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The predictive value of a battery of imitative articulation and auditory discrimination tests in the speech development of kindergarten children

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THE PREDICTIVE VALUE OF A BATTERY OF IMITATIVE ARTICULATION
AND AUDITORY DISCRIMINATION TESTS IN THE SPEECH
DEVELOPMENT OF KINDERGARTEN CHILDREN

Submitted by

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In Partial Fulfillment of Requirements for
the Degree of Doctor of Education

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CHAPTER I
INTRODUCTION

During the initial stages of the process of speech development all children produce some sounds defectively. The sound development studies of Templin^{1/} and Poole^{2/} indicate that certain speech sounds are not acquired for some children until 7½ years. The individual with an articulation defect is not as fortunate as his peers in that he does not "outgrow" his speech handicap by the 7½ year level when most children have acquired all their speech sounds. The child who has an articulation defect may grow into adolescence or adulthood having the same misarticulated sounds within his speech pattern that were present during the preschool years.

Defective articulation is the most prevalent type of speech disorder. Surveys^{3/} of public school speech correction programs disclose that functional articulation defectives represent between 75 and 80 per cent of all speech defectives in the school popula-

1/Mildred Templin, "Speech Development in the Young Child: 3. The Development of Certain Language Skills in Children," The Journal of Speech and Hearing Disorders, (September, 1952), 17: 280-285.

2/Irene Poole, "Genetic Development In Articulation of Consonant Sounds in Speech," Elementary English, (June, 1934), 11:159-161.

3/Margaret H. Powers, "Functional Disorders of Articulation-Symptomatology and Etiology," Chapter XXIII, Speech Pathology, Lee E. Travis, Editor, Appleton-Century-Crofts, Inc., 1957, p. 711.

tion. More functional articulation defects occur among children in the primary grades than at any other grade level.

Inadequate auditory discrimination and organic deficiencies are among the reasons some children might not acquire accurate articulation of speech sounds by the time set as normal acquisition. The child who is deficient in auditory discrimination may have normal hearing but is incapable of differentiating similar phonemes.

At the present time, the research dealing with misarticulation and auditory discrimination is conflicting. However, one recent study^{1/} indicates that normal speakers are significantly superior to speech defectives in discriminatory ability.

Speech therapy places considerable emphasis on auditory stimulation and auditory discrimination in the therapeutic program. The important role of auditory discrimination during the initial stages of articulation therapy has been stressed in the texts by Van Riper,^{2/} Hall,^{3/} Milisen,^{4/} West,^{5/} and others. In

1/R. L. Schielfelbusch and Mary Jeanne Lindsey, "A New Test of Sound Discrimination," *The Journal of Speech and Hearing Disorders*, (May, 1958), pp. 153-159.

2/Charles Van Riper, *Speech Correction: Principles and Methods*, (3rd ed.) Prentice-Hall, Inc., New York, 1954, pp. 221-234.

3/Margaret H. Powers, "Clinical and Educational Procedures in Functional Disorders of Articulation," Chapter XXIV, *Speech Pathology*, Lee E. Travis, Editor. Appleton-Century-Crofts, Inc., New York, 1957, pp. 791-793.

4/Robert Milisen, "A Rationale for Articulation Disorders," *The Journal of Speech and Hearing Disorders*, Monograph Supplement No. 4, (December, 1954), 19: 6-17.

5/Robert West, *The Rehabilitation of Speech*, (3rd ed.) Harper and Brothers, New York, 1957, p. 356.

addition the authors have given recognition to the consequence of therapy which included a progressive program of auditory stimulation, auditory discrimination, and imitative articulation.

Two studies have been made which attempted to identify the young child who would profit from speech therapy. Pettit's^{1/} study had negative results and Carter's^{2/} study disclosed that 71.7 per cent of the first grade children who achieved 25 per cent or more correction on imitation of the correct form of the misarticulated sound in nonsense syllables made 100 per cent correction nine months later. Only one of the two investigations has prognostic value and this study was limited to examining the imitative ability of the child.

Statement of the Problem

It is the purpose of this study to inquire into the prognostic value of a battery of imitative articulation and auditory discrimination tests in dealing with two groups of kindergarten children who have not developed all their speech sounds.

Justification of the Study

The prognostic studies that have been undertaken in the field of speech pathology are sparse. In a study made at the

^{1/}Calvin W. Pettit, "The Predictive Efficiency of a Battery of Articulatory Diagnostic Tests", Speech Monographs, (August, 1957), pp. 219-226.

^{2/}Eunice T. Carter and McKenzie Buck, "Prognostic Testing for Functional Articulation Disorders Among Children in the First Grade", The Journal of Speech and Hearing Disorders, (May, 1958), pp. 124-133.

first grade level, Carter^{1/} designed a battery of spontaneous and imitative speech tests. The imitation of nonsense syllables was found to be highly predictive.

In Pettit's^{2/} study of the speech of five year old children, tests currently employed during diagnostic examinations in speech clinics were evaluated for prognostic purposes. It was found that none of the tests investigated had prognostic value for five year old speech development.

The only area of prognosis explored and found to be pertinent is that of imitative articulation. At the present time, auditory discrimination has not been investigated for prognostic purposes.

No attempt has been made to determine the relationship between auditory discrimination and growth in ability to articulate speech sounds accurately.

Since speech therapy utilizes both auditory discrimination and imitative articulation as major therapeutic techniques, it would appear that a study should be undertaken which investigated both areas.

Scope

This study will attempt to determine the predictive value of a battery of auditory discrimination and imitative articulation tests for 100 kindergarten children with "mild" and "severe"

1/Ibid., pp. 126-127.

2/Pettit, op. cit., pp. 219-226.

speech difficulties. Group I, the children who had "severe" speech difficulties, had numerous articulation errors and considerable interference with communication, according to the Wood Articulation Index.^{1/} Group II, the "mild" group, had few articulation errors and little interference with communication according to the Wood Index.

Definition of Terms

Imitative Articulation Ability: In this study imitative articulation ability is the efficiency displayed by the child in imitating an aural stimulus presented by the examiner.

Auditory Discrimination: In this study auditory discrimination is the ability to perceive similarities or differences of sounds produced by the examiner.

Wood's Articulation Index: In this study the Wood Articulation Index^{2/} is employed as a method for the quantitative description of the child's ability to articulate consonant sounds correctly. Each consonant phoneme is assigned a numerical score. The consonants which appear more frequently in the language are given heavier weighted scores than those consonants which are less frequently uttered. If the child is able to produce all the consonant phonemes correctly his articulation index would be 100. The score given by Wood to the phoneme(s) misarticulated are

^{1/}Kenneth S. Wood, "Measurement of Progress in the Correction of Articulatory Speech Defects", The Journal of Speech and Hearing Disorders, (June, 1949), 14: 171-174.

^{2/}Ibid., pp. 171-174.

subtracted from 100 and the difference is the child's articulation index.

Null Hypothesis: In order to make the decision whether the hypothesis designed for this study should be rejected or retained the null hypothesis was employed. The null hypothesis asserts that the true mean difference between the two groups being compared is zero; and the obtained difference (if one is found) is inconsequential and could well be zero.^{1/} The selected level of significance for this investigation was the five per cent level of confidence. In rejecting the null hypothesis it was asserted that the difference obtained was significant, that it indicated the existence of a true difference greater than zero.^{2/} In accepting the null hypothesis, on the other hand, it was considered that there was reason to suspect - as far as the data were concerned - that a true difference was not zero.^{3/}

^{1/}Henry E. Garrett, Elementary Statistics, Longmans, Green and Company, New York, 1956, p. 97.

^{2/}Ibid., p. 97.

^{3/}Ibid., p. 97.

CHAPTER II

SURVEY OF THE LITERATURE

As this investigation is concerned with the growth of speech development during the kindergarten year and testing procedures of imitative articulation and auditory discrimination to ascertain a prognosis of this growth, the literature included in this study is divided into the following categories:

1. Literature on the effect of maturation on misarticulation.
2. Literature on prognostic studies of the young child who has misarticulations within his speech pattern.
3. Literature on the significant role of auditory training in the speech correction program.
4. Literature on the correlation of auditory discrimination and misarticulation.
5. Literature on articulation testing procedures.
6. Literature on auditory discrimination testing procedures employed in speech correction.

The Effect of Maturation on Misarticulation

Research indicates speech matures most rapidly during the years of early childhood. Templin^{1/} studied several language skills of children: articulation, sound discrimination, sentence

^{1/}Mildred C. Templin, Certain Language Skills in Children: Their Development and Interrelationship, The University of Minnesota Press, Minneapolis, 1957, p. 7.

development, and vocabulary. Her sample included 480 children, 240 boys and 240 girls between the ages of three and eight years. The sample was divided by age into eight subsamples. Due to the rapid growth in language during the earlier ages, the subsamples were selected at half-year intervals between three and five years, and at year intervals between five and eight years. Templin's data reveal that at three years substantial growth had already occurred in the language areas tested. The three year old children's over-all accuracy of articulation of speech sounds was approximately 50 per cent that of the eight year old group. A substantial amount of articulation growth took place between the three and eight year old levels. The maximum increment occurred between 3 and 3.5 years, the two earliest ages tested, and a sharp deceleration was evident after seven years.

Roe and Milisen^{1/} conducted an extensive study of nearly 2000 children in the first six grades. The investigation took place in Indiana communities which had no speech correction program in the schools. Contrary to other investigations, Roe and Milisen found no significant difference between the mean number of errors for the boys and girls. The effect of maturation indicated that there was a definite difference between the mean number of errors from the first through fifth grades. The number of errors dropped most rapidly in grades one, two, and three. Roe and Milisen's data revealed that the relationship of chronological age and maturation of speech sounds varies from one sound to another.

^{1/}Vivian Roe and Robert Milisen, "The Effect of Maturation Upon Defective Articulation in the Elementary Grades", The Journal of Speech Disorders, (March, 1942), 7: 37-50.

The effect of maturation on speech was investigated at the national level in The White House Conference Survey,^{1/} which indicated a gradual decrease of articulation defects occurred from grade to grade up through grade 12. The most rapid decrease of misarticulation occurred between kindergarten and grade four. Misarticulations appeared to level off at this level and there was little further decrease due to maturation alone.

Spriestersbach and Curtis^{2/} report several studies which reveal the inconsistencies of misarticulation and maturation of sounds. Among their conclusions they state:

(1) individuals who misarticulate the speech sounds typically do so inconsistently. (2) the inconsistencies are to be accounted for on a lawful basis. (3) need exists for a rather detailed testing of any defective sound in all phonetic contexts in which it normally occurs for the subject being tested. (4) from a clinical point of view, to look for phonetic contexts in which the individual consistently articulates the sound correctly is feasible and advisable. As Van Riper suggests such correct productions may be "nuggets of gold" to be used in speeding the establishing of correct habit patterns. (5) during early stages of retraining the routine use for all subjects of words in which the sound occurs as a single is to be questioned. Rather, articulation of blends may facilitate generalized improvement.

Anderson^{3/} feels that a child is ready to learn to talk only when his speech organs and nerve centers have matured to a certain point. He suggests that there is a marked variation among indi-

1/White House Conference on Child Health and Protection, Special Education, D. Appleton-Century, New York, 1931, pp. 349-381.

2/Duane Spriestersbach and James Curtis, "Misarticulation and Discrimination of Speech Sounds," Quarterly Journal of Speech, (December, 1951), 37: 483-491.

3/Virgil A. Anderson, Improving the Child's Speech, Oxford University Press, New York, 1954, p. 23.

vidual children in the degree of maturity to which they have attained at any given age and for any given specific ability or characteristics.

Everhart^{1/} reports maturation of articulation to be contingent upon several factors and describes them in the following manner. He states:

It is impossible to confine maturation of articulation to one single factor of growth and development. Rather, the development of articulatory patterns within the normal range is dependent upon the degree to which each aspect of growth and development operates in the individuation of speech out of the psychophysical systems possessed by the individual.

Prognostic Studies of the Speech Handicapped

Prognosis is vital to the speech therapist in planning each case's therapeutic program. An accurate knowledge of the amount of time necessary to eradicate the defective speech is seldom possible. However, both the therapist and the subject should have some awareness of the quantity of time which will be involved in therapy.

Hall^{2/} views prognosis in the following manner. She states:

The person who is entering upon speech therapy wants and should have some idea of how long it will probably take - a month, a year, five years. The clinician should be prepared to discuss, at least in general terms, the speech outcome to be expected and indicate at the same time the factors which will tend to hasten or retard speech improvement.

In 1952, Pettit^{3/} determined the efficiency of a battery of

1/Rodney W. Everhart, "The Relationship Between Articulation and other Developmental Factors in Children", *The Journal of Speech and Hearing Disorders*, (December, 1953), 18, p. 332.

2/Hall, *op. cit.*, p. 783.

3/Pettit, *op. cit.*, pp. 219-226.

speech diagnostic tests in predicting the articulatory development of five year old children. Seventy-two children were administered the following battery of tests: pure tone audiometric, speech perception, imitation of Non-English sounds, imitation and articulation of English sounds, memory span, gross motor control, specialization of movement, speed of muscle movement, intelligence, and personality. The children in the study did not receive formal speech assistance during the year. A retest of articulation was made seven to eight months later. However, a statistical analysis showed that the results of the battery of tests used in this study were not correlated with articulation development. Therefore, the study did not reveal any factors which would have predictive value. Although not statistically significant, Pettit^{1/} found the child with the lower initial articulation score, in general, improved more in the second articulation examination than the child who started with the higher score.

In 1958, Carter and Buck^{2/} report a study which evaluated methods of articulation testing that might determine the effect of maturation of speech deviations among children in the first grade. One hundred seventy-five children were divided into two groups. The 83 children in the control group received therapy twice a week for thirty minute periods throughout the school year. The 92 children in the experimental group received no special help other than incidental to first grade

1/Calvin W. Pettit, The Predictive Efficiency of a Battery of Speech Diagnostic Tests for the Articulatory Development of a Group of Five-Year-Old Children, Unpublished Doctoral Dissertation, University of Wisconsin, 1952.

