, 343-356.

Berry, M. and Eisenson, J. Speech disorders: principles and practices of therapy. New York: Appleton-Century Crofts, Inc. 1956.

Brookshire, Robert H. Speech pathology and the experimental analysis of behavior. Journal of Speech and Hearing Disorders, 1967, 32, 215-227.

Garrett, Edgar R. Correction of functional misarticulation under an automated self-correction system. Final Report (USOE, Project Number 2749), New Mexico State University, University Park, 1965.

Girardeau, Frederic L. and Spradlin, Joseph E. (Ed.) Applications of a functional approach to speech and hearing. Journal of Speech and Hearing Disorders, in press, 13 (Monograph Supplement 14).

Hull, C. L. Principles of behavior. New York: Appleton-Century-Crofts, 1943.

Johnson, W., Brown, S., Curtis, J., Edney, D., and Keaster, J. Speech handicapped school children. New York: Harper and Row, 1948.

Karlin, I. W. and Strazzula, M. Speech and language problems of mentally deficient children. Journal of Speech and Hearing Disorders, 1952, 17, 286-294.

McLean, James E. Shifting stimulus control of articulation responses by operant techniques. Unpublished doctoral dissertation, University of Kansas, 1965.

McLean, James E. and Spradlin, Joseph E. Programming of antecedent stimulus conditions in operant programs for speech modification. Parsons Demonstration Project, November, 1967, Report Number 87.

McReynolds, L. V. Contingencies and consequences in speech therapy. Journal of Speech and Hearing Disorders, in press.

Mechner, F. A. A notation system for the description of behavioral procedures. Journal of Experimental Analysis of Behavior, 1959, 2, 133-150.

Milisen, Robert. A rationale for articulation disorders. Journal of Speech and Hearing Disorders, 1954 (Monograph Supplement 4).

REFERENCES (Continued)

Miller, G. A. and Nicely, P. E. An analysis of perceptual confusions among english consonants. Journal of the Acoustic Society of America, 1955, 27, 338-352.

Mowrer, D. E., Baker, R. L., and Schutz, R. E. Operant procedures in the control of speech articulation. In Sloane, Howard N., Jr. and MacAulay, Barbara D. (Ed.) Operant procedures in remedial speech and language training. Boston: Houghton Mifflin Co., 1968, 296-321.

Peterson, R. Imitation: a basic behavioral mechanism. In Sloane, Howard N., Jr. and MacAulay, Barbara D. (Ed.) Operant procedures in remedial speech and language training. Boston: Houghton Mifflin Co., 1968, 61-74.

Powell, J. and McReynolds, L. V. A procedure for testing position generalization from articulation training. Journal of Speech and Hearing Research, 1969, 12, 629-645.

Schiefelbusch, Richard L. Language studies of mentally retarded children. Journal of Speech and Hearing Disorders, 1963 (Monograph Supplement 10).

Schlanger, Bernard B. Speech therapy with mentally retarded children. Journal of Speech and Hearing Disorders, 1958, 23, 298-301.

Shelton, R., Elbert, M., and Arndt, W. A task for evaluation of articulation change: II. comparison of task scores during baseline and lesson series testing. Journal of Speech and Hearing Research, 1967, 10, 578-585.

Skinner, B. F. Science and human behavior. New York: Macmillan, 1953.

________, Verbal behavior. New York: Appleton-Century-Crofts, Inc., 1957.

________, Operant behavior. In Honig, Werner K. (Ed.) Operant behavior: areas of research and application. New York: Appleton-Century-Crofts, Inc., 1966, 12.

Sloane, Howard N., Jr., and MacAulay, Barbara D. Teaching and the environmental control of behavior. In Sloane, Howard N., Jr. and MacAulay, Barbara D., (Ed.) Operant procedures in remedial speech and language training. Boston: Houghton Mifflin Co., 1968, 3-18.

Sommers, R. K. Factors in the effectiveness of articulation therapy with educable retarded children. Final Report (USDHEW, Project Number 7-0342) Montgomery Public Schools, March, 1969.

