A COMPARATIVE STUDY OF THE PERFORMANCE OF NEGRO SENIORS OF OKLAHOMA CITY HIGH SCHOOLS ON THE WECHSLER ADULT INTELLIGENCE SCALE AND THE PEABODY PICTURE VOCABULARY TEST

By

MARY WINSTEAD BONNER

Bachelor of Science
St. Paul's College
Lawrenceville, Virginia
1946

Master of Science
Virginia State College
Petersburg, Virginia
1952

Submitted to the faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the degree of
DOCTOR OF EDUCATION
May, 1968

A COMPARATIVE STUDY OF THE PERFORMANCE OF NEGRO SENIORS OF OKLAHOMA CITY HIGH SCHOOLS ON THE WECHSLER ADULT INTELLIGENCE SCALE AND THE PEABODY PICTURE VOCABULARY TEST

Thesis Approved:

Bernard E. Belcher
Thesis Adviser

Idella Lohmann

L. Dodson Gilbert

Daniel Selakovich

N. Durham
Dean of the Graduate College

PREFACE

For many years I have been interested in minority group problems, especially as they are related to school performance. During my years of graduate study an opportunity presented itself whereby I could work with intelligence testing.

Secondary pupils were chosen because in recent years there has been a tendency to extend the teaching of reading per se from the boundaries of the elementary school into high schools, colleges, and the mature adult level. Secondly, the nature of the two instruments used in the study, i.e., a Peabody Picture Vocabulary Test ceiling of 18-5 and a Wechsler Adult Intelligence Scale basal of 16 made it necessary to secure a sample with an age range between these two limits.

Current trends indicate that the Peabody Picture Vocabulary Test which is being used in some reading centers might serve as a screening device where a trained tester is not available. It was felt, however, that before too much credence is placed in the index obtained on this tool which excluded Negroes from its standardization procedures, it would be wise to compare it with a criterion test such as the Wechsler Adult Intelligence Scale which included a portion of the non-white population in its norming sample.

Indebtedness is acknowledged to the Research Committee of the Oklahoma City Public Schools and to Dr. Nelda Ferguson, Messrs. John Sadberry, Leon Bruner, James Mosley, Abe Holmes, Fred Factory, and

Mrs. Elnora Douglas of Oklahoma City for providing data collection facilities.

In particular, I would like to thank Dr. Bernard Belden for serving as my committee Chairman, and Drs. Idella Lohmann, Dan Selakovich, Judson Milburn, and Vernon Troxel who served as advisers.

I wish to express my gratitude to Drs. Thomas Bonner, Wayne Hayes, David Geiger, and John Burger for advice and assistance with the statistical analysis and programing. Special consideration is reserved for Dr. Darrel D. Ray in whose class the idea for the research was conceived.

I am grateful to my mother, Mrs. Mason Winstead and my sister Dr. Ruth W. Diggs for the confidence that they have had in me.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

In 1958 the Peabody Picture Vocabulary Test (PPVT) was standardized on a sample consisting of white children only. Since that time the test has been widely used as a clinical tool in various situations including reading clinics. Consequently, the status of individuals who are not white are determined by instruments from whose standardization procedures they have been excluded. It seems feasible to test these instruments on such groups. Only then can some decision be made concerning the reliability of these instruments for the total society.

Another important consideration is that if investigators are prone toward using such instruments for comparative purposes of white and Negro children as was done by Hughes (15) some statement should be made relative to the standardization methods so that the research can be viewed objectively. This problem was recognized by Wechsler (31) when he suggested that the group on which a test is standardized should be highly representative of the persons on which it is to be used.

Many educators are aware of the limitations of intelligence tests; nevertheless, it is admitted that they are invaluable if the information thus obtained is used in a constructive manner, i.e., for improving the quality of education according to each individual's needs, abilities, and special aptitudes. That these tools should be used exclusively for relegating subjects to the "educational disposal heap" is highly

questionable, and detrimental to the cause of educational opportunities for all.

In 1951 work was begun leading to the standardization of the present Wechsler Adult Intelligence Scale (WAIS). This standardization procedure included a portion of the non-white population in its norming group. Therefore, any erroneous conclusion reached through the use of this instrument on non-white individuals can not be laid to the claim of unfair representation in the standardization process. In brief, one must admit that the test is as accurate for assessing the intelligence of Negroes as it is for any other sub-population of United States' adults. Just how precise or accurate this evaluation may be is not a problem of this investigation. Rather, the purpose of this dissertation is to compare the performance of Negroes on two instruments which are used for measuring intelligence only one of which included them in its standardization procedure.

