

THE IMPROVEMENT OF FUNCTIONAL ARTICULATION ERRORS  
UNDER PRINCIPLES OF OPERANT CONDITIONING  
IN A PUBLIC SCHOOL SETTING

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A THESIS

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our supervision by Mary C. Scott

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## CHAPTER I

### INTRODUCTION

Many authorities in the field of speech therapy agree that one of the most frequent problems encountered by speech therapists is that of defective articulation. Research indicates that articulation cases comprise over one-half of the case-load of the public school speech therapist.<sup>1,2,3,4</sup> The majority of articulation defects are considered to be functional; that is, defects which have no known organic basis or cause. These functional defects are usually assumed to be caused by faulty learning, poor habits, or emotional maladjustments.

Van Riper believes that the most important maintaining cause of articulation errors is habit strength. The person who has an articulation defect has over-learned a

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<sup>1</sup>Virgil A. Anderson, Improving the Child's Speech (New York: Oxford University Press, 1954), p. 126.

<sup>2</sup>Mildred Berry and Jon Eisenson, Speech Disorders (New York: Appleton-Century-Crofts, Inc., 1956), p. 3.

<sup>3</sup>Jerry Griffith, "The Modification of Functional Articulation Errors Under Principles of Instrumental Conditioning" (unpublished Ph.D. dissertation, University of Illinois, 1961), p. 1.

<sup>4</sup>Charles Van Riper, Speech Correction (New York: Prentice-Hall, 4th ed., 1963), p. 35.

speech pattern through constant use of that speech pattern.

These error patterns operate automatically:

Used in controlling others, in exchanging messages, in thinking, in the display of self, in the expression of emotion, they have received a tremendous amount of reinforcement along the way. Such learned responses persist of their own inertia, their own momentum. They resist extinction and change.<sup>1</sup>

The speech therapist in the public school setting must be as concerned with the habit strength of functional articulation disorders as she is with the etiology of the functional articulation disorder. The original cause of the misarticulation may no longer be present, or may be impossible to remove. The therapist must employ techniques which provide new habits or speech patterns to take the place of the faulty ones which have been over-learned.

Some behavioral psychologists use the technique of operant conditioning to bring about a change in the learned habitual behavior of individuals. Speech is one form of human behavior which can be modified or changed. This study is an experimental application of some of the findings of psychologists to functional defects of articulation. This is an investigation of the use of operant conditioning in the correction of functional articulation disorders in a public school setting. The hypothesis to be investigated is:

That there is no significant difference in the improvement of functional errors of articulation between a group of public school children receiving

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<sup>1</sup>Ibid., p. 218.

operant conditioning and a group of public school children receiving "traditional" speech therapy.

In order for all readers to understand the terms which are being used, the following definitions are offered:

Functional articulation errors. Articulation errors have been traditionally defined as the substitution, omission, or distortion of speech sounds. Functional articulation defects are those articulation defects which have no known organic basis or cause, but represent learned stereotyped behavior patterns. Powers has suggested the following as a definition of a functional disorder:

. . . a functional articulation disorder can be defined as an inability to produce correctly all of the standard speech sounds of the language, an inability for which there is no appreciable structural, physiological or neurological basis in the speech mechanism or its supporting structures, but which can be accounted for by normal variations in the organism by environmental or psychological factors.<sup>1</sup>

Operant conditioning. Operant conditioning is a technique for providing a tangible primary reinforcement for a specific response from a subject. Operant conditioning is also referred to as instrumental conditioning. The reward which is presented in operant conditioning is contingent upon the occurrence of the specific response.

Traditional speech therapy. The therapists who participated in this research considered that Van Riper's

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<sup>1</sup>Margaret H. Powers, "Functional Disorders of Articulation-Symptomatology and Etiology," Handbook of Speech Pathology, ed. L. E. Travis (New York: Appleton-Century-Crofts, Inc., 1957), p. 708.

description of the treatment of articulation disorders best described the training they were providing. They trained the child in:

- (1) minimizing those causal factors which still maintain the disorder . . .
- (2) identifying the error and the standard pattern of the sound;
- (3) scanning and comparing his own utterance with this standard;
- (4) varying his utterance until correct sound production is achieved; and
- (5) stabilizing and habituating the new correct ways of speaking so that they can be used automatically.<sup>1</sup>

Many studies describing the use of operant conditioning, or instrumental conditioning, have been reported in the literature. Most of these studies were done in clinical settings. The purpose of this research was to determine whether functional errors of articulation are subject to the principles of habit acquisition and extinction through the use of operant conditioning in a public school therapy program. The basic hypothesis to support the use of operant conditioning is that functional articulation errors are based on habit.

Van Riper states that the most important maintaining cause of articulation disorders is habit strength and that the poor habits of articulation resist extinction and change.<sup>2</sup> Griffith supports Van Riper's habit theory of the cause of articulation disorders. Research done by Griffith established

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<sup>1</sup>Van Riper, op. cit., p. 242.

<sup>2</sup>Ibid., p. 218.



an operational definition of a functional articulation disorder which strengthens Van Riper's theory: "A functional articulation error is a learned habit, the modification of which is subject to the principles of habit acquisition and extinction."<sup>1</sup>

A change in habits of misarticulation is expected to be accomplished by learning new habits of articulation. According to Mann, a change in habits or behavior is expected to be accomplished by learning new behavior patterns or habits by associating them with a systematically applied reward. Mann believes that if a subject is rewarded for performing a certain act, he will tend to repeat it.<sup>2</sup>

A systematically applied reward for the correct production of a speech sound will increase the probability of the sound being produced correctly in the future. This, in turn, should increase the carry-over or transfer from sounds produced correctly in therapy sessions into conversational speech. Operant conditioning is therefore expected to modify faulty habits of articulation, facilitate the extinction of these faulty habits and increase the repetition of the desired patterns of speech responses.

If the above expectations can be realized, the advantages of the use of operant conditioning in the public

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<sup>1</sup>Griffith, op. cit., p. 68.

<sup>2</sup>John Mann, Changing Human Behavior (New York: Scribner's and Sons, 1965), pp. 56-66.

school therapy program are numerous. The practicality of the use of operant conditioning in a public school setting was of primary concern in the plan and design of this experiment. All of the materials, equipment and facilities used in this study were those which would readily be available to the typical public school therapist.

## CHAPTER II

### RELATED RESEARCH

Research which is related to this study will be divided into three main headings: (1) learning theory, (2) articulation theory and (3) articulation therapy. The study and analysis of human behavior has suggested new approaches to speech therapy. Behavioral research has revealed many factors which contribute to the cause of articulation disorders and offers new techniques for the treatment of misarticulation.

The progression of the use of operant conditioning from the laboratory to the clinic and from the animal to the human has taken many years. There exists a large body of literature concerning this evolutionary process. Some of the work which has been accomplished may be considered necessary for background information. The works of Skinner<sup>1</sup> and Mowrer<sup>2</sup> are sources of basic information on learning theory

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<sup>1</sup>B. F. Skinner, Verbal Behavior (New York: Appleton-Century-Crofts, Inc., 1957).

<sup>2</sup>O. H. Mowrer, Learning Theory and Behavior (New York: Wiley and Sons, 1960).

and conditioning. The work of Michael and Meyerson<sup>1</sup> provides a general review of the behavioral approach. General information about articulation theory and therapy may be found in the writings of Van Riper,<sup>2</sup> Berry and Eisenson,<sup>3</sup> Griffith<sup>4</sup> and Travis.<sup>5</sup>

### Learning Theory

Holland advises the speech therapist to become aware of some elementary behavioral techniques and analysis:

Since speech is behavior just as is walking or pressing a lever, methods used to change the frequency or form of other behaviors can also be used to modify speech. From psychological laboratory data a number of behavioral principles have emerged with explicit relevance to modifying behavior; these principles have been applied to a wide range of nonlaboratory behaviors.<sup>6</sup>

The behavior which we call speech is learned, and researchers in the field of learning theory are concerned with the conditions necessary for learning to take place. Munn describes their concern:

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<sup>1</sup>Jack Michael and Lee Meyerson, "A Behavioral Approach to Counseling and Guidance," Harvard Educational Review, Vol. XXXII, No. 4 (Fall, 1962), pp. 382-402.