Spence, K. W. Behavior theory and conditioning. New Haven: Yale University Press, 1953.

Terrace, H. S. Stimulus control. In Honig, Werner K. (Ed.). Operant behavior: areas of research and application. New York: Appleton-Century-Crofts, Inc., 1966, 271.

REFERENCES (Continued)

Thorndike, E. L. Provisional laws of acquired behavior or learning. In Birney, R. C. and Teevan, R. C. (Ed.) Reinforcement: an enduring problem in psychology. New Jersey: D. Van Nostrand Co., Inc., 1961, 3-8.

Travis, L. E. Disorders of articulation and phonation. Speech pathology. New York: D. Appleton and Co., 1931, 193-231.

Van Riper, Charles. Articulation disorders: treatment. Speech correction: principles and methods. (4th ed.) Englewood Cliffs, N. J.: Prentice-Hall, Inc. 1963.

Van Riper, Charles and Irwin, John C. Voice and articulation. Englewood Cliffs, N. J.: Prentice-Hall, Inc. 1958.

West, Robert, Ansberry, Merle and Carr, Anna. Dyslalia -- speech difficult of perception. The rehabilitation of speech. New York: Harper and Row, 1957.

Wilson, Frank B. Efficacy of speech therapy with educable mentally retarded children. Journal of Speech and Hearing Research, 1966, 9, 423-433.

Winitz, Harris and Bellerose, Betty. Sound discrimination as a function of pretraining conditions. Journal of Speech and Hearing Research, 1962, 5, 340-348.

Wood, Nancy E. Delayed speech and language development. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1964.

Young, E. H. and Hawk, S. S. Moto-kinesthetic speech training. Palo Alto: Stanford University Press, 1955.

APPENDICES

APPENDIX A

Test Data on Subjects

Subject A (J.M.)

Birthdate: 6-1-53

CA: 15-10

MI: -1, AB: -1

Parsons Language Sample III (Spradlin, 1963)

Verbal	62
Non-Verbal	61
Mean	61

Peabody Picture Vocabulary Test, Form B

Raw Score	79
MA	10-5
IQ	82

Developmental Articulation Test-Picture Stimuli

Phoneme Tested	I	M	F	(Scale 1-5) Stimulability
k				
g				
f				
l			om	1
r				
tʃ				
s	θ	θ	θ	1
z	ð	ð	ð	1

Phoneme Selected /s/

Subject B (D.B.)

Birthdate: 11-21-54

CA: 14-5

AB = 1 MI = 11

Parsons Language Sample III (Spradlin, 1963)

Verbal	57
Non-Verbal	54
Mean	55.6

Peabody Picture Vocabulary Test, Form B

Raw Score	80
MA	10-7
IQ	83

Developmental Articulation Test-Picture Stimuli

Phoneme Tested	I	M	F	(Scale 1-5) Stimulability
k		om	om	2
g		om	om	4
f			approx.	3
l		om		1
r	w	om	om	5
tʃ		om	om	4
s	f	om	om	1
z		om	om	1

Phoneme Selected /s/

Subject C (G.M.)

Birthdate: 2-16-57

CA: 12-2

AB = -11 MI = -11

Parsons Language Sample III (Spradlin, 1963)

Verbal	53
Non-Verbal	56
Mean	54

Peabody Picture Vocabulary Test, Form B

Raw Score	61
MA	7-0
IQ	69

Developmental Articulation Test-Picture Stimuli

Phoneme Tested	I	M	F	(Scale 1-5) Stimulability
k			om	I
g				
f				
l	w	w	om	I
r	w			I
tʃ				
s				
z				

Phoneme Selected /L/

Subject D (J.R.)