2/Carter and Buck, op. cit., pp. 124-133.

instruction. Both groups were administered three types of articulation tests: Test I (Spontaneous Speech) consisted of 114 pictures using 13 consonant sounds three times each in the initial, medial, and final positions. Two exceptions to this procedure were (z) and (ð). Test II (Imitation) consisted of the same words employed in the Spontaneous Test I. The child was asked to watch the examiner as the word was spoken and to listen carefully. He then was asked to repeat the word in the same manner. Test III (Nonsense Syllables) used the same sounds employed in Tests I and II. These sounds, however, were used in unfamiliar phonetic environments, nonsense syllables. The Spontaneous and Imitation Tests were statistically analyzed and significant improvement was indicated in the Imitation Test. Nine months later, the two groups were readministered the Spontaneous Test. Carter and Buck's^{1/} data revealed that in the Experimental Group 71.7 per cent of the children who achieved 25 per cent or more correction on the Nonsense Syllable Test made 100 per cent correction in the final Spontaneous Articulation Test. The trend toward self-improvement was consistent throughout the Experimental Group. To illustrate, of those children who made 55 per cent correction on the Nonsense Syllable Test, there were 80.6 per cent who made 100 per cent final correction, while of the children who scored 80 per cent or more correction on the Nonsense Syllable Test 96 per cent corrected all their defective sounds by the end of the school year without therapy. Carter and Buck make the following observation. They state:

^{1/}Carter and Buck, op. cit., pp. 124-133.

In using the Nonsense-syllable type test as compared with the Spontaneous Test, the speech therapist might expect that those children who make no correction on this test will need therapy to correct their misarticulations. She may become more efficient with these children by excluding those who achieve 75 per cent or more correction on the Nonsense-syllable Test. It is possible that such exclusion will give maturation a chance to take effect. At the beginning of the second grade they may be retested. Those few who have not corrected by this time may then be offered therapy.

Snow and Milisen^{1/} studied 81 defective speaking first and second grade children in a Kentucky public school which did not receive speech therapy. In the fall each child was given a picture articulation test and a test of imitated verbalization on 25 consonants and blends. Six months later, in the spring, each child was retested with the same tests. Of the spring tests only the results for the Final Picture Test were used for the study. In general, children made more errors, or more severe errors on the Initial Picture Test than on the Initial Oral Test. They received the examiner's oral stimulus from the oral test, but none from the picture test. In regard to these tests having prognostic value, Snow and Milisen state:

For the most part, those who had the greatest differential score between the two tests were the ones who showed the greatest spontaneous improvement in articulation as measured six months later by the Final Picture Test.

This would indicate a probability that the difference in a child's responses to an oral and a picture articulation test could be used as one valuable factor in predicting his progress in correcting his articulation errors . . . It also indicates that, to a considerable extent, sounds which are produced better in an oral than in a picture articulation test, are the ones which will show the most spontaneous improvement in articulation.

^{1/}Katherine Snow and Robert Milisen, "Spontaneous Improvement in Articulation as Related to Differential Responses to Oral and Picture Articulation Tests", The Journal of Speech and Hearing Disorders, Monograph Supplement No. 4, (December, 1954) 19:45-50.

Auditory Training in the Speech Correction Program

The two forms of auditory training to be discussed are imitative articulation, or auditory stimulation, and auditory discrimination. Imitative articulation, no doubt receives greater emphasis than auditory discrimination by many speech therapists. This may be partially accounted for in the confusion that has existed in the research dealing with auditory discrimination and children with defective articulation. However, auditory discrimination is the speech therapist's strongest tool in dealing with functional articulation defects. Recognition of its value in the therapeutic program is held by many authorities in the field of speech pathology.

Auditory discrimination has been accepted as a form of perceptual behavior. Strauss^{1/} portrays the perception of the young child in terms of Gestalt psychology. He states:

The perception of a young child differs from that of an older child and adult. In the developing organism, perceptual organization and integration proceeds from the primitive and simple to larger and more complex structures, but always with these same characteristics of wholeness and relatedness of parts to parts and figure to background. The more differentiated the nervous system becomes during growth, the more articulate are their relationships, and the larger and more complex become the wholes which are perceived.

Van Riper^{2/} stresses the importance of ear training as the first step in remedial training. He states: "It may be said with utmost emphasis that no teacher should attempt to get a child to make a new sound without first giving systematic ear training."

^{1/}Alfred A. Strauss and Laura E. Lehtinen, Psychopathology and Education of the Brain-Injured Child, Grune and Stratton, New York, 1947, pp. 29-30.

^{2/}Van Riper, op. cit., p. 222.

Van Riper^{1/} indicates the four types of ear training to be applied to this systematic procedure are isolation, stimulation, identification, and discrimination.

Van Riper^{2/} sets forth that the imitative articulation method to produce the correct sounds is the simplest and easiest but depends upon preliminary ear training for its value. He states:

If the ear training has been adequate, this simple routine, in which the wrong sound is pronounced, identified, and rejected, then followed by a correct sound given several times, will bring a perfect production of the correct sound on the first attempt. Occasionally it will be necessary to repeat this routine several times before it works, and the student should be encouraged to take his time and to listen carefully both to the stimulation and to his response. He should be told he has made an error or that he has made it almost correctly.

Hall^{3/} supports the necessity of auditory training in the speech correction program since hearing is the primary sensory basis for the acquisition of speech in early childhood. She states:

Most important of all, audition provides the person with a permanent monitoring system of his own speech. If he develops reliable auditory discrimination through training, it carries over to all situations - away from the speech therapy session as well as in it - and permits autoevaluation of speech sound production. Auditory training becomes, therefore, a powerful technique for habituating the correct production of speech sounds.

Hall^{4/} suggests a function of imitative articulation in the following manner. She states:

1/Ibid., p. 224.

2/Ibid., p. 235.

3/Hall, op. cit., p. 789.

4/Ibid., p. 779.

The relative ease with which the case can produce his various defective sounds by imitation will also be a good place at which to begin training with the sounds which the individual can correct most easily. A trial of the person's response to retraining, therefore, is well worth making from a diagnostic, a prognostic, and a therapeutic point of view.

Anderson^{1/} recognizes the importance of ear training and states the child must be able to realize that words are made up of speech-sound units, and he must be trained to listen for these sounds and be able to isolate them. He states:

The importance of ear training in the process of reeducating a child's speech can scarcely be exaggerated. If the child is to become aware of his bad speech habits, it is essential that he learn to hear and identify the undesirable speech pattern and recognize it as being different from what he is attempting to acquire. This process requires ear training.

The role of auditory discrimination in the therapeutic program is stressed by Curtis.^{2/} He states:

. . . the child not only needs to learn to make auditory discriminations which he has never made before, but he needs to learn to break down these word patterns, at least to the extent of being able to recognize, out of the word pattern, those sounds on which he tends to make errors . . . The speech therapist, therefore, spends some time in ear training as one important part of the corrective procedure.

Additional support is given to auditory discrimination by Spriestersbach and Curtis.^{3/} They state that a longer period of ear training may be necessary for eradicating certain types of articulation errors than for others. They indicate that ear training adapted to the particular phonetic contexts in which the in-

^{1/}Anderson, op. cit., p. 141.

^{2/}James F. Curtis, "Disorders of Articulation", Chapter III, Speech Handicapped School Children, Wendell Johnson, Editor, (Revised Edition), Harper and Brothers, New York, 1956, p. 122.

^{3/}Spriestersbach and Curtis, op. cit., p. 491.

dividual's misarticulations occur: is probably more effective than the gross type.

West^{1/} confirms that ear training should be incorporated into the dyslalic's therapeutic program. He states:

Treatment for dyslalia of . . . causation consists in ear training and phonetic drills to familiarize the child with sound combinations so that he will be ready to make use of them as he develops the ability to recall what sounds he hears and the order in which they occur.

In their study of the relationship of auditory discrimination to articulatory defects Kronvall and Diehl^{2/} discuss an understanding of auditory discrimination. According to Kronvall and Diehl:

Auditory discrimination is generally defined as a judgment calling for a distinction or comparison among sounds. As a function it is not well understood. Whether it is inherent in the efficient operation of the mechanism for normal audition, whether it involves additional neurological processes, or whether it relates to a specific perception dependent upon training appear to be unanswerable at this time.

Milisen^{3/} prefers a strong form of stimulation which he calls Integral Stimulation. He defines such stimulation as whole stimulation and that it makes use of all the stimulation complex needed to elicit a correct response. Integral Stimulation requires vividness in every aspect of stimulation in order to make up for the child's deficient skills and therefore to make the sound movement easier to imitate. Milisen states that Integral Stimulation is the basic method used in eliciting practically all misarticulated

1/West, op. cit., p. 405.

2/Ernest L. Kronvall and Charles F. Diehl, "The Relationship of Auditory Discrimination to Articulatory Defects of Children With No Known Organic Impairment," The Journal of Speech and Hearing Disorders, (September, 1954), 19:335.

3/Milisen, op. cit., p. 9.

sounds and therefore is used at the beginning of most therapy programs. Milisen suggests three procedures in Integral Stimulation which should be followed. He states:

Each Integral Stimulation includes the stimulation of the child with a whole speech configuration, and his imitation of it. It is divided into three parts: (1) the production of the sound by the clinician so that the child hears and sees and perhaps feels it. (2) the child's response, which he and the clinician hear and see and feel, and (3) the evaluation of the response by both the child and the clinician.

The Correlation of Auditory Discrimination and Misarticulation

The research data dealing with the speech handicapped individual and his auditory discrimination ability are conflicting. Some studies have proven there is no correlation between deficient ability in auditory discrimination and articulatory defects while other studies have found that auditory discrimination is a highly significant factor in poor articulation.

Travis and Rasmus^{1/} compared the discrimination ability of normal speaking individuals at the elementary school level and at the university freshmen level. Their study revealed that at every age compared, the individuals having functional articulation disorders made significantly more errors than did normal speakers.

Conversely, the research of Hall,^{2/}Mase,^{3/}Barnes^{4/} and

1/Lee E. Travis and B. Rasmus, "The Speech Sound Discrimination Ability of Cases With Functional Disorders of Articulation", The Quarterly Journal of Speech Education, (1931), 17: 217-226.

2/Hall, op. cit., p. 741.

3/Ibid., p. 741.

4/Ibid., p. 741.

Hansen^{1/} have found no significant differences between speech sound discrimination and defective articulation. The Averell^{2/} study of articulation and auditory discrimination in kindergarten children supports the preceding findings. Averell's sample included 195 kindergarten children who were administered tests of articulation, speech sound discrimination, and auditory discrimination. The data of this study indicates that coefficients of correlation were nil for all the comparisons made. Also, the children with poor articulation considered separately were found to be similar to the total group for all comparisons.

Dumbleton^{3/} analyzed possible relationships between certain aspects of speech and reading abilities. Tests of articulation, speech sound discrimination, auditory discrimination, and reading ability were administered to approximately 425 first grade children. The data revealed that the relationship between articulation ability and speech sound discrimination, reading ability and auditory discrimination was very low. However, when the children with poor articulation were considered separately, they were found to be consistently poorer than the whole group in all aspects tested. The greatest difference between the children with poor articulation and the whole group was in speech sound discrimination.

1/Ibid., p. 741.

2/Lois Averell, et al, An Analysis of the Relationship Between Articulation and Auditory Discrimination in Kindergarten Children, Unpublished Master's Thesis, Boston University, 1953.

3/Charles Dumbleton, et. al, An Analysis of the Relationship Between Speech and Reading Abilities of 425 First-Grade Children, Unpublished Master's Thesis, Boston University, 1952.

The more recent studies of auditory discrimination and defective articulation have found significant differences between the ability of speech defectives and normal speakers to discriminate.

In 1954, Kronvall and Diehl^{1/} investigated the relationship of auditory discrimination to articulation defects. They administered the Templin Speech Sound Discrimination Test to 30 children with severe functional articulation defects and their matched controls. The age range of the population in this study was from six to nine years. Kronvall and Diehl's data indicates the controls made significantly fewer errors than the articulation cases.

In 1956, Lindsey^{2/} designed a test of auditory discrimination which was administered to 24 functional articulation defectives and their matched controls, normal speakers. The children included in the study were enrolled in the first and second grades. A significant difference was found between the speech defectives and the normal speaking group in relation to speech sound discrimination ability.

In 1957, Taylor^{3/} administered the short form of the Lindsey Test to 389 first, second, third, and fourth grade children. Among Taylor's conclusions it is revealed that a significant difference in discrimination was found between children with one or more articulatory defect errors and the children with normal articulation.

^{1/}Kronvall and Diehl, op. cit., pp. 335-338.

^{2/}Mary Jeanne Lindsey, A Test of Sound Discrimination, Unpublished Master's Thesis, University of Kansas, 1956.

^{3/}Marilyn J. Taylor, Standardization of a Speech Sound Discrimination Test, Unpublished Master's Thesis, University of Kansas, 1957.

Articulation Testing Procedures

The two types of articulation testing which have been investigated by research methods are those in which spontaneous and imitative speech have been elicited from the child.

Templin^{1/} reported in her study of spontaneous versus imitated verbalization in testing articulation of preschool children that similar results are obtained if the sounds are measured in words spontaneously elicited or repeated after the examiner.

Milisen^{2/} and his associates have made several investigations of articulation testing in which they found a significant improvement when an auditory stimulus elicits the child's response. Snow and Milisen^{3/} found there was a consistent differential in favor of better responses to the imitative test. This differential was present at all grade levels tested and seemed to indicate that the small amount of stimulation present in the aural test influenced the articulation responses by aiding the children to form their sounds more correctly.

Carter and Buck's^{4/} study supports the findings of Milisen. An analysis of their tests results of 175 first grade children

1/Mildred Templin, "Spontaneous Versus Imitated Verbalization In Testing Articulation in Preschool Children", *The Journal of Speech Disorders*, (September, 1947), 12: 293-300.