<sup>2</sup>Van Riper, op. cit.

<sup>3</sup>Berry and Eisenson, op. cit.

<sup>4</sup>Griffith, op. cit.

<sup>5</sup>Travis, op. cit.

<sup>6</sup>Audrey L. Holland, "Some Applications of Behavioral Principles to Clinical Speech Problems," Journal of Speech and Hearing Disorders, Vol. XXXII, No. 1 (February, 1967), p. 11.

Theories of learning are especially concerned with such questions as whether there is a single learning process, or more than one, and with the principles essential for learning. Those who believe that there is basically one learning process take their lead from Pavlov's idea that all learning is the conditioning of responses. Others have posited as many as six different learning processes, including response learning and acquiring information.<sup>1</sup>

There is not agreement that there is a single learning process at this time. There is, however, according to Munn, a set of principles which have great significance for learning:

One of these is the principle of contiguity (close temporal and spatial occurrence of the events to be associated). Another is motivation. Although there are some apparent exceptions, it is doubtful whether any learning occurs without motivation . . . This opens the way for another important principle--that of reinforcement.<sup>2</sup>

Munn also believes that learning requires repetition, except in rare instances. He states that "contiguity, by itself, is of doubtful significance. The same is true of repetition."<sup>3</sup> The above principles outlined by Munn have been incorporated into the basic design of this project.

The principle of reinforcement is not held by many learning theorists to be the most important factor in human learning. According to Spence, there is a controversy between those who believe reinforcement to be of the most

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<sup>1</sup>Norman L. Munn, Psychology (Boston: Houghton Mifflin Co., 3rd ed., 1956), pp. 256-57.

<sup>2</sup>Ibid., p. 257.

<sup>3</sup>Ibid.

importance and those who believe that learning does not require reinforcement. Spence describes the reinforcement point of view as being held by those who believe that learning requires some kind of motivating state, primary or secondary, and the occurrence of a reinforcing situation.

The non-reinforcement point of view is held by those who believe that learning does not require reinforcement. Spence outlines a compromise point of view which many individuals including Skinner and Mowrer support. They believe that there are two basically different learning processes. To one process reinforcement is necessary, to the other process reinforcement is unnecessary, learning being assumed to be governed by the law of association by contiguity.<sup>1</sup>

Dyal also describes the two major theoretical positions which are taken on the fundamental question of "What is it that is learned when learning takes place?"

In general, there are two major theoretical positions: the stimulus-response theories (as represented by Clark Hull) hold that what is learned is an association between a stimulus and the response which the subject makes; the cognitive theories represented by Edwin C. Tolman) hold that the making of an overt response is not necessary for learning, but rather the organism is said to learn the relationship between two sets of stimuli, that is, "what leads to what."<sup>2</sup>

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<sup>1</sup>Kenneth W. Spence, "Theoretical Interpretations of Learning," Handbook of Experimental Psychology, ed. S. S. Stevens (New York: Wiley and Sons, Inc., 1963), p. 694.

<sup>2</sup>James A. Dyal, "The Learning Process," Readings in Psychology: Understanding Human Behavior, ed. J. A. Dyal (New York: McGraw-Hill, Inc., 1962), p. 196.

This research involved the use of the four principles of learning mentioned previously: (1) contiguity, (2) motivation, (3) reinforcement and (5) repetition. The principle of contiguity was applied to the modification of incorrect speech responses by having the stimulus word and the speech response presented in approximately the same place as well as at the same time. The desirable responses were reinforced and stimulated under conditions which brought the stimuli for the response contiguous with it close together.

The principle of motivation was closely associated with the principle of reinforcement. The principle of repetition has been utilized by having the subject repeat several times the desired speech response.

The principle of motivation for learning is of the utmost importance. One of the values of operant conditioning for the school therapist is that it provides motivation for the subjects enrolled in therapy. Stronger motivation should make the learning process more rapid and effective.

The use of motivation through specific reinforcement is explained by Mowrer:

"Habits" may thus be either facilitated or inhibited, with or without actual doing on the part of the subject . . . the important thing is simply to get stimuli which ordinarily accompany a given response to be experienced and then followed by the appropriate type of "effect" (reward or punishment) . . . Since a word response can be made by one person and its (major) sensory consequences experienced by another, the resulting stimulation can be conditioned to hope and the basis thus laid for the other person to start

making the word sound himself, without having previously done much of anything but "listen."<sup>1</sup>

Although there is controversy about this theory of motivation as opposed to the drive theory, Michael and Meyerson state the position which was taken for the purpose of this investigation:

. . . motivation can be considered not as an innate function of specific drives but as a function of environmental determiners of which one of the most important is reinforcement. Under appropriate environmental conditions, which man can create, almost anyone can be motivated to do anything.<sup>2</sup>

Raph, on the other hand, presents arguments which represent the point of view of those who support the drive theory of motivation as opposed to the theory of reinforcement. She suggests that the speech therapist should view speech in relation to the person's total drive to achieve satisfaction and security and should not disregard the presence of the many determinants of behavior which influence the speech process. She feels that the child may fail to change his speech because of a basic motivational pattern. This pattern may serve him as a means of coping with such things as parental restrictions. The child may resist change because this is a way of "grasping at a thin thread of interest or support from the therapist which might be denied him if his speech became adequate." Another child

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<sup>1</sup>O. H. Mowrer, "Hearing and Speaking: An Analysis of Language Learning," Journal of Speech and Hearing Disorders, Vol. XXIII (1958), p. 151.

<sup>2</sup>Michael and Meyerson, op. cit., p. 401.



may be determined to improve his speech because of a need for approval, to increase his sense of his own worth, because of a drive for mastery or a pattern of affiliation with an authority figure as a means of maintaining security.<sup>1</sup>

Maslow summarizes the drive theory of motivation by listing the physiological needs as of primary importance to the human organism. If the physiological needs of the individual are met then a new set of needs emerge. These are: (1) "the safety needs," (2) "the love needs," (3) "the esteem needs" and (4) the "need for self actualization."<sup>2</sup>

The need for safety might be the desire for a savings account or a pension plan for some individuals. The need for love includes the need for affection and belongingness. The need for esteem includes both the esteem of others and self-esteem. Even if the physiological needs, the "safety needs," the "love needs" and the "esteem needs" are met, the individual still must realize "self-actualization" if he is to be happy. The thwarting of the freedom to satisfy these basic needs will be reacted to with a threat or emergency response.<sup>3</sup>

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<sup>1</sup>Jane Beasley Raph, "Determinants of Motivation in Speech Therapy," Journal of Speech and Hearing Disorders, Vol. XXV, No. 1 (February, 1960), p. 16.

<sup>2</sup>A. H. Maslow, "A Theory of Human Motivation," Readings in Psychology, ed. J. A. Dyal (New York: McGraw-Hill, 1962), pp. 94-99.

<sup>3</sup>Ibid.

Other writers have suggested that drives may be stronger than reinforcement. Lawson describes some experiments conducted with animals which seem to demonstrate that the drive of hunger will be stronger than reinforcement. However, he draws an important conclusion for those who are proponents of operant conditioning by stating: "Organisms can learn specific habits involving not the presentation of external S's, 'but the arousal of needs.' But it takes a long time."<sup>1</sup> It is our hope to shorten the time needed for our subjects to learn a new habit. It should also be noted that any type of speech therapy should satisfy some psychological needs and contribute to drive reduction by satisfying some of those needs.

Other concepts associated with learning theory which are of importance to this study are: stimulus generalization, response generalization, extinction, and knowledge of results.

Mednick presents a most graphic instance of stimulus generalization and response generalization in his report of work done by Watson and Rayner. A nine-month-old infant was conditioned to fear the sight of a white rat. The fear response generalized to include the sight of a white ball of cotton, a white rabbit or a white mask.<sup>2</sup>

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<sup>1</sup>Reed Lawson, Learning and Behavior (New York: The Macmillan Co., 1960), pp. 331-37.