Birthdate: 6-12-56

CA: 12-10

AB = II MI = III

Parsons Language Sample III (Spradlin, 1963)

Verbal	54
Non-Verbal	63
Mean	58.5

Peabody Picture Vocabulary Test

Raw Score	71
MA	8-11
IQ	92

Developmental Articulation Test-Picture Stimuli

Phoneme Tested	I	M	F	(Scale 1-5) Stimulability
k				
g				
f	p	p	p	1
l	om	om	om	2
r	om	om	om	3
tʃ	t	t	t	2
s	θ	t	ts	2
z	ð	t	θ	4

Phoneme Selected /tʃ/

APPENDIX B

Training and Generalization Stimuli

/t /

I. Stimulus Words and Generalization Items (*)

A. Initial

chief, cherry, cheese, chain, chalk, chest, chin, chipmunk, chaps, chocolate, *church, *chair, *check, *chicken, *chimney

B. Medial

butcher, pitcher, matches, preacher, peaches, *patches, *kitchen, *handkerchief, *teacher, *hatchet

C. Final

peach, switch, latch, match, patch, *sandwich, *bench, *wrench, *watch, *witch

II. Intraverbal Stimuli

A. Initial

1. My favorite kind of cake is chocolate.
2. The pants that a cowboy wears are called chaps.
3. The animal that looks like a squirrel is a chipmunk.
4. Pirates bury their treasure in a treasure chest.
5. Between your neck and your mouth is your chin.
6. We can pull heavy things with a chain.
7. We write on the blackboard with chalk.
8. A small, sweet, red, round fruit is called a cherry.
9. You can catch a mouse with cheese.
10. The leader of an Indian tribe is called an Indian chief.

B. Medial

1. My favorite dessert is fresh, sliced peaches.
2. In church, the man who makes the sermon is called the preacher.
3. To light fires, we use matches.
4. The iced tea was in the big pitcher.
5. The man who cut meat is our butcher.

C. Final

1. On his eye, the pirate had a big, black patch.
2. I would like to eat a fresh, ripe peach.
3. We will lock the door with a strong latch.
4. Don't light that match.
5. On the wall, by the door, is the light switch.

/L/

I. Stimulus Words and Generalization Items (*)

A. Initial

light, ladder, lemon, log, loaf, lettuce, lightning, lawnmower, lock, lipstick, *lamp, *leaf, *lamb, *letter, *lion

B. Medial

umbrella, valentine, sailor, rolling pin, collar, *ruler, *pillow, *calendar, *telephone, *balloon

C. Final

ball, school, nail, well, towel, *wall, *doll, *pencil, *bowl, *bell

II. Intraverbal Stimuli

A. Initial

1. To get to the roof of the house, we will have to climb up on a ladder.
2. A fruit that is yellow and that tastes very sour is a lemon.
3. We cut the grass with a lawnmower.
4. Girls like to wear lipstick.
5. Turn on the light.
6. Rabbits eat lettuce.
7. I don't want just a piece of bread, I want the whole loaf.
8. In a rainstorm, the light in the sky is caused by lightning.
9. The fire needed another log.
10. I put the key in the lock.

B. Medial

1. Around the neck of a blouse is not a sleeve, but a collar.
2. Mother makes cookies with a rolling pin.
3. A man that is in the Navy is called a sailor.
4. A heart that says "I love you" that we give to Mother is called a valentine.
5. When it's raining outside, we use an umbrella.

C. Final

1. We dry ourselves with a towel.
2. There is fresh, cool water in our well.
3. Take that hammer and hit the nail.
4. We learn how to read at school.
5. I like to bounce the ball.

/s/

I. Stimulus Words and Generalization Items (*)

A. Initial

sack, soup, saw, salt, scales, scissors, suit, soap, sign, socks, *saddle, *sink, *seal, *sun, *safe

B. Medial

gas station, bicycle, whistle, mousetrap, grasshopper, *mixer, *glasses, *basket, *ice cream, *pencil

C. Final

lace, mattress, cross, horse, glass, *house, *ice, *mouse, *dress, *bus

II. Intraverbal Stimuli

A. Initial

1. The man had on a new suit.
2. After we take off our shoes, we take off our socks.
3. In the olden days, bankers weighed their money on a set of scales.
4. You should go slow when you see a yellow sign.
5. When we use pepper, we usually use salt.
6. I wash my hands with soap.
7. The man cut off the board with a saw.
8. Many times for lunch we have sandwiches and soup.
9. We cut paper with scissors.
10. We buy groceries at the store and they are put in a brown paper sack.