2/Milisen, *op. cit.*, p. 19-45.

3/Katherine Snow and Robert Milisen, "The Influences of Oral Versus Pictorial Presentation Upon Articulation Testing Results," *The Journal of Speech and Hearing Disorders*, Monograph Supplement No. 4 (December, 1954), 19: 29-36.

4/Carter and Buck, *op. cit.*, p. 132.

administered tests of spontaneous and imitative speech shows significant improvement of the Imitative Test over the scores of the Spontaneous Test.

Speech Tests of Auditory Discrimination

One of the diagnostic instruments employed by the speech therapist is the auditory discrimination test. The information derived from such testing is used by the therapist in planning each case's therapeutic program.

The Travis-Rasmus Test,^{1/} published in 1931, has been utilized for the development of most of the succeeding discrimination instruments. The test employs 366 pairs of nonsense syllables which include every sound in the English language. Each pair consists of two nonsense syllables which may be different or which may be repetitious of the same syllable. The examiner utters each pair of nonsense syllables and the subject indicates whether he perceives them as the same syllable repeated or as two different syllables.

In 1943, Templin^{2/} reported a study of sound discrimination at the elementary school level, including grades two through six. Templin included 200 test items similar to those in the Travis-Rasmus Test. The 200 pairs of nonsense syllables made up two tests of 100 items. Both tests were identical except for the position of the sound to be discriminated. In one test the dis-

^{1/}Travis and Rasmus, op. cit., pp. 217-226.

^{2/}Mildred Templin, "A Study of Sound Discrimination Ability of Elementary School Pupils", The Journal of Speech Disorders, (June, 1943), 8: 127-132.

crimination was in the initial position and in the second test the 100 items of discrimination took place in the final position. A shorter form of the test was constructed which included the 70 most discriminating items of the previous testing. Templin's findings revealed that children in all grades made more errors when the phoneme to be discriminated was in the medial and final positions. Templin's test provides normative data for auditory discrimination of grades two through six.

In 1950, Mansur^{1/} designed a test to measure the speech sound discrimination ability of young speech handicapped children. The test instrument incorporated 20 phonetically balanced word pairs presented in picture form. Each pair of words was read to the child and he responded by pointing to the correct picture pair. The child made a choice from the groups of pictures presented as to the one pair that represented the aural stimulus given by the tester. In 1951, Haroian^{2/} validated the Mansur Test with a sample of 199 kindergarten and first grade children.

A revision of the Mansur Test is reported by Pronovost and Dumbleton.^{3/} As a result of the analyses of the Mansur and Haroian data some of the word pairs were eliminated and others were

1/Richard W. Mansur, The Construction of a Picture Test for Speech Sound Discrimination, Unpublished Master's Thesis, Boston University, 1950.

2/R. D. Haroian, Preliminary Validation of Mansur's Speech Sound Discrimination Test in the Kindergarten and First Grade, Unpublished Master's Thesis, Boston University, 1951.

3/Wilbert Pronovost and Charles Dumbleton, "A Picture Type Speech Sound Discrimination Test", The Journal of Speech and Hearing Disorders, (September, 1953), 18: 258-266.

changed so that the pictures would be more readily identified by children. Additional word pairs were included, especially more words for vowel discrimination. Only three of the possible combinations of each pair of words was represented on a test page, one "unlike" pairing and two "like" pairings. The position of the pictures of the word pairs was selected at random in order to eliminate the factor of pattern responses. The order of presentation of the items was determined at random also. On each half of the test, one half of the "unlike" pairs was presented, and one half of the "like" pairs - the picture sheets being used twice in the same order. The test was administered to 434 children of the first grade. The mean, median, and mode were computed and found to indicate a negatively skewed distribution. Although this is believed to indicate that instrument is a poor one for a definitive study of a normal population, Pronovost and Dumbleton feel it does not decrease its value as a diagnostic instrument. Results of the study indicate that about 10 per cent of first grade children are deficient in speech sound discrimination ability. The reliability coefficient of the test was found to be .88. An item analysis was made to determine the validity of individual items. It was found that all items except three of the unlike pairs were significant at the .01 level of confidence.

In 1953, Averell^{1/} designed an articulation test, an auditory discrimination test and administered the Dumbleton Speech Sound Discrimination Test to 195 kindergarten children. Averell's test of auditory discrimination consisted of four rows of four pictures for each sound. Three of the pictures in each row repre-

^{1/}Averell, et. al, op. cit., p. 4.

sented words which began (or ended) with the sound being examined. The other picture in each row represented a word that did not begin (or end) with the sound being tested. The teacher dictated the words which the pictures represented and the children were directed to mark only those which began (or ended) with the sound being tested. In the selection of the word in each row that did begin (or end) with the sound being tested, the auditory characteristics of the sound were kept in mind. In the sample row and the first two rows, the different word was selected so that the beginning or ending sound was acoustically very different from the sound being tested. The word as a whole was also very different. In the last two rows of the test the different word was one that rhymed with one of the other words so that the two were phonetically alike except for the initial and final sound. The different sounds were acoustically similar to the sound under test. Thus the discrimination became progressively more difficult and an attempt was made to make this a more controlled test than previous ones from the acoustic viewpoint. The majority of the items of the test were significant or very significant. The coefficient of correlation between the auditory discrimination test, the Dumbleton Speech Sound discrimination test and speech development was found to be significant at the .01 level of confidence. The coefficients of correlation between articulation and auditory discrimination were found to have no relationship. No significant differences were found in this study between those children with poor articulation and the total group in respect to speech sound and auditory discrimination. The results of this study and the

Dumbleton study indicate that when reading and speech tests are administered at a specific period in the child's development, no relationship between articulation of words and auditory discrimination of speech sounds exists.

Schiefelbusch and Lindsey^{1/} report a picture test which included 90 picture cards for purposes of testing the child's ability to discriminate rhyming, initial, and final sounds. This introduces an auditory discrimination test which includes the monitoring aspects of speech testing. Each of the three categories were equally represented. The picture cards presentation utilized three different methods: in the first section the tester named the three pictures on the cards and asked the child to indicate the two pictures that sounded alike; in the second section the child named the three pictures and told which two sounded alike; in the third section the child evaluated the cards silently and told which two pictures sounded alike. On each card were three pictures, two of which were alike in regard to rhyming, initial, or final sounds and a third which contained a sound frequently substituted for the one employed in the other two pictures. The test was administered to 48 first and second grade children. The experimental group contained 24 speech handicapped children and the control group contained 24 normal speakers. Schiefelbusch and Lindsey indicate that all three methods used in administering the test produced highly similar results. Therefore, the method of presentation did not show any conclusive results which would indicate that speech defective children have greater difficulty in discerning the test pictures when the child names the three

^{1/}Schiefelbusch and Lindsey, op. cit., pp. 153-159.

pictures and determines the two pictures which are alike.

Taylor's^{1/} study was constructed to develop normative data of the short form of the Lindsey Sound Discrimination Test. In addition, maturational levels between grades one, two, three, and four for the total test and for phonetic units were determined. Included among Taylor's results are: (1) There was a significant difference between the mean discrimination scores of children at the first, second, third, and fourth grade levels; (2) The difference was consistent for tasks involving both the initial and final sounds; (3) The largest difference for both the initial and final sounds was found between the first and second grades.

1/Taylor, op. cit.

CHAPTER III

PROCEDURE

Introduction

In order to determine the predictive value of a battery of imitative articulation and auditory discrimination tests for kindergarten speech development it was necessary to test a large group of children to select the two groups for this study. Three hundred kindergarten children were administered a Spontaneous Picture Articulation Test which was scored according to the Wood^{1/} Articulation Index. On the bases of their Articulation Indices and misarticulations the 100 children in the sample population were selected for the study. Each child in the "mild" and "severe" groups was administered the following tests of imitative articulation: ability to imitate the correct form of a misarticulated sound in isolation, nonsense syllables, and words; and the following tests of auditory discrimination: auditory discrimination of gross sounds, auditory discrimination of the correct form of a misarticulated sound among vowels, acoustically dissimilar consonants, acoustically similar consonants, and 20 children were administered an auditory discrimination test of (θ) in the initial and final positions of words. Each group of tests included in the investigation took approximately three weeks to administer and was

^{1/}Wood, op. cit., p. 172.

presented to the entire population before the succeeding examining procedure was undertaken. The children included in the sample population did not receive formal speech training during the school year.

Selection of the Groups

Two suburbs within a fifteen mile radius of Boston, Massachusetts, were selected for this study. The communities were chosen as representative of high and low socio-economic status. During September, 1957, the writer met with each principal whose school was involved in the investigation and presented an explanation of the study. A short time later, the study was described to the kindergarten teachers whose classes were to take part in the experiment.

The first test, a spontaneous picture articulation test, was administered to 300 kindergarten children. On the basis of the data derived from this instrument, 100 kindergarten children with undeveloped speech sounds were chosen to participate in the experiment.

All tests were administered on an individual basis outside the classroom. An unoccupied room space, such as the teacher's lounge, was utilized to provide an environment free from classroom distractions and ambient noise. The first testing took place two weeks after the kindergarten children had entered school. As the writer was a stranger who took the child from his familiar classroom, a short time was spent in establishing rapport with each child. Some children felt secure in the new situation immediately while others required a longer period for adjustment.

The Spontaneous Picture Articulation Test.-- An investigation of the research^{1/} dealing with the spontaneous vocabularies of kindergarten children was undertaken to determine the words which could be represented in black line picture form.

The sound development data of Templin^{2/} and Poole^{3/} were utilized to select the phonemes to be examined in this study. The last 14 consonant sounds to enter a child's speech pattern were chosen for this investigation. These sounds were (k), (g), (v), (d₃), (z), (ʃ), (l), (s), (z), (r), (θ), (f), (tʃ), and (ʃ). Whenever possible each sound was tested in all three positions: initially, medially, and finally.

1/Agnes Battit et. al, The Spontaneous Speaking Vocabulary of Children in Nursery, Kindergarten, Grades One, Two, and Three, Unpublished Master's Thesis, Boston University, 1954.

2/Templin, op. cit., pp. 280-285.

3/Poole, op. cit., pp. 159-161.

Pilot study: A pilot study was undertaken with 36 children from a kindergarten classroom not included in the population of the study. Each one of the 14 consonant sounds examined was tested whenever possible by nine pictures: three pictures were of the sound in the initial position of words; three pictures were of the sound in the medial position of words; and three pictures were of the sound in the final position of words. This preliminary test was found to be too long for the age group of the sample. Also, it provided information as to the pictures most easily recognized by kindergarten children.

Description of the Test: As a result of the foregoing procedure the pictures for the Spontaneous Articulation Test were selected and one picture was chosen to represent each position of the 14 consonant sounds tested. For example, the (k) sound was examined in the initial position by a picture of a "cage", in the medial position by a picture of "ice cream", and in the final position by a picture of a "fork".

It was not possible to test all of the 14 phonemes examined in the initial, medial, and final positions. The (r) was examined in only the initial and medial positions as the regional Bostonian accent of the population does not include (r) in the final position. It was not found possible to illustrate words containing (ʒ) in the initial and final positions for kindergarten children, therefore, (ʒ) was tested in the medial position only. The (ʒ) sound was examined only in the medial position as it does not occur in the initial position of the English language and it could not be illustrated in the final position for kindergarten children.

The pictures of the Spontaneous Picture Articulation Test, the directions for its administration, and its score sheet will be found in Appendix A.

Reliability checks.-- Two checks of reliability were made of the Spontaneous Picture Articulation Test. The first was a reliability check of the writer's judgment relative to defective articulation as checked by means of another speech therapist testing ten randomly selected children at the same time as the writer. The coefficient of correlation between the writer's judgments and those of another speech therapist is .98.

Reliability was also checked by a retest of ten children one week after the first test. The coefficient of correlation for the two tests of the ten randomly selected children is .94. Therefore, it can be assumed that the Spontaneous Picture Articulation Tests are reliable indications of each child's speech ability.

Compilation of the Wood Articulation Index.-- The Wood Articulation Index^{1/} provides a method of determining a quantitative description of a person's ability to articulate consonant sounds correctly. Every consonant sound is assigned a numerical score, those consonants which occur more frequently in the language receive heavier weighted scores than those that occur less frequently.

The Wood Index supplies the sum of relative values of each consonant sound the person is able to produce correctly. If he could produce them all correctly his score would be 100. If he were able to produce every sound but (s) his score would be 91.1 because (s) accounts for 8.9 per cent of the consonant sounds oc-

^{1/}Wood, op. cit., p. 172.

curring in the language. Each child's misarticulations were converted into Wood's scores and their sum was subtracted from 100 in order to derive the articulation index for each child.

Criteria for Selecting the Sample Groups: The 300 test results of the Spontaneous Picture Articulation Test were scored according to the Wood Articulation Index and then ranked in a descending numerical order.

It was decided that if a child misarticulated a sound in only one position, the misarticulation was of too narrow scope to be investigated in this study. Beginning with the highest scores of the Spontaneous Picture Articulation Test, the first 50 children who had misarticulated one sound in at least two positions were selected to represent the children with "mild" speech difficulties.

The children who had the 50 lowest scores on the Spontaneous Picture Articulation Test were chosen to represent the "severe" group.

The 100 children studied in this investigation included 59 boys and 41 girls. Table 1 shows the distribution of the sexes within the two experimental groups.

Table 1. Distribution of the Sexes in the "Mild" and "Severe" Groups

Sex	"Mild"	"Severe"	Total
(1)	(2)	(3)	(4)
Males	23	36	59
Females	27	14	41
Totals	50	50	100

Testing Auditory Acuity: Upon the selection of the 100

children for the population of this study an individual test of auditory acuity was made. A sweep check method was the technique employed. The testing was accomplished on an Audiovox Audiometer, model number 7B, serial number 1088. The frequencies 250, 500, 1000, 2000, 4000, and 8000 were swept at 20 decibels. Any child who did not respond to the sweep check was given a threshold examination. None of the 100 children selected for this study had hearing losses.

