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THE GROWTH AND DEVELOPMENT OF NEGRO AND WHITE ELEMENTARY CHILDREN WITH ARTICULATORY DEFECTS

by

Rodney Warren Everhart

A dissertation submitted in partial fulfillment
of the requirements for the degree of
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THE GROWTH AND DEVELOPMENT OF NEGRO AND WHITE ELEMENTARY CHILDREN WITH ARTICULATORY DEFECTS

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This is a study to determine the importance of various growth and developmental factors in the maturation of speech articulation for elementary children in grades one through six.

A secondary part of the investigation is concerned with a comparison of articulatory handicapped negro and white elementary children in order to determine similarities and differences in selected growth and developmental factors.

More specifically, the research is concerned with the relationship of physical, mental, and environmental variables to articulation. Relative to the physical conditions of the children, such factors as onset of holding head up, onset of sitting alone, onset of crawling, onset of walking, onset of talking, onset of voluntary control of bladder, eruption of first tooth, handedness, sex-ratio, grip, height, and weight are investigated.

From the mental view point, the following factors are investigated to determine their possible effect upon the maturation of speech articulation: (1) intelligence, (2) reading, and (3) arithmetic.

Paternal occupation is used as an index of broad

environmental or socio-economic differences.

A clinical analysis of one hundred and ten negro and white elementary children having articulatory deviations is made and evaluated statistically. A corresponding study of one hundred and ten negro and white elementary children possessing articulatory patterns within the normal range is also made to determine what factors are common to the two groups and what factors differentiate them. These two groups are compared by utilizing the t-distribution of the difference between means and the chi-square statistical technique, in order to determine whether or not significant differences exist. An inter-racial comparison using the above named statistical tests is also made to determine any significant growth and developmental differences in negro and white elementary children with articulatory handicaps.

The following conclusions grow out of the investigation:

1. A lower average intelligence score was found in the group with articulatory defects when compared to the group having normal speech.

2. Articulatory disorders occur more frequently among males than among females in the elementary school.

3. The factor of paternal occupation is not related to the occurrence of articulatory deviations.

4. Elementary children having handicaps of articulation do not display significant growth and developmental differences when compared with elementary children producing consonants

within the normal range, with the exception of intelligence.

5. In general, negro elementary children having articulatory defects show comparable patterns of growth and development when compared with white elementary children similarly afflicted.

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THE GROWTH AND DEVELOPMENT OF NEGRO AND WHITE ELEMENTARY CHILDREN WITH ARTICULATORY DEFECTS

Chapter I

INTRODUCTION

Statement of the Problem

The investigation was undertaken for the purpose of determining the importance of various growth and developmental factors in the maturation of articulatory patterns of speech in elementary children.

A secondary purpose was concerned with comparing the articulatory handicapped negro and white elementary children in order to study any existing differences in selected growth and developmental factors.

This study centralizes its attention upon four main questions:

1. Are there significant differences in elementary children exhibiting articulatory defects, and elementary children producing consonants within the normal range, with respect to the following factors of growth and development: (a) onset of holding head up; (b) onset of sitting alone;

(c) onset of crawling; (d) onset of walking; (e) onset of talking; (f) onset of voluntary control of bladder; (g) eruption of first tooth; (h) grip; (i) height; (j) weight; (k) handedness; (l) intelligence; (m) reading; and (n) arithmetic?

2. What significant relationships exist between negro and white elementary children having disorders of articulation, for factors (a) through (n) listed in question number one above, in conjunction with (o) onset of articulatory defect; (p) sex-ratio; and (q) number of defective consonants?

3. How do paternal occupations compare in elementary children having deviations of articulation, and elementary children producing consonants within the normal range?

4. What, if any, is the association of paternal occupations to dyslalia in negro and white elementary children from a growth and developmental point of view?

Statement of Method

SOURCE OF DATA. This study encompasses original statistical data obtained by the investigator through the cooperation of administrative authorities and teachers in the Ypsilanti Township School District, Number One Fractional, Willow Run, Michigan, during the school year, 1950-1951.

One hundred and ten elementary children exhibiting defects of articulation and one hundred and ten elementary children producing consonants within the normal range were analyzed in this school district. Table I and Table II below present a breakdown of frequency distributions according to chronological age and the resulting means, for the samples studied. In general, it is felt that the age levels represented in tables I and II demonstrate a typical age trend when compared with the total population of students enrolled. The letters "N", "W", and "T" found in these tables stand for the words "negro", "white", and "total" respectively. A careful examination of row one in Table I indicates that for boys with articulatory defects in the age range 73-78 months, there are two negro boys and three white boys resulting in a total of five when combined. The frequencies found in this same age range for girls having deviations of articulation are read in a comparable manner. A grand total of six is found when the data for both boys and girls are considered collectively. The remaining rows included in this table are to be read in the same way. The calculated means for the different columns may be found at the bottom of the table. Table II is to be read and interpreted on the same basis as Table I.

TABLE I

Chronological Age Distributions of Children with Articulatory Defects

	Boys			Girls			
Months	N	W	T	N	W	T	Grand Total
73-78	2	3	5	0	1	1	6
79-84	5	6	11	5	1	6	17
85-90	1	8	9	0	2	2	11
91-96	2	6	8	1	2	3	11
97-102	5	5	10	3	5	8	18
103-108	1	3	4	1	0	1	5
109-114	3	6	9	3	0	3	12
115-120	3	1	4	3	0	3	7
121-126	2	1	3	0	1	1	4
127-132	0	1	1	0	1	1	2
133-138	0	3	3	0	0	0	3
139-144	4	1	5	1	1	2	7
145-150	0	2	2	0	0	0	2
151-156	1	0	1	0	1	1	2
157-162	0	0	0	0	0	0	0
163-168	1	1	2	0	0	0	2
169-174	0	1	1	0	0	0	1
Totals	30	48	78	17	15	32	110
Mean*	108.2	104.3	105.8	101.9	105.3	103.5	105.1

* Calculated from raw data rather than grouped data of this table.

TABLE II

Chronological Age Distributions of Children with Normal Articulation

Months	Boys			Girls			Grand Total
	N	W	T	N	W	T	
73-78	2	5	7	3	0	3	10
79-84	4	9	13	3	3	6	19
85-90	2	4	6	1	0	1	7
91-96	4	1	5	1	4	5	10
97-102	3	7	10	0	2	2	12
103-108	0	5	5	2	1	3	8
109-114	7	4	11	1	0	1	12
115-120	4	5	9	4	1	5	14
121-126	0	2	2	2	2	4	6
127-132	0	0	0	0	1	1	1
133-138	1	4	5	0	1	1	6
139-144	2	1	3	0	0	0	3
145-150	1	1	2	0	0	0	2
Totals	30	48	78	17	15	32	110
Mean*	105.3	102.1	103.3	99.5	102.8	101.1	102.7

* Calculated from raw data rather than grouped data of this table.

PROCEDURE FOR OBTAINING DATA. Three weeks were spent in conducting a thorough speech survey in the various schools participating in this investigation, in order to determine the total number of elementary children (grades one through

six) possessing defects of articulation. This was accomplished by utilizing a quick individual test of spontaneous and directed speech. The test consisted of special sentences constructed to include several examples of the various sounds in the initial, medial, and final positions, for the child with reading skill. An assortment of pictures selected so that their names contained the sounds in all three positions was used for the child whose reading was faulty. It further consisted of observing the pupil's connected and continuous speech during a brief conversation . The results of the testing indicated that forty-seven negro and sixty-three white elementary children, or a total of 110 out of a school enrollment of 1,497 (grades one through six) could be classified as exhibiting defects of articulation.

Step number two in the procedure for obtaining data consisted of selecting a cross-sectional sample of elementary children producing consonants within the normal range from the total number of students (grades one through six) enrolled in the various cooperating schools, and matching them according to sex, grade, and race. A cross-sectional sampling was obtained by dividing the total number of students enrolled in grades one through six into four groups, namely, white boys, white girls, negro boys, and negro girls, according to their grade level. The total number of pupils were subsequently recorded alphabetically on a list according to the classification mentioned in the previous sentence. It then became necessary to determine a ratio, based upon the number of

students classified in a given group to the number of pupils similarly classified in the articulatory handicapped sample already selected for the purpose of comparison. Finally, the cross-sectional sampling was completed by going through the four alphabetical lists and selecting children according to the interval set by the ratio determined for each group. For example, if the official school census revealed that two-hundred white boys were enrolled in the first grade, and the speech survey indicated that twenty-five white boys exhibited defects of articulation, the ratio would indicate one white articulatory handicapped boy to eight white boys producing consonants within the normal range. Consequently, every eighth white boy in this group would be selected in order to meet the requirements of cross-sectional sampling.

The statistical data encompassing various factors of growth and development for this study were contained in a mimeographed questionnaire sent home with each elementary child included in the previously mentioned samples. In general, these case history questionnaires were filled out by the parents or near relative of the student.

Paternal occupations obtained from the above mentioned questionnaire were classified on the basis of the Minnesota Scale for Paternal Occupations (9).

Data on intelligence were obtained from the administration of the California Short Form Test of Mental Maturity, Primary, 1950 S-Form (grades 1-3), the California Short Form Test of Mental Maturity, Elementary, 1950 S-Form (grades 4-8), which yielded a mental age (MA) for each ele-

mentary child studied in this investigation. The Gates Primary Reading Tests, Types 1, 2, and 3, Form 3 (grade 1), the Gates Advanced Primary Reading Tests, Types 1, and 2, Form 3 (grade 2), and the Gates Basic Reading Tests, Types A, B, C, and D, Form 4 (grades 3-8), were given in order to secure a reading age (RA) for each pupil. An arithmetic age (AA) was obtained by administering the Iowa Every-Pupil Tests of Basic Skills, Test D: Basic Arithmetic Skills-Form O, Elementary Battery (grades 3-5), and the Iowa Every-Pupil Tests of Basic Skills, Test D: Basic Arithmetic Skills-Form O, Advanced Battery (grades 6-9). The investigator felt that it was necessary to have all the tests given at approximately the same time. Consequently, an arrangement was made whereby all the tests were administered during the last two weeks of March, 1951. The tests were all given by the regular classroom teachers, principals, and by the investigator. Simple instruction sheets were sent out to all the participating schools, and it was requested that all persons involved in giving the tests do so in strict accordance with these instructions. The scoring and checking were done by means of keys prepared by the authors of each test.

Grip was obtained by using the Smedley Dynamometer, on the basis of the best performance for both hands. Height and weight were secured from each pupil's CA39 folder. These three measurements were then converted into age units (months).

PROCEDURE FOR MAKING A STATISTICAL ANALYSIS. The resulting data were recorded on 3"x5" cards and master work sheets which had been divided into appropriate sections. The procedures utilized in making the analysis were the statistical techniques employed in any study of averages and distributions of statistical data.

FUNDAMENTAL LIMITATIONS OF METHOD. It becomes apparent that any statistical investigation is subject to certain basic limitations. Moreover, an investigation of this type must be considered in the light of certain fundamental assumptions. The present investigation is no exception to this. All inferences drawn from the investigation should be considered in relation to those fundamental limitations and assumptions. Therefore, it will be well to have them in mind throughout the report.

(a) The speech correction questionnaire* utilized in this study was devised for the purpose of tapping the parent's fund of information, in order to explore various factors of growth and development in a given child. An attempt was made to phrase the questions in such a manner that the influence of suggestion would not prejudice the answer. The writer is aware that the method possesses certain fundamental limitations with respect to the size and representative character of the sample, and the inaccuracy of report. However, after consideration was given the limitations and desirable qualities of this particular method of survey, the conclusion was reached that the questionnaire was the only feasible and practical way in which to collect the desired information.

* See Appendix C.

The validity of the answers given in the questionnaire will therefore be interpreted on the basis of the fundamental limitations imposed by the method.

(b) A second limitation is the restriction of the investigation to grades one through six. While this restriction could tend to magnify the possible selective factors involved in the final interpretation, it was deemed necessary on the basis of available time, accessible children, and the unique problems involved in securing the cooperation of the necessary personnel. However, it is not felt that this delimitation will detract appreciably from the validity of the investigation, if the resulting sample will correspond to those of the whole group.

(c) It is altogether possible that certain results of this study may have psychological bearings. However, this investigation is not essentially a psychological study. No effort has been made to ascertain or interpret the relevancy of any existing psychological implications to the various factors of growth and development considered in this study. On the contrary, the main purpose has been to compare elementary children exhibiting defects of articulation with elementary children producing consonants within the normal range, in order to determine the importance of various growth and developmental factors in the maturation of acceptable patterns of speech articulation.

(d) Another limitation that should be pointed out is that the group type of tests used in this investigation do not provide an opportunity to study the examinee from an

individual point of view, so that his oral responses may be thoroughly analyzed. Also there is the possibility that the national norms established for the group tests previously mentioned are not indicative of the actual existing situation, when applied to a population composed of the product of in-migration. These facts could tend to detract from the validity of the group tests administered. However, the economy of time and certain administrative and personnel involvements necessitated the use of the group tests rather than individual ones.

(e) Finally there must be acknowledged the fundamental weaknesses involved in the cross-sectional method of survey. The method admittedly tells little about individuality of growth or change with time in a given child, but it does provide an economical and reasonably rapid means of collecting data without extraordinary investments of time and money.

FUNDAMENTAL ASSUMPTIONS. The following assumptions are submitted in the belief that they are necessary and reasonable. It is also felt that they should be postulated in order to pave the way for more accurate and precise interpretation of the results of this investigation.

(a) It will be assumed that the pupils surveyed represent a typical sample of articulatory cases and students producing consonants within the normal range in the first, second, third, fourth, fifth, and sixth grade school population.

(b) It will be assumed that the questionnaire method is a feasible and practical way in which to collect desired information germane to the present investigation.

(c) It will be assumed that the group type of tests will provide an adequate and valid indication of mental performance, the ability to read, and the ability to demonstrate basic arithmetic skills for the purposes of this investigation.

(d) It will be assumed that the various maturative factors studied in this investigation are samples of the total growth and development of elementary children having defects of articulation, and elementary children producing consonants within the normal range.

(e) It will be assumed that certain results of this study may have psychological implications, however, these aspects will not be taken into consideration in the final interpretation of the present discussion.

Description of Ypsilanti Township School District, Number One Fractional, Willow Run, Michigan

The Ypsilanti Township District, Number One Fractional, Willow Run, Michigan, contains five schools, namely, Spencer Annex (grades four through six), Spencer (grades kindergarten through three), Foster (grades kindergarten through six), Ross (kindergarten through nine), and Simmonds (grades kindergarten through six). The schools have been geared to handle the unique problems presented by the area, and are competently staffed. A number of provisions have been made for parent education by sponsoring active parent-teacher and

child-study groups. They also offer a program of recreational activities for both children and adults, which has tended to establish the schools as community centers. Many after-school clubs are sponsored by the teachers.

There are many undesirable forces operating in the Willow Run community which have a retarding effect on the process of training and education of the children living in the area. For example, the village has a transient population, which has tended to minimize the in-group feeling, loyalities, and civic pride ordinarily found in the citizens of a more stable community. (16) A large proportion of its citizens expect to remain for only a short period of time, consequently the feeling of temporary residence does not make for stability in their outlook upon the problems of living.