The question of how much reliance is to be placed in any test for the measurement of intelligence has been the subject of much discussion. Abrams (1) declares that it is a very difficult job to appraise intelligence, but it is essential that it be done in order to adapt instructional methods to fit the individual needs of the students. The writer concurs in this as long as those who are responsible for the education of the nation's youth would remember that children are being taught and not I.Q.'s. The concept of the changing I.Q. suggests that this hypothetical construct is not necessarily static and invariable. It has been said that one teacher discovered at the end of the school year that the list of numerals which she had in her desk drawer were locker numbers rather than I.Q.'s. Mazurkiewicz (19) believes that

verbal and non-verbal intelligence tests should be used as estimators of a student's potential capacity level. He also emphasizes the fact that the information thus derived should be used for planning educational experiences for the pupils.

The WAIS has been accepted generally in most educational circles as a satisfactory tool for measuring intelligence. Plant and Lynd (23) observed the fact that the use of the WAIS is becoming increasingly important for various purposes in high school guidance and counseling situations, in vocational rehabilitation work, and for psychological and remedial programs in colleges and clinics. It was also noted that the WAIS is often used for predicting future educational developments.

While a trained and skilled person must administer the WAIS, the PPVT can be administered by a classroom teacher or an administrator with no specialized training. Often diagnosticians and other specialists would like to use quick screening devices. Negro children and other minority group members are sometimes the ones who need immediate help; therefore, if research demonstrates that the PPVT can be used effectively for assessing the intelligence of these sub-groups, then the possibility of its use in many situations where trained psychologists or qualified testers are not available will be unlimited.

Significance of the Problem

Sub-cultures of the population of the United States have to operate on the same bases of the criteria that are set up for judging the capacities of those who make up the major portion of the society. Since this is true, it is important for research workers to evaluate

the instruments that are being used. A good way to do this is to compare any new device such as the PPVT with some other device which has already been used widely and accepted such as the WAIS. Webb (30) in a comparison of the WAIS and the Wechsler Intelligence Scale for Children (WISC) secured significantly higher I.Q.'s on the WAIS. He attributed this difference to the fact that even though these two tests were constructed by the same author and sampled populations of mental defectives; since the WAIS was the one which included Negroes in the standardization process, it probably presented a better picture of Negro intelligence.

Experts in the field of education often caution investigators against going off on tangents in their zealous attempts to accomplish the impossible. This warning was heeded, and a search was made of numerous research articles, professional journals, theses, and dissertations in order that proper identification could be given to the present problem; therefore the aim of this discourse is to make a contribution to an organized body of knowledge to which many scholars in education and psychology have offered their talents. A perusal of various works revealed several related studies, but not one which would be a replication of the present study i.e., one which is concerned with a large metropolitan complex involving a Negro group. However, this relatively large number of sources of information presented an excellent array of materials which are akin to the thesis which is under consideration herein. The justification of these presentments can thus be defended. The main purpose is to compare the performance of a Negro sample on the WAIS and the PPVT. A related purpose is to see if the PPVT scores can be used to predict their performance on the WAIS.

If the Full Scale WAIS I.Q.'s happen not to correlate significantly with the PPVT, an examination of WAIS subtest patterns might reveal high relationships.

Specific Statement of the Problem

This research involves a two-fold problem:

(1) A comparative study of the performance of Oklahoma City, Oklahoma Negro High School Seniors between the ages of sixteen and seventeen on the Wechsler Adult Intelligence Scale and the Peabody Picture Vocabulary Test;

(2) A study of the use of the PPVT scores to predict WAIS scores.

Definition of Terms

The stipulations concerning the terminology used in this research are essential in order to make it convenient for the reader and for educators or investigators who might consider possible replication of this dissertation.

Comparative study. A study of the relationship between two or more variables.

Performance. The indices that are obtained for measuring intelligence when the PPVT and the WAIS are used as instruments for measuring intelligence.

Oklahoma City Negro High School Seniors. Those persons who have discernible characteristics attributed to a particular class of people who attend school in one of three Oklahoma City High Schools and represent approximately seventy-five per cent of the Negro High School population of that city.