Children not included in the study.-- Any child who appeared to be emotionally disturbed, mentally retarded, brain damaged, or had a physical condition which made normal articulation impossible, such as cerebral palsy or cleft palate, was not included in the study.

During the initial testing two children presented behavior which in the opinion of the writer was bizarre and were therefore excluded from the study.

Testing Imitative Articulation Ability

Testing ability to imitate the correct form of a misarticulated sound in isolation.-- The child's ability to imitate the correct form of his misarticulation was determined by presenting each misarticulated sound in isolation. Three sequences of vowels, the earlier developing consonants, and the correct form of a misarticulated sound were designed. The correct form of a misarticulated sound occurred at random three times within the sequence. The child was requested to imitate the vowels and other consonants as well as the correct production of a misarticulated sound. In this way, no special emphasis was placed upon the child's ability

to imitate a correct form of the misarticulation. The sequences and directions for administering the test will be found in Appendix B.

Testing ability to imitate the correct form of a misarticulated sound in nonsense syllables.-- The Carter^{1/}Nonsense Syllable Test was utilized to present the sound to the child in an unfamiliar phonetic environment. The same three vowel sounds: (i); (æ); and (ɑ) were employed throughout the tests of nonsense syllables. The testing of the (l) sound was accomplished in the following manner: initially (li, læ, lɑ); medially (ili, æ læ, ɑld); and finally (il, æ l, ɑl). The nonsense syllables and directions for administering the test will be found in Appendix B.

Testing ability to imitate the correct form of a misarticulated sound in words.-- The third test of imitation was of the correct form of a misarticulated sound in words. The words were the same as those employed in the test of the child's spontaneous speech. The words which had been misarticulated by the child in the Spontaneous Picture Articulation Test were spoken by the writer and the child was requested to imitate the word uttered. The directions for administering this test may be found in Appendix B.

Administration of the tests.-- The short attention span of the population during the first months of school made it impossible to administer the tests of imitative articulation in one sitting if four or more sounds were being examined. In this instance, the writer tested three sounds during the first session

^{1/}Carter & Buck, op. cit., p. 127.

and tested the remaining one or two sounds during the second period. In order to minimize the differences of response during the two testing periods, the second test occurred either on the same day or the succeeding day.

The entire population was administered the tests of imitative articulation before the auditory discrimination tests were given.

A speech therapist assisted the writer in administering the tests of auditory acuity, imitative articulation, and auditory discrimination to 24 children located in one of the schools included in the sample of the investigation.

Testing Auditory Discrimination Ability

Upon completion of the imitative articulation tests the 50 "mild" cases and the 50 "severe" cases were examined by the tests of auditory discrimination.

The phonemes investigated in the tests of auditory discrimination were the same sounds examined in the tests of imitative articulation. The auditory discrimination examination was divided into two sessions when four or more sounds were being examined.

Throughout the testing procedures the child was requested to clap his hands each time he thought he heard the test sound. With the exception of gross sounds, this response was made throughout the entire sequence of auditory discrimination procedures.

Testing auditory discrimination of gross sounds.-- Prior to the discrimination of phonemes the child's ability to discriminate gross sounds was examined. A group of noisemakers were first presented to the child and each sound was demonstrated by the writer. The Noisemakers selected as test items were a bell, horn,

cricket, and a rubber toy dog that made a noise when squeezed. The child listened for the bell throughout the entire testing sequence of gross sounds. As the noise-makers were in front of the child he was requested to turn around and listen. Each time he heard the bell he responded by turning around and facing the writer. The bell was presented to the child in three discriminating sequences. The directions for administering the test will be found in Appendix C.

Testing auditory discrimination of the correct form of a misarticulated sound among vowels.-- The writer presented the correct form of a misarticulated sound in a sequence of vowel sounds. The correct form was presented in three test items. The child responded to the aural stimulus of the test sound by clapping his hands. The test sequences and directions for administering the test will be found in Appendix C.

Testing auditory discrimination of the correct form of a misarticulated sound among acoustically dissimilar consonants.-- Three test items were constructed which examined the correct form of a misarticulated sound among acoustically dissimilar consonants. To illustrate, if the child was being tested on the unvoiced fricative (s), no fricatives or unvoiced sounds would appear in the discriminating sequence. Instead, (s) would be examined among nasals, voiced plosives and semi-vowels. Conversely, when a voiced sound was being examined, the testing sequence included unvoiced sounds of other phonetic categories.

A testing procedure for each voiced and unvoiced phonetic category was designed to include the misarticulations represented in the population of the study. Three test items were constructed

for the following categories: voiced fricatives, unvoiced fricatives, voiced plosives, unvoiced plosives and semi-vowels. The tests of each phonetic category and the directions for administering these tests will be found in Appendix C.

Testing auditory discrimination of the correct form of a misarticulated sound among acoustically similar consonants.--

Three testing procedures were designed that examined a misarticulated sound among acoustically similar consonants. To illustrate, if unvoiced fricative (s) was being examined the testing sequence included all unvoiced sounds, fricatives as well as other consonants.

A testing format was designed for each phonetic category represented by the misarticulations of the population. The tests of each phonetic category and the directions for administering these tests will be found in Appendix C.

Testing auditory discrimination of (θ) in the initial and final positions of words.-- Ten "mild" cases and ten "severe" cases were tested at the word level of discrimination. Time did not allow for the entire population to be tested by this procedure.

It was decided that all the children should be examined on the same sound. The (θ) was selected as the phoneme to be discriminated at the word level as not only was it the most frequent error in the Spontaneous Picture Articulation Test but the numerical score of (θ) in the Wood Articulation Index was low enough for it to be included within the scores of the "mild" group as well as the "severe" group. Each child tested had misarticulated the (θ) sound on the Spontaneous Picture Articulation Test.

In an attempt to have all the words included in the test items familiar to the child, spontaneous vocabulary lists^{1/} of

1/Battit, op. cit.

kindergarten children were utilized for the selection of the words employed. The testing of (θ) in the initial and final positions of words occurred approximately one month after the other tests of auditory discrimination had been administered.

Eight test items were designed; four items examined (θ) in the initial position of words and four items tested (θ) in the final position of words. Each test item contained four words. The (θ) word appeared once in each of the four word sequences. The child responded each time he thought he heard the (θ) word. The other three words in each test item did not contain the (θ) sound: the first two test items contained words that began (or ended) with a nasal, semivowel, and voiced plosive; the third test item contained words that began (or ended) with unvoiced plosives; and the final item contained an unvoiced fricative, an unvoiced plosive, and a word containing the sound the child substituted for (θ). In this manner, an attempt was made to have the test items progress in difficulty. The directions for administering the test and the words employed will be found in Appendix C.

Retest of Spontaneous Articulation Ability

Seven months after the initial Spontaneous Picture Articulation Test was given, the two groups were retested by the same instrument in order to ascertain the amount of speech growth of each child within the two groups. During the intervening seven month period, three children in the "mild" group had moved from the communities. This change of population now gave the sample 47 "mild" cases and 50 "severe" cases.

The entire Spontaneous Picture Articulation Test was read-

ministered to each child. Upon completion of the second testing, the sample was given a second spontaneous speech score according to the Wood^{1/} Articulation Index. The differences of each child's two spontaneous speech scores was ascertained and the 47 "mild" cases and 50 "severe" cases were ranked in order of the amount of difference or improvement in their two spontaneous speech tests. The rank order of differences was made separately for each of the two groups, "mild" and "severe".

Scoring of the Tests

The number of sounds being examined in the tests of imitative articulation and auditory discrimination was variable from child to child. Some children had been tested on only one misarticulated sound while others had been tested on two to five sounds. Therefore, the writer computed the number of correct responses made on each type of test and converted them into percentages. This procedure was followed for each test administered.

^{1/}Wood, op. cit., p. 172

Treatment of the Data

The specific statistical technique employed for the analysis of the data of this investigation was the chi square test. The chi square is a statistical method of testing if two groups are different by means of a null hypothesis. The statistical formula^{1/} employed was:

$$X^2 = \sum_{i=1}^k \frac{(o_i - e_i)^2}{e_i}$$

Hoel^{2/} describes the formula in the following manner. He states:

Now as a measure of the compatibility of . . . observed and expected frequencies, it is customary to calculate the statistic called X^2 , which is defined by

$$X^2 = \sum_{i=1}^k \frac{(o_i - e_i)^2}{e_i}$$

where k is the number of pairs of frequencies to be compared, o_i and e_i denote these frequencies and $\sum o_i = \sum e_i = n$. A value of zero would correspond to exact agreement with expectation, whereas increasingly large values of X^2 may be thought of as corresponding to increasing poor agreement.

^{1/}Paul G. Hoel, Introduction to Mathematical Statistics, John Wiley and Sons, New York, 1947, p. 187.

^{2/}Ibid.

The chi square test was applied to the following comparisons:

1. The "Mild" and "Severe" Groups: Ability to Imitate the Correct Form of a Misarticulated Sound in Isolation.
2. The "Mild" and "Severe" Groups: Ability to Imitate the Correct Form of a Misarticulated Sound in Nonsense Syllables.
3. The "Mild" and "Severe" Groups: Ability to Imitate the Correct Form of a Misarticulated Sound in Words.
4. The "Mild" and "Severe" Groups: Combined Scores of the Three Tests of Imitation.
5. The "Mild" and the "Severe" Groups: Ability to Discriminate Gross Sounds.
6. "Mild" and "Severe" Groups: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Vowels.
7. "Mild" and "Severe" Groups: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Dissimilar Consonants.
8. The "Mild" and "Severe" Groups: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Similar Consonants.
9. The "Mild" and "Severe" Groups: Combined Scores of the Four Tests of Auditory Discrimination.
10. The Upper and Lower Halves of the "Mild" Group: Ability to Imitate the Correct Form of a Misarticulated Sound in Isolation.
11. The Upper and Lower Halves of the "Mild" Group: Ability to Imitate the Correct Form of a Misarticulated Sound in

Nonsense Syllables.

12. The Upper and Lower Halves of the "Mild" Group: Ability to Imitate the Correct Form of a Misarticulated Sound in Words.
13. The Upper and Lower Halves of the "Mild" Group: Combined Scores of the Three Tests of Imitation.
14. The Upper and Lower Halves of the "Mild" Group: Ability to Discriminate Gross Sounds.
15. The Upper and Lower Halves of the "Mild" Group: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Vowels.
16. The Upper and Lower Halves of the "Mild" Group: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Dissimilar Consonants.
17. The Upper and Lower Halves of the "Mild" Group: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Similar Consonants.
18. The Upper and Lower Halves of the "Mild" Group: Combined Scores of the Four Tests of Auditory Discrimination.
19. The Upper and Lower Halves of the "Severe" Group: Ability to Imitate the Correct Form of a Misarticulated Sound in Isolation.
20. The Upper and Lower Halves of the "Severe" Group: Ability to Imitate the Correct Form of a Misarticulated Sound in Nonsense Syllables.
21. The Upper and Lower Halves of the "Severe" Group: Ability to Imitate the Correct Form of a Misarticulated

Sound in Words.

22. The Upper and Lower Halves of the "Severe" Group: Combined Scores of the Three Tests of Imitation.
23. The Upper and Lower Halves of the "Severe" Group: Ability to Discriminate Gross Sounds.
24. The Upper and Lower Halves of the "Severe" Group: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Vowels.
25. The Upper and Lower Halves of the "Severe" Group: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Dissimilar Consonants.
26. The Upper and Lower Halves of the "Severe" Group: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Similar Consonants.
27. The Upper and Lower Halves of the "Severe" Group: Combined Scores of the Four Tests of Auditory Discrimination.

CHAPTER IV

ANALYSIS OF THE DATA

The variables of this study will be analyzed and in all cases, the 5 per cent level of significance was used as the critical value; that is, if the value of chi square was significant at the 5 per cent level, the null hypothesis was rejected. Where the chi square fell at the .05 level, .01 level, or .001 levels of significance they are shown in the tables.

Improvement in Articulation Ability

Upon inspection of Tables 2 and 3 of the differences of the two Articulation Indices of the Spontaneous Articulation Tests of the "mild" and "severe" groups, it appears, that in general, both groups showed improvement in the second Spontaneous Picture Articulation Test.

In the "mild" group the greatest amount of difference in any one child's Articulation Index was 6.17. The mean articulation index of the "mild" group's Spontaneous Picture Articulation Test I was 97.39, and 98.62 was the mean of Spontaneous Picture Articulation Test II. The mean of the differences between Tests I and II for the "mild" group was 1.22. Five children's Articulation Indices remained the same as on the earlier test and four children's Articulation Indices were lower on the second test than the index received on the first test.