<sup>2</sup>Sarnoff A. Mednick, Learning (New York: Prentice-Hall, Inc., 1964), p. 32.

Mowrer has discussed stimulus generalization and response generalization. He states that living organisms react to many similar situations as if they were the original situation with which an experience has been associated. If an organism has been rewarded for making a particular response, it will tend to reproduce not only this response but similar ones.<sup>1</sup>

Extinction as defined by Holland means the withholding of reinforcement:

Simply withholding reinforcement, however, is extremely inefficient in eliminating behavior, especially if we are dealing with behavior maintained by intermittent reinforcement . . . It seems reasonable therefore, to look for methods other than extinction for eliminating responses.

A much better method for eliminating an undesired response clinically is to reinforce an incompatible, desired response.<sup>2</sup>

Mowrer points out that stimulus generalization, response generalization and extinction are adaptive behaviors of the organism:

. . . an organism makes some distinctive response and experiences a particular pattern of "feedback" and is then either rewarded or punished, and if, in later moving toward this situation the organism "anticipates" being in the situation . . . then this response and its correlated stimuli will call out either hope or fear, and the organism's

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<sup>1</sup>Mowrer, Learning Theory and Behavior, pp. 439-89.

<sup>2</sup>Holland, op. cit., p. 15.

progress toward the situation in question will be adaptively speeded or slowed (stopped), as the case may be.<sup>1</sup>

Knowledge of results has been found to be of great importance in learning. Mednick states that there are many variables that will affect the speed of skill learning. When it is specific and immediate, one of the most effective of these is knowledge of results.<sup>2</sup>

Skinner discusses the contingencies of reinforcement in the classroom, and makes the following pertinent observation:

Eventually, of course, the pupil may be able to check his own answers and achieve some sort of automatic reinforcement, but in the early stages the reinforcement of being right is usually accorded by the teacher. The contingencies she provides are far from optimal. It can easily be demonstrated that, unless explicit mediating behavior has been set up, the lapse of only a few seconds between response and reinforcement destroys most of the effect.<sup>3</sup>

A discussion of learning theory and the behavioral technique of operant conditioning should include a discussion of operant versus classical conditioning. Operant conditioning differs from classical conditioning, but may not be completely separated from classical conditioning. Mednick contrasts the two and draws the following distinctions:

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<sup>1</sup>O. Hobart Mowrer, Learning Theory and the Symbolic Processes (New York: Wiley and Sons, Inc., 1960), p. 65.

<sup>2</sup>Mednick, op. cit., p. 67.

<sup>3</sup>B. F. Skinner, "The Science of Learning and the Art of Teaching," Readings in Psychology, ed. J. A. Dyal (New York: McGraw-Hill, 1962), p. 222.

In general terms the major difference seems to be that operant conditioning relates to learning that requires voluntary responses whereas classical conditioning involves involuntary responses. More specifically, classical conditioning seems more appropriate for learning that involves emotional conditioning such as fear or anxiety (in which the autonomic nervous system is involved) while operant conditioning is more applicable to responses of the skeletal musculature or higher mental processes (in which the central nervous system is involved).<sup>1</sup>

At present the terms instrumental and operant conditioning are being used as synonymous terms. Hilgard and Marquis have described instrumental conditioning as follows:

The essential aspect of instrumental training is that the reward depends on what the organism does and follows the response in some systematic fashion . . . The appropriate response in instrumental learning may be encouraged in many artificial ways, depending upon the ingenuity of the experimenter or animal trainer.<sup>2</sup>

In operant conditioning, the reinforcement is contingent upon the occurrence of the response. In classical conditioning the reinforcement, positive or negative, is initially presented without regard to the responsive behavior of the organism.

Rice has described a stimulation cycle which has been used in operant conditioning. There are three essential steps: (1) stimulation by the experimenter, (2) imitation by the subject, and (3) reinforcement provided by the

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<sup>1</sup>Mednick, op. cit., p. 53.

<sup>2</sup>Ernest R. Hilgard and Donald G. Marquis, Conditioning and Learning (New York: Appleton-Century-Crofts, Inc., 1940), pp. 54 and 67.

experimenter.<sup>1</sup>

This research has been planned to test the concepts of stimulus generalization and response generalization in speech responses by measuring the transfer of the desired response into words which contained the subject's incorrect response. The testing of extinction of the incorrect responses was done in each session after the initial one. The subjects were able to have immediate knowledge of results. They were rewarded immediately for correct responses and received no reward for incorrect responses. The stimulation cycle was used in the manner suggested above by Rice.

The work of Horowitz was used as a basis for the type of reinforcer which was used. Horowitz found that a combination of candy-vocal reinforcers tended to be the most effective in a task which included the naming of familiar pictures by mentally retarded children.<sup>2</sup>

Salzinger and her associates found that speech rate increased in young children as a result of reinforcement and decreased or stabilized when reinforcement was withheld.

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<sup>1</sup>Donald B. Rice and Robert Milisen, "The Influence of Increased Stimulation upon the Production of Unfamiliar Sounds as a Function of Time," Journal of Speech and Hearing Disorders, Mono. 4 (1954), pp. 79-86.

<sup>2</sup>Frances Degen Horowitz, "Partial and Continuous Reinforcement of Vocal Responses Using Candy, Vocal, and Smiling Reinforcers Among Retardates," Journal of Speech and Hearing Disorders, Monograph (1959-63), p. 55.

They also found that reinforcements were not effective unless more than ten were given.<sup>1</sup>

Myers and Myers tested the effects of schedules of reinforcement on extinction behavior and discovered that the groups which received a 50% primary reinforcement made more responses than the group which received a 100% primary reinforcement. They concluded that after the period of active learning, the schedule of 50% reinforcement was the most effective in maintaining the specific behavior desired.<sup>2</sup>

The use of candy as a primary reinforcer was an essential part of the research described in this paper. The research done by others seemed to indicate that candy would serve as a primary reinforcement and provide the most motivation for a prompt modification of speech responses.

In accordance with the findings of Salzinger and her associates,<sup>3</sup> the procedure was planned so that more than ten reinforcements were given during the experimental period. The schedules tested by Myers and Myers<sup>4</sup> were followed. During the period of active learning, or acquisition of new

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<sup>1</sup>Suzanne Salzinger, et al., "Operant Conditioning of Continuous Speech in Young Children," Child Development, Vol. XXXIII (1962), p. 1067.

<sup>2</sup>Jerome Myers and Nancy A. Myers, "Effects of Schedules of Primary and Secondary Reinforcement on Extinction Behavior," Child Development, Vol. XXXIV (1963), p. 1062.

<sup>3</sup>Salzinger, op. cit.

<sup>4</sup>Myers and Myers, op. cit.

speech responses, correct responses were reinforced on a 100% schedule. During the time of strengthening, or less active learning, a 50% schedule of reinforcement was followed.

#### Articulation Theory

A functional defect of articulation is a learned habitual response. As Van Riper and Irwin state: "We must never forget that both correct and incorrect pronunciations are products of learning. A lisp is not a broken down s; it is a highly integrated habitual response."<sup>1</sup>

Van Riper, as previously mentioned, believes that the misarticulations are not only learned, but over-learned. He states that "Both a lateral lisp and the substitution of the /f/ for the /th/ sound are learned reactions."<sup>2</sup>

Milisen asserts that defective articulation is a substitute response for normal articulation. It is, in his opinion, the result of the "disruption of the normal learning process."<sup>3</sup>

Berry suggests that misarticulations be termed either "stereotyped behavior patterns or stereotyped learned responses." She believes that some misarticulations are a

<sup>1</sup>Charles Van Riper and John V. Irwin, Voice and Articulation (New York: Prentice-Hall, Inc., 1958), pp.41-42.

<sup>2</sup>Van Riper, op. cit., p. 218.