The school district was established as a result of federal housing constructed during World War II to house workers employed at the Willow Run Bomber Plant. The housing therefore does not provide adequately for family needs, functions and responsibilities on a permanent residence basis. Also, the area is not of sufficient capacity to house the ever-increasing number of in-migrants. The units, or apartments, consist of one main room that is generally used for living, cooking, and eating, a small bathroom, and from one to three bedrooms, which are allotted according to the number in the family. Frequently, people with large families find it necessary to live in quarters insufficient in size for the proper rearing of their children due to the crowded conditions. In addition, the neighbors on both sides of a

given unit may be heard plainly through the thin plasterboard walls. Thus, it can readily be seen that the whole setting is not condusive to good living.

The people in Willow Village may be grouped in three main divisions as follows (16): (1) The negro workers, who live mostly on Clay Hill, and the negro veterans, who are scattered throughout the village; (2) The northern and southern industrial workers, who live in the housing project and in private homes outside the project; and (3) Students with families who live in housing units throughout the village.

It is felt that such heterogeneity of population does not contribute to social solidarity. Also people with such widely varied cultural backgrounds and lack of common interests are not likely to develop strong community spirit or organization. Intolerance and conflict between the various groups in the area is evident.

Justification of the Study

The literature regarding the articulatory defective child has become so vast in the past few years that it is difficult to integrate the broad principles governing present day thought and practice. The lapse of time has produced innumerable opinions and a great many theories. In spite of the immense accumulation of literature, little has been done about the relationship of growth and developmental factors to negro and white elementary children exhibiting defects of articulation.

The current literature increasingly stresses the necessity of a sound diagnostic methodology, in order to insure the ultimate success of a program of remedial speech therapy. Certainly, on the basis of this observation alone, the importance of knowing the role of growth and development in the maturation of speech articulation can hardly be doubted. This would seem to be particularly true if one accepts the thesis that if the child is viewed as a whole, an underlying unity is discovered in the individuation of structures, functions, and achievement out of total growth and development. Further, many studies have substantiated the fact that articulatory defective children exhibiting a history of mental retardation, and inadequate functioning of the articulatory mechanism have a background of slow growth and development.

It is these facts which have given rise to the present investigation. The justification of the study is to be found in the hope that the detailed information to be presented in the following pages will contribute to a better understanding of the part played by growth and development in the maturation of speech articulation. It is also hoped that the results of this investigation will lead to more effective remedial procedures in the treatment of elementary children having defects of articulation.

Definition of Terms Used in this Study

For the purposes of this investigation the following terms will be used as defined below:

(a) Growth and Development: The changes in com-

plexity of the psychophysical systems within an organism which occur during the process of maturing.

(b) Maturation: The development of the organism in response to internal stimuli impelling it toward growth. (22)

(c) Defect of Articulation: The disorder produced by the abnormal addition, substitution, omission, and distortion of the speech sounds.

(d) Dyslalia: A handicap characterized by the abnormal addition, substitution, omission and distortion of the speech sounds.

Chapter II

GROWTH AND DEVELOPMENTAL FACTORS THAT COULD INFLUENCE THE MATURATION OF SPEECH ARTICULATION

Articulatory patterns of speech develop as one aspect of the psychophysical systems encompassing total growth and development of an individual in conjunction with maturation and learning. Speech articulation is dependent upon a continuous process of development from a simple and homogeneous medium to a highly complex, modified, and differentiated level of growth. As a child matures, he must endeavor to make a fundamental adjustment to his intrinsic and extrinsic environments, regardless of what prospects they hold in store for him. Whether or not the child develops acceptable patterns of speech articulation depends upon numerous complex and multi-dimensional elements. It is impossible to confine the maturation of articulation to one single factor of growth and development. Rather, the development of articulation 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.

The maturation of speech articulation in many children does not proceed in an orderly cycle, but is subjected to various disturbances imposed by individual deviations in

sequence, rate, and pattern of growth and development. A few investigations during the past thirty years have been concerned with the relationship between articulatory maturation and other influences such as chronological age, intelligence, reading, retarded physical development, sex differences, handedness, occupational class differences, and race. Wherever feasible, the writer has included studies reporting any existing correlations between speech defectiveness and language development in general to the above stated influences. It is felt that this is permissable if the reader interprets the terms "speech" and "language" as including the maturation of speech articulation. Some of the important findings have been summarized below.

Chronological Age

It is very evident that a normal child has a progressively greater command of the speech process as he grows older. (15) Indeed, chronological age has a decided influence over the neuromuscular mechanism involved in producing the finely coordinated movements necessary for acceptable patterns of articulation. It reinforces the child's nervous system in such a way as to reduce the more generalized biological functions of the peripheral speech mechanism to the highly specialized movements involved in producing the articulatory patterns of speech. This fact was substantiated by Wellman, Case, Mengert and Bradbury (36) in 1931, when they gave an articulatory test consisting of one hundred and thirty-three speech sounds, including vowels, consonant elements,

consonants, and diphthongs to two hundred and four preschool children. The purpose was to determine each child's ability to use correct sounds in words, phrases, or conversational speech which was elicited in response to questions about pictures. The results indicated that there was a rapid improvement with an increase in age in the ability of children to produce English sounds.

Roe and Milisen (24) offered further confirmation when they reported that the mean number of articulatory deviations decreased as the grade level increased. The only exception to this was the sixth grade where there was a slight increase, probably due to the selectivity of sampling. They noted a significant difference between the mean number of sound errors in grade one and two, two and three, and three and four. This indicates that increased growth and development eliminates articulatory errors in these grades. The absence of a significant difference in the mean number of dyslalic mistakes between grades four and five, and five and six, indicates that maturation does not result in any noticeable improvement in the speech sounds of higher grades. This was also apparent in the fact that many defects of articulation still persisted in the fifth and sixth grade.

Poole (23) made a study of the relationship of consonant sounds to genetic development. She administered an articulation test and found that chronological age, intelligence, and social contacts with other children decidedly influence a child's ability to articulate consonant sounds.

Consequently, it must be recognized that chronological age alone is not the sole criterion for developing articulatory patterns of speech within the normal range. The maturation of the complex structures necessary for articulation are intricately related to the development of intelligence among other factors.

Intelligence

It has become an established fact that intelligence plays a significant role in the development of the highly specialized movements involved in speech articulation. A child possessing a good intellectual capacity has innumerable advantages over the child with low intelligence. His ability to meet new situations quickly and successfully and his power of apprehending the inter-relationships existing in his psychosocial systems are distinct attributes.

Many investigators have observed a positive correlation between the factor of low intelligence and the incidence of articulatory disorders. Mead (17), McCarthy (15), Smith (29), and Town (32) have reported a direct relationship between mental retardation and speech handicaps (including defective articulation).

According to Spiker and Irwin (30), there appears to be a small but reliable relationship between certain aspects of infant speech sound maturation and the abilities measured by the Kuhlmann Test of Mental Development. Even though the results of this study do not preclude this possibility, it is not advisable to generalize from this evidence

that the entire process of speech sound development is related to these abilities.

Beckey (3) found in her study of certain factors related to retardation of speech that children with delayed speech tend to be inferior in intelligence as compared to children exhibiting normal patterns of speech.

Hall (11) in her study involving both college and elementary school students found that memory span for speech sounds was significantly correlated with intelligence. She hypothesizes:

> "Results found in the past of auditory memory span (i.e., positive correlation between auditory memory span and speech defects) were probably due to the differences in general intelligence in which auditory memory span is a factor, rather than to a specific disability in this trait."

If this finding is acceptable, it would further substantiate the thesis that the incidence of articulatory defectiveness is greater in children of retarded mental development than among normal speaking children.

Gens (7) makes a conjecture that seems to offer an additional confirmation of the role of intelligence in the maturation of speech articulation. It is his impression that delayed speech may be attributable to a lack of mental ability. He concludes that in general one-tentn of the children enrolled in public schools and three-fourths of the mentally deficient children have speech disorders, as a result of inferior intelligence.

Bangs (2) and Voelker (34) opine that feeble-minded

individuals exhibit more articulatory defects than those of normal intelligence. However, many feeble-minded adults with mental ages of seven or more are able to speak with few articulatory errors. Therefore, we can ask is intelligence the primary factor inherent in the incidence of defective articulation, or does it merely enhance other growth and developmental factors that might be involved?

Sirkin and Lyons (27) examined twenty-five hundred institutionalized mental defectives and discovered that only one-third of the individuals studied had speech within the normal range. They concluded that the lower the intelligence rating, the lower the incidence of normal speech.

The same relationships were observed when Davis (4) and Day (5) traced the relationship of chronological age to mental age in mental defectives. These studies compare favorably to those of Sirkin and Lyons (27) when they pointed out that a definite parallel exists between intellectual capacity and defective speech.

Reading

An investigation of research reports indicates an absence of complete agreement as to the relationship of reading defects to articulatory deviations. Nevertheless, in considering this question an attempt was made to appraise the literature to account for whatever correlation appears to exist.

At the outset, one is confronted with two aspects of the problem that need to be differentiated. The first is

concerned with the maturation of articulation in a background devoid of meaningful experiences. Any limitation in real or vicarious experiences, with their concomitant limitations in word meaning and articulatory fluency could peradventure have a bearing upon reading ability. This holds true if reading is interpreted to be a process of reconstructing facts based upon the visual symbols. The second deals with a subsidiary part of the problem, that of the relation between the inability to produce the correct speech sounds and reading ability. This discussion has been concerned mainly with the second aspect of the problem, as it appears to coincide more concretely with the intent of this report.

Speech and reading are inextricably associated in the process known as communication or language. Any limitation or facility in one is directly reflected to some degree in the other. Researchers in the field have long since given up looking for a single factor that would explain and account for reading handicaps. On the contrary, they have concluded that reading difficulties as well as the other factors involved in the language process, could be attributed to a multiplicity of inter-related factors. Such factors which may render reading particularly effective on the one hand and impotent on the other include, inferior instructional materials, absence of motivation, visual or auditory handicaps, articulatory defects, and irregular patterns of growth and development.

Hildreth (12) mentioned a number of language handicaps that could contribute to reading retardation. She

listed along with other factors inadequate or immature motor coordination in articulation, indistinct or inaccurate articulation, and poor auditory discrimination of speech sounds.

Jackson (13) compared approximately three hundred advanced readers with a similar number of retarded readers in grades two through four. This was done in order to determine psychological, social and environmental differences between advanced and retarded readers. His findings indicated that ten percent of the accelerated readers and twenty-three percent of the retarded readers possessed speech defects. In this connection, he revealed that a critical ratio of 3.66 had been established, which designates this frequency to be above the expected rate due to chance.

Thirty-six matched pairs of children were used by Voss (19) in her study to determine the influence of speech defects on reading achievement. One child from each pair had a speech defect, while the other possessed speech within the normal range. The Grey Standardized Oral Reading Test was utilized to check reading ability. It was found that children with normal speech surpassed the children with defective speech, in both speed of reading and freedom from reading errors. She also discovered that the average child with a speech deviation required 8.7 seconds longer to read a given selection, and that he made 1.8 more errors on a given page than the average child having normal speech.

Artley (1) has discussed selected research which indicates that a definite relationship exists between speech difficulties and deficiencies in reading ability, though

there is a lack of agreement as to the extent of this relationship. He points out that where speech handicaps exist as a cause of oral reading defects, an explanation may be in the fact, among other things, that articulatory deviations could result in errors of pronunciation which would have an effect upon the standard of interpretation.

In a comprehensive and analytical investigation completed by Yedinack (37), children with functional articulatory defects, reading disabilities or both were located in the second grade of ten public school systems. Forty-two cases of defective articulation, thirty-five reading handicapped cases, twenty-seven articulation-reading disability cases, and seventy-four control cases were selected after extensive reading, speech and intelligence testing. A significant parallel was observed in both oral and silent reading between children with functional articulatory deviations and children having normal speaking ability. Also, she pointed out that children with reading disability frequently have articulatory handicaps.

No doubt many factors other than those considered in this discussion may have an etiological relationship to reading and articulatory problems. Obviously the final word has not been written. In the writer's opinion, further research in the relationship of various growth and developmental factors will undoubtedly shed additional light on both diagnosis and correction.

Retarded Physical Development

A cursory reading of available research reports makes it quite obvious that a systematic knowledge of delayed physical growth and development to articulatory maturation has not yet been achieved. The work done thus far tends to be spotty, meager and in many instances unscientific. However, it is felt that an inquiry into the available investigations would profitably contribute to an additional knowledge of factors that could influence articulatory growth and development.

Mead (17) reported a correlation between slow physical growth and speech maturation. The results pointed out that children deficient in linguistic development and intelligence were two months slower in learning to walk when compared with children from the normal group.

These observations were further borne out by Beckey(3) in a study conducted to determine the relationship of certain factors to speech retardation. She noted a delayed maturation of the large muscular mechanisms necessary for walking, until after the fifteenth month in a significant number of children possessing language handicaps. Her data also showed that the group of children with delayed speech development had tendencies toward slow dental growth, and late voluntary control of bladder and bowels. This fact indicates that speech does not develop until sufficient maturation has been attained by the large muscular mechanisms.

Van Riper (33) also found a definite connection be-

tween retarded physical growth and speech maturation. His findings indicated that thirty-five percent of the cases studied were slow in dental, physical, or coordinated development.

Here again it is impossible to divorce the factor of intelligence from physical growth and development. While there is overlapping with other groups, there is a strong tendency for the child with "good intelligence" to excel other groups in such physical factors as height and weight, breathing capacity, strength of muscles and grip. Also, there is some evidence to indicate that they walk and talk at earlier ages. Naturally, the sequence, rate, and pattern of physical growth and development is dependent upon a favorable environment. Without a desirable milieu, the child's time table for physical development can be disturbed and result in distortions of his unfolding design.

Therefore, if we assume that speech articulation is an individuation out of organismic growth and development, it becomes immediately apparent that retarded physical development and inferior intelligence could appreciably impede articulatory maturation. This is especially true if we accept the theses that speech articulation does not develop until a certain degree of intellectual growth has been attained, and until the large muscular mechanisms have matured.

Sex Differences

Sex appears to have an important bearing upon the growth and development of speech articulation in children.

Consistent findings have emerged to date that reveal positive differences in favor of girls in almost every aspect of linguistic development. Many observers report that whenever groups of boys and girls are matched according to well defined variables, there seems to be a more rapid rate of language development (including articulatory maturation) in girls. In rare instances these sex differences are reversed or fail to appear. No doubt, this can be attributed to poor sampling, and the failure to consider adequately certain primary factors.

McCarthy (15) and Smith (28) have postulated that linguistic development is more rapid in girls than in boys, in extent of vocabulary, in the age at which short sentences are used, and in comprehensibility of their speech at early ages.

In a careful study made by Wellman and others (36), they observed that girls tend to articulate consonant sounds earlier and more accurately than boys.

In a doctoral dissertation completed in 1934, Poole(23) reported a comparable rate of development in articulatory efficiency in boys and girls from two and one-half to five and one-half years of age. After the five and one-half year level, girls tend to display more rapid growth as pointed out by zero scores on the articulation test. She also indicated that girls approach articulatory efficiency at six and one-half years while boys usually require another year to attain the same degree of proficiency.

The greater incidence of articulatory defectiveness

in boys can no doubt be accounted for in part by the fact that the growth and development of boys is generally slower when compared with girls of the same chronological age. The more frequent occurrence of articulatory and speech deviations among males can be noted in practically every study; however, the ratio of male to female articulatory handicapped children reported varies.

Morris (18) made a speech survey of two hundred and eight pupils enrolled in grades 3A to 7A of the Laboratory School at Indiana State Teachers College. He reported forty-five percent of these children to have voice or speech defects, with a higher ratio of boys to girls having articulatory errors.