Table 2. "Mild" Group - Articulation Indices of the Spontaneous Picture Articulation Tests I and II

Case No.	Articulation Indices of Spontaneous Test I	Articulation Indices of Spontaneous Test II	Differences
1	99.40	99.70	.30
2	99.40	99.40	.00
3	99.40	100.00	.60
4	99.40	100.00	.60
5	99.40	99.40	.00
6	99.40	100.00	.60
7	99.37	99.10	-.27
8	99.10	99.70	.60
9	99.10	99.10	.00
10	99.10	100.00	.90
11	99.10	99.10	.00
12	99.10	100.00	.90
13	98.87	100.00	1.13
14	98.60	100.00	1.40
15	98.40	100.00	1.60
16	98.40	99.20	.80
17	98.40	100.00	1.60
18	98.10	98.90	.80
19	98.10	98.37	.27
20	97.77	100.00	2.23
21	97.77	98.07	.30
22	97.74	98.34	.60
23	97.60	100.00	2.40
24	97.60	99.20	1.60
25	97.44	98.21	.77
26	97.37	100.00	2.63
27	97.30	98.90	1.60
28	97.00	99.10	2.10
29	97.00	97.00	.00
30	96.97	98.40	1.43
31	96.97	99.20	2.23
32	96.91	98.57	1.66
33	96.70	98.90	2.20
34	96.70	97.50	.80
35	96.50	98.20	1.70

(continued on next page)

Table 2. (concluded)

Case No.	Articulation Indices of Spontaneous Test I	Articulation Indices of Spontaneous Test II	Differences
36	96.47	96.80	.33
37	96.17	95.87	-.30
38	95.70	100.00	4.30
39	95.67	97.77	2.10
40	95.57	99.67	4.10
41	95.50	95.80	.30
42	95.47	99.77	4.30
43	95.40	91.54	-3.86
44	94.81	91.34	-3.47
45	94.10	99.40	5.30
46	93.83	100.00	6.17
47	93.60	95.70	2.10
Mean	97.39	98.62	1.22

Table 3. "Severe" Group - Articulation Indices of the Spontaneous Picture Articulation Tests I and II

Case No.	Articulation Indices of Spontaneous Test I	Articulation Indices of Spontaneous Test II	Differences
1	63.71	64.61	.90
2	64.28	74.66	10.38
3	65.76	74.66	8.90
4	67.35	74.72	7.37
5	69.90	80.31	10.41
6	71.14	78.07	6.93
7	72.07	77.21	5.14
8	73.67	88.11	14.44
9	74.18	76.28	2.10
10	75.38	82.21	6.83
11	76.18	77.98	1.80
12	76.84	76.84	.00
13	78.50	87.97	9.47
14	78.71	85.11	6.40
15	79.10	90.57	11.47
16	80.60	80.60	.00
17	81.17	83.27	2.10
18	81.81	83.04	1.23
19	82.04	83.67	1.63
20	82.37	90.36	7.99
21	82.62	82.62	.00
22	82.87	84.34	1.47
23	83.04	86.57	3.53
24	83.10	82.70	-.40
25	83.27	84.07	.80
26	84.24	96.60	12.36
27	84.47	86.57	2.10
28	84.54	99.40	14.86
29	84.70	86.80	2.10
30	84.84	84.84	.00
31	85.01	90.61	5.60
32	85.10	90.96	5.86
33	85.14	94.04	8.90
34	85.31	94.31	9.00
35	85.77	89.50	3.73

(continued on next page)

Table 3. (concluded)

Case No.	Articulation Indices of Spontaneous Test I	Articulation Indices of Spontaneous Test II	Differences
36	86.30	86.60	.30
37	86.41	94.04	7.63
38	86.80	81.56	-5.24
39	86.80	86.80	.00
40	86.80	86.80	.00
41	86.80	86.80	.00
42	86.80	86.80	.00
43	86.80	100.00	13.20
44	86.84	91.27	4.43
45	87.31	90.67	3.36
46	87.32	93.07	5.75
47	87.40	90.60	3.20
48	87.41	87.41	.00
49	87.44	88.24	.80
50	88.87	89.67	.80
Mean	78.09	84.09	4.39

The greatest amount of difference of improvement in any one child's Articulation Index in the "severe" group was 14.86. The mean articulation index of the "severe" group's Spontaneous Picture Articulation Test I was 78.09, and 84.08 was the mean of Spontaneous Picture Articulation Test II. The mean of the differences between Tests I and II for the "severe" group was 4.39. Nine children in the "severe" group showed no difference of improvement in their articulation in the second test and two children had lower scores on the second test of spontaneous speech than they had had on their first test. Although the "severe" group as a whole showed improvement in their second Spontaneous Picture Articulation Test as compared to the first, their gain did not place them at an articulatory level with the "mild" group.

As the greatest difference of improvement in the "severe" group was 14.86 and highest difference of improvement of the "mild" group was 6.17, it would appear that these data support Pettit's^{1/} findings that the children with the lower initial articulation scores, in general, showed greater changes in raw scores in the second articulation examination than the child who started with a higher score.

Table 4. t-Test of the Spontaneous Picture Articulation Tests I and II of the "Mild" and "Severe" Groups

Group	Mean Difference	Standard Deviation	t-scores
Mild	1.2223	.2590	4.7193***
Severe	4.3926	.6486	6.7724***

*** All t ratios in this table are significant at the .001 level.

^{1/}Pettit, op. cit.

Table 4 indicates that when the "mild" and "severe" groups are taken as wholes each made highly significant improvement of their misarticulated sounds during a seven months period without any remedial methods being employed.

Table 5. Number of Misarticulations on the 14 Sounds Examined in the Spontaneous Picture Articulation Tests I and II

Sounds	"Mild" Group						"Severe" Group					
	Test I			Test II			Test I			Test II		
	I	M	F	I	M	F	I	M	F	I	M	F
l	3		7	3		1	12	18	25	9	8	14
f		1	2				8	12	11	3	5	5
s	1	2	1				42	38	34	33	32	26
tʃ	2	2	2	1	2	2	10	13	13	8	16	15
θ	28	29	25	16	15	11	25	23	22	21	22	18
k								6	2		6	2
dʒ		2	7		1	4	9	13	18	7	12	13
z	4	4	4	3	1	3	36	36	36	29	28	31
r	1	1	*	1	1	*	23	26	*	21	19	*
ʒ	*	8	*	*	4	*	*	22	*	*	18	*
ʃ	*	6	*	*	3	*	*	24	*	*	17	*
ʒ	4	6	5	3	3	3	13	18	18	6	14	15
g							1	2	2		1	1
v	17	13	11	10	3	3	26	13	15	19	10	10

* Sound was not tested in this position

Table 5 shows the number of misarticulations in the initial, medial, and final positions of the 14 phonemes examined in the two Spontaneous Picture Articulation Tests. The data of this table would appear to indicate that if a child does not have (k) in his speech pattern by the beginning of kindergarten it will not evolve through maturation. The most frequent misarticulation of the entire sample was (θ). However, the greatest misarticulation of the "severe" group in Tests I and II was (s) and the "mild" group's most frequent misarticulation in Tests I and II was (θ). This discrepancy may be accounted for by the use of the Wood^{1/} Index. Wood gives (s) a total score of 8.9 for all three posi-

^{1/}Wood, op. cit., p. 172.

tions: initial, medial, and final, and a score of 2.97 for each individual position. The numerical total score Wood gives (θ) is .9 for the three positions: initial, medial, and final, and a score of .30 for each individual position. The numerical weight of the (s) would, in general, tend to place a child in the "severe" group. Therefore, there would be more misarticulations of (s) among the "severe" group.

The "mild" group had a slight improvement of ($t\int$) in the initial position but no improvement in the medial and final positions. The "severe" group had a similar slight improvement of ($t\int$) in the initial position but the number of misarticulations in the medial and final positions increased slightly during the second testing. All other sounds examined indicate a gradual improvement of articulation.

Significance of Comparisons

Table 6a. Chi Square Table - "Mild" and "Severe" Groups: Ability to Imitate the Correct Form of a Misarticulated Sound in Isolation

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Mild	29	22.8	18	24.2	47
Severe	18	24.2	32	25.8	50
Total	47		50		97

Table 6b. Chi Square Information - Relative to the "Mild" and "Severe" Groups' Abilities to Imitate a Misarticulated Sound in Isolation

(1)	(2)	(3)	(4)	(5)	(6)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	χ^2 .001	Interpretation
6.4078	1	3.84	6.64	10.43	Denys the null hypothesis at the .05 level. Does not deny at the .01 or .001 levels

The null hypothesis was made that there is a lack of relationship between the "mild" and "severe" groups' abilities to imitate a misarticulated sound in isolation. The chi square denies the null hypothesis at the .05 level of confidence. The null hypothesis is not denied at the .01 level or the .001 level. Thus, the "mild" tends to have greater ability in imitating the correct form of a misarticulated sound in isolation than the "severe" group.

Table 7a. Chi Square Table - "Mild" and "Severe" Groups: Ability to Imitate the Correct Form of a Misarticulated Sound in Nonsense Syllables

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Mild	34	23.7	13	23.3	47
Severe	15	25.3	35	24.7	50
Total	49		48		97

Table 7b. Chi Square Information - Relative to the "Mild" and "Severe" Groups' Abilities to Imitate the Correct Form of a Misarticulated Sound in Nonsense Syllables

(1)	(2)	(3)	(4)	(5)	(6)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	χ^2 .001	Interpretation
17.3745	1	3.84	6.64	10.43	Denys the null hypothesis at all levels

The null hypothesis was made that there is a lack of relationship between the "mild" and "severe" groups' abilities to imitate a misarticulated sound in nonsense syllables. At the .001 level, the hypothesis of no difference in ability to imitate nonsense syllables is rejected or denied. The "mild" group had greater ability in imitating the correct form of a misarticulated sound in nonsense syllables.

Table 8a. Chi Square Table - "Mild" and "Severe" Groups: Ability to Imitate the Correct Form of a Misarticulated Sound in Words

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Mild	30	23.3	17	23.7	47
Severe	18	24.7	32	25.3	50
Total	48		49		97

Table 8b. Chi Square Information - Relative to the "Mild" and "Severe" Groups' Abilities to Imitate the Correct Form of the Misarticulated Sound in Words.

(1)	(2)	(3)	(4)	(5)	(6)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	χ^2 .001	Interpretation
7.5062	1	3.84	6.64	10.43	Hypothesis denied at the .01 level and .05 levels. Does not deny the .001 level.

The null hypothesis was made that there is a lack of relationship between the "mild" and "severe" groups' abilities to imitate the misarticulated sound in words. The chi square of 7.5062 denies the null hypothesis at the 1 per cent level of significance. The children in the "mild" group had greater ability in imitating the correct form of the misarticulated sound in words.

Table 9a. Chi Square Table - "Mild" and "Severe" Groups - Combined Scores of the Three Tests of Imitation

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Mild	32	22.3	15	24.7	47
Severe	14	23.7	36	26.3	50
Total	46		51		97

Table 9b. Chi Square Information - Relative to the Combined Scores of the "Mild" and "Severe" Groups' Three Tests of Imitation

(1)	(2)	(3)	(4)	(5)	(6)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	χ^2 .001	Interpretation
15.6127	1	3.84	6.64	10.83	Denys the null hypothesis at all levels

The null hypothesis was made that there is a lack of relationship between the "mild" and "severe" groups' three tests of imitation. At the .001 level of confidence the hypothesis of the three tests of imitation is rejected or denied. Children in the "mild" group have greater ability in the three tests of imitation than the children in the "severe" group.

Table 10a. Chi Square Table - "Mild" and "Severe" Group: Ability to Discriminate Gross Sounds

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Mild	34	33.9	13	13.1	47
Severe	36	36.1	14	13.9	50
Total	70		27		97

Table 10b. Chi Square Information - Relative to the "Mild" and "Severe" Groups' Abilities to Discriminate Gross Sounds

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
.0014	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the "mild" and "severe" groups' abilities to discriminate gross sounds. Since chi square was not significant at the 5 per cent level the null hypothesis is not denied. The ability to discriminate gross sounds was similar for both groups.

Table 11a. Chi Square Table - "Mild" and "Severe" Groups:
Ability to Discriminate the Correct Form of a
Misarticulated Sound Among Vowels

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Mild	28	22.3	19	24.7	47
Severe	18	23.7	32	26.3	50
Total	46		51		97

Table 11b. Chi Square Information - Relative to the "Mild" and
"Severe" Groups' Abilities to Discriminate the Correct
Form of a Misarticulated Sound Among Vowels

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
5.4000	1	3.84	6.64	Denys the null hypothesis at the 5 per cent level; does not deny at 1 per cent level

The null hypothesis was made that there is a lack of relationship between the "mild" and "severe" groups' abilities to discriminate a misarticulated sound among vowels. The chi square denys the null hypothesis at the 5 per cent level. The null hypothesis is not denied at the 1 per cent level. The children in the "mild" group tend to have greater ability in discriminating the correct form of a misarticulated sound among vowels.

Table 12a. Chi Square Table - "Mild" and "Severe" Groups: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Dissimilar Consonants

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Mild	30	23.3	17	23.7	47
Severe	18	24.7	32	25.3	50
Total	48		49		97

Table 12b. Chi Square Information - Relative to the "Mild" and "Severe" Groups' Abilities to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Dissimilar Consonants

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
7.5062	1	3.84	6.64	Denys the hypothesis at both levels

The null hypothesis was made that there is a lack of relationship between the "mild" and "severe" groups' abilities to discriminate a misarticulated sound among acoustically dissimilar consonants. The hypothesis was denied at both levels; there is a relationship. The "mild" group had greater ability in discriminating a misarticulated sound among acoustically dissimilar consonants.

Table 13a. Chi Square Table - "Mild" and "Severe" Groups: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Similar Consonants

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Mild	31	28.6	16	18.4	47
Severe	28	30.4	22	19.6	50
Total	59		38		97

Table 13b. Chi Square Information Relative to the "Mild" and "Severe" Groups' Abilities to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Similar Consonants

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
1.0081	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the "mild" and "severe" groups' abilities to discriminate the correct form of a misarticulated sound among acoustically similar consonants. Since chi square was not significant at the 5 per cent level the null hypothesis was not denied.

Table 14a. Chi Square Table - "Mild" and "Severe" Groups: Comparison of the Combined Scores of the Four Tests of Auditory Discrimination

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Mild	30	25.7	17	21.3	47
Severe	23	27.3	27	22.7	50
Total	53		44		97

Table 14b. Chi Square Information - Relative to the "Mild" and "Severe" Groups' Combined Scores of the Four Tests of Auditory Discrimination

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	$\chi^2_{.05}$	$\chi^2_{.01}$	Interpretation
3.1074	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the "mild" and "severe" groups on the four tests of auditory discrimination. Since the null hypothesis is not denied it can be assumed that the two groups are not different in auditory discrimination ability.

Chi Square Test of the Upper and Lower Halves of the
"Mild" and "Severe" Groups

In order to determine the predictive value of the tests within the "mild" and "severe" groups, comparisons were made between the upper and lower halves of each group. Thus, within each group, those children for whom there was "greater growth" in articulation ability in each group were compared with those for whom there was "less growth" in articulation ability. Since the "mild" group had an uneven number of cases, 47, the upper 23 cases were compared with the lower 23 cases.