The Wechsler Adult Intelligence Scale. The WAIS was standardized by Wechsler (31). He used a stratified sampling plan and included a proportionate representation of the non-white population based on the 1950 U. S. Census. In order to get representatives for each of his strata, Wechsler had to abandon the technique of random sampling. The variables governing his stratification were age, sex, geographic region, urban-rural residence, race, occupation, and education. The WAIS consists of eleven tests. Six of these are grouped into the Verbal Scale; the remaining five comprise the Performance Scale. The Verbal Tests are Information, Comprehension, Arithmetic, Similarities, Digit Span, and Vocabulary. The Performance Tests are Digit Symbol, Picture Completion, Block Design, Picture Arrangement, and Object Assembly.

The Peabody Picture Vocabulary Test. The PPVT was created by Dunn (6). It consists of one hundred fifty plates arranged in ascending order of scientifically determined difficulty extending over an age range of two years six months (2-6) through eighteen years (18-0), but having extrapolated age norms below this level. Forms A and B are given by using the same plates with different answer sheets. An illustration in the form of a picture provides the representation for the stimulus word. A basal point is obtained for a subject when eight correct consecutive answers are given. The raw score is obtained by adding the basal point to the number of correct responses a subject makes before reaching a ceiling of six incorrect answers on any eight consecutive illustrations.

Predict. To estimate the values of the indices of the WAIS Scale from the values which were obtained on the PPVT.

Patterns. Information regarding high, medium, and low values and how these are related to each other.

Interrelationships. The patterns which are revealed by a study of the intercorrelations among test values which are obtained from variables of the two instruments which were administered in this study.

Intelligence (operational definition). A scientific construct which can be observed and measured by administering the WAIS. This same abstraction or concept can also be observed and measured by administering the PPVT.

Sub-tests. A group of eleven tests; six of which make up the Verbal Scale; five of which compose the Performance Scale; all of which make up the Full Scale WAIS values.

The Information test is a sampling of pertinent items from various sources. It measures a person's ability to retrieve from a storage of background knowledge definite answers to specified questions. The responses are depressed by cultural deficiences.

The Comprehension test is made up of common sense questions which make an assessment of the testee's reactions under pressure. It also determines one's concepts of moral values and ascertains one's emotional maturity.

The Arithmetic test is made up of items that become increasingly more difficult. It measures reasoning power, memory, attention span, and the ability to manipulate abstract symbols and perform fundamental operations without the aid of printed symbolism.

The Similarities test measures the testee's ability to do deductive and inductive reasoning, to conceptualize, to see relationships, and to

generalize.

The Vocabulary test requires the examinee to respond to the examiner's questions by giving definitions to words which are presented as auditory stimuli. Reading disability and adverse environmental circumstances serve as depressive factors on the scores obtained on this test.

The Digit Span test measures one's ability to memorize and to recall numerals in sequential order backwards and forward.

The Picture Arrangement test measures the subject's ability to place events in a logical sequential order. It involves visual perception, and assesses the testee's power to note details, and to see cause and effect relationships.

The Picture Completion test checks the examinee's power to conceptualize, to select significant details, and one's reactions to the presentation of visual stimuli under time pressure.

The Block Design test is a measure of a person's synthetic and conceptual skills, and the ability to form patterns from abstract designs. Both visual and motor coordination are evaluated.

The Object Assembly test involves visual perception and motor dexterity. The testee is required to synthesize and perceive a pattern which he forms by manipulating puzzle like pieces which make relatively familiar figures.

The Digit Symbol test requires the individual to reproduce visual stimuli kinesthetically. This device gives clues to eye-hand coordination, and left to right progression problems which are so important in reading.

Delimitations

Specific conclusions concerning the performances on the PPVT and the WAIS will be used to make inferences about the population from which this sample was derived, but will not be utilized for generalizations for any larger population. Neither will cause and effect relationships between and among phenomena be given in this research.

The time dimensions which attribute to the semantic differentiation between predictive and concurrent validity are important notations to make. Those elements of predictive validity which are synonymous with the meaning when applied to concurrent validity will be explored in the paper. More specifically, one of the problems will be concerned only with the aspects of predictive validity when predicting from one variable to another. The primary concern is with the present and not with the past or the future.