<sup>3</sup>Robert Milisen, "A Rationale for Articulation Disorders," Journal of Speech and Hearing Disorders, Monograph 4 (1954), p. 6.



result of "a child's very poor articulatory competence at two years,--before 'habit' has had a chance." She agrees that misarticulations are learned responses but would not choose the word "habit" to describe them.<sup>1</sup>

Griffith reviews the many theories and therapies concerning articulation and notes that there is no widely used operational definition of a functional articulation defect. He feels that his research supports the Van Riper-Irwin hypothesis that a "functional articulation error is a learned habit."<sup>2</sup>

#### Articulation Therapy

There are many techniques and approaches being used in articulation therapy at this time. Griffith includes a review of these techniques and makes the following summary:

While all of the above mentioned techniques have been used with a certain amount of success, the very diversity of techniques suggests the lack of a common basic premise. Although descriptions of these techniques are liberally sprinkled with references to the use of sound learning principles, the exact nature of the behavior (speech) being learned has not been experimentally defined and examined within a learning framework.<sup>3</sup>

Holland also supports the use of behavioral techniques based on learning theory in the treatment of speech problems:

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<sup>1</sup>Mildred F. Berry, personal communication, June, 1967.

<sup>2</sup>Griffith, op. cit., p. 68.

<sup>3</sup>Ibid., p. 11.

. . . speech clinicians can place reliance on the science of behavior as a source of tools for modifying speech and language behavior . . .

Behaviorism holds as yet unexplored advantages for the practice of speech correction. In some instances, careful and systematic incorporation of the findings of the behavioral laboratory has a high probability of evolving new methods of clinical management. In others it can help us do our jobs more efficiently. In many others, it can help us to understand why what we are doing produces the results it does.<sup>1</sup>

Brookshire refers to operant conditioning as "the experimental analysis of behavior." He states that operant conditioning principles have been utilized in considering stuttering, disfluency and aphasia.

The application of these principles to modification of specific speech and language disorders has been demonstrated and can hardly be contested. Moreover, they are likely to prove even more valuable as a guide to the structure and conduct of clinical activities in general. Operant conditioning has certain characteristics which make it uniquely suitable to serve as such a guide.<sup>2</sup>

Brookshire believes that experimental analysis or operant conditioning is more likely to involve "detailed observation of the performance of individual subjects than study of average performance by groups of subjects."<sup>3</sup>

Similarly, experiments within this framework make little use of statistical methods, and do not generally need them . . .

<sup>1</sup>Holland, op. cit., pp. 11, 16.

<sup>2</sup>Robert H. Brookshire, "Speech Pathology and the Experimental Analysis of Behavior," Journal of Speech and Hearing Disorders, Vol. XXXII, No. 3 (August, 1967), p. 215.

<sup>3</sup>Ibid., p. 215.

If any approach to behavior has a hallmark, then the hallmark of this experimental approach is the use of baseline, or baserate. The experimental analyst does not customarily measure the effects of experimental treatments by comparing a treated subject with a control or untreated subject. Instead he measures the rate at which the subject emits the response of interest before any treatment is begun. This response rate serves as a baseline against which the effects of the experimental treatments can be measured.

The basic datum of the experimental analyst is a response. These responses are observable and can be counted.<sup>1</sup>

Milisen states that articulation therapy should be directed positively toward the production of correct responses rather than negatively toward the unlearning of the incorrect responses.<sup>2</sup>

Griffith reported that his experimental evaluation of the characteristics of the speech responses of school age children exhibiting functional articulation errors resulted in the following conclusions:

1. The speech responses of the subjects were modified to the extent that error responses were corrected. Therefore, it appeared that functional articulation errors could be manipulated as habit by utilizing the principles of instrumental conditioning in which meaningful words served as instrumental stimuli.
2. The results of this study suggest an operational definition of a functional articulation error which can be stated as follows: A functional articulation error is a learned habit, the

<sup>1</sup>Ibid., pp. 215-16.

<sup>2</sup>Robert Milisen, "The Disorder of Articulation: A Systematic Clinical and Experimental Approach," Journal of Speech and Hearing Disorders, Monograph 4 (1954), p. 617.

modification or "correction" of which is subject to the principles of habit acquisition and extinction. Such a definition is consistent with and in support of the Van Riper-Irwin hypothesis stated earlier . . .<sup>1</sup>

Griffith's thesis has been used as a model for this investigation. This is an extension of the operational definition which he established. There are several differences in the two, however. Griffith used three forty-five minute sessions once each week for three weeks. The third session was considered a re-test. Only three words were selected for each subject which contained the sound he misarticulated. The subjects were conditioned in the same place each time, with the exception of five children. The participants in Griffith's investigation had no prior experience in speech therapy.

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<sup>1</sup>Griffith, op. cit., pp. 67-69.

## CHAPTER III

### RESEARCH DESIGN

The basic problem of the study was an experimental evaluation of the characteristics of the speech responses of school age children exhibiting functional articulation errors within the context of an experimental learning procedure.

The specific hypothesis was:

That there is no significant difference in the improvement of functional errors of articulation between a group of public school children receiving operant conditioning and a group of public school children receiving "traditional" speech therapy.

#### Selection of Subjects

Subjects. The subjects consisted of forty public school children who were enrolled in speech therapy in six schools in the Hurst-Euless-Bedford school district. The children were selected to meet the following criteria:

1. Age--from 7 years to 11 years.
2. English-speaking, Caucasian, with no other language spoken in the home.
3. Having no history of organic defects (other than tongue thrust) or of observable organic pathology that might account for the present errors in articulation.

4. Having one or more of the following defective speech sounds: /s/, /r/, or /th/.
5. Having normal hearing in the speech range as demonstrated by a recent audiometric sweep test.
6. Having average learning ability or above as indicated by scores in the normal range on the Metropolitan Readiness Test, the California Test of Mental Maturity and the California Achievement Test. For the subjects in the second grade, a score of average or above on the Metropolitan Readiness Test and a score consistent with grade level placement on the California Achievement Test was required for selection for either the experimental or control group. For subjects in the third grade and above, the California Test of Mental Maturity and the California Achievement Test scores were in the normal range or above. No subject was selected who had failed a grade.

The subjects selected for both the experimental and the control group were taken from the regular case-loads of three public school therapists. The therapists were asked to supply the names of subjects who might meet the criteria. The records of the therapists and the school's cumulative record for each subject were then carefully studied before the subjects were selected for screening of speech errors.

To satisfy the requirement that each subject have average or above learning ability, the tests given in the public schools were studied. The Metropolitan Readiness Test is given prior to entrance in the first grade. The California Test of Mental Maturity is given in the third and fifth grades. The California Achievement Test is given in the fall to all students in elementary school.

Table 1 contains the data on the experimental group. It includes age, grade level, and test scores for each subject. The subjects in the experimental group consisted of eleven girls and nine boys. There were eight second graders, eight third graders and four fourth graders. The ages of these subjects ranged from seven years, one month, to nine years, eleven months. The mean age for the experimental group was eight years, two months. The age range within the experimental group was two years, ten months.

There were no I.Q. scores available for the second grade subjects. Second grade subjects were selected who had made a score of "normal" or above on the Metropolitan Readiness Test, who had received a score consistent with grade level placement on the California Achievement Test, and whose teachers considered them to have average or above learning ability.

TABLE 1  
 AGE, GRADE LEVEL, ACHIEVEMENT, I.Q., AND READINESS  
 RANGE FOR THE EXPERIMENTAL GROUP

Subject Number	Age (9-1-66)	Grade	Tests Given	Score
1b*	7.2	2	Metropolitan Readiness California Achievement	Normal 2.1
2	8.7	3	California Mental Maturity California Achievement	116 3.4
3	8.9	3	California Mental Maturity California Achievement	117 4.0
4b	8.11	3	California Mental Maturity California Achievement	112 4.2
5b	7.4	2	Metropolitan Readiness California Achievement	Normal 2.1
6	8.2	3	California Mental Maturity California Achievement	103 3.4
7	8.6	3	California Mental Maturity California Achievement	112 3.4
8	7.11	2	Metropolitan Readiness California Achievement	Normal 2.0
9b	7.6	2	Metropolitan Readiness California Achievement	Normal 2.1
10	7.1	2	Metropolitan Readiness California Achievement	Normal 2.0
11	7.2	2	Metropolitan Readiness California Achievement	Normal 3.1
12b	7.5	3	California Mental Maturity California Achievement	110 3.3
13b	7.7	2	Metropolitan Readiness California Achievement	Normal 2.4
14b	9.6	4	California Mental Maturity California Achievement	120 4.3
15b	7.11	2	Metropolitan Readiness California Achievement	Hi.Norm 2.4
16b	9.11	4	California Mental Maturity California Achievement	113 5.9
17	9.10	4	California Mental Maturity California Achievement	129 6.1
18b	8.11	3	California Mental Maturity California Achievement	119 3.0
19b	8.10	3	California Mental Maturity California Achievement	129 4.5
20	8.11	4	California Mental Maturity California Achievement	110 4.1

\*indicates sub-group within the experimental group.