Table 15a. Chi Square Table - "Mild" Group's Ability to Imitate a Misarticulated Sound in Isolation

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	11	10.5	12	12.5	23
Less Improvement	10	10.5	13	12.5	23
Total	21		25		46

Table 15b. Chi Square Information - Relative to the "Mild" Group's Ability to Imitate a Misarticulated Sound in Isolation

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
.0876	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "mild" group in ability to imitate a misarticulated sound in isolation. Since chi square was not denied at the 5 per cent level the null hypothesis is not denied. Therefore, ability to articulate a sound in isolation is not related to the amount of improvement within the "mild" group.

Table 16a. Chi Square Table - "Mild" Group's Ability to Imitate a Misarticulated Sound in Nonsense Syllables

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	14	12	9	11	23
Less Improvement	10	12	13	11	23
Total	24		22		46

Table 16b. Chi Square Information - Relative to the "Mild" Group's Ability to Imitate a Misarticulated Sound in Nonsense Syllables

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
1.3939	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "mild" group in ability to imitate a misarticulated sound in nonsense syllables. Since chi square was not denied at either level of significance the null hypothesis is not denied. Therefore, ability to articulate nonsense syllables is not related to the amount of improvement within the "mild" group.

Table 17a. Chi Square Table - "Mild" Group's Ability to Imitate a Misarticulated Sound in Words

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	15	10	8	13	23
Less Improvement	5	10	18	13	23
Total	20		26		46

Table 17b. Chi Square Information - Relative to the "Mild" Group's Ability to Imitate a Misarticulated Sound in Words

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
8.8462	1	3.84	6.64	Denys the null hypothesis at both levels

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "mild" group in ability to imitate a misarticulated sound in words. The null hypothesis is clearly adjusted at both levels in favor of an alternative hypothesis, that the ability to imitate words is related to the amount of improvement within the "mild" group.

Table 18a. Chi Square Table - Combined Scores for the "Mild" Group on the Three Tests of Imitation

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	15	11.5	8	11.5	23
Less Improvement	8	11.5	15	11.5	23
Total	23		23		46

Table 18b. Chi Square Information - Relative to the Combined Scores for the "Mild" Group on the Three Tests of Imitation

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
4.2609	1	3.84	6.64	Denys the null hypothesis at the 5 per cent level: does not deny at the 1 per cent level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "mild" group's combined scores of imitation. At the 5 per cent level, the hypothesis of the combined scores is rejected. Therefore, the ability encompassed in the three tests of imitation is related to the amount of improvement within the "mild" group.

Table 19a. Chi Square Table - "Mild" Group's Ability to Discriminate Gross Sounds

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	17	16.5	6	6.5	23
Less Improvement	16	16.5	7	6.5	23
Total	33		13		46

Table 19b. Chi Square Information - Relative to the "Mild" Group's Ability to Discriminate Gross Sounds

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
.1072	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "mild" group in ability to discriminate gross sounds. The chi square test supports the null hypothesis of no relationship. Therefore, ability to discriminate gross sounds is not related to the amount of improvement within the "mild" group.

Table 20a. Chi Square Table - "Mild" Group's Ability to Discriminate a Misarticulated Sound Among Vowels

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	14	13	9	10	23
Less Improvement	12	13	11	10	23
Total	26		20		46

Table 20b. Chi Square Information - Relative to the "Mild" Group's Ability to Discriminate a Misarticulated Sound Among Vowels

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
.3538	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "mild" group in ability to discriminate the correct form of a misarticulated sound among vowels. The chi square test supports the hypothesis of no relationship. Therefore, the ability to discriminate the correct form of the misarticulated sound among vowels is not related to the amount of improvement within the "mild" group.

Table 21a. Chi Square Table - Mild Group: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Dissimilar Consonants

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	14	13.5	9	9.5	23
Less Improvement	13	13.5	10	9.5	23
Total	27		19		46

Table 21b. Chi Square Information - Relative to the Mild Group's Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Dissimilar Consonants

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
.0897	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "mild" group in ability to discriminate the correct form of a misarticulated sound among acoustically dissimilar consonants. The chi square of .0897 does not deny the null hypothesis. Therefore, the ability to discriminate the correct form of a misarticulated sound among acoustically dissimilar consonants is not related to the amount of improvement within the "mild" group.

Table 22a. Chi Square Table - "Mild" Group: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Similar Consonants

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	14	15	9	8	23
Less Improvement	16	15	7	8	23
Total	30		16		46

Table 22b. Chi Square Information - Relative to the "Mild" Group's Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Similar Consonants

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	$\chi^2_{.05}$	$\chi^2_{.01}$	Interpretation
.3833	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "mild" group in ability to discriminate the correct form of a misarticulated sound among acoustically similar consonants. Since chi square was not significant the null hypothesis is not denied. Therefore, the ability to discriminate the correct form of a misarticulated sound among acoustically similar consonants is not related to the amount of improvement within the "mild" group.

Table 23a. Chi Square Table - Combined Scores for the Mild Group on Four Tests of Auditory Discrimination

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	15	14.5	8	8.5	23
Less Improvement	14	14.5	9	8.5	23
Total	29		17		46

Table 23b. Chi Square Information - Relative to the Combined Scores for the Mild Group on Four Tests of Auditory Discrimination

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
.0933	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "mild" group on the four tests of auditory discrimination. The chi square test supports the hypothesis of no relationship. Therefore, the combined score of the four tests of auditory discrimination is not related to the amount of improvement within the "mild" group.

Table 24a. Chi Square Table - "Severe" Group's Ability to Imitate the Correct Form of a Misarticulated Sound in Isolation

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	15	12	10	13	25
Less Improvement	9	12	16	13	25
Total	24		26		50

Table 24b. Chi Square Information - Relative to the "Severe" Group's Ability to Imitate the Correct Form of a Misarticulated Sound in Isolation

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
2.8846	1	3.84	6.84	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "severe" group in ability to imitate the correct form of a misarticulated sound in isolation. The chi square test of 2.8846 does not deny the null hypothesis. Therefore, the ability to articulate a sound in isolation is not related to the amount of improvement within the "severe" group.

Table 25a. Chi Square Table - "Severe" Group - Ability to Imitate the Correct Form of a Misarticulated Sound in Nonsense Syllables

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	17	12.5	8	12.5	25
Less Improvement	8	12.5	17	12.5	25
Total	25		25		50

Table 25b. Chi Square Information - Relative to the "Severe" Group's Ability to Imitate the Correct Form of a Misarticulated Sound in Nonsense Syllables

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
6.4800	1	3.84	6.64	Denys the null hypothesis at the 5 per cent level; does not deny at the 1 per cent level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "severe" group in ability to imitate the correct form of a misarticulated sound in nonsense syllables. The null hypothesis is denied at the 5 per cent level of confidence but not at the 1 per cent level of confidence. Therefore, it appears that ability to imitate nonsense syllables will be related to the amount of improvement in most children with "severe" articulatory disorders.

Table 26a. Chi Square Table - "Severe" Group - Ability to Imitate the Correct Form of a Misarticulated Sound in Words

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	16	12	9	13	25
Less Improvement	8	12	17	13	25
Total	24		26		50

Table 26b. Chi Square Information - Relative to the "Severe" Group's Ability to Imitate the Correct Form of a Misarticulated Sound in Words

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
5.1282	1	3.84	6.64	Denys the null hypothesis at the 5 per cent level; does not deny at the 1 per cent level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the severe group's ability to imitate the correct form of a misarticulated sound in words. The chi square test ~~denys~~ the null hypothesis at the 5 per cent level. The null hypothesis is not denied at the 1 per cent level. Therefore, the ability to articulate a misarticulated sound in words is related to the amount of improvement for most cases within the "severe" group.

Table 27a. Chi Square Table - Combined Scores for the "Severe" Group on Three Tests of Imitation

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	15	11.5	10	13.5	25
Less Improvement	8	11.5	17	13.5	25
Total	23		27		50

Table 27b. Chi Square Information - Relative to the Combined Scores for the "Severe" Group on Three Tests of Imitation

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
3.9452	1	3.84	6.64	Denys the null hypothesis at the 5 per cent level; does not deny at 1 per cent level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "severe" group on three tests of imitation. The null hypothesis was denied at the 5 per cent level. The chi square test was not denied at the 1 per cent level. Therefore, the combined score of the "severe" group's three tests of imitation is related to the amount of improvement for most individuals within the "severe" group.

Table 28a. Chi Square Table - "Severe" Group - Ability to Discriminate Gross Sounds

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	19	18	6	7	25
Less Improvement	17	18	8	7	25
Total	36		14		50

Table 28b. Chi Square Information - Relative to the "Severe" Group's Ability to Discriminate Gross Sounds

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
.3968	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "severe" group in ability to discriminate gross sounds. The chi square test does not deny the null hypothesis at either level of confidence. Therefore, the ability to discriminate gross sounds is not related to the amount of improvement within the "severe" group.

Table 29a. Chi Square Table - "Severe" Group's Ability to Discriminate the Correct Form of a Misarticulated Sound Among Vowels

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	13	12.5	12	12.5	25
Less Improvement	12	12.5	13	12.5	25
Total	25		25		50

Table 29b. Chi Square Information - Relative to the "Severe" Group's Ability to Discriminate the Correct Form of a Misarticulated Sound Among Vowels

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
.0800	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "severe" group in ability to discriminate the correct form of a misarticulated sound among vowels. The chi square of .0800 does not deny the null hypothesis. Therefore, the ability to discriminate the correct form of a misarticulated sound among vowels is not related to the amount of improvement within the "severe" group.

Table 30a. Chi Square Table - "Severe" Group: Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Dissimilar Consonants

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	12	12.5	13	12.5	25
Less Improvement	13	12.5	12	12.5	25
Total	25		25		50

Table 30b. Chi Square Information - Relative to the "Severe" Group's Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Dissimilar Consonants

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
.0800	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "severe" group in ability to discriminate the correct form of a misarticulated sound among acoustically dissimilar consonants. The chi square test does not deny the null hypothesis at either level of confidence. Therefore, the ability to discriminate the correct form of a misarticulated sound among acoustically dissimilar consonants is not related to the amount of improvement within the "severe" group.

Table 31a. Chi Square Table - "Severe" Group: Ability to Discriminate a Misarticulated Sound Among Acoustically Similar Consonants

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	14	14	11	11	25
Less Improvement	14	14	11	11	25
Total	28		22		50

Table 32b. Chi Square Information - Relative to the "Severe" Group's Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Similar Consonants

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
0	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "severe" group in ability to discriminate the correct form of a misarticulated sound among acoustically similar consonants. Since chi square equalled zero the null hypothesis is not denied. Therefore, the ability to discriminate the correct form of a misarticulated sound among acoustically similar consonants is not related to the amount of improvement within the "severe" group.

Table 32a. Chi Square Table - Combined Scores for the "Severe" Group on Four Tests of Auditory Discrimination

	Superior Ability		Inferior Ability		Total
	Observed Values	Expected Values	Observed Values	Expected Values	
(1)	(2)	(3)	(4)	(5)	(6)
Greater Improvement	12	12	13	13	25
Less Improvement	12	12	13	13	25
Total	24		26		50

Table 32b. Chi Square Information - Relative to the Combined Scores for the "Severe" Group on Four Tests of Auditory Discrimination

(1)	(2)	(3)	(4)	(5)
Calculated χ^2	d.f.	χ^2 .05	χ^2 .01	Interpretation
0	1	3.84	6.64	Does not deny the null hypothesis at either level

The null hypothesis was made that there is a lack of relationship between the upper and lower halves of the "severe" group on four tests of auditory discrimination. Since chi square equalled zero the null hypothesis is not denied. Therefore, the combined scores on the four tests of auditory discrimination are not related to the amount of improvement within the "severe" group.

Table 33. Auditory Discrimination of (θ) Words Compared to Improvement in Articulation of (θ) From the First to the Second Spontaneous Speech Test by the "Mild" Group

Case No.	Percentage of Correct Responses on Auditory Discrimination Test	Percentage of Improvement on (θ) in Second Spontaneous Speech Test
1	32	0
2	0	67
3	0	100
4	0	100
5	62	67
6	0	100
7	87	33
8	0	0
9	25	0
10	0	0

Table 33 indicates that only four of the children in the "mild" group were able to discriminate any of the (θ) words. Also, the amount of improvement in ability to articulate (θ) does not appear to be related to the ability to discriminate (θ) in words as the three children who scored 100 per cent improvement in articulation of (θ) in the second spontaneous speech test had zero discrimination scores.

Table 34. Auditory Discrimination of (Θ) in Words Compared to Improvement in Articulation of (Θ) From the First to the Second Spontaneous Speech Test By the "Severe" Group

Case No.	Percentage of Correct Responses on Auditory Discrimination Test	Percentage of Improvement of (Θ) in Second Spontaneous Speech Test
1	0	0
2	0	0
3	0	0
4	50	67
5	0	0
6	0	33
7	0	100
8	0	0
9	0	0
10	0	50

Table 34 indicates that only one child in the "severe" group was partially able to discriminate (Θ) in words. It would appear that kindergarten children who have "severe" misarticulations are incapable of discriminating the sounds which they misarticulate in the initial and final positions of words. The one child in the "severe" group who had 100 per cent improvement of (Θ) in the second spontaneous speech test misarticulated (Θ) in only one position.

Inspection of the data of the tests of auditory discrimination of (Θ) in the initial and final positions of words would indicate that this instrument had no prognostic value.

CHAPTER V

SUMMARY AND CONCLUSIONS

Purpose of the study.-- This study attempted to determine the value of a battery of imitative articulation and auditory discrimination tests in predicting the speech development of two groups of kindergarten children.

Procedure.-- The children who comprise the sample population were obtained by means of a Spontaneous Picture Articulation Test. This test instrument was administered to 300 kindergarten children in two communities. The test results were scored according to the Wood Articulation Index^{1/} and then ranked in a descending numerical order. The 50 children who had misarticulated one sound in at least two positions and had the higher Articulation Indices were selected to represent the "mild" type of articulation difficulty. The children who had the 50 lowest Articulation Indices were chosen to represent the "severe" type of articulation disorder.