For a discussion of the semantic differences, the reader is referred to Travers (28) on page 197, Kerlinger (17) on page 447, and Van Dalen (29) on page 314.

Variables

The independent or assigned variables in this study are the WAIS test scores which consists of the results from the Verbal Scale, Performance Scale, and Full Scale.

The dependent variable is the index of intelligence measured by the PPVT. In some instances the WAIS indices are alluded to as the criterion variables and the PPVT index as the predictor variable.

Sample and Population

The sample used in this study is in reality a collection of four samples--each representing a certain population. In every case, however, the population represented is one composed of Negro students who are in the senior class of some high school, who are not special education students, who are either sixteen or seventeen years of age and who are of normal intelligence.

The total number of students used is sixty; the total number of people in the population for which inferences may be directly drawn is 610; but the actual population which is indirectly at issue here is the large group of Negro high school seniors who are sixteen or seventeen and who are like those of Oklahoma City schools. Since the latter include both metropolitan and rural types, there is no reason to believe that this population is not a considerable portion of the sixteen and seventeen year old Negro students of the Southwest.

The specific description of the sample will be found later in the section on Procedure and Design.

Hypotheses

Hypothesis I. There is a positive significant correlation between the WAIS Full Scale raw scores and the PPVT scores.

Hypothesis II. There is a positive significant correlation between the WAIS Performance Scale raw scores and the PPVT scores.

Hypothesis III. There is a positive significant correlation between the WAIS Verbal Scale raw scores and the PPVT scores.

Hypothesis IV. There is a positive significant correlation between the WAIS I.Q. scores and the PPVT I.Q. scores.

Hypothesis V. There is a positive significant correlation between the WAIS Information test raw scores and the PPVT scores.

Hypothesis VI. There is a positive significant correlation between the WAIS Comprehension test raw scores and the PPVT scores.

Hypothesis VII. There is a positive significant correlation between the WAIS Arithmetic test raw scores and the PPVT scores.

Hypothesis VIII. There is a positive significant correlation between the WAIS Similarities test raw scores and the PPVT scores.

Hypothesis IX. There is a positive significant correlation between the WAIS Digit Span test raw scores and the PPVT scores.

Hypothesis X. There is a positive significant correlation between the WAIS Vocabulary test raw scores and the PPVT scores.

Hypothesis XI. There is a positive significant correlation between the WAIS Digit Symbol test raw scores and the PPVT scores.

Hypothesis XII. There is a positive significant correlation between the WAIS Picture Completion test raw scores and the PPVT scores.

Hypothesis XIII. There is a positive significant correlation between the WAIS Block Design test raw scores and the PPVT scores.

Hypothesis XIV. There is a positive significant correlation between the WAIS Picture Arrangement test raw scores and the PPVT scores.

Hypothesis XV. There is a positive significant correlation between the WAIS Object Assembly test raw scores and the PPVT scores.

The significance level to be used in testing the above hypotheses will be set at .05.

The reason for comparing the performances on the basis of raw scores is the fact that for the PPVT there is no scaled score which

could be interpreted as the equivalent of the scaled score which does exist for WAIS. The only PPVT score which is scaled is the I.Q. itself; and this score must of course be compared as in Hypothesis IV with the I.Q. score of WAIS.

Aside from the above hypotheses, one other question will be raised--namely, the question of predicting individual WAIS Full Scale raw scores and WAIS I.Q. scores from known PPVT raw scores and PPVT I.Q. scores respectively. As experimental hypotheses:

Hypothesis XVI. PPVT scores may be used satisfactorily to predict WAIS raw scores.

Hypothesis XVII. PPVT I.Q. scores may be used satisfactorily to predict WAIS I.Q. scores.

Basic Assumptions

The hypotheses in this study are outgrowths of an organized body of knowledge from several related studies. However, since research revealed no evidence of a study of this nature, dealing with Negro high school seniors in a large metropolitan area, the justification for this study rests on this fact.

The WAIS, by virtue of the fact that non-whites were included in the standardization procedures, is an acceptable instrument for measuring the intelligence of Negroes. Indices of intelligence thus obtained can be used as criterion variables for testing the validity of the PPVT.

The PPVT from which non-whites were excluded from the standardization of the norming population is not necessarily an acceptable nor an unacceptable instrument for measuring the intelligence of Negroes.