The I.Q. scores of the subjects in the third and fourth grade ranged from 103 to 129, with a mean I.Q. for the group being 116. The achievement scores for the entire experimental group ranged from one month below grade level to two years and one month above grade level. The mean grade level for the experimental group was six months above grade level placement.

Table 2 contains similar data on the control group. There were ten boys and ten girls in the control group. There were eight second grade subjects, eight third grade subjects, two fourth grade subjects and two fifth grade subjects. The age range for the control group was also from seven years, one month to nine years, eleven months. The mean age for the control group was eight years, one month. There was an age range of two years, ten months within the control group.

The I.Q. scores for the control group ranged from 101 to 123, with a mean I.Q. for the group of 111. The achievement scores ranged from one month below grade level to two years, six months above grade level. The mean achievement for the entire control group was five months above grade level placement.

The subject numbers used to designate each subject in Tables 1 and 2 indicate the matching of the experimental subjects with the control group subjects. Subject 1 in the experimental group is matched with subject 1 in the control group throughout the discussion of procedure and results.

TABLE 2

AGE, GRADE LEVEL, ACHIEVEMENT, I.Q., AND READINESS  
RANGE FOR THE CONTROL GROUP

Subject Number	Age (9-1-66)	Grade	Tests Given	Score
1	8.1	2	Metropolitan Readiness California Achievement	Normal 2.1
2	9.1	3	California Mental Maturity California Achievement	101 3.8
3	9.11	5	California Mental Maturity California Achievement	115 5.1
4	9.10	4	California Mental Maturity California Achievement	117 6.6
5	8.8	3	California Mental Maturity California Achievement	103 3.0
6	8.3	3	California Mental Maturity California Achievement	104 3.5
7	7.6	2	Metropolitan Readiness California Achievement	Normal 2.1
8	7.5	2	Metropolitan Readiness California Achievement	Normal 2.2
9	7.11	2	Metropolitan Readiness California Achievement	Hi.Norm 2.2
10	9.10	5	California Mental Maturity California Achievement	119 5.6
11	7.10	2	Metropolitan Readiness California Achievement	Superior 2.0
12	7.9	2	Metropolitan Readiness California Achievement	Normal 2.9
13	7.11	3	California Mental Maturity California Achievement	109 4.3
14	7.8	2	Metropolitan Readiness California Achievement	Normal 2.0
15	7.1	2	Metropolitan Readiness California Achievement	Normal 2.0
16	8.6	3	California Mental Maturity California Achievement	109 3.7
17	9.7	4	California Mental Maturity California Achievement	101 5.0
18	8.6	3	California Mental Maturity California Achievement	123 3.7
19	8.4	3	California Mental Maturity California Achievement	121 3.2
20	8.9	3	California Mental Maturity California Achievement	115 3.4

A comparison of this information reveals some differences between the experimental and the control group which were not considered of major importance. The experimental group had one more girl than did the control group. The control group had two subjects who were in the fifth grade whereas the experimental group had none higher than grade four. The control group subjects who were in the second grade scored slightly higher on the readiness test than did the ones in the experimental group; however, there was little difference on the achievement scores made by the second grade subjects. The experimental group had a mean I.Q. on the mental maturity test which was five points higher than the control group. The experimental group also had a mean achievement score which was one month higher than that of the control group. The age range for the two groups was identical, as was the mean age of the two groups.

All of the subjects had an audiometric screening test given by the school nurse. None of the subjects selected had any indications of a hearing loss.

Testing of subjects. Each child selected for the experimental and the control group received a modified Templin-Darley<sup>1</sup> test of articulation to determine the extent of deviation in the articulation of the three test sounds: /s/, /r/, and /th/. Subjects who had a defective /r/ sound

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<sup>1</sup>Mildred C. Templin and Frederick L. Darley, The Templin-Darley Tests of Articulation (Iowa City, Iowa: The University of Iowa, 1960).

were tested on thirty-eight items from the Templin-Darley which contain words with the /r/ sound. Subjects with a defective /s/ sound were tested on twenty-one items and six items were tested for /th/. The modified test will be included in Appendix A.

The Templin-Darley items served as a baseline for the evaluation of the child's speech. The use of such a baseline concept is explained by Brookshire.<sup>1</sup> The effectiveness of articulation was the parameter of concern. The baseline or criterion for improvement in each case was established by the articulation test administered. A subject with an /s/ deviation was tested on twenty-one words containing the /s/ sound. The number twenty-one served as the baseline or criterion. The baseline for each sound was set up in the same manner.

Matching of subjects. Each child in the experimental group was matched with a child from the control group. The matching was done primarily on the basis of the number of errors made on the first test of articulation. As suggested by Jordan<sup>2</sup> and endorsed by Templin,<sup>3</sup> the defectiveness of a child's speech may be effectively judged by the number of defective single sounds.

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<sup>1</sup>Brookshire, op. cit., pp. 222-23.

<sup>2</sup>E. P. Jordan, "Articulation Test Measures and Listener Ratings of Articulation Defectiveness," Journal of Speech and Hearing Disorders, III (1960), pp. 303-19.

<sup>3</sup>Templin, op. cit., p. 8.

Table 3, on the following page, illustrates the manner in which the subjects were matched on the basis of errors made on the first test of articulation. In some instances there will be noted discrepancies of more than five errors between matched subjects. In these instances, the variable of age or sex was considered to be important enough to influence the probable score on the test. In very few cases was it possible to match the scores exactly. As may be observed in Table 3, the experimental group made more errors on the first test than did the control group.

#### Experimental Procedure

Control group. The children in the control group received traditional speech therapy as outlined and practiced in the school system and under the direction of the speech therapists who were not involved with the experimental group. Traditional speech therapy has been defined as following the concepts of Van Riper.<sup>1</sup> It may also be defined as following the concepts of Berry and Eisenson:

1. Development of an awareness of environment and of himself in relation to his environment.
2. Increasing acoustic perception through training in auditory stimulation and discrimination.
3. Increasing perception of articulatory positions by strengthening visual-kinesthetic cues.
4. Developing articulatory flexibility.
5. Setting the new pattern in isolation, in structured speech in the clinical situation and in free conversational speech.<sup>2</sup>

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<sup>1</sup>Van Riper, op. cit., p. 242.

<sup>2</sup>Berry and Eisenson, op. cit., p. 134.

TABLE 3

## SUBJECTS MATCHED BY ERROR SOUNDS AND NUMBER OF ERRORS ON FIRST TEST

Experimental Group				Control Group			
Subject Number	Error Sound	Base-line	Number of Errors	Subject Number	Error Sound	Base-line	Number of Errors
1(b)*	/r/	38	36	1	/r/	38	25
2	/r/	38	34	2	/r/	38	26
3	/r/	38	30	3	/r/	38	24
4(b)	/r/	38	26	4	/r/	38	26
5(b)	/r/	38	25	5	/r/	38	26
6	/s/	21	21	6	/s/	21	20
7	/s/	21	21	7	/s/	21	20
8	/s/	21	17	8	/s/	21	19
9(b)	/r/	38	16	9	/r/	38	17
10	/s/	21	13	10	/s/	21	13
11	/s/	21	13	11	/s/	21	15
12(b)	/r/	38	12	12	/r/	38	13
13(b)	/s/	21	10	13	/s/	21	9
14(b)	/s/	21	10	14	/s/	21	13
15(b)	/r/	38	8	15	/r/	38	6
16	/s/	21	8	16	/s/	21	7
17	/s/	21	8	17	/s/	21	2
18(b)	/s/	21	5	18	/s/	21	5
19(b)	/s/	21	5	19	/s/	21	3
20	/th/	6	4	20	/th/	6	2

\*Subjects in experimental sub-group (b).