The two groups were screened for hearing acuity on a pure tone audiometer at 20 decibels. Any child who presented a physical or emotional condition which would affect normal articulation was not included in the investigation.

A group of Imitative Articulation and Auditory Discrimination Tests were administered to each child for each of the

^{1/}Wood, op. cit., p. 172.

sounds he misarticulated. Imitative articulation ability was secured by means of the following test instruments:

1. A Test of Ability to Imitate the Correct Form of a Misarticulated Sound in Isolation.
2. A Test of Ability to Imitate the Correct Form of a Misarticulated Sound in Nonsense Syllables.
3. A Test of Ability to Imitate the Correct Form of a Misarticulated Sound in Words.

Auditory discrimination ability was determined from the following tests:

1. An Auditory Discrimination Test of Gross Sounds.
2. An Auditory Discrimination Test of the Correct Form of a Misarticulated Sound Among Vowels.
3. An Auditory Discrimination Test of the Correct Form of a Misarticulated Sound Among Acoustically Dissimilar Consonants.
4. An Auditory Discrimination Test of the Correct Form of a Misarticulated Sound Among Acoustically Similar Consonants.
5. An Auditory Discrimination Test of (Θ) in the Initial and Final Positions of Words.

Seven months after the initial Spontaneous Picture Articulation Test was administered, the two groups were retested by the same instrument in order to ascertain the amount of speech growth of each child within the "mild" and "severe" groups.

The data of this study was analyzed by means of the chi square test.

Results of the study.-- Comparisons between the amount of growth in articulation ability and the imitative articulation and auditory discrimination abilities revealed the following results:

1. The "mild" and "severe" groups made highly significant improvement in articulation during the seven months period without receiving speech therapy. In the "mild" group the mean Articulation Index was 97.39 on the first test, and 98.62 on the second test. In the "severe" group the mean Articulation Index was 78.09 on the first test and 84.09 on the second test. The improvement for each group was significant at the .001 level of confidence.
2. (θ) was the most frequent misarticulated sound of the entire sample.
3. The "mild" group had significantly greater ability than the "severe" group in the imitation of the correct form of a misarticulated sound in nonsense syllables. This factor was significant at the .001 level of confidence.
4. The "mild" group had significantly greater ability than the "severe" group in the imitation of the correct form of a misarticulated sound in words. This factor was significant at the .01 level of confidence.
5. The "mild" group had significantly greater ability than the "severe" group in the imitation of the correct form of a misarticulated sound in isolation. The difference in ability was significant at the .05 level of confidence.

6. The "mild" group had significantly greater ability than the "severe" group in the imitation of the correct form of a misarticulated sound in words. The difference in ability was significant at the .01 level of confidence.
7. The "mild" group had significantly greater ability than the "severe" group in the auditory discrimination of the correct form of a misarticulated sound among acoustically dissimilar consonants. The difference in ability was significant at the .01 level of confidence.
8. The "mild" group had significantly greater ability than the "severe" group in the auditory discrimination of the correct form of a misarticulated sound among vowels. The difference in ability was significant at the .05 level of confidence.
9. The ability to imitate the correct form of a misarticulated sound in words was related to the amount of improvement within the "mild" group. This factor was significant at the .01 level of confidence.
10. The following abilities were not related to the amount of improvement within the "mild" group: ability to imitate the correct form of a misarticulated sound in isolation; ability to imitate the correct form of a misarticulated sound in nonsense syllables; ability to discriminate gross sounds; ability to discriminate the correct form of a misarticulated sound among vowels; ability to discriminate the correct form of a misarticulated sound among acoustically dissimilar consonants; and ability to discriminate the correct form of a mis-

- articulated sound among acoustically similar consonants.
11. The ability to imitate the correct form of a misarticulated sound in nonsense syllables and the ability to imitate the correct form of a misarticulated sound in words was related to the amount of improvement within the "severe" group. These factors were significant at the .05 level of confidence.
 12. The following abilities were not related to the amount of improvement within the "severe" group: ability to imitate the correct form of a misarticulated sound in isolation, ability to discriminate gross sounds; ability to discriminate the correct form of a misarticulated sound among vowels; ability to discriminate the correct form of a misarticulated sound among acoustically dissimilar consonants; and ability to discriminate the correct form of a misarticulated sound among acoustically similar consonants.
 13. Of the 20 children administered the Auditory Discrimination Test of (Θ) in the Initial and Final Positions of Words, there were no children in either the "mild" or "severe" groups who were able to discriminate all of the (Θ) words correctly. Four children in the "mild" group were able to discriminate some of the (Θ) words and only one child in the "severe" group was partially able to discriminate (Θ) in words.
 14. The amount of improvement in ability to articulate (Θ) in words does not appear related to the ability to discriminate (Θ) words as the three children in the "mild"

group and the one child in the "severe" group who had 100 per cent improvement of (θ) in the second spontaneous speech test had zero discrimination scores.

Conclusions.-- As the result of this investigation the following conclusions have been drawn:

1. The findings of this study indicate that a relationship exists between imitative articulation and prognosis.
2. It appears that imitative articulation of the correct form of a misarticulated sound in nonsense syllables has prognostic value. If the child can imitate nonsense syllables accurately, the probability of his misarticulated sound improving during the kindergarten year is greater than that of a child who cannot imitate nonsense syllables. These data support the findings of Carter and Buck,^{1/} who found nonsense syllables had prognostic value at the first grade level.
3. In terms of deciding which children with functional articulation disorders should be enrolled for speech therapy the results of this study indicate that imitative articulation tests of nonsense syllables and words will divulge which children can imitate accurately and will, therefore, eradicate their misarticulations through maturation during the school year from the child who requires enrollment in the speech correction program.
4. As the children who misarticulated (k) in the first test of spontaneous speech showed no improvement seven

^{1/}Carter and Buck, op. cit., pp. 124-133.

months later in the second test, it appears that if a child does not have (k) in his speech pattern by the beginning of kindergarten it will not evolve through maturation during the school year.

5. Children with "severe" speech problems have significantly inferior ability in imitative articulation and in some areas of auditory discrimination than children with "mild" speech problems.
6. As the children in the "severe" group had significantly inferior ability in discriminating the correct form of their misarticulated sounds in two of the three auditory discrimination tests of speech sounds, it appears that this study supports the findings of Schiefelbusch and Lindsey,^{1/} that auditory discrimination is a significant factor among children with functional articulation disorders.
7. Although the children with "severe" speech problems had less ability in the auditory discrimination tests than the children with "mild" speech difficulties, the "severe" group's auditory discrimination ability was not related to the amount of improvement in articulation.

Limitations of the Study

1. The spontaneous speech of the sample could be examined only through pictures. It was not possible to illustrate for kindergarten children all of the phonemes included

^{1/}Schiefelbusch and Lindsey, op. cit., pp. 153-159.

- in the investigation in the initial and final positions.
2. The geographical location of the sample had a regional accent which precluded the testing of (r) in the final position.
 3. At the present time there is not a standardized test of articulation available. The articulation test employed in this study was not standardized. However, the articulation test utilized appears reliable as its tabulations of the sample's misarticulated sounds agrees with other articulation tests.

Suggestions for Further Research

The results of this study indicate that the following research areas could be investigated:

1. That a similar study be made of children at an older age level.
2. A prognostic study be made employing the self-monitoring aspects of auditory discrimination of the correct form of misarticulated sounds.
3. That the speech of the sample population be investigated annually during the elementary school years and additional tests of imitative articulation and auditory discrimination be employed.
4. A study be made which compared the ability of children with functional articulation disorders to discriminate sounds which they do not misarticulate with sounds that they do misarticulate.

5. A study be made of the effect of training in auditory discrimination on growth in articulation.

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APPENDIX A

Directions for Administering the Spontaneous
Picture Articulation Test

Present Picture Test Card Number I to the child. Directly under the first row of pictures place a piece of oak tag that is large enough to cover the second and third rows of test items. This measure is taken to keep the young child's attention on the pictures of the sound being examined.

If the child has difficulty in naming an object give him suggestions as to its use or any other information which will help elicit the desired response. Under no circumstances say the word for the child as this is a test of spontaneous speech. The child's ability to imitate the examiner will be examined in the imitative articulation tests series.

The child's misarticulation should be entered on the phonetic inventory sheet of the Spontaneous Picture Articulation Test in the following manner: an "O" if the sound is omitted, a "D" if the sound is distorted, or the sound substitution.

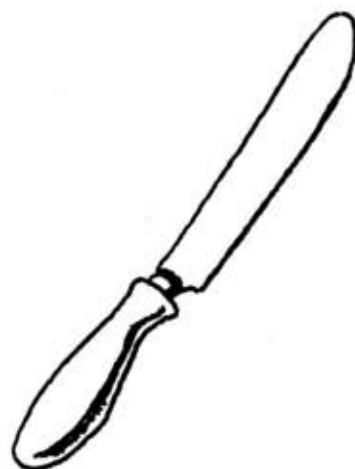
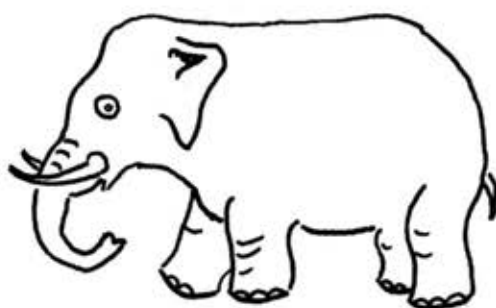
Examiner: "I have some pictures of things you have seen at home, or at the store, or on television. I would like to have you tell me the names of these pictures. Here is the first picture. What is that?"

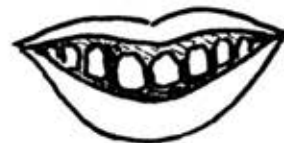
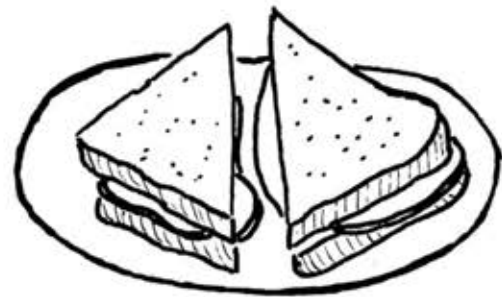
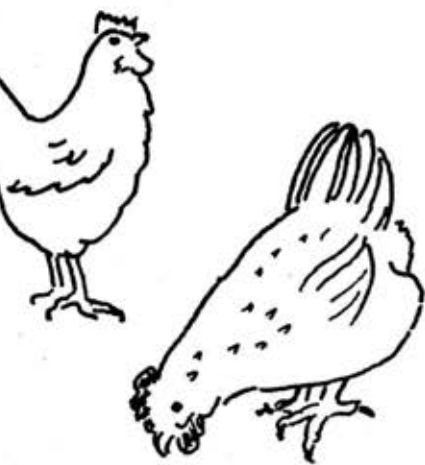
PHONETIC INVENTORY OF THE SPONTANEOUS PICTURE ARTICULATION TEST

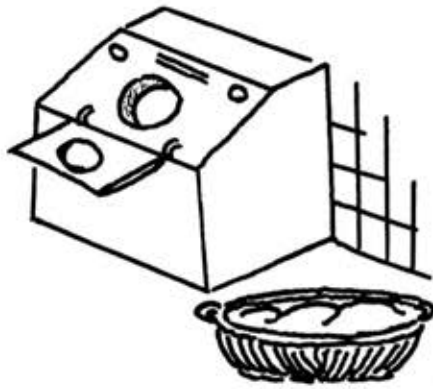
NAME _____ DATE OF BIRTH _____
 SCHOOL _____ DATE OF TEST I _____
 AM or PM GROUP _____ DATE OF TEST II _____

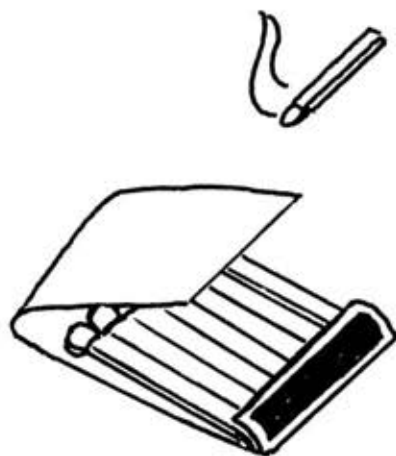
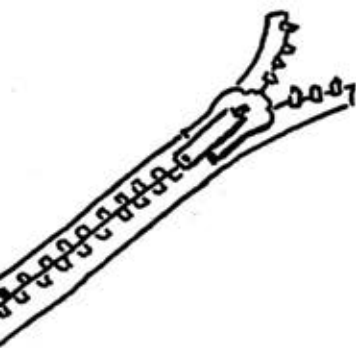
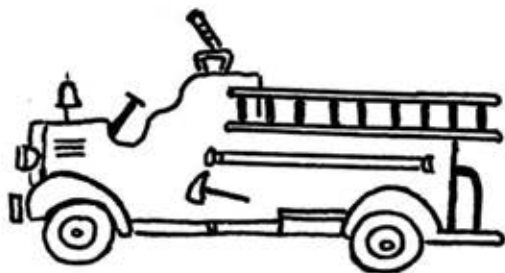
Sound	Initial	Test I	Test II	Medial	Test I	Test II	Final	Test I	Test II
l	lollipop			telephone			ball		
f	father			elephant			knife		
s	scissors			ice cream			horse		
tʃ	chickens			teacher			sandwich		
θ	thumb			birthday cake			teeth		
k	cage			ice cream			fork		
ʃ	shoe			washing machine			fish		
g	girl			fingers			dog		
v	vacuum			shovel			glove		
dʒ	jam			fire engine			garage		
z	zipper			present			matches		
r	ring			barrel					
ʒ				television					
ð				mother					

1









APPENDIX B

Directions for Administering the Tests of Imitative Articulation

1. Test of Ability to Imitate the Correct Form of a Misarticulated Sound in Isolation.

In a sequence of vowels and the earlier developing consonant sounds present the correct form of a misarticulated sound three times. Enter the response made by the child each time he imitates the correct form of his misarticulation. On the score sheet for the tests of Imitative Articulation, enter a "D" for distortions, and "O" for omissions, or the sound substitution.