Root (25) discovered the incidence of speech defectiveness to be six and three-tenths percent and the ratio of boys to girls to be one and five-tenths percent to one, when he sent out a questionnaire to determine whether speech difficulties presented a problem in the public schools of South Dakota. Judgment as to who were speech deviates was made from definitions of different disorders on the questionnaire.

A similar speech survey was conducted in 1916 by Wallin (35) of eighty-nine thousand, and fifty-seven students in the public schools of St. Louis. These children ranged in chronological age from five to twenty-one years. The ratio between boys and girls was set at two to one, and two and eight-tenths percent of the children were found to have speech defects.

In the data quoted above, experimental rather than

statistical evidence has been presented of the reality of sex differences. Although some of these differences appear to be small, it is not felt that there is a need for the reassurances of the statistical significance of critical ratios when experimental trends check in study after study.

In summary, there should be some question as to what extent articulatory and speech maturation is innerently connected with sex differences, if one considers the effect of given dissimilarities in social stimulation.

Handedness

Several investigations have been conducted to determine the relationship between handedness and speech defects. The results of most of these studies are inconclusive and questionable. However, it is generally believed that children with speech handicaps tend to lack hand preference.

This assumption was substantiated by Mice (21) who discovered seven cases of delayed speech in which ambidextrous tendency seems to be a constant factor. Beckey (3) also reported that the delayed speech group utilized in her study tended to be somewhat more ambidextrous than the control group. Data for her investigation were secured from statements made by parents, as to the handedness of each child studied. No handedness tests were actually administered. This fact considered alone could detract appreciably from the validity of the results subsequently obtained.

The above quoted studies are concerned chiefly with

the relationship of handedness to idiolalia (retarded speech). It should be pointed out that a child with delayed speech usually has many other difficulties along with a severe dyslalic disorder. These children frequently lack hand preference and are often handicapped linguistically and semantically. They lack ability in the basic use of the articulators and general over-all speech skill.

The reader is reminded that children exhibiting the common disorders of articulation found in the public school do not necessarily display the conditions stated above. Rather, their misarticulations generally consist of sound substitutions, omissions, and distortions, without any appreciable language handicap. However, it is felt that the two types of speech disorders can be considered conjunctively here, if defective articulation is used as the common denominator.

Certain investigations in aphasia have demonstrated that the portion of the brain which controls speech is directly related to the hand preference. Therefore, it is logical to assume that confused laterality could have a pronounced affect on the maturation of articulation and speech in general. This hypothesis is based upon the fact that often miraculous results seem to follow a program of remedial therapy, in which stress is placed upon manual activity and motor skills to establish hand preference.

In conclusion, it is felt that ambidextrous tendency and the occurrence of defective articulation may be part and parcel of the same basic phenomenon evolving out of organismic

growth and developmant. However, if this relationship does exist, it is probably only an indirect one.

Occupational Class Differences

The literature reveals a high correlation between occupational class as a factor contributing to socio-economic status and language maturation in the child. A number of studies have been conducted in which groups of children were matched on the basis of chronological age, intelligence, home cultural index, and parental education, in order to appraise the influence of occupational class on linguistic development. These investigations indicate that children originating from the higher socio-economic levels have usually been exposed to more favorable environmental influences which are conducive to better language development.

Beckey (3) found that children with language retardation are usually members of the lower socio-economic groups. The reverse was indicated for children having speech within the normal range whose parents represented most frequently the professional and managerial occupations.

This finding was further substantiated by Gesell (8) and Smith (29) when they reported that linguistic maturation is superior among the upper social levels (occupational groups).

Without doubt, there are many reasons why children from a privileged milieu develop more acceptable patterns of articulation, a subdivision of the language process, than children from a less favored environment. The child from the

upper socio-economic level is exposed to more enlightening and stimulating cultural advantages including art, music and literature. He is subjected to superior patterns of articulation, pronunciation, grammar and sentence structure. These factors could enhance the maturation of speech articulation at an earlier age and aid the child in developing the ability to use better syntax, rate and rhythm, and inflections. Also, these environmental influences would probably assist him in developing longer and more mature sentences earlier.

From the scientific evidence available there appears to be some justification for the assumption that intellectual capacity is related to socio-economic level. Apparently, the individual possessed with "good" ability has decided advantages when it comes to learning or adapting on levels of ever increasing complexity. His quantitative and qualitative differences in intelligence aid him in continuing indefinitely to increase in knowledge and skill. Consequently, a child coming from a higher occupational class has a far greater chance of possessing a better intellectual endowment genetically speaking, than the child in a lower class. Further, a child so blessed has many more opportunities for maximum intellectual growth and development, by virtue of his enriched environment. Certainly all these factors could contribute immeasurably to the child's opportunities for future membership in the hi her occupational classes, and the subsequent maturation of more favorable patterns of speech articulation.

Children from under-privileged milieus are frequently

relegated to the lower occupational classes because of their inability to engage in the higher mental processes, and the fact that they are generally submitted to poor environmental surroundings and standards. Also, it would logically follow that articulatory growth and development and the maturation of the language process as a whole suffer as a direct consequence of inferior environmental influences.

There have been a few investigations of the relation between socio-economic groups and various growth and development factors, which balance in favor of the higher socio-economic groups. However, the writer did not feel that presenting abstracts of these studies here would contribute appreciably, as they did not appear to shed additional light on the relation of articulatory maturation to occupational class.

Race

In presenting a discussion on this subject, the investigator would like to remind the reader that this study has been concerned solely with the negro and white racial groups. Therefore, the term race as used in this discourse will be interpreted on this basis.

To date, no data have been advanced which study the relationship of race to factors of growth and development, and the maturation of speech articulation. The studies reported during the past thirty years are only remotely allied with the purposes of this investigation. The writer has endeavored to arrive at some tentative suppositions as to the

possible influence of race on the unfolding design inherent in the maturation of the articulatory patterns of speech. This has been done on the basis of the related literature.

During the past few years anthropologists, psychologists, and sociologists have resorted to the selective migration theory and the environmental theory along with other hypotheses, in an effort to explain racial differences. These hypotheses point out that important differences in the average status of growth in people are influenced by their racial origin, the section of the country in which they reside, or their membership in a given socio-economic group. However, the literature reveals that at the present time psychological interest has been centered mainly around the intellectual classification of races on the basis of broad assumptions, the validity of which is uncertain. This is unfortunate when one considers this problem from a two fold point of view. One, there is an appalling lack of information concerning the mental characteristics of various racial and cultural groups that is based upon direct measurement. Two, there is a relatively small amount of data concerning the relationship of various other intrinsic and extrinsic growth and developmental factors that could contribute to racial differences.

An early racial study was made in 1917 by Sunne (31) on one hundred and twenty-six negroes and one hundred and twelve whites in New Orleans with the Binet and with the Yerkes Point Scale. The report of the study showed the whites as being one year mental age older than the negroes of the

same chronological age.

A later investigation of negro-white differences of mental ability in the United States conducted by Garrett (6) also indicated that the American Negro on the average ranks consistently lower than American Whites on tests of mental ability. He pointed out that the regularity of data from babyhood to adulthood makes it extremely unlikely that environmental opportunities could possibly explain all the differences found. However, his investigation did not sufficiently explain the differences between American Negroes, Northern and Southern, and whites. It is felt that the national norms established for different tests of intelligence would not always take into consideration the significant and constant differences existing between given racial and cultural groups. Therefore, the validity of this investigation is to be questioned, if we take into consideration that our present tests are not completely standardized on the members of pre-literate cultures and do not yield positive data on how the individuals think.

Certain investigators have pointed out that as a race, negroes tend to be smaller than whites. Royster and Hulvey (26) examined approximately nine thousand negro children, and discovered that they were shorter than whites in boys from six to eighteen years and from fifteen to eighteen years in girls.

This finding was also borne out when Lloyd-Jones (14) reported whites to be the tallest and heaviest, negroes and Mexicans following respectively, with the Japanese shortest

and lightest.

In an investigation reported by Goodenough (10), she pointed out that most psychologists are satisfied with the disproof of the exorbitant claims of racial differences which have been made. In short, they are willing to objectively accept or reject certain racial differences, in the light of available data. On the other hand, some psychologists have stalwartly recognized certain racial differences, regardless of the accessible information refuting their claims.

Other studies could be cited accepting or rejecting hypotheses laying claim to various racial differences. But, the writer did not feel that they would contribute appreciably to an understanding of the relationship of race to factors of growth and development, and the maturation of speech articulation. Further, the validity and reliability can and should be questioned in many of the investigations conducted in the past. Therefore, the investigator will attempt in the succeeding lines to elucidate some tentative assumptions that seem to make their appearance from the survey of literature.

Without doubt racial groups show differences in mental capacity. The question might be asked, do these arise from the physical basis of race, or are they allied with certain cultural distinctions? Thus far, no substantial tests have been devised for determining mental traits of races. The current tests fail to consider that habits and customs of one group might not indicate the status quo of another. We will not be able to demonstrate that one race

is mentally superior to another, until a test of mental ability is devised which measures "pure native intelligence".

Logically, it could be expected that average and mentally gifted children, regardless of race, would tend to develop more acceptable patterns of articulation than the ones less endowed. Their superior associative processes render them capable of abstract reasoning to a far greater extent than is true of children below average. This ability to reason is likely to result in fewer sound errors, during the maturation of speech articulation. This fact was borne out in a Yearbook of the National Society for the Study of Education (20) on "The Grouping of Pupils". It stated that the bright, or superior child probably began talking at an earlier age than usual and displayed special ability in putting sounds and sentences together in order to represent connected thought.

Obviously, a tremendous amount of work remains to be done in this unscratched field. Innumerable possibilities lie in store for research workers interested in exploring racial differences in the maturation of speech articulation from the point of view of growth and development. Unfortunately, past research has concerned itself almost exclusively with only comparing the racial groups on the basis of intelligence. The relationship of race to other growth and developmental factors has been significantly neglected. Possibly this can be attributed to the lack of scientific measuring devices.

Chapter III

COMPARISON OF ELEMENTARY CHILDREN WITH AND WITHOUT ARTICULATORY DEFECTS

The object of the present chapter is to compare the incidence of certain growth and developmental factors for elementary children with and without articulatory defects.

The t-Distribution of the Difference between Means

The t-distribution of the difference between means was used to test this major null hypothesis: there is no significant relationship between the various physical growth and developmental factors studied in this investigation and the incidence of defective articulation. This hypothesis was established on the premise that elementary children with and without articulatory handicaps experience certain stages of physical growth and development at the same average age. Further, this hypothesis is based upon the assumption that the differences observed in the average age at which these stages of growth and development were experienced in the two groups is due to chance, and is not associated with articulatory difficulties.

This general test of independence or lack of relationship between selected growth and developmental factors and the occurrence of defective articulation are contingent upon these specific null hypotheses which were tested: there is no significant relationship between the incidence of ar-

ticulatory defectiveness and:

1. onset of holding head up.
2. onset of sitting alone.
3. onset of crawling.
4. onset of walking.
5. onset of talking.
6. onset of voluntary control of bladder.
7. eruption of the first tooth.

Interpretation and Discussion of Results Obtained from Using the t-Distribution of the Difference between Means

PHYSICAL FACTORS OF GROWTH AND DEVELOPMENT. It will be desirable first to examine Table III in order to compare elementary boys with and without articulatory defects on the bases of means and the calculated values of t. This table may be read as follows: the mean age for onset of holding head up for sixty-four elementary boys having dyslalic disorders is 3.0 months, while it is 2.6 months for sixty-two elementary boys with normal articulation. The two means when compared yield a difference of 0.4. The t-value for the two groups is set at 1.5, which produces a significance level of 0.1, or 10% on the basis of 124 degrees of freedom. Therefore, the results for this factor indicate no significant difference in the two samples. The same procedure is used in interpreting the other factors in Table III.

The data displayed in Table III indicate no significant differences in elementary boys with and without articulatory handicaps in regard to the physical factors of

TABLE III

Comparative Table for Selected Physical Factors of Growth and Development in Elementary Boys with and without Articulatory Defects

Factor	Boys with Dyslalia N	Mean Age (months)	Boys with Norm. Sp. N	Mean Age (months)	Mean Diff.	t*	d.f.	Signif. Level
Holding Head Up	64	3.0	62	2.6	.4	1.5	124	10%
Sitting Alone	72	6.4	67	5.9	.5	2.0	137	5%
Crawling	67	7.3	67	7.1	.2	.56	132	55%
Walking	70	12.2	73	11.6	.6	1.08	141	28%
Talking	64	13.2	63	11.5	1.7	1.1	125	25%
Bladder Control	61	21.9	66	22.1	-.2	.08	125	94%
First Tooth	72	6.5	69	6.7	-.2	.51	139	62%

*t is roughly equivalent to the better-known "critical ratio". However, the significance of any given t depends entirely on its "degrees of freedom" ("d.f." in the table) which means, in this study, the size of each sample less one. The formulae for computing the t's used in this study and the tables used for determining the significance level of the t's may be found in E. F. Lindquist, Statistical Analysis in Educational Research, New York: Houghton Mifflin, 1940, pp. 53-54, 59.

onset of holding head up, onset of sitting alone, onset of crawling, onset of walking, onset of talking, onset of voluntary control of bladder, and eruption of first tooth.

The significance levels for t in regard to onset of

holding head up and onset of sitting alone for elementary boys with and without articulatory difficulties fall within the range 5% to 10%. These significance levels acquired from the table tend to cast some doubt upon the specific null hypotheses stating that there is no significant difference between these factors of physical growth and development and the incidence of defective articulation.

In brief, these data tend to suggest a relationship between defective articulation and onset of holding head up, and onset of sitting alone for elementary boys. However, from a statistical point of view the results are not definite enough to conclude that significant differences have been demonstrated.

Table III also bears out the fact that the mean differences for both groups are all quite small. Further, this table reveals that the mean ages for elementary boys possessing dyslalic handicaps tend to be higher in all physical factors except voluntary control of bladder and eruption of first tooth than the mean ages for elementary boys having normal speech articulation. This observation tends to support the findings advanced by Mead (17) and Van Riper (33), who reported a definite correlation between retarded physical growth and development and speech maturation.

The accumulated evidence for the seven factors listed in Table III indicates that there might have been significant differences between elementary boys with and without articulatory defects had the sample sizes been considerably larger,

and if it could be demonstrated that the elementary children are representative samples of all of the category. However, even though these differences may exist in the universe, the collected data presented here do not permit the writer to say that significant differences are present in his sample or need to be taken regularly into account in his analysis of trends.

The data concerning the results obtained for various physical factors of growth and development in elementary girls with and without disorders of dyslalia are summarized below in Table IV. This table should be read and interpreted on the same basis as Table III. The significance levels for t for elementary girls with and without articulatory deviations are indicated in the last column of Table IV. It is apparent that the two groups are highly similar and do not show any significant differences for the seven factors included in Table IV. It is felt that larger sample sizes would not have contributed data to support the possibility of significant differences existing between elementary girls with and without articulatory difficulties, as in the case of the boys.

TABLE IV

Comparative Table for Selected Physical Factors of Growth and Development in Elementary Girls with and without Articulatory Defects

Factor	Girls with Dyslalia N	Mean Age (months)	Girls with Norm. Sp. N	Mean Age (months)	Mean Diff.	t*	d.f.	Signif. Level
Holding Head Up	19	2.7	25	2.8	-.1	.19	42	86%
Sitting Alone	25	5.9	28	5.8	.1	.30	51	75%
Crawling	21	7.7	25	7.4	.3	.6	44	55%
Walking	31	12.3	29	12.4	-.1	.15	58	86%
Talking	21	10.5	25	10.2	.3	.27	44	80%
Bladder Control	24	18.8	26	20.2	-1.4	.41	48	66%
First Tooth	23	7.2	29	6.3	.9	1.22	49	22%

* See footnote to Table III.