Note: Column entitled baseline indicates the number of items on the test, i.e., a perfect score for /s/ would be 21.

None of the therapists who were involved with the control group were using operant conditioning. None of them were using any plan of systematic reward for the correct production of a speech sound.

Experimental group. The experimental group consisted of eleven females and nine males. Eight subjects had a defective /r/ sound, eleven had a defective /s/ or /z/ sound and one had a defective /th/ sound. The subjects with a defective /r/ sound had defective consonant /r/ and semi-vowel /r/ sound. The /s/ group also had a defective /z/ sound and the subject with a defective /th/ sound had errors in both the voiced and voiceless /th/ sound.

The experimental group was subdivided. Sub-group (a) consisted of subjects who received conditioning alone with no other child present during the session. Sub-group (b) consisted of ten subjects who received conditioning with one other child present. In every session for sub-group (b), the subjects alternated in being first to receive conditioning, to allow for possible learning during the conditioning of the other subject.

Equipment. The equipment used was designed to be as simple as possible. A cardboard box was covered with yellow paper. Vari-colored polka-dots were glued to the paper. The instrument had a drawer with a knob for the child to pull after each trial to receive immediate knowledge of the results of that trial. The box was designed so that the

experimenter could place and keep her left hand inside the box to place the reinforcer in the drawer. "M&M" candies were used as the primary reinforcer.

Preliminary training. Before conditioning was begun a short period of training for each subject was undertaken. The child was given the following instructions:

We are going to play a new speech game. I will say a word. You will try to say it just as I do. After you have said the word you may open the drawer to the box. If you have said your sound right, there will be a piece of candy. If you did not say your sound right, there will be no candy. You may take as long as you like after I have said the word to try to say it. You may keep all the candy you get, but you must save it until after the game is over to eat it. We will start with some easy words first that do not have your sound to see if the box is working today. Do you have any questions? Listen carefully to the word I say and then say it after me.

The words "baby," "cat," and "dog," were used as the three trial words. Each child received a reward after correctly saying each of these words.

Selection of stimulus words. The words selected for stimulus words for the /r/ and /s/ sounds were selected from the lists in My Speech Workbook, Book 2,<sup>1</sup> and My Speech Workbook.<sup>2</sup> The words for these sounds "are based upon the primary reading vocabulary words recommended by Gates, Stone

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<sup>1</sup>Jayne Hall Parker, My Speech Workbook, Book 2 (Danville, Ill.: Interstate Publishers, Inc., 1964).

<sup>2</sup>Jayne Hall Parker, My Speech Workbook, Book 1 (Danville, Ill.: Interstate Publishers, Inc., 1964).



and Thorndike."<sup>1</sup> The words selected as stimulus words for /th/ were selected from lists in My Sound Book.<sup>2</sup> Sample lists will be included in Appendix B.

The stimulus words were selected to provide reinforcement for each subject for the correct production of words which contained sound combinations shown to be most defective for him. If the subject missed most of the words containing /r/ blends on the articulation test, then he was given the opportunity to repeat words containing the /r/ blends during conditioning sessions. The words used as stimuli differed between subjects, although many of the same words were used.

The stimulus words were selected to contain the defective sound in all positions in different words. Words which contained the defective sound in more than one position were avoided whenever possible.

A group of words which contained the defective sound in the initial position was used in the first session. These twenty words were selected to provide a test of the consonant sound preceding a vowel, with several different vowel sounds being used. The twenty words were the same for each subject who had the same defective sound.

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<sup>1</sup>Parker, My Speech Workbook, Book 2, p. vi.

<sup>2</sup>Ernest J. Burgi, Jack W. Birch and Jack Matthews, My Sound Book, Manual for Effective Use (Pittsburg, Pa.: Stanwix House, Inc., 1961), pp. 50, 52, 54.

Description of experimental sessions. There were ten sessions of conditioning for each subject. Each session lasted ten minutes and occurred once a week for sub-group (a) For the subjects in sub-group (b) the sessions lasted twenty minutes, but each child was actively being conditioned for only ten minutes. When the alternate subject was not being conditioned, he was asked to remain quiet. The alternate subject was not instructed to listen or to pay any special attention to the session in progress for the subject being conditioned.

The conditioning sessions had the following phases: (1) testing and acquisition of words where the error sound occurred in the initial, medial, and final position, (2) strengthening and correct production of the speech sound by using a schedule of fifty per cent reinforcement, and (3) final re-check of all the words acquired and strengthened. The word was said first by the experimenter, repeated by the subject and then reinforced by the experimenter if the sound was correct in the word.

A schedule of 100 per cent reinforcement was used during the acquisition phase for each subject. The subject was required to repeat the sound correctly five times in succession before the word was considered acquired. Each time he repeated the word with the sound made correctly he was rewarded during the acquisition phase.

A schedule of fifty per cent reinforcement was used during the period of strengthening. After the word was acquired as above, it was used as a stimulus in succeeding sessions. The subject did not receive a reward each time the word was said correctly during this phase. He received a reward only fifty per cent of the time he made the correct response. He received no reward if the response was incorrect. The words acquired were presented on a random schedule. The period of strengthening was included for further practice on the words and for a partial test of retention.

The first session was designed to test the accuracy of the production of the error sound in the initial position preceding various vowel sounds. Session two was a continuation of the acquisition phase. For most subjects session three included a period of strengthening using words which had been acquired in the first two sessions. Sessions four and five were very similar to the third session for most subjects, with both acquisition and strengthening of the stimuli words.

Session six was, for most subjects, an entire session of strengthening of words acquired in earlier sessions. Session seven included more new words for each child, with a period of re-test or strengthening.

Session eight consisted of the use of stimuli words which were carefully matched to the words each subject had

missed on the articulation test. For example, if the subject had missed the word "bird" on the test, the word "heard" was used as a stimulus in this session. Strengthening of acquired words was also used in this session. Session nine was a continuation of the eighth session. Session ten included some new words matched as in session eight. Most of session ten was used to test the words acquired in previous sessions and reinforced on a fifty per cent schedule. This served as both a retest of words learned and a test of retention from the earlier sessions. All of the words acquired were strengthened on a schedule of fifty per cent reinforcement at least three times.

Summary of experimental sessions. Careful records were kept of the words which were used as stimuli for each child. These words necessarily differed from subject to subject. A notation was made of the number of times each child produced the word correctly and incorrectly with 100 per cent or continuous reinforcement and the number of times he produced it correctly or incorrectly with fifty per cent reinforcement. A notation was made when a word was never produced with the sound made correctly. Such a word was recorded as not acquired.

The experimental sessions were not identical for each child, as each child progressed according to his own ability to produce the sound correctly. Some of the subjects did not acquire the words as rapidly as others and therefore did not

have as much strengthening as the other subjects. For the majority of subjects, the words which were acquired were re-tested or strengthened five times or more. The number of words acquired varied between subjects in direct proportion to the ability of the child to produce the error sound correctly under operant conditioning.

Data collected on the experimental group during conditioning included the number of words acquired, the number of times the word was strengthened, and the accuracy of the production of the error sound under conditions of strengthening with fifty per cent reinforcement. The number of sessions necessary for modification to occur was noted.

Retesting of all subjects. Both the control and the experimental group were re-tested at the end of the experimental period. They were given the same form of the articulation test as before the experimental period. The results of each test of articulation were compared.

## CHAPTER IV

### RESULTS

The results of the use of operant conditioning to modify the speech responses of public school children with functional articulation disorders are presented in this chapter. The statistical data obtained by comparing the performance of an experimental and a control group will be presented. There will also be a summary of the data obtained during conditioning sessions with the experimental group.