B. Medial

1. A green bug that jumps is called a grasshopper.
2. I put some cheese in the mousetrap.
3. We should stop when a policeman blows his whistle.
4. When you go outside, you might ride your bicycle.
5. Father buys oil for the car at the gas station.

C. Final

1. Out in the stable, we have a white horse.
2. On top of the Church is a cross.
3. At home, we drink water in a glass.
4. On the bed, there is always a mattress.
5. A bride wears a pretty dress that is made out of lovely, white lace.

EFFECTS OF SYSTEMATIC TRAINING PROGRAMS ON THE GENERALIZATION OF NEW PHONEME RESPONSES ACROSS DIFFERENT POSITIONS IN WORDS

by

SANDRA LEE RAYMORE

B. A., Western Washington State College, 1967

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF ARTS

Department of Speech

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1970

Abstract

McLean (1965) developed a systematized program of shifting stimulus control designed to modify articulation disorders. The program was based on the "stimulus method" of Travis (1931), the auditory stimulation techniques of Milisen (1954), Van Riper (1963) and Berry and Eisenson (1956), and the behavior modification techniques of Skinner (1953, 1957). McLean's study was developed to determine what effects a systematized program of specific phoneme training would have on phoneme response acquisition and generalization. One of the results of the McLean study revealed that subjects were unable to generalize a trained phoneme response to word positions other than the particular word position in which it was trained. It was felt that an extension of McLean's shifting stimulus program, which included specific word position training, would enhance across-position phoneme learning.

The purpose of the present investigation was to determine if specific training in all three word positions would result in a high rate of across-position phoneme learning. The hypothesis to be examined was presented in the following manner: Since McLean's study had shown that training in the initial position did not result in generalization to medial and final positions, correct phoneme responding in all three word positions requires specific position training. Thus, at least with mentally retarded children, the key is not across-position generalization of initial-position training, but generalization of across-position training to untrained items.

The experimental program designed to investigate the hypothesis followed the same basic procedure as that of McLean. Four mentally retarded subjects were given specific phoneme training in a program using the pairing and shifting of echoic (verbal imitation), picture-textual (picture), grapheme-textual (printed word), and intraverbal (incomplete sentence) stimulus conditions. The program was extended past that of McLean

in that the subjects were given training in the initial, final, and medial word positions, with additional differential training with stimuli being presented in randomized medial-final and initial-medial-final treatments.

In order to assess the progress of each subject the following testing and probing sequence was developed. Prior to training all subjects were presented all training and test stimuli to determine the baseline of articulatory behavior. During specific points in training, seven intratraining probe tests were given to determine the effects of previous training and the influence of the previous training on generalization to untrained positions and/or words. After the entire training program was completed, three posttraining tests were given: (a) immediately after training: new-item generalization, (b) 24 hours after training: training and new-item generalization, and (c) one week after training: training and new-item generalization.

Results of the training program tended to support the hypothesis. Training on the initial position revealed an inability of all four subjects to generalize the trained phoneme to untrained word positions. Independent word position training on the untrained final and medial positions was then given with the following results after termination of medial position training: (a) a loss of correct responding for two of the four subjects in the initial and final word positions and (b) enhanced, but inconsistent, responding to untrained items in all three positions for three of the four experimental subjects. These results indicated relatively unstable phoneme response levels which, in turn, indicated a need for further training. After training was terminated on two randomized word-position treatments, where differential responding was reinforced, all four subjects were able to produce the trained phoneme in all three word positions to trained and untrained words c high response levels. These levels were generally maintained over the 24 hour and one week periods when retention tests were given. It can be seen, then, that a systematized presentation of shifting stimuli in a program of specific word position training which includes treatments requiring differential word position responding, such as that presented in this study, is effective in the attainment of across-position phoneme learning and new-item (trained-untrained) generalization.