Chi-square Statistical Technique

The chi-square statistical technique was used to compare the relationships of several growth and developmental factors to chronological age in elementary children with and without articulatory deviations, and to test the significance of the differences in the relationships observed. The method utilized in order to apply this technique was to plot the factors of mental age, reading age, arithmetic age, grip age, height age, and weight age against chronological age. Each figure was divided subsequently into four partitions, which

served as norms or quotient ranges. These quotient ranges were developed for the purpose of providing a measuring stick against which each sample could be analyzed, in order to determine whether or not the samples were significantly different. The next step in this process was concerned with counting up the frequencies in the following four established norms or quotient ranges: below 0.90, 0.90 to 1.00, 1.00 to 1.10, and above 1.10. These counted frequencies were entered into an appropriate table, and the value of chi-square was calculated. The chi-square table was used in order to determine whether or not the value of chi-square obtained from the two samples showed significant differences.

It was not necessary to plot figures for handedness and paternal occupation, or establish specific norms. Rather, the variables of right-handedness and left-handedness, and occupational class status in relation to frequency could be abstracted directly from the raw data, in order to calculate the values of chi-square.

It is felt that the chi-square statistical technique best fulfills the requirements for a precise and accurate analysis of the data included in this section. The t-test, and certain correlation or regression techniques to test the difference between slope and level in two samples could have been employed to differentiate between the variates studied here. These techniques are somewhat more difficult to calculate and generally do not render a better analysis of the data. However, where a significance level of 20% or below was found after the application of the chi-square

technique, the writer applied the t-test in order to further check the reliability of the results. It should be noted here that in a few instances where the significance level was 20% or below, the t-test was applied in order to check the data obtained from chi-square with the result that no appreciable differences in significance levels were discovered.

A number of reasons may be cited depicting why correlation or regression techniques would have proved inadequate in this study.

(1) Correlation, or regression techniques are only employed to determine the closeness of the relationship between two measures. In other words, correlation is used to determine the amount of variation in the spread of points around some line which best seems to fit the pattern of points. The figures plotted in this investigation indicated strikingly similar patterns of points in respect to the closeness of the relationships observed between chronological age and the variables studied in this section. In general, the differences observed between the patterns of points in the samples to be compared were not in the closeness of the relationships, but in the positioning of the relationships with regard to slope and level of the regressions. Consequently, it became convenient to establish the quotient ranges referred to above and apply the chi-square statistical technique, in order to test the independence of classification.

(2) Correlation, or regression techniques would have yielded questionable results, if one realizes that the

assumption of equal variance in one variable over any specific value of the other variable is not fulfilled in many of the distributions included in this investigation. Lastly, it is felt that these techniques would have had considerable uncertainties attached to them because of the rather small sample sizes.

The following null hypotheses are tested with the chi-square statistical technique in the section indicated below: there is no significant relationship between the incidence of defective articulation and:

1. grip.
2. height.
3. weight.
4. handedness.
5. intelligence
6. reading
7. arithmetic.
8. paternal occupation.

It is suggested that the reader refer to the tables in Appendix A for the primary data used in the chi-square calculations reported in this chapter.

Results Secured from Using the Chi-Square Statistical Technique

OTHER PHYSICAL FACTORS OF GROWTH AND DEVELOPMENT. The data secured from this section revealed no significant differences between elementary boys and girls with and without articulatory difficulties for the following factors of physical growth and development: grip, height, weight, and handedness.

The significance levels obtained from the calculated values of chi-square for grip and handedness were 18% and 9%, in elementary boys with and without disorders of dyslalia. A significance level of 8% was reported for elementary girls with and without articulatory handicaps for handedness. These findings are indicative of the fact that some doubt can be cast upon the specific null hypotheses denoting no association between grip, handedness, and articulatory deviations. Possibly larger sample sizes would have resulted in significant differences.

It is also worthy to note that the means for grip age, height age and weight age in the case of elementary boys and girls with and without articulatory errors are all fairly comparable. These findings tend to further corroborate the mathematics of chi-square connoting no significant differences.

The results for this heading have been recorded below in tables V, VI, VII, VIII, IX, and X. The plotted figures which supplied the data for tables V and VI were not included, as the patterns of points were strikingly similar.

Table V indicates that the calculated value of chi-square for the two groups in respect to grip is 4.934, which gives a significance level of 18% on the basis of three degrees of freedom. The other factors are interpreted in the same manner.

TABLE V

Summary of Data Relative to Other Physical Factors of Growth and Development for Elementary Boys with and without Disorders of Dyslalia

Classification	x^2	d.f.	Signif. Level
Grip	4.934	3	18%
Height	1.018	3	70%
Weight	2.135	3	55%

A summary of the data relative to other physical factors of growth and development for elementary girls with and without handicaps of articulation is presented below in Table VI.

TABLE VI

Summary of Data Relative to Other Physical Factors of Growth and Development for Elementary Girls with and without Disorders of Dyslalia

Classification	x^2	d.f.	Signif. Level
Grip	.321	1	50%
Height	.632	3	80%
Weight	.475	3	90%

Table VI is to be read in the same way as Table V.

Mean ages for elementary children with and without articulatory handicaps are shown in Table VII and Table VIII. Table VII reveals that means for seventy-eight boys with and

without dyslalia are 89.3 months and 89.2 months, in as far as grip age is concerned. A contrast of these means shows a difference of 0.1 months. The other factors are to be read in the same manner.

TABLE VII

Mean Ages for Other Physical Factors of Growth and Development for Elementary Boys with and without Dyslalia

	Boys with Dyslalia		Boys with Norm. Sp.		
Factor	N	Mean Age (months)	N	Mean Age (months)	Mean Diff.
Grip Age	78	89.3	78	89.2	.1
Height Age	78	109.3	78	110.1	-.8
Weight Age	78	110.5	78	111.5	-1.0

It can be seen in Table VIII below that the mean differences for elementary girls with and without articulatory errors tend to be slightly greater for the factors of grip age and height age than in the case of the boys. However, they tend to substantiate the significance levels shown in Table VI indicating no significant differences between the two samples.

TABLE VIII

Mean Ages for Other Physical Factors of Growth and Development for Elementary Girls with and without Dyslalia

	Girls with Dyslalia		Girls with Norm. Sp.		
Factor	N	Mean Age (months)	N	Mean Age (months)	Mean Diff.
Grip Age	32	83.8	32	79.8	4.0
Height Age	32	111.8	32	106.0	5.8
Weight Age	32	105.8	32	107.1	-1.3

Table VIII is to be read in the same way as Table VII.

The results of handedness for elementary children exhibiting articulatory defects compared with children producing normal consonants are shown below in Table IX and Table X.

TABLE IX

Analysis of Handedness for Elementary Boys with and without Articulatory Handicaps

	Boys with Dyslalia		Boys with Norm. Sp.				
Factor	Right	Left	Right	Left	χ^2	d.f.	Signif. Level
Handedness	65	13	72	6	2.936	1	9%

It is apparent from Table IX that there are sixty-five right-handed and thirteen left-handed elementary boys with dyslalia. Boys possessing normal articulatory patterns show seventy-two with a preference for the right hand and six for the left. The value of chi-square is 2.936, and

with one degree of freedom produces a significance level of 9%.

TABLE X

Analysis of Handedness for Elementary Girls with and without Articulatory Handicaps

	Girls with Dyslalia		Girls with Norm. Sp.				
Factor	Right	Left	Right	Left	X^2	d.f.	Signif. Level
Handedness	32	0	29	3	3.147	1	8%

It is suggested that this table be interpreted on the same basis as Table IX.

MENTAL FACTORS OF GROWTH AND DEVELOPMENT. An examination of the chi-square calculations displayed in Table XI and Table XII below derived as a result of plotting figures I, II, III, and IV indicate that the intelligence for elementary boys and girls possessing normal articulatory patterns is at a considerably higher level than the intelligence of elementary boys and girls having articulatory difficulties.

The second and fourth columns of Table XI show that the observed frequencies for elementary boys with and without articulatory defects falling within the norm of greater than 1.10 are 8 and 24 respectively. For the same norm, columns three and five reveal expected frequencies of 16 for elementary boys with and without handicaps of articulation. The other columns in the table are to be read in the same way. A value of 17.73 is apparent for the mathematics of chi-square in this table. Three degrees of freedom yields a

TABLE XI

Comparison of Intelligence for Boys with and without Articulatory Defects

Norms MA/CA	Boys Having Articulatory Defects		Boys with Normal Articulation	
	Observed f	Expected f	Observed f	Expected f
> 1.10	8	16	24	16
1.00-1.10	16	21	26	21
0.90-1.00	18	18	17	17
< 0.90	36	23	11	24

$x^2 = 17.73$

d.f. = 3

Signif. Level = 0.1%

significance level of 0.1%, which points up a definite significant difference between the two samples.

Table XII that follows may be read and interpreted in the same manner as Table XI.

TABLE XII

Comparison of Intelligence for Girls with and without Articulatory Defects

Norms MA/CA	Girls Having Articulatory Defects		Girls with Normal Articulation	
	Observed f	Expected f	Observed f	Expected f
> 1.10	3	8	13	8
1.00-1.10	4	8	12	8
0.90-1.00	11	8	4	7
< 0.90	14	8	3	9

$x^2 = 21.161$ d.f. = 3 Signif. Level = 0.1%

A summary of the calculated means in Table XIII tends to support the results obtained from the application of the chi-square technique indicating significant differences favoring children possessing articulatory patterns within the normal range.

TABLE XIII

Mean Mental Ages for Elementary Boys and Girls with and without Articulatory Defects

	Children with Dyslalia	Children with Normal Articulation	
Sex	Mean Age (months)	Mean Age (months)	Mean Diff.
Boys	96.9	107.7	-10.8
Girls	92.1	108.5	-16.4

Table reads: The mean mental age for elementary boys with dyslalia is 96.9, and 107.7 for elementary boys having normal articulation. These two means when compared yield a mean difference of -10.8. The same procedure is used in reading the row for girls.

These data for intelligence clearly point out that elementary boys and girls with normal speech articulation tend to occupy the higher norm ranges, and that elementary boys and girls possessing disorders of dyslalia occupy the lower norm ranges. For both elementary boys with and without articulatory defects, and elementary girls with and without articulatory handicaps the mathematics of chi-square indicate highly significant values, or very low significant levels. Therefore, it is necessary to reject the original null hypothesis and conclude that real significant differences appear