The criterion for evaluating the errors made by subjects in both the experimental and the control group was a modified Templin-Darley picture articulation test. The same form of the articulation test was administered to each subject in each group at the beginning of the experimental period. At the end of the ten-week experimental period, the test was given again. The subjects were matched by error sound and as closely as possible by the number of errors made on the pre-test of articulation. The pre-test and post-test scores were compared for each matched pair of subjects. Table 4 shows the results of this comparison.

Chapter III contained the information that the experimental group made more errors on the first test than

did the control group. Therefore, it may be stated that the experimental group was further below the baseline than the control group at the beginning of the conditioning experiment.

TABLE 4  
COMPARISON OF ERRORS MADE BY MATCHED PAIRS OF  
SUBJECTS BEFORE AND AFTER  
EXPERIMENTAL SESSIONS

Experimental Group			Control Group		
Subject Number	Errors on Pre-test	Errors on Post-test	Subject Number	Errors on Pre-test	Errors on Post-test
1b	36	18	1	25	19
2	34	4	2	26	14
3	30	0	3	24	16
4b	26	13	4	26	26
5b	25	15	5	26	18
6	21	0	6	20	3
7	21	1	7	20	19
8	17	0	8	19	8
9b	15	2	9	17	10
10	13	3	10	13	15
11	13	0	11	15	9
12b	12	4	12	13	9
13b	10	2	13	9	8
14b	10	2	14	13	0
15b	8	5	15	6	3
16	8	1	16	7	17
17	8	1	17	2	0
18b	5	1	18	5	3
19b	5	0	19	3	2
20	4	1	20	2	0

The experimental group made more improvement under operant conditioning than did the control group who received "traditional" speech therapy. The difference between the two groups was significant about the one per cent level of confidence. Appendix C contains the statistical analysis of the performance of the two groups.

The statistical analysis of the results of the comparison of the performance of the two groups resulted in findings which made it necessary to reject the hypothesis which stated:

That there is no significant difference in the improvement of functional errors of articulation between a group of public school children receiving operant conditioning and a group of public school children receiving "traditional" speech therapy.

Summary of the results of conditioning. Of further interest to this investigation was the performance of the experimental subjects during the ten sessions of conditioning. Table 5 is a summary of sessions for each of the twenty subjects. It includes the total number of words acquired by each subject and those not acquired. The number of responses which were correct under conditions of 100 per cent reinforcement and the number of responses which were incorrect under 100 per cent reinforcement have been totaled. This indicates the time spent on the acquisition of words by each subject. The number of responses which were correct and incorrect under conditions of fifty per cent reinforcement



TABLE 5  
SUMMARY OF EXPERIMENTAL SESSIONS

Subject Number	Words Acquired	Not Acquired	Responses Under				Mean No. Sessions Per Word	
			100% Reinforcement		50% Reinforcement		100%	50%
			Right	Wrong	Right	Wrong	Reinforcement	Reinforcement
1b	55		289	156	251	44	1.4	5.4
2	59		298	90	260	19	1.2	4.6
3	60		303	38	302	30	1.1	5.4
4b	47	1	268	205	289	50	1.7	7.0
5b	33	4	297	371	140	71	2.0	5.8
6	62		312	48	329	11	1.1	5.3
7	59		307	128	291	23	1.3	5.4
8	61		300	16	321	3	1.1	7.0
9b	57		280	16	375	5	1.0	6.7
10	41	3	239	299	240	34	2.5	6.3
11	57		295	9	273	0	1.0	4.3
12b	56		285	39	330	18	1.1	7.9
13b	64		324	22	307	2	1.1	4.9
14b	53		270	64	278	11	1.2	5.4
15b	59		255	22	309	5	1.0	5.3
16	55		275	62	187	17	1.2	5.3
17	50		258	43	266	10	1.0	5.5
18	59		297	26	371	4	1.1	5.9
19b	50		254	17	273	3	1.0	5.5
20	48		254	68	234	11	1.1	5.3

indicates the time spent on strengthening or re-testing of acquired words.

The mean number of sessions per word under conditions of 100 per cent reinforcement indicates how successful the subject was at acquiring words during the period of acquisition. The mean number of sessions per word under fifty per cent reinforcement indicates the number of times the acquired words were strengthened.

The number of words acquired by the subjects ranged from 33 to 64, with the mean number acquired by the group being 54.2. Only three subjects failed to acquire stimulus words presented during conditioning. Subject 4b failed to acquire one word, subject 10 failed to acquire three words and subject 5b failed to acquire four words. The word not acquired by subject 4b was not used as a stimulus until the sixth session of conditioning. One word not acquired by subject 10 was not presented until the fourth session, but the other two were words which were presented as stimuli during all ten sessions of conditioning. Subject 5b failed to acquire two words presented in the second session of conditioning and two words presented as stimuli during the fourth session of conditioning.

The number of correct responses under a 100 per cent schedule of reinforcement ranged from 239 to 324. These were responses which were correct during the acquisition phase. The range of incorrect responses during the acquisition phase

was from nine to 371. For each subject these numbers represent the number of times the subject was able to make correct responses during the acquisition phase of conditioning.

The number of correct responses during strengthening with a fifty per cent schedule of reinforcement was from 140 to 375. Incorrect responses ranged from zero to 71. Since these were the same words which had been acquired earlier, the number of correct responses made by the subject during this phase indicates the amount of modification which had taken place. Under operant conditioning, all subjects were able to modify their defective sounds in varying degrees.

The number of sessions necessary for acquisition ranged from 1.0 to 2.5. As might be expected, there were considerable individual differences in the ability to acquire words, and the amount of time necessary to acquire words. Since the number of sessions necessary for the acquisition of words determined the time which could be spent on the strengthening of those words, the number of times a word was strengthened was dependent on how early the words were acquired. The number of sessions spent on reinforcement ranged from 4.3 to 7.0.

Comparison of sub-groups. There were some differences in performance between group (a) which received conditioning alone, and group (b) which received conditioning with one other child present during the session. These are minor as far as overall results are concerned.

Group (a) acquired 2.1 more words than group (b). Group (a) had only one subject who failed to acquire three words, whereas group (b) had two subjects who failed to acquire a total of six words. Group (a) had 2.2 more correct responses during the acquisition phase and 13.7 less incorrect responses during this phase. Group (b) had 22.1 more correct responses during strengthening, but they also had 9.7 more incorrect responses during strengthening than did group (a). As far as the mean number of sessions necessary to acquire words was concerned, there was no difference. There was also very little difference between the groups in the number of sessions which were spent strengthening words already acquired.

CHAPTER IV  
DISCUSSION AND CONCLUSIONS

The use of operant conditioning in the treatment of functional defects of articulation in public school therapy is supported by the findings of this study. It satisfies the need for a technique which improves the motivation of the subject, stimulates interest in self-correction, and rewards the subject for a specific type of behavior.

Motivation. The experimental subjects appeared to be keenly interested in the new speech "game." Although "M&M's" were used as a primary reinforcer to reward correct behavior, it was found that the counting of the rewards appeared to be as important to the subject as was the eating of them. This would indicate that the same amount of motivation could possibly be accomplished with a system of "tokens" or "chips" for this type of population. All of the subjects were interested in the number of total responses they had made correctly during each session and seemed to be comparing their results each time with the results of the time before. As has been suggested in the research, the accuracy of responses even when the subject knew there would not be a reward each time the response was correct, was even

higher than during the phase were a 100 per cent schedule of reinforcement was used. In other words, the number of correct sounds produced during the strengthening or re-test phase was even higher than during the period of acquisition. This indicates that not only had a modification of errors taken place, but that motivation remained high.

Self-correction. Many of the experimental subjects showed a high interest in self-correction during conditioning sessions. Some of them would not reach for a reward if they felt that they had not made the sound correctly in their response. They would repeat the stimulus word instead, usually making it correctly before they anticipated a reward. This behavior was in no way suggested by the examiner, but seemed to be a spontaneous behavior on the part of most subjects, especially after the first two sessions.

Most of the subjects who were most capable of self-correction had received some months of basic "traditional" speech therapy, which seems to indicate that a knowledge of basic principles is helpful for self-correction to be effective. This suggests that if this self-corrective behavior is desired operant conditioning should be used in conjunction with other techniques of speech therapy.