Examiner: "I want to see if you can play a game with me. I am going to say some sounds and I want you to say them after me. Listen and watch me carefully".

"(m) (p) (w) (test sound) (æ) (b)
(test sound) (n) (i) (h) (d) (test sound)."

2. Test of Ability to Imitate the Correct Form of a Misarticulated Sound in Nonsense Syllables.

The sound which was just examined in isolation is now examined in nonsense syllables and tested in the same position as it was misarticulated in the Spontaneous Picture Articulation Test. The Carter Nonsense Syllable Test^{1/} and the directions designed for its administration were employed in this study. Carter's Nonsense Syllable Test^{2/} will be found in this Appendix, page 105.

1/Carter, op. cit.

2/Ibid.

The child's response should be entered on the score sheet in the following manner: a "D" if the sound is distorted, an "O" if the sound is omitted, or the sound substitution.

Examiner: "Now you are going to be asked to say some silly sounds; they are not words but just funny sounds I have made up. See if you can be a good 'copy cat' and make these sounds just as I do. Listen and watch me carefully".

3. Test of Ability to Imitate the Correct Form of a Misarticulated Sound in Words.

The sound which has been examined in isolation and nonsense syllables is next tested in words. Refer to the Spontaneous Picture Articulation Test and ask the child to repeat the misarticulated words that contain the test sound.

Enter the child's response on the score sheet in the following manner: a "D" if the sound is distorted, and "O" if the sound is omitted, or the sound substitution.

SCORE SHEET FOR TESTS OF IMITATIVE ARTICULATION

Name _____ AM or PM Group _____

School _____ Date _____

Test Sound	Isolation	Nonsense Syllables			Words		
		I	M	F	I	M	F
1. _____	1.	1.	1.	1.	1.	1.	1.
	2.	2.	2.	2.			
	3.	3.	3.	3.			
2. _____	1.	1.	1.	1.	1.	1.	1.
	2.	2.	2.	2.			
	3.	3.	3.	3.			
3. _____	1.	1.	1.	1.	1.	1.	1.
	2.	2.	2.	2.			
	3.	3.	3.	3.			
4. _____	1.	1.	1.	1.	1.	1.	1.
	2.	2.	2.	2.			
	3.	3.	3.	3.			
5. _____	1.	1.	1.	1.	1.	1.	1.
	2.	2.	2.	2.			
	3.	3.	3.	3.			

CARTER'S NONSENSE SYLLABLE TEST

Initial	Medial	Final	Initial	Medial	Final
(si)	(isi)	(is)	(ri)	(iri)	(ir)
(sæ)	(æsæ)	(æs)	(ræ)	(æræ)	(ær)
(sa)	(osa)	(as)	(ra)	(ara)	(ar)
(zi)	(izi)	(iz)	(Si)	(iSi)	(iS)
(zæ)	(æzæ)	(æz)	(Sæ)	(æSæ)	(æS)
(za)	(aza)	(az)	(Sa)	(asa)	(aS)
(li)	(ili)	(il)	(tSi)	(itSi)	(itS)
(læ)	(ælə)	(æl)	(tSæ)	(ætSæ)	(ætS)
(la)	(ala)	(al)	(tSa)	(atSa)	(atS)
(fi)	(ifi)	(if)	(dSi)	(idSi)	(idz)
(fæ)	(æfæ)	(æf)	(dSæ)	(ædSæ)	(ædz)
(fa)	(afa)	(af)	(dSa)	(adSa)	(adz)
(vi)	(ivi)	(iv)	(θi)	(iθi)	(iθ)
(væ)	(ævæ)	(æv)	(θæ)	(æθæ)	(æθ)
(va)	(ava)	(av)	(θa)	(aθa)	(aθ)
(ki)	(iki)	(ik)	(ʃi)	(iʃi)	(iʃ)
(kæ)	(ækæ)	(æk)	(ʃæ)	(æʃæ)	(æʃ)
(ka)	(aka)	(ak)	(ʃa)	(aʃa)	(aʃ)
(gi)	(igi)	(ig)			
(gæ)	(ægæ)	(æg)			
(ga)	(aga)	(ag)			

APPENDIX C

Directions for Administering the Tests of Auditory Discrimination

1. Test of Ability to Discriminate Gross Sounds.

The child is seated at a table facing the examiner. On the table are four noise-makers: a bell, horn, cricket, and a rubber dog that makes a noise when squeezed. The examiner engages the child in conversation about the noise-makers and demonstrates each sound. Since the child is in view of the noise-makers he is requested to turn around during the testing procedure. The child responds each time he hears the bell by turning to face the examiner.

Enter the child's three responses on the Auditory Discrimination Score Sheet in the following manner: a "V" if the response is correct; an "X" if the child responds to a sound that is not the test sound; and "E" if the child responds to every item; and a "N" if no response is made to any sound in the test item.

Examiner: "I have brought some toys that make different sounds. Let's listen to their sounds. (Present each noise-maker and demonstrate its sound). You and I are going to play a game in which you can only turn around when you hear the bell sound. Like this. (Ring bell). If I blow the horn (demonstrate) you cannot turn around as that is not the bell; if I do this to the cricket (demonstrate), you cannot turn around as that is not the bell. If I squeeze the dog (demonstrate), can you turn around? No, that is not the bell.

When I do this (ring bell), what are you going to do? Yes, you turn around. Now we are ready to play the game so turn your chair around so that you cannot see the toys. I will make all the toys say their sounds but you will only turn around when you hear me ring the bell. Now listen".

Gross Sounds Test Items

1. Horn bell cricket rubber animal.
 2. Cricket horn rubber animal bell.
 3. Rubber animal cricket bell horn.
2. Test of Ability to Discriminate the Correct Form of a Misarticulated Sound Among Vowels.

Immediately following the discrimination of gross sounds the correct form of one of the sounds misarticulated in the Spontaneous Picture Articulation Test and examined in the Imitative Articulation Tests is examined in discrimination among vowels. The correct form of a misarticulated sound was placed in a different position in each test item in order to eliminate pattern responses.

Enter the three responses made by the child on the Auditory Discrimination Score Sheet. A "V" if the response is correct, and "X" if the child responds to a sound that is not the test sound, an "E" if the child responds to every item, and a "N" if no response is made to any sound in the test item.

Examiner: "Now you are going to listen for a different sound.

It is the (test sound). Every time you hear me say (test sound) clap your hands like this. (Demon-

strate) You will clap your hands only when you hear the (test sound). (Test sound), good, clap your hands just like that each time you hear me say the sound".

Test Items for the Discrimination of the Correct Form of a Misarticulated Sound Among Vowels.

1. (a) (i) (ʊ) (test sound).
2. (i) (test sound) (a) (ʊ).
3. (ʊ) (a) (test sound) (i).

3. Test of Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Dissimilar Consonants.

The sound which was tested among vowels is next examined among acoustically dissimilar consonants. Consult the phonetic categories and select the category that contains the test sound and administer the three test items.

Enter the child's three responses on the Auditory Discrimination Score Sheet in the following manner: a "V" if the response is correct; an "X" if the child responds to a sound that is not the test sound; an "E" if the child responds to every sound; and a "N" if no response is made to any sound in the test item.

Examiner: "Now you are going to listen for (test sound) among some different sounds. Clap your hands again every time you hear me say (test sound). (Test sound), good, you remembered".

Test Items for the Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Dissimilar Consonants.

Unvoiced Fricatives

1. (m) (r) (test sound) (g)
2. (d) (test sound) (l) (n)
3. (m) (g) (b) (test sound)

Voiced Fricatives

1. (p) (w) (test sound) (t)
2. (k) (test sound) (h) (p)
3. (w) (t) (k) (test sound)

Unvoiced Plosives

1. (v) (ð) (test sound) (z)
2. (ʒ) (test sound) (w) (dʒ)
3. (m) (b) (d) (test sound)

Voiced Plosives

1. (w) (f) (test sound) (θ)
2. (s) (test sound) (ʃ) (h)
3. (f) (θ) (w) (test sound)

Semi-Vowels

1. (t) (s) (test sound) (k)
2. (p) (test sound) (f) (ʃ)
3. (h) (k) (t) (test sound)

4. Test of Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Similar Consonants.

The sound that has been examined in the previous discrimination tests is now examined among acoustically similar consonants. During the testing sequence it is particularly important that the examiner speak distinctly as some of the similar phonemes require keen listening on the part of the young child. However, no emphasis or prolongation should be made of the test sound. The same phonetic category employed in the preceding test will be utilized again in this testing procedure as the same sound is being examined.

Enter the child's three responses on the Auditory Dis-

crimination Score Sheet in the following manner: a "V" if the response is correct, an "X" if the child responds to a sound that is not the test sound, an "E" if the child responds to every sound, and a "N" if the child does not respond to any of the test items.

Examiner: "This time you are going to hear the (test sound) among some new sounds. Clap your hands each time you hear me say (test sound), just as you did before. (Test sound), fine, now let's begin".

Test Items For the Ability to Discriminate the Correct Form of a Misarticulated Sound Among Acoustically Similar Consonants.

Unvoiced Fricatives

1. (p) (t) (k) (test sound)
2. (ʍ) (f) (test sound) (p)
3. (h) (test sound) (θ) (ʃ)

Voiced Fricatives

1. (b) (d) (g) (test sound)
2. (m) (v) (test sound) (n)
3. (v) (test sound) (z) (ð)

Unvoiced Plosives

1. (ʃ) (s) (θ) (test sound)
2. (ʍ) (t) (test sound) (f)
3. (p) (test sound) (t) (k)

Voiced Plosives

1. (r) (v) (ð) (test sound)
2. (z) (d) (test sound) (m)
3. (b) (test sound) (d) (g)

Semi-Vowels

1. (m) (z) (b) (test sound)
2. (v) (Semi-vowel not misarticulated) (test sound) (ð)
3. (semi-vowel not misarticulated) (test sound) (w) (dʒ)

5. Test of Ability to Discriminate (θ) in the Initial Position of Words.

Caution should be exercised by the examiner that the word containing the (θ) sound is not emphasized or prolonged.

In selecting the third word of the fourth test item, employ the word that contains the sound the child substitutes for (θ). If the child substitutes s/θ the third word in the test item would be Santa, but if he substitutes f/θ the test word would be feet. Enter the child's response to the three test items on the Auditory Discrimination Score Sheet. The same scoring utilized in the other discrimination tests should be employed in the present test: a "V" if the response is correct; an "X" if the response is to a word other than the (θ) word; an "E" if the child responds to every test item; and a "N" if no response is made to any word in the test item.

Examiner: "Today we are going to listen for the (θ) sound at the beginning of some words. Every time you hear me say a word that begins with (θ) you will clap your hands just as you did the last time we played the game together. Some of the words will not begin with the (θ) sound, only clap your hands when I say a word that begins with (θ). Let's listen first to some words that do begin with (θ). 'Thanksgiving'. Did you hear the (θ) at the beginning of Thanksgiving? Clap your hands. 'Thursday'. (Make appropriate comment to child's response). 'Boat'. Good, you did not clap your hands as you did not hear (θ) at the beginning of boat. 'Gun' (Make appropriate comment). Listen to these words and only clap your hands when I say a word that begins with (θ). 'Nap, lion, thick,

bird'. Good, you clapped your hands when I said 'thick'. Now listen to some words and clap your hands whenever you hear me say a word that begins with (θ)".

Test Items for Ability to Discriminate (θ) in the Initial Position of Words.

1. milk rain thumb girl
 2. dog throw leg night
 3. pail tire key three
 4. thin sheep feet school
- tall
- Santa

6. Test of Ability to Discriminate (θ) in the Final Position of Words.

The auditory discrimination of (θ) in the final position of words immediately follows the preceding test procedure. The first word in the fourth test item should be a word that ends with the sound the child substitutes for (θ). If the child substitutes f/θ the word cough would be utilized or if he substitutes t/θ the word coat would be selected.

Enter the child's response in the previously described manner: a "V" if the response is correct; an "X" if the response is to a word that does not end with (θ); and "E" if the child responds to every word in the item; and a "N" if no response is made to any word.

Examiner: "Now I want you to clap your hands when you hear (θ) at the end of some words. Let's listen and clap your hands whenever you hear me say (θ) at

the end of a word. 'Bag, arm, both, door'. (Give the child assistance if he makes an incorrect response). Now clap your hands when you hear me say (θ) at the end of these words".

Test Items for the Ability to Discriminate (θ) in the Final Position of Words.

1. Game teeth car egg
 2. Bath green hand apple
 3. Cup light book cloth
 4. Cough fish tooth bus
- Horse
- Coat

SCORE SHEET FOR TESTS OF AUDITORY DISCRIMINATION

Name _____ AM or PM Group _____

School _____ Date _____

A. Testing the Discrimination of Gross Sounds

- 1.
- 2.
- 3.

B. Testing the Discrimination of the Correct Form of a Misarticulated Sound Among Vowels

Sound ()	Sound ()	Sound ()	Sound ()	Sound ()
1.	1.	1.	1.	1.
2.	2.	2.	2.	2.
3.	3.	3.	3.	3.

C. Testing the Discrimination of the Correct Form of a Misarticulated Sound Among Acoustical Dissimilar Consonants

1.	1.	1.	1.	1.
2.	2.	2.	2.	2.
3.	3.	3.	3.	3.

D. Testing the Discrimination of the Correct Form of a Misarticulated Sound Among Acoustically Similar Consonants

1.	1.	1.	1.	1.
2.	2.	2.	2.	2.
3.	3.	3.	3.	3.

E. Testing the Discrimination of (Θ) in the Initial Position of Words

- 1.
- 2.
- 3.
- 4.

F. Testing the Discrimination of (Θ) in the Final Position of Words

- 1.
- 2.
- 3.
- 4.