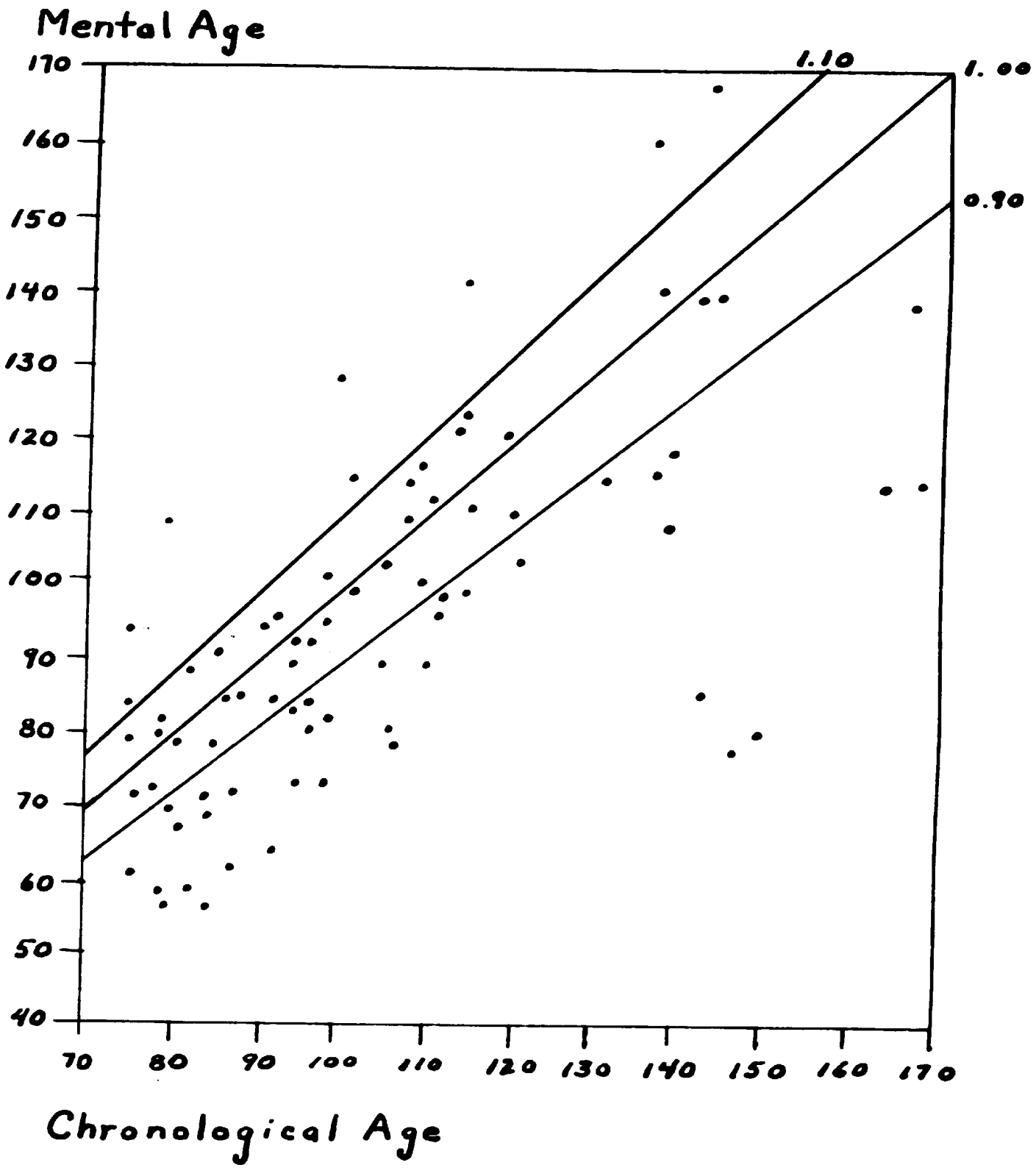


Figure I

Intelligence for Elementary Boys Having Articulatory Defects

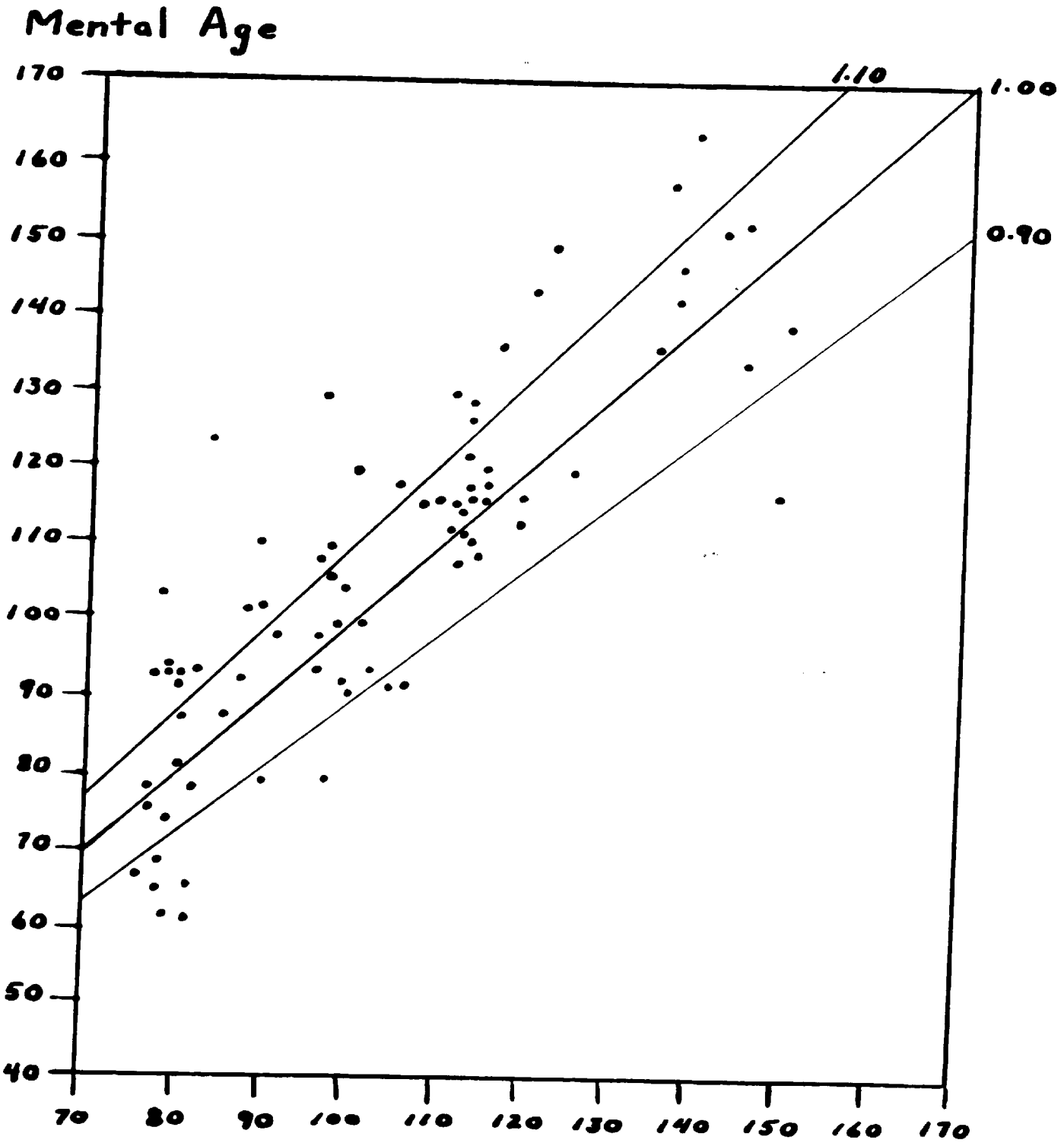


Figure II

Intelligence for Elementary Boys Having Normal Articulation

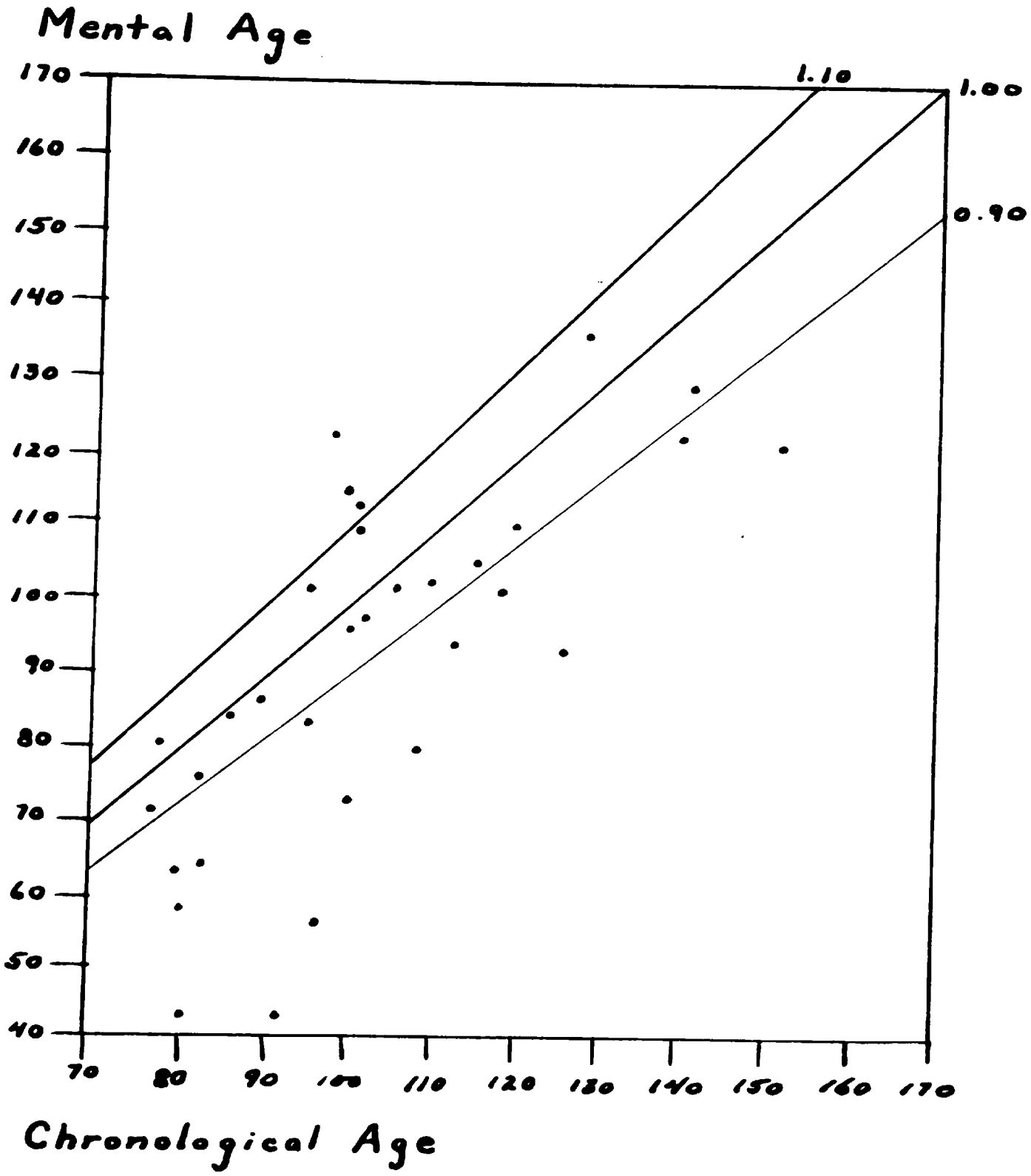


Figure III

Intelligence for Elementary Girls with Deviations of Articulation

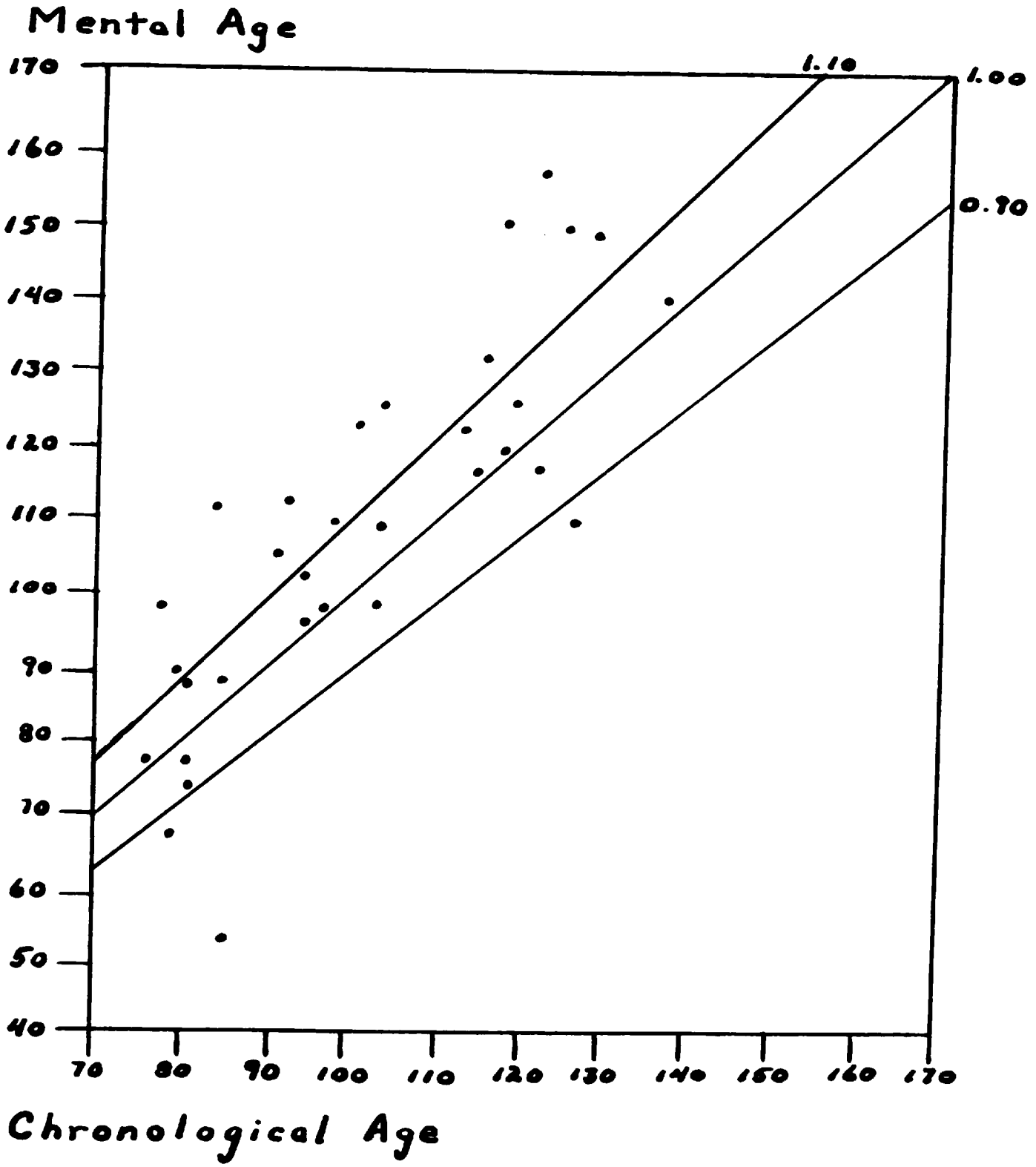


Figure IV

Intelligence for Elementary Girls Exhibiting Normal Articulation

to exist between children with defects of articulation and children possessing speech articulation within the normal range. This finding bears out the observations reported by Mead (17), McCarthy (15), Smith (29), and Towne (32), who found a direct relationship between mental retardation and speech handicaps (including articulation). Gens (7), and Poole (23), also discovered that among other things, a child's ability to articulate consonant sounds in his speech is conditioned by intelligence.

A summary of the results obtained from analyzing reading for elementary boys with and without articulatory deviations is given in Table XIV.

TABLE XIV

Summary of Chi-Square Analysis of Reading for Elementary Boys with and without Articulatory Handicaps

Norms RA/CA	Boys Having Articulatory Defects		Boys with Normal Articulation	
	Observed f	Expected f	Observed f	Expected f
> 1.10	2	21	3	20
1.00-1.10	14		22	
0.90-1.00	28	30	31	29
< 0.90	34	27	22	29

$x^2 = 7.41$

d.f. = 2

Signif. Level = 1.5%

Table reads: The observed frequencies for boys with articulatory defects in the norm ranges greater than 1.10 and

1.00 to 1.10 are 2 and 14, or 16 when combined; the expected frequency for these norm ranges is 21. The observed frequencies for boys having normal articulation falling within the ranges greater than 1.10 and 1.00 to 1.10 are 3 and 22, or 25; the expected frequency is set at 20. The other rows in the table are to be read in a similar manner. The calculated value of chi-square is 7.41, and on the basis of 2 degrees of freedom the significance level is 1.5%.

An analysis of the data in Table XIV provides no grounds for definite rejection of the null hypothesis regarding no association between reading and the incidence of defective articulation. However, it should be mentioned that a significance level of approximately 1.5% tends to shed considerable doubt on the hypothesis, even though it is not sufficient enough to reject it statistically. We see in Table XIV that for boys having normal articulation the observed frequencies are higher than the expected frequencies in the upper norm ranges, and that the observed frequency is lower than the expected frequency in the norm range less than 0.90. In the case of boys with articulatory defects this finding is just reversed. This is evidence that if larger samples were available, a significant relationship might be observed between reading and the occurrence of inferior articulation. Also, larger sample sizes might reveal a tendency for boys with normal articulation to have higher reading ages than boys possessing articulatory difficulties.

In careful investigations conducted by Artley (1), Hildreth (12), and Vedinack (37), a direct relationsnip was reported between inferior patterns of articulation and deficiencies in reading ability. The results of these investigations appear to corroborate the conclusion stated above

indicating that larger sample sizes would no doubt yield a significant relationship between reading and defective articulation.

A summary of the mean reading ages for boys with and without deviations of articulation and the resulting mean difference is presented in Table XV below.

TABLE XV

Mean Reading Ages for Elementary Boys with and without Defects of Articulation

	Boys with Dyslalia		Boys with Normal Speech		
Factor	N	Mean Age (months)	N	Mean Age (months)	Mean Diff.
Reading Age	78	94.0	78	97.1	-3.1

The mean difference of -3.1 recorded in Table XV tends to support the finding advanced by chi-square connoting no significant difference from a statistical view point. However, larger sample sizes might have resulted in a larger mean difference.

Table XVI shows the chi-square values and significance levels for reading and arithmetic in elementary girls with and without deviations of articulation. Here again the figures from which these data were abstracted are not included, as it was felt that they would not contribute appreciably to a further understanding of the results.

TABLE XVI

Summary of Data Relative to Reading and Arithmetic for Elementary Girls with and without Articulatory Deviations

Classification	X^2	d.f.	Signif. Level
Reading	1.610	2	30%
Arithmetic	0.533	1	90%

This table may be read and interpreted as follows: the chi-square value for elementary girls with and without articulatory disorders in respect to reading is 1.610. This value when calculated in the chi-square table with two degrees of freedom reveals a significance level equal to 30%. The classification dealing with arithmetic is to be read in the same manner.

A careful study of Table XVI points out that the significance levels for chi-square are equal to 30% and 90% respectively. Therefore, it can be concluded that elementary girls having disorders of dyslalia present no significant differences in reading and arithmetic when compared with elementary girls possessing speech articulation within the normal range.

It is felt that the mean differences found in Table XVII that follows tend to back up the conclusion that significant differences do not exist between elementary girls with and without handicaps of articulation. This table is to be read in the same manner as Table XV.

TABLE XVII

Mean Reading and Arithmetic Ages for Elementary Girls with and without Dyslalia

	Girls with Dyslalia		Girls with Norm. Sp.		
Factor	N	Mean Age (months)	N	Mean Age (months)	Mean Diff.
Reading Age	32	96.1	32	98.7	-2.6
Arithmetic Age	16	104.9	16	110.8	-5.9

It is apparent from Table XVIII presented below that arithmetic for elementary boys with and without articulatory deviations displays no significant relationship. On the other hand, a significance level of 18% tends to direct some doubt upon the hypothesis intimating no association between arithmetic age and defective articulation.