Rewarding specific behavior. One of the most valuable aspects of the use of operant conditioning in an investigation of this type, or in therapy itself, is the rewarding of specific behavior. When a child clearly knows

the task he is expected to perform and receives an immediate tangible reward for performing that task correctly, he can be expected to perform well under similar conditions in the future.

Children who participate in many of the activities of "traditional" speech therapy do not receive an immediate reward for performing the activity well. They have no immediate knowledge of the results of their behavior. The careful use of operant conditioning provides the subject with both the immediate knowledge of results and the immediate reward for the desired response.

#### Limitations of Study

This study was conducted in a public school setting with a public school population. Because the experimental sessions were a part of regular therapy sessions for each subject, the amount of time which could be spent was limited. It was not possible to control as many variables in a public school setting as might possibly be controlled in a clinical setting.

The subjects for experimentation were selected to meet criteria which excluded children with speech defects having a known organic basis and children who did not have average or above average learning ability. The average public school speech therapist would probably not exclude such subjects from her case-load.

The subjects in the control group did not receive their "traditional" speech therapy from the same therapists who were working with the experimental group. It was not possible to measure the effect of the difference which the personality, capability and therapy techniques of the therapist herself made on the improvement of the speech of either group of subjects.

The study herein described was performed over a relatively short period of time, and there was no provision for the testing of retention of the acquired speech responses of either group. The study was limited in the measurement of permanent modification of speech responses by either group of subjects.

#### Suggestions for Further Study

There are many interesting fields of research to be developed through the use of behavioral techniques in the treatment of functional articulation disorders. The use of operant conditioning should be further explored in the public school setting.

A research project which included a longer experimental period would perhaps reveal the validity of the assumption that the speech responses which were acquired during operant conditioning were retained by the subject. A more lengthy study might test the concept of stimulus generalization in this type of behavior.



The use of operant conditioning to reinforce useful speech phrases as well as single words should be tested with a group of public school children having functional articulation defects. This should provide the opportunity for secondary reinforcement of the desired response.

In the use of operant conditioning with groups of children, an effort might be made to include the subject who is not being conditioned. The subject who is not being conditioned should be encouraged to participate in some way in the procedure to avoid periods of relative inactivity. The rehearsal behavior of young subjects who are listening to another subject being conditioned should be observed and recorded and utilized if possible.

A study of the comparative value of words selected by the subject versus words selected by the therapist would perhaps reveal words which are more easily modified by the subject. Most therapists arbitrarily select the material used for drill or practice by the subject. Words and phrases which are selected by the child himself might prove to have more meaning, and more secondary reinforcement. A comparison of these types of words and phrases should provide some valuable information for therapists.

The use of mechanical devices, such as pre-recorded tapes might also be a course of further study. The responses of subjects to a machine might be compared to their responses to direct individual stimulation.

### Conclusions

The data in this paper indicate that in this particular instance, using the population and procedures described in Chapter III, the experimental group made more improvement than did the control group. Under the conditions herein described, a group of public school children who received operant conditioning as part of their speech therapy program made a significant improvement when compared to a control group who did not receive conditioning. The hypothesis that there would be no difference in improvement between the two groups was rejected on the basis of a statistical comparison of the results of an articulation test administered to both groups before and after the experimental period.

It is further concluded that significant learning took place during the conditioning sessions with the experimental subjects. The subjects learned an average of over fifty new speech responses during the ten week experimental period. When these responses were strengthened and re-tested under conditions of fifty per cent reinforcement, retention was demonstrated by the number of correct responses which were made.

There was no significant difference within the experimental group as far as the sub-group performances were concerned. The subjects who received conditioning with one other child present and those who received conditioning

alone seemed to do equally well as far as total modification of defective sounds was concerned.

The experimental group made more improvement during the experimental period than did the control group. It is therefore suggested that operant conditioning is a useful tool for the public school therapist to employ in the treatment of functional articulation cases.

APPENDIX A

RECORD SHEETS FOR ARTICULATION TESTS

## Words Tested for /r/

- |              |              |
|--------------|--------------|
| 1. bird      | 20. cracker  |
| 2. car       | 21. tiger    |
| 3. rabbit    | 22. gopher   |
| 4. arrow     | 23. mother   |
| 5. presents  | 24. washer   |
| 6. bread     | 25. arm      |
| 7. tree      | 26. horn     |
| 8. dress     | 27. sharp    |
| 9. crayons   | 28. curb     |
| 10. grass    | 29. heart    |
| 11. frog     | 30. card     |
| 12. three    | 31. fork     |
| 13. shredded | 32. iceberg  |
| 14. hammer   | 33. scarf    |
| 15. dinner   | 34. fourth   |
| 16. paper    | 35. sister   |
| 17. rubber   | 36. whisker  |
| 18. doctor   | 37. December |
| 19. ladder   | 38. first    |

## Words Tested for /s/

- |             |                |
|-------------|----------------|
| 1. soap     | 12. sweeping   |
| 2. bicycle  | 13. splash     |
| 3. mouse    | 14. sprinkling |
| 4. scissors | 15. string     |
| 5. windows  | 16. scratch    |
| 6. smoke    | 17. possum     |
| 7. snake    | 18. wasp       |
| 8. spider   | 19. nest       |
| 9. stairs   | 20. mask       |
| 10. sky     | 21. books      |
| 11. sled    |                |

## Words Tested for /th/

- |            |            |
|------------|------------|
| 1. thumb   | 4. there   |
| 2. bathtub | 5. feather |
| 3. teeth   | 6. smooth  |

APPENDIX B

EXAMPLES OF STIMULUS WORDS

An example of words used as stimulus words for conditioning of subject with a defective /r/ sound:

race	learn
raw	hurt
ribbon	first
run	tower
room	hurry
road	turn
round	curl
rag	other
reach	ever
roof	later
rap	harder
rice	herd
rock	burn
rake	work
rest	girl
rust	water
rush	backward
rope	dollar
ring	freezer
ribbon	pride
air	broke
bar	trap
deer	cross
floor	borrow
hour	press
ear	break
wire	frost
war	thread
your	shrub
jar	summer
cheer	thinner
star	dipper
where	harbor
fur	motor
serve	leader
dirt	baker

An example of words used as stimulus words for conditioning of subject with a defective /s/ sound:

sack	also
salt	except
sale	herself
supper	message
seen	person
some	aside
sigh	fasten
sort	lesson
circle	outside
santa	useful
see	stack
sang	us
sap	rest
sent	snail
side	scout
sigh	task
son	slap
silly	asleep
Sunday	sprang
some	scrap
across	space
bless	small
bus	stand
case	house
curious	Thursday
dress	smell
gas	smooth
geese	grasp
ice	guest
kiss	skip
place	swim
moss	split
notice	spring
toss	strip
nuts	Tuesday
pets	sore
tops	close
rats	



An example of words used as stimulus words for conditioning of subject with a defective /th/ sound:

thank	Smith
thump	booth
thistle	toothpick
thief	pathway
thigh	eighth
theme	other
then	further
thousand	within
thug	bathe
thatch	norther
thick	another
third	method
thaw	mouthful
thorn	earthworm
Thursday	brother
thing	smother
thunder	weather
thirst	farther
theft	leather
thereafter	bother
than	with
that	although
the	together
they	thermos
then	thump
thus	everything
them	oath
this	sixth
though	youth
theirs	month
themselves	breathe
they'll	thatch

APPENDIX C

STATISTICAL ANALYSIS

## Statistical Analysis

To determine the difference in improvement between the group which received conditioning and the group which did not, the scores of each matched pair of subjects were compared for both the first and the second test. The difference in performance on pre-test and post-test was tabulated.

A "t" test for matched groups using the direct-difference method was calculated using the following formula:

$$\sigma D = \sqrt{\frac{\sum D^2}{N} - \frac{(M)^2}{D}}$$

$$t = \frac{MD}{\sigma M_D}$$

According to Underwood and associates,<sup>1</sup> a difference of 2.861 with 19 df would be necessary for this "t" ratio to be significant at the one per cent level of confidence. The resultant "t" was 3.22 which is beyond the one per cent level of confidence.

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