TABLE XVIII

Summary of Results Relative to Arithmetic for Elementary Boys with and without Handicaps of Articulation

Classification	X^2	d.f.	Signif. Level
Arithmetic	3.470	2	18%

Table XIX records a mean difference of -6.5 for arithmetic age in the case of elementary boys with and without errors of articulation. This finding tends to support the possibility suggested by the significance level of 18% reported

in Table XVIII indicating that some doubt can be cast upon the null hypothesis involved.

TABLE XIX

Mean Arithmetic Ages for Elementary Boys with and without Defects of Articulation

	Boys with Dyslalia		Boys with Normal Speech		
Factor	N	Mean Age (months)	N	Mean Age (months)	Mean Diff.
Arithmetic Age	37	104.7	37	111.2	-6.5

Table is to be read in the same way as Table XVII.

PATERNAL OCCUPATION. The results of comparing paternal occupations for elementary boys and girls with and without handicaps of articulation are given in Table XX and Table XXI. No significant differences were found. However, it should be mentioned that the significance level found for elementary boys with and without articulatory defects tends to cast some doubt upon the null hypothesis involved.

These data are not confirmatory of previous research conducted by Beckey (3), Gesell (8), and Smith (29) in which they reported a relationship between defective articulation and paternal occupation. It is felt this possibly can be accounted for in the fact that small sample sizes were used, which could tend to distort the results of the statistical analysis presented here.

TABLE XX

Paternal Occupations for Elementary Boys and Girls with and without Handicaps of Articulation

Occupational Class	Boys with Dyslalia N	Boys with Norm. Sp. N	Girls with Dyslalia N	Girls with Norm. Sp. N
I	1	2	1	1
II	4	3	0	1
III	14	17	3	5
IV	0	1	0	0
V	14	20	11	7
VI	31	20	11	10
VII	12	7	4	4

χ^2 = 4.882 for Boys χ^2 = 1.850 for Girls

d.f. = 3 d.f. = 3

Signif. Level = 18% Signif. Level = 60%

Table XXI presents a further study of paternal occupations as related to articulatory defectiveness, with the variable of sex eliminated.

TABLE XXI

Paternal Occupational Classes for Elementary Children with and without Handicaps of Articulation

Occupational Class	Children with Dyslalia N	Children having Normal Speech N
I	2	3
II	4	4
III	17	22
IV	0	1
V	25	27
VI	42	30
VII	16	11

χ^2 = 3.61

d.f. = 6

Signif. Level = 72%

It is interesting to note how the samples studied in this section tend to occupy the lower occupational classes.

Chapter IV

COMPARISON OF NEGRO AND WHITE ELEMENTARY BOYS AND GIRLS WITH ARTICULATORY HANDICAPS

The Second Problem

In the first part of this investigation the purpose was to ascertain the importance of various growth and developmental factors in the maturation of speech articulation in elementary children. In this second part the study will be directed toward the problem of finding out whether or not there are significant inter-racial differences in negro and white elementary children with articulatory defects with regard to selected growth and developmental indicators.

The Techniques Employed for Analysis

The t-distribution of the difference between means was utilized to test the following specific null hypotheses: there is no significant relationship between negro and white elementary children with articulatory defects and:

1. onset of holding head up.
2. onset of sitting alone.
3. onset of crawling.
4. onset of walking.
5. onset of talking.
6. onset of voluntary control of bladder.
7. onset of articulatory defect.

8. eruption of the first tooth.

9. number of defective consonants.

The chi-square distribution was employed to test the following major hypotheses: there is no significant relationship between negro and white elementary children having articulatory handicaps and:

1. grip.
2. height.
3. weight.
4. handedness.
5. intelligence.
6. reading.
7. arithmetic
8. paternal occupation.

The primary data for the chi-square calculations revealed in this chapter may be found in Appendix B.

Interpretation of Results Derived from Sampling Distribution of t

PHYSICAL FACTORS OF GROWTH AND DEVELOPMENT. A careful study of the facts recorded in Table XXII and Table XXIII below shows no significant differences for negro and white boys and girls with articulatory handicaps in regard to onset of crawling, onset of walking, onset of talking, onset of articulatory defect, and eruption of first tooth. The foregoing findings indicating no significant differences were discovered after the t-test was applied to the above physical factors, and the significance levels determined.

TABLE XXII

Comparative Table of Physical Factors of Growth and Development for Negro and White Elementary Boys with Articulatory Defects

Factor	Negro Boys N	Mean Age (months)	White Boys N	Mean Age (months)	Mean Diff.	t*	d.f.	Signif. Level
Holding Head Up	26	3.5	38	2.7	.8	2.3	62	2%
Sitting Alone	29	5.8	43	6.8	-1.0	2.8	70	.8%
Crawling	28	7.1	39	7.4	-.3	.55	65	57%
Walking	28	11.3	42	12.2	-.9	.75	68	46%
Talking	27	12.4	37	14.4	-2.0	1.0	62	30%
Bladder Control	18	29.0	43	18.9	10.1	3.79	59	.08%
Artic. Defect	20	50.8	29	43.3	7.5	.93	47	36%
First Tooth	29	6.2	43	6.7	-.5	.91	70	35%

* See footnote to Table III

Table XXII shows that the mean age in the case of onset of holding head up for twenty-six negro boys having articulatory disorders is 3.5 months, and 2.7 months for thirty-eight white boys possessing dyslalic difficulties; the mean difference is 0.8 and the value of t is 2.3. Sixty-two degrees of freedom produces a significance level of two percent. The other factors included in this table are to be read in a similar manner.

TABLE XXIII

Comparative Table of Physical Factors of Growth and Development for Negro and White Elementary Girls with Articulatory Defects

	Negro Girls		White Girls					
Factor	N	Mean Age (months)	N	Mean Age (months)	Mean Diff.	t*	d.f.	Signif. Level
Holding Head Up	8	3.0	11	2.3	.7	1.59	17	16%
Sitting Alone	13	6.2	12	5.5	.7	1.73	23	12%
Crawling	10	7.7	11	7.6	.1	.74	19	45%
Walking	16	12.4	15	12.3	.1	.112	29	93%
Talking	10	9.2	11	11.7	-2.5	1.54	19	15%
Bladder Control	11	18.2	13	19.4	-1.2	.35	22	75%
Artic. Defect	7	28.6	6	49.0	-20.4	1.5	11	15%
First Tooth	10	6.8	13	7.5	- .7	.57	21	58%

*See footnote to Table III.
Table XXIII is to be read in the same way as Table XXII.

There is some reason to believe that the significance level of two percent established in Table XXII for onset of holding head up in negro and white boys having articulatory defects indicates a probable significant difference. However, on the strength of the data presented here it is not possible to say positively that sufficient evidence is available to definitely reject the null hypothesis implying no association.

It is worthwhile to note that Table XXII appears to indicate real differences for onset of sitting alone, and voluntary control of bladder in negro and white elementary boys having defects of articulation, in so far as these data are representative of the true situation. The significant differences observed favor the negro boys in the case of onset of sitting alone, and white boys for voluntary control of the bladder. It is also interesting to note the lower mean ages for negro boys with disorders of dyslalia in onset of crawling, onset of sitting alone, onset of walking, onset of talking, and eruption of first tooth when compared with white elementary boys having disorders of articulation.

Table XXIII points out no significant difference in onset of holding head up for negro and white elementary girls with articulatory handicaps. Further, the mean ages for all the factors studied in Table XXIII reveal small mean differences, with the exception of onset of articulatory defect. Even though a mean difference of 20.4 exists in this instance, the application of the t-test did not produce a significance level indicating a real difference. On the other hand, one certainly can reach the conclusion that there is a decided

tendency for the onset of articulatory defect to be appreciably lower in negro elementary girls with disorders of dyslalia. Possibly a larger sample size would have resulted in the appearance of a significant difference.

There is reason to believe that a true difference exists for the number of defective consonants found in negro and white elementary boys with articulatory handicaps. Even though a mean difference of only -1.3 is indicated in Table XXIV, a significance level of 1% is revealed. Therefore, it is feasible to conclude that possible significant inter-racial differences are present favoring negro boys. This conclusion does not hold true for negro and white elementary girls with respect to the same factor shown in Table XXV below where a significance level of 20% makes its appearance.

TABLE XXIV

Number of Defective Consonants for Negro and White Elementary Boys with Dyslalia

	Negro Boys		White Boys					
Factor	N	Mean No.	N	Mean No.	Mean Diff.	t*	d.f.	Signif. Level
Defective Cons.	30	2.6	47	3.9	-1.3	2.65	75	1%

Read Table XXIV in the same manner as Table XXIII, except that the mean is interpreted in the light of number, rather than months.

* See footnote to Table III.

TABLE XXV

Number of Defective Consonants for Negro and White Elementary Girls with Dyslalia

Factor	Negro Girls N	Negro Girls Mean No.	White Girls N	White Girls Mean No.	Mean Diff.	t*	d.f.	Signif. Level
Defective Cons.	20	2.0	15	2.8	-.8	1.31	33	20%

Interpret this table on the same basis as Table XXIV.
* See footnote to Table III.

Discussion of Results Acquired from Chi-Square Distributions

OTHER PHYSICAL FACTORS OF GROWTH AND DEVELOPMENT. It is apparent from the results presented in Table XXVI that the levels of significance justify the acceptance of the null hypothesis stating no significant differences exist between negro and white elementary boys having articulatory difficulties with regard to height, and weight. This table shows that for height the value of chi-square is equal to 5.951. With

TABLE XXVI

Summary of Data Relative to Other Physical Factors of Growth and Development for Negro and White Elementary Boys Having Articulatory Handicaps

Classification	x^2	d.f.	Signif. Level
Height	5.951	3	15%
Weight	.440	3	92%

three degrees of freedom, the significance level is established at 15%. The other factor is to be read in the same way.

It can be observed in Table XXVII that a mean difference of 9.5 months for height age exists between the mean ages of negro and white elementary boys having articulatory handicaps. This finding tends to corroborate the significance level of 15% reported above in Table XXVI suggesting that some doubt can be cast upon the proposal of no relationship. Read this table in the same way as Table XIX.

TABLE XXVII

Mean Ages for Other Physical Factors of Growth and Development for Negro and White Elementary Boys Having Articulatory Defects

	Negro Boys		White Boys		
Factor	N	Mean Age (months)	N	Mean Age (months)	Mean Diff.
Height Age	30	114.4	48	104.9	9.5
Weight Age	30	111.3	48	110.0	1.3

The factor of grip appears to present another point of view. It can be observed in Table XXVIII that a significance level of 1.5% has been established for this physical factor, which tends to cast considerable doubt upon the major null hypothesis involved. However, from a statistical point of view it is not possible to conclude that a significant difference exists.

Figure V and Figure VI from which the data for grip age was abstracted may be found below.

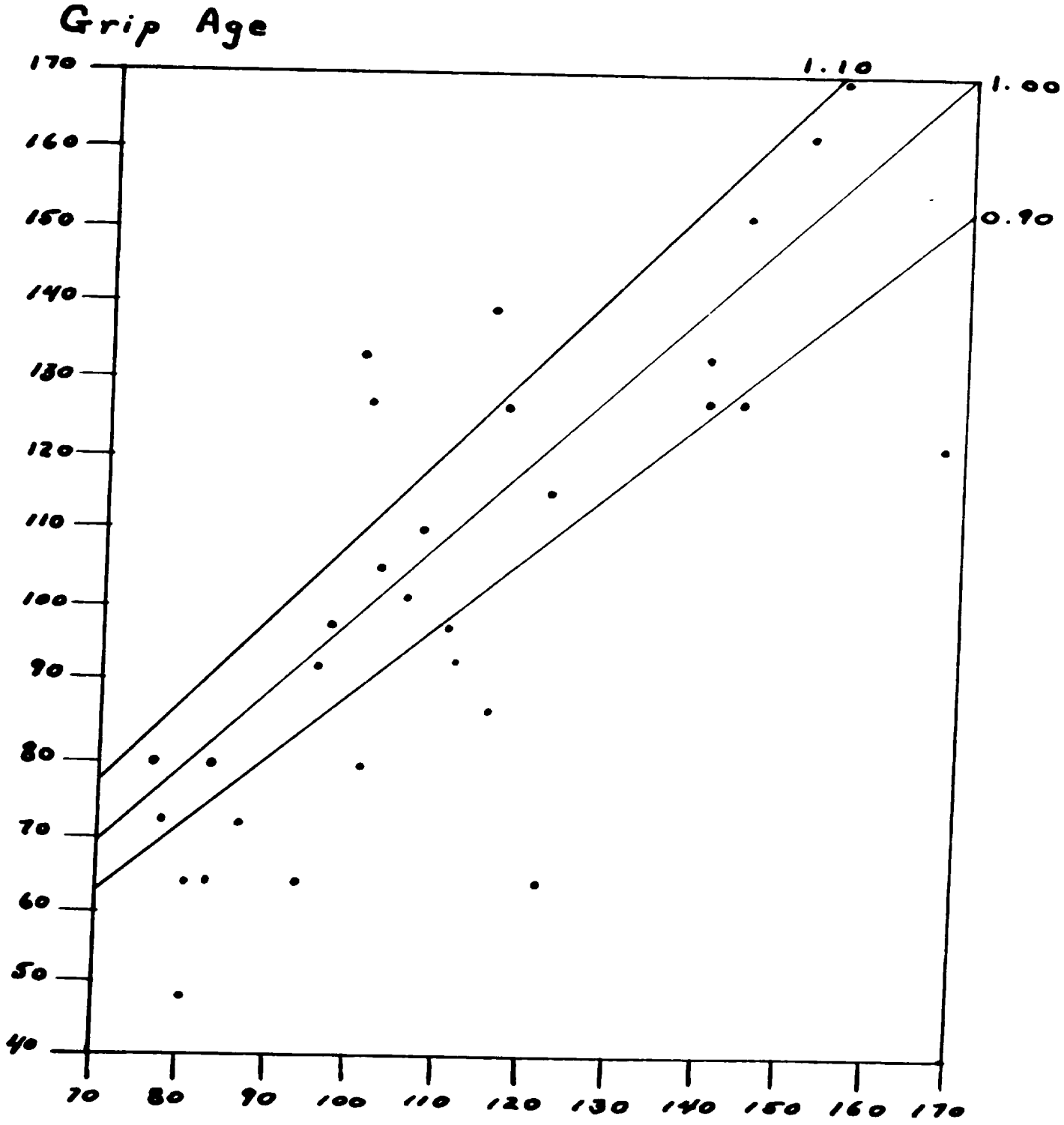


Figure V

Grip for Negro Boys Exhibiting Defects of Articulation

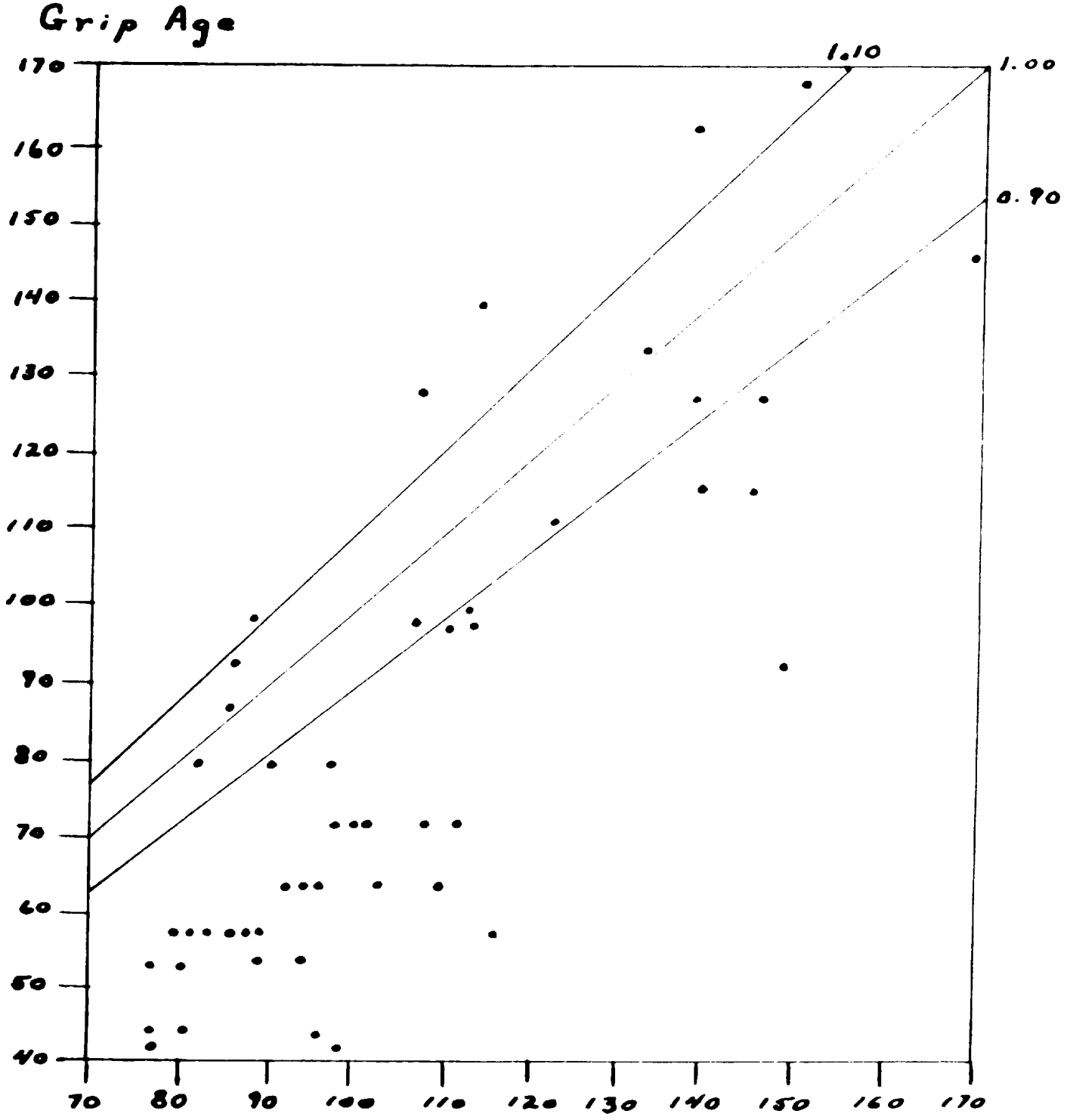


Figure VI
Grip for White Boys Having
Articulatory Handicaps

We can note for white boys having articulatory defects the observed frequencies tend to be lower than the expected frequencies in the upper norm ranges, and that the observed frequency is higher than the expected frequency in the norm range less than 0.90. In the case of negro boys with disorders of dyslalia this finding is just reversed. This may be interpreted that if larger sample sizes were available, a significant relationship might be found favoring negro boys having defects of articulation with regard to grip.

TABLE XXVIII

Summary of Chi-Square Analysis for Grip of Negro and White Elementary Boys with Dyslalia

Norms $\frac{GA}{CA}$	Negro Boys		White Boys	
	Observed f	Expected f	Observed f	Expected f
> 1.10	3	3	5	5
1.00-1.10	7	4	3	6
0.90-1.00	7	4	4	7
< 0.90	13	19	36	30

$X^2 = 10.39$

d.f. = 3

Signif. Level = 1.5%

Table is to be read in the same way as Table XIV.

A study of the data in Table XXIX makes it apparent that there is a substantial mean difference of 16.5 months. Here again the evidence tends to support the results obtained from the mathematics of chi-square indicating that some doubt can be shed upon the null hypothesis inferring no relationship between defective articulation in negro and white elementary boys and grip.

TABLE XXIX

Mean Grip Ages for Elementary Boys Having Deviations of Articulation

	Negro Boys		White Boys		
Factor	N	Mean Age (months)	N	Mean Age (months)	Mean Diff.
Grip Age	30	99.7	78	83.2	16.5

Read Table XXIX in the same manner as Table XXVII.

Comparison of the available data for grip, height, and weight in negro and white elementary girls with defects of articulation showed no significant differences. The figures from which these results were obtained were not included, as the writer did not feel they would shed further light on the discussion and interpretation of the data. Tables XXX and XXXI below present a summary of these results.

TABLE XXX

Summary of Data Relative to Other Physical Factors of Growth and Development for Negro and White Elementary Girls Having Articulatory Handicaps

Classification	χ^2	d.f.	Signif. Level
Grip	2.33	1	13%
Height	3.475	2	18%
Weight	1.48	3	68%

Read table in the same manner as Table XXV.

TABLE XXXI

Mean Ages for Other Physical Factors of Growth and Development for Negro and White Elementary Girls Having Articulatory Defects

	Negro Girls		White Girls		
Factor	N	Mean Age (months)	N	Mean Age (months)	Mean Diff.
Grip Age	17	87.7	15	79.3	8.4
Height Age	17	114.0	15	109.3	4.7
Weight Age	17	103.5	15	108.4	-4.9

This table is to be interpreted in the same way as Table XXIX.

It is immediately seen that the significance levels for the three factors of physical growth and development included in the last column of Table XXX are all fairly high. Also, the mean differences shown in Table XXXI are all com-

paritively small. Therefore, it is felt we can safely conclude that there is little probability of true differences.

It is observed that handedness for negro and white elementary boys and girls displaying articulatory difficulties presents no significant differences, as determined by the chi-square test. The data for this factor have been recorded in Table XXXII and Table XXXIII. Both of these tables are to be read on the same basis as Table X.

TABLE XXXII

Analysis of Handedness for Negro and White Elementary Boys with Errors of Articulation

	Negro Boys		White Boys				
Factor	Right	Left	Right	Left	X^2	d.f.	Signif. Level
Handedness	27	3	38	10	1.56	1	22%

TABLE XXXIII

Analysis of Handedness for Negro and White Elementary Girls with Errors of Articulation

	Negro Girls		White Girls				
Factor	Right	Left	Right	Left	X^2	d.f.	Signif. Level
Handedness	17	0	15	0	0	1	99%

A consideration of sex differences indicated that deviations of articulation occur more frequently among negro and white elementary boys than in negro and white elementary

girls. This conclusion is based upon several corroborating findings that follow. Thirty negro boys were found to have articulatory handicaps, compared with seventeen negro girls, yielding a sex-ratio of 1.76 to 1. A comparison of forty-eight white boys with fifteen white girls set the sex-ratio at 3.2 to 1. A sex-ratio of 2.43 to 1 was established when the negro and white boys were considered collectively and contrasted with the total number of negro and white girls.

It is interesting to observe how the sex-ratio for negro and white elementary boys compared with negro and white elementary girls coincides very closely with a speech survey completed by Wallin (35) in 1916 in which he reported a sex-ratio of 2.8 to 1. Moreover, the ratios calculated for negro boys and girls having articulatory defects, and white boys and girls possessing disorders of dyslalia tend to substantiate the findings of Morris (18), Poole (23), and Root (25), who found positive differences in favor of girls in the maturation of speech articulation.

A summary of the chi-square calculation of these data are presented in Table XXXIV below. This table reveals a significance level of 15%, which is fairly high. Therefore, it becomes necessary to accept the hypothesis stating that no association is present between race and sex among elementary negro and white boys and girls with articulatory handicaps.

TABLE XXXIV

Summary of Data Relative to Sex-ratio for Negro and White Children with Articulatory Deviations

	Negro		White	
Sex	Observed f	Expected f	Observed f	Expected f
Boys	30	33.4	48	44.6
Girls	17	13.6	15	18.4

$\chi^2 = 2.10$

d.f. = 1

Signif. Level = 15%

Table reads: The observed frequency and expected frequency for negro boys having dyslalia are 30 and 33.4 respectively. The numbers 48 and 44.6 represent the observed and expected frequencies for white boys. The same procedure is utilized in reading and interpreting the frequencies for girls. The value of chi-square is calculated to be 2.10. The degree of freedom produces a significance level of 15%.

It is also worthwhile to observe how these results favor the possibility of a direct association between sex and the incidence of inferior articulation.

MENTAL FACTORS IN ORIGIN AND DEVELOPMENT. An examination of the data displayed in Table XXXV and Table XXXVI points out that there is no significant relationships between negro and white elementary boys and girls and intelligence, reading, and arithmetic.

TABLE XXXV

Summary of Results Relative to Mental Factors for Negro and White Elementary Boys with Articulatory Defects

Classification	x^2	d.f.	Signif. Level
Intelligence	1.971	3	60%
Reading	2.440	2	45%
Arithmetic	0	1	99%

Table is to be interpreted on the same basis as Table XXX.

TABLE XXXVI

Summary of Results Relative to Mental Factors for Negro and White Elementary Girls with Articulatory Defects

Classification	x^2	d.f.	Signif. Level
Intelligence	.511	1	45%
Reading	0	2	99%
Arithmetic	0	1	99%

Table is to be read in the same manner as Table XXXV.

A range of 45% to 99% is revealed in Table XXXV and Table XXXVI, in respect to significance level. These levels are definitely high and tend to dispel any possibility for the existence of substantial significant differences. It is felt these data are indicative of the real situation and that larger sample sizes would not appreciably alter these

conclusions. Further, it should be pointed out that the mean differences found for the samples represented in Tables XXXVII and XXXVIII very definitely substantiate the chi-square tests indicating high significance levels. The latter mentioned tables follow and are to be read and interpreted in the same manner as Table XXXI.

TABLE XXXVII

Mean Ages for Mental Factors of Growth and Development for Negro and White Elementary Boys Possessing Dyslalia

	Negro Boys		White Boys		
Factor	N	Mean Age (months)	N	Mean Age (months)	Mean Diff.
Mental Age	30	97.8	48	96.1	1.7
Reading Age	30	94.3	48	93.8	.5
Arithmetic Age	16	101.4	21	107.2	-5.8

TABLE XXXVIII

Mean Ages for Mental Factors of Growth and Development for Negro and White Elementary Girls Possessing Dyslalia

	Negro Girls		White Girls		
Factor	N	Mean Age (months)	N	Mean Age (months)	Mean Diff.
Mental Age	17	86.8	15	93.1	-1.3
Reading Age	17	94.5	15	97.8	-3.3
Arithmetic Age	9	101.3	7	109.6	-8.3

The results analyzed in this section fail to bear out investigations made by Sunne (31) and Garrett (6) postulating that negroes on the average rank consistently lower than whites on tests of mental ability.

OCCUPATIONAL GROUP DIFFERENCES. The mathematics of chi-square point up significance levels of 13% for negro and white elementary boys with articulatory deviations and 40%

TABLE XXXIX

Paternal Occupations for Negro and White Elementary Boys and Girls with Handicaps of Articulation

Occupational Class	Negro Boys N	White Boys N	Negro Girls N	White Girls N
I	0	1	0	1
II	0	4	0	0
III	5	9	1	2
IV	0	0	0	0
V	4	10	6	5
VI	12	19	8	3
VII	8	4	2	2

$X^2 = 5.772$ for Boys	$X^2 = 2.88$ for Girls
d.f. = 3	d.f. = 3
Signif. Level = 13%	Signif. Level = 40%

for negro and white elementary girls possessing handicaps of articulation for paternal occupations. Here again, the significance levels appear to indicate no relationship between paternal occupation and children possessing articulatory defects. The data for this heading are presented in Table XXXIX.

In order to conduct a more comprehensive analysis of the available data in this section, the variable of sex was dispensed with in Table XL. A study of the frequency distributions in this table reveals a noticeable tendency for the children investigated to fall in the lower three occupational classes.

TABLE XL

Paternal Occupations for Negro and White Elementary Children with Handicaps of Articulation

Occupational Class	Negro Children N	White Children N
I	0	2
II	0	4
III	6	11
IV	0	0
V	10	15
VI	20	22
VII	10	6

$X^2 = 7.886$

d.f. = 5

Signif. Level = 17%

The significance level of 17% reported for negro and white elementary children grouped together in Table XL tends to throw some doubt upon the major hypothesis involved. However, here again it is not possible to reject the hypothesis on the basis of the statistical evidence.

Chapter V

SUMMARY AND RECOMMENDATIONS

This investigation was undertaken to determine the importance of various growth and developmental factors in the maturation of speech articulation for elementary children in grades one through six.

A secondary part of the study was concerned with a comparison of articulatory handicapped negro and white elementary children in order to determine similarities and differences in selected growth and developmental factors.

More specifically, the research was concerned with the relationship of physical, mental, and environmental variables to articulation. Relative to the physical conditions of the children, such factors as onset of holding head up, onset of sitting alone, onset of crawling, onset of walking, onset of talking, onset of voluntary control of bladder, eruption of first tooth, handedness, sex-ratio, grip, height, and weight, were investigated.

From the mental view point, the following factors were investigated to determine their possible effect upon the maturation of speech articulation: (1) intelligence, (2) reading, and (3) arithmetic.

Paternal occupation was used as an index of broad

environmental or socio-economic differences.

A clinical analysis of one-hundred and ten elementary children having articulatory deviations was made and evaluated statistically. A corresponding study of one-hundred and ten elementary children possessing articulatory patterns within the normal range was also made to determine what factors were common to the two groups and what factors differentiated them. These two groups were compared by utilizing the t-distribution of the difference between means and the chi-square statistical technique. An inter-racial comparison using the above named statistical tests was also made to determine any significant growth and developmental differences in negro and white elementary children with articulatory handicaps.

Summary of Findings

The relationship of various physical factors to the maturation of speech articulation were evaluated with the following significant results:

1. There were no significant physical differences noted for elementary boys and girls with and without articulatory defects, in respect to onset of holding head up, onset of crawling, onset of sitting alone, onset of walking, onset of talking, onset of voluntary control of the bladder, eruption of first tooth, grip, height, weight, and handedness.

2. Low significance levels were found for onset of holding head up, onset of sitting alone, grip and handedness for boys with and without articulatory defects. This finding tends to suggest a relationship between defective articulation and these factors.

3. The factor of handedness for elementary girls with and without disorders of articulation showed a low significance level, which tends to cast some doubt upon the null hypothesis inferring no relationship to dyslalia.

4. The means for elementary boys with defective articulation tended to be higher for the factors of onset of holding head up, onset of crawling, onset of sitting alone, onset of walking, and onset of talking, than for boys having speech within the normal range. This was not true of voluntary control of bladder and eruption of first tooth.

5. There is some reason to believe that the low significance level established for boys having dyslalia with regard to onset of holding head up denotes a probable significant difference.

6. No significant difference was observed for onset of holding head up for girls having inferior articulation.

7. Negro and white elementary boys and girls possessing articulatory deviations showed no significant differences for onset of crawling, onset of walking, onset of talking, onset of articulatory defect, eruption of first tooth, and number of defective consonants.

8. Real differences seemed to exist for onset of sitting alone, voluntary control of the bladder, and number of defective consonants for boys with articulatory difficulties, in so far as the data are representative of the true situation. The significant differences noted favored negro boys in the case of onset of sitting alone, and white boys for voluntary control of the bladder and number of defective consonants.

9. The means for negro boys with dyslalia for onset of crawling, onset of sitting alone, onset of walking, onset of talking, eruption of first tooth, and number of defective consonants were lower than for white boys similarly afflicted.

10. For grip, negro and white boys possessing handicaps of articulation revealed a significance level tending to point up a possible difference. A larger sample size might have indicated this probable significance more definitely.

11. The levels of significance justify the acceptance of the null hypotnesis inferring no significant differences between negro and white boys having defects of articulation in regard to height, weight, and handedness.

12. Grip, height, weight, and handedness for girls exhibiting articulatory disorders showed no significant differences.

13. The evidence presented in this study favors the possibility of a direct relationship between sex and the maturation of defective articulation. This was substantiated

when negro and white girls were contrasted with negro and white boys, resulting in a sex-ratio of 2.43 boys to 1 girl. A ratio of 1.76 to 1 was discovered for the negroes and 3.2 to 1 in the case of the whites. However, the mathematics of chi-square denoted no significant relationship between sex and the occurrence of defective articulation.

From the mental factors that were investigated to ascertain their bearing upon the maturation of defective articulation, the following findings were obtained:

1. Intelligence for boys and girls having articulation within the normal range was at a considerably higher level than the intelligence for boys and girls having defective articulation.

2. No association was found for reading in negro and white boys having dyslalic disorders. However, a low significance level tends to cast some doubt upon the hypothesis involved, but not enough to actually reject it. Larger sample sizes might have revealed a significant relationship. Also larger sample sizes might have further indicated the tendency for boys possessing normal articulation to have higher reading ages than boys having disorders of dyslalia.

3. Arithmetic for boys with and without articulatory deviations displayed no relationship. On the other hand, a low level of significance tended to shed doubt upon the hypothesis indicating no association.

4. It was found that negro and white girls with and without articulatory handicaps presented no significant

differences for reading and arithmetic.

5. The factors of intelligence, reading, and arithmetic were not significant for boys and girls having handicaps of dyslalia.

In order to determine the role of the environment as an etiological factor in the maturation of defective articulation, paternal occupations were studied with these results:

1. Children with and without articulatory difficulties showed no significant differences for paternal occupations. These data are not confirmatory of previous research.

2. Inter-racial comparisons indicated no relationship between paternal occupations and children possessing articulatory defects.

Some Tentative Conclusions

As a result of this study of various growth and developmental factors that could influence the maturation of speech articulation, certain conclusions and recommendations for further study are presented.

On the basis of the evidence presented in this report it is reasonable to conclude that a positive correlation exists between the factor of low intelligence and the incidence of articulatory disorders. This no doubt can be attributed to the fact that a child possessing a good intellectual capacity has superior powers of critical ob-

servation, of seeing relations, and of grasping meanings, which could assist the natural and unfolding design of his articulatory growth and development. However, the question may well be raised as to whether a child's maturation of acceptable patterns of articulation is a resultant of his superior intelligence, or whether the latter is caused by his superior articulatory development. The findings of this investigation do not render a valid basis for making a definite conclusion in this respect.

Articulatory disorders occur more frequently among elementary males than among elementary females. This could be attributed to biological differences affecting the sequence, rate, and pattern of growth and development in elementary male and female children.

The factor of paternal occupation is not related to the occurrence of articulatory deviations.

Elementary children having handicaps of articulation do not display significant growth and developmental differences when compared with elementary children producing consonants within the normal range, with the exception of intelligence.

In general, negro elementary children having articulatory defects show comparable patterns of growth and development when examined with white elementary children similarly afflicted.

Recommendations for Further Study

The following recommendations for further study are deemed worth consideration:

1. It would be desirable to have the problems studied in this investigation submitted to further experimental verification. It would be well to have a larger sampling of schools and to extend the basic parts of the study over a grade range which would include the junior high school period.

2. Research should be continued further in regard to intelligence in children having defective articulation. As articulatory development seems to be so closely related to the maturation of intelligence, children might be observed over a period of several years in order to ascertain more conclusively that mental deficiency is one of the major growth and developmental factors in most cases of inferior articulation.

3. As this investigation has indicated, a number of factors might be operating successively or simultaneously to interfere with the maturation of acceptable patterns of speech articulation in children. Therefore, the problem for the future research student is not to isolate the one or two elements causing defective articulation, but to find what factors are precipitating the inhibitions of the articulatory process, and what growth and developmental factors are contributing to its continual retardation.

4. There is need for a more extensive investigation of the relationship of race to different factors of growth and development and the maturation of speech articulation.

5. It probably would be worth-while to further investigate the relation of sex differences to the maturation of defective articulation.

6. A real contribution might be made by conducting a similar study utilizing the longitudinal method of research, rather than the cross-sectional method employed in this investigation.

7. Further research of reading disability and its relationship to defective articulation would be valuable.

8. Eventually there will be a very definite need of a study which will review and integrate the findings of all growth and developmental investigations relative to the maturation of speech articulation, and which will offer broad interpretations and generalizations based upon scientific procedure.

There are doubtless many other questions related to the role of various growth and developmental factors to the maturation of articulation, investigation of which would be of much value in enriching the present store of knowledge about their influence in effecting the satisfactory development of articulatory patterns of speech. It is the belief of the writer that a series of studies extending the present investigation along lines indicated above would make ulti-

mately very significant contributions to the fields of child growth and development and speech correction.

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APPENDIX A

Supplementary Data for Chapter III

The following tables contain the primary data used in the chi-square calculations reported in Chapter III for elementary boys and girls with and without articulatory deviations.

TABLE 1

Comparative Table of Grip for Elementary Boys with and without Articulatory Defects

Norms $\frac{CA}{GY}$	Boys having Articulatory Defects		Boys with Normal Articulation	
	Observed f	Expected f	Observed f	Expected f
> 1.10	7	10	12	9
1.00-1.10	11	12	15	13
0.90-1.00	11	8	5	8
< 0.90	49	47	46	48

$\chi^2 = 4.934$

d.f. = 3

Signif. Level = 18%

TABLE 2

Comparative Table of Height for Elementary Boys with and without Articulatory Defects

Norms $\frac{HA}{CA}$	Boys Having Articulatory Defects		Boys with Normal Articulation	
	Observed f	Expected f	Observed f	Expected f
> 1.10	29	31	32	30
1.00-1.10	16	17	17	16
0.90-1.00	16	15	14	15
< 0.90	17	15	15	17

$\chi^2 = 1.018$

d.f. = 3

Signif. Level = 70%

TABLE 3

Comparative Table of Height for Elementary Boys with and without Articulatory Defects

Norms $\frac{HA}{CA}$	Boys Having Articulatory Defects		Boys with Normal Articulation	
	Observed f	Expected f	Observed f	Expected f
> 1.10	25	29	32	28
1.00-1.10	16	16	15	15
0.90-1.00	24	21	18	21
< 0.90	13	12	13	14

$\chi^2 = 2.135$

d.f. = 3

Signif. Level = 50%

TABLE 4

Comparative Table of Arithmetic for Elementary Boys with and without Articulatory Defects

Norms $\frac{AA}{CA}$	Boys Having Articulatory Defects		Boys with Normal Articulation	
	Observed f	Expected f	Observed f	Expected f
> 1.10	1	4	2	4
1.00-1.10	2		3	
0.90-1.00	11	14	17	14
< 0.90	23	19	15	19

$x^2 = 3.470$

d.f. = 2

Signif. Level = 18%

TABLE 5

Summary of Data Relative to Reading for Elementary Girls with and without Dyslalia

Norms $\frac{RA}{CA}$	Girls Having Articulatory Defects		Girls with Normal Articulation	
	Observed f	Expected f	Observed f	Expected f
> 1.10	2	12	3	12
1.00-1.10	8		11	
0.90-1.00	12	12	11	11
< 0.90	10	8	7	9

$x^2 = 1.610$

d.f. = 2

Signif. Level 30%

TABLE 6

Summary of Data Relative to Grip for Elementary Girls with and without Dyslalia

Norms $\frac{GA}{CA}$	Girls Having Articulatory Defects		Girls with Normal Articulation	
	Observed f	Expected f	Observed f	Expected f
> 1.10	2		2	
1.00-1.10	2	9	4	8
0.90-1.00	6		1	
< 0.90	22	23	25	24

$X^2 = .321$

d.f. = 1

Signif. Level = 50%

TABLE 7

Summary of Data Relative to Weight for Elementary Girls with and without Dyslalia

Norms $\frac{HA}{CA}$	Girls Having Articulatory Defects		Girls with Normal Articulation	
	Observed f	Expected f	Observed f	Expected f
> 1.10	13	13	12	12
1.00-1.10	12	11	10	11
0.90-1.00	4	5	6	5
< 0.90	3	3	4	4

$X^2 = .632$

d.f. = 3

Signif. Level = 80%

TABLE 8

Summary of Data Relative to Weight for Elementary Girls with and without Dyslalia

Norms $\frac{WA}{CA}$	Girls Having Articulatory Defects		Girls with Normal Articulation	
	Observed f	Expected f	Observed f	Expected f
> 1.10	11	12	13	12
1.00-1.10	5	5	5	5
0.90-1.00	8	7	5	6
< 0.90	8	8	9	9

$x^2 = .475$

d.f. = 3

Signif. Level = 90%

TABLE 9

Summary of Data Relative to Arithmetic for Elementary Girls with and without Dyslalia

Norms $\frac{AA}{CA}$	Girls Having Articulatory Defects		Girls with Normal Articulation	
	Observed f	Expected f	Observed f	Expected f
> 1.10	1		1	
1.00-1.10	1	10	4	10
0.90-1.00	7		6	
< 0.90	7	6	5	6

$x^2 = .533$

d.f. = 1

Signif. Level = 90%

APPENDIX B

Supplementary Data for Chapter IV

The primary data recorded in the tables below form the bases of the chi-square calculations presented for the inter-racial comparisons found in Chapter IV.

TABLE 1

Analysis of Intelligence for Negro and White Elementary Boys with Articulatory Handicaps

Norms	Negro Boys		White Boys	
$\frac{MA}{CA}$	Observed f	Expected f	Observed f	Expected f
> 1.10	5	5	3	3
1.00-1.10	12	10	4	6
0.90-1.00	10	12	9	7
< 0.90	21	21	14	14

$X^2 = 1.9713$

d.f. = 3

Signif. Level = 60%

TABLE 2

Analysis of Reading for Negro and White Elementary Boys with Articulatory Handicaps

Norms RA/CA	Negro Boys		White Boys	
	Observed f	Expected f	Observed f	Expected f
> 1.10	2	9	0	6
1.00-1.10	7		6	
0.90-1.00	21	18	8	11
< 0.90	18	21	16	13

$x^2 = 2.440$

d.f. = 2

Signif. Level = 45%

TABLE 3

Analysis of Height for Negro and White Elementary Boys with Articulatory Handicaps

Norms HA/CA	Negro Boys		White Boys	
	Observed f	Expected f	Observed f	Expected f
> 1.10	13	17	15	11
1.00-1.10	9	10	7	6
0.90-1.00	14	11	3	6
< 0.90	12	10	5	7

$x^2 = 5.951$

d.f. = 3

Signif. Level = 15%

TABLE 4

Analysis of Weight for Negro and White Elementary Boys with Articulatory Handicaps

Norms	Negro Boys		White Boys	
$\frac{WA}{CA}$	Observed f	Expected f	Observed f	Expected f
> 1.10	15	16	10	9
1.00-1.10	11	10	5	6
0.90-1.00	15	15	9	9
< 0.90	7	7	6	6

$x^2 = .4402$

d.f. = 3

Signif. Level = 92%

TABLE 5

Analysis of Arithmetic for Negro and White Elementary Boys with Articulatory Handicaps

Norms	Negro Boys		White Boys	
$\frac{AA}{CA}$	Observed f	Expected f	Observed f	Expected f
> 1.10	1		0	
1.00-1.10	2	8	0	6
0.90-1.00	5		6	
< 0.90	13	13	10	10

$x^2 = 0$

d.f. = 1

Signif. Level = 99%

TABLE 6

Summary of Data Relative to Intelligence for Negro and White Elementary Girls with Handicaps of Articulation

Norms	Negro Girls		White Girls	
MA/CA	Observed f	Expected f	Observed f	Expected f
> 1.10	2		1	
1.00-1.10	3	8	1	10
0.90-1.00	4		7	
< 0.90	6	7	8	7

x^2 = .511

d.f. = 1

Signif. Level = 45%

TABLE 7

Summary of Data Relative to Reading for Negro and White Elementary Girls with Handicaps of Articulation

Norms	Negro Girls		White Girls	
RA/CA	Observed f	Expected f	Observed f	Expected f
> 1.10	2		0	
		5		5
1.00-1.10	3		5	
0.90-1.00	6	6	6	6
< 0.90	4	4	6	6

X^2 = 0

d.f. = 2

Signif. Level = 99%

TABLE 8

Summary of Data Relative to Grip for Negro and White Elementary Girls with Handicaps of Articulation

Norms GA/CA	Negro Girls Observed f	Negro Girls Expected f	White Girls Observed f	White Girls Expected f
> 1.10	0		2	
1.00-1.10	1	5	1	5
0.90-1.10	2		4	
< 0.90	12	10	10	12

$x^2 = 2.33$

d.f. = 1

Signif. Level = 13%

TABLE 9

Summary of Data Relative to Height for Negro and White Elementary Girls with Handicaps of Articulation

Norms HA/CA	Negro Girls Observed f	Negro Girls Expected f	White Girls Observed f	White Girls Expected f
> 1.10	5	7	9	7
1.00-1.10	5	5	6	6
0.90-1.00	2	3	2	4
< 0.90	3		0	

$x^2 = 3.475$

d.f. = 2

Signif. Level = 18%

TABLE 10

Summary of Data Relative to Weight for Negro and White Elementary Girls with Handicaps of Articulation

Norms	Negro Girls		White Girls	
$\frac{WA}{CA}$	Observed f	Expected f	Observed f	Expected f
> 1.10	5	5	6	6
1.00-1.10	3	2	2	3
0.90-1.00	3	4	5	4
< 0.90	4	4	4	4

$x^2 = 1.48$

d.f. = 3

Signif. Level = 68%

TABLE 11

Summary of Data Relative to Arithmetic for Negro and White Elementary Girls with Handicaps of Articulation

Norms	Negro Girls		White Girls	
$\frac{AA}{CA}$	Observed f	Expected f	Observed f	Expected f
> 1.10	1		0	
1.00-1.10	1	4	0	5
0.90-1.00	2		0	
< 0.90	3	3	4	4

$x^2 = 0$

d.f. = 1

Signif. Level = 99%

APPENDIX C

Speech Correction Questionnaire

Ypsilanti School District No. 1 Fr.
Willow Run, Michigan

Name of student_____Age____Sex____Date_____

Birth date_____Telephone_____

Street address_____City_____State_____

CASE HISTORY OF STUDENT

At what age did your child say his first words_____

At what age did you become aware of your child's speech defect_____

Give relationship to all members of your child's immediate family and blood relatives who have ever had defective speech_____

_____

At what age did your child gain voluntary control of the bladder_____

How old was your child when he first: held head up_____

crawled_____sat alone_____walked_____

Which hand does your child use now for writing_____

throwing a ball_____Has he ever been changed_____

At what age did your child cut his first tooth_____

Father's occupation (be specific)_____

_____

Information given in this questionnaire will be treated confidentially.

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