Responses from this instrument can therefore be used as predictor variables for ascertaining approximate values on a criterion test. If the index from this tool of investigation which is a unitary value can serve as a predictor variable for ascertaining approximate values on the criterion instrument, then there is a possibility that the PPVT can be substituted for the more difficult to administer WAIS.

The group of seniors who were tested on the two instruments represent Negro high school students of normal intelligence.

Subsets of the population should be represented in norming procedures if instruments on which they are evaluated are used for inferential or comparative purposes.

The degree of comparability between the WAIS and the PPVT can be determined by using the Pearson-Product Moment Correlation technique.

CHAPTER II

SURVEY OF RELATED LITERATURE

Several investigations have been done which yielded relatively high correlations between the PPVT and other standardized instruments for measuring intelligence. While a large percentage of the studies have reported no significant differences in comparisons between the PPVT and other tools of this nature, Shipe (25) reported discrepancies involving the PPVT and the WISC. In his investigation of the meaningfulness of relationships between the two tests, sixty institutionalized mentally retarded children and adolescents were used, along with an equivalent group of children with normal intelligence chosen from nearby institutions for dependent children. An analysis of the data showed that in general the retarded group had PPVT test scores above those which were obtained on the WISC. Inverse results were reported for the normal group. Scoggins (24) found significant differences among mental age scores among all levels in an experimental population of sixty-five children with functional articulation disorders on the Full Range Vocabulary Test and the PPVT. These differences were reported at the .05 level of significance for the following groups: Twenty-five-year olds; Twenty-six-year olds; Twenty-seven-year olds.

Brown (2) conducted research to determine the value of the PPVT as a predictor of specific language dysfunction in a sample of ninety educable mentally retarded children. The nine subtests of the Illinois

Test of Psycholinguistic Abilities (ITPA) were used as predictor variables. The investigator failed to find that the PPVT was an adequate measure of any of the nine specific language functions of Auditory Decoding, Visual Decoding, Auditory-Vocal Association, Vocal Encoding, Auditory-Vocal Automatic, Auditory-Vocal Sequential, and Visual-Motor Sequential. The correlations reported for the total ITPA scores and Forms A and B of the PPVT were .46 and .58 respectively. The following conclusions were drawn:

1. The content validity of the PPVT is highly questionable.
2. The PPVT is not an adequate estimator of intelligence and the results should not be confused with the results of an individual intelligence test.
3. The PPVT could possibly serve as a test for measuring hearing vocabulary.

Lloyd (18) utilized the PPVT and the Parson's Language Sample (PLS) for comparative purposes on a sample of thirty-six mentally retarded subjects diagnosed as having normal hearing, conductive or sensori-neural hearing impairments. The PLS is a test of communicative ability which was developed and standardized with a retarded population. It was found that as far as the assessment of hearing impaired retardates is concerned the PLS offered more differential information than the PPVT since it embodies both vocal and nonvocal subjects. It was also observed that the PPVT is a test of verbal ability standardized on a group having a normal distribution on that attribute as such it is valuable for providing descriptive information about a retarded group in relation to normal subjects.

Burnett (4) surveyed the intelligence of two hundred thirty-eight

mentally retarded male and female students with an age range of eight to twenty-one years. The results of the PPVT were compared with existing Stanford-Binet (S-B) and Wechsler Bellevue (W-B) test data. The PPVT correlated .469, .272, .400, and .433 with the W-B Verbal, W-B Performance, W-B Full Scale, and S-B respectively. All correlations were significant at the .01 level. Higher mean performances were obtained for the PPVT than on the other two tests. The conclusion was drawn that the PPVT served as a good screening device for measuring intelligence for emotionally disturbed educable mentally retarded children and adolescents.

Gage (10) summarized data for thirty consecutive referrals to the psychological services at the Ellenburg, Washington, D. C. Public Schools. Significant correlations were recorded between the PPVT and the Verbal, Performance, and Full Scale Intelligence Quotients on the WISC at the .01 level. Significance levels for scaled sub-scores and the comprehension subtests of the WISC were .01 and .05 respectively. Gage felt that the flexibility of the PPVT added to its usefulness as a clinical tool since there was no penalty for lack of verbal facility.

Non-whites were not used in the standardization samples of the WISC nor the PPVT. However, Hughes (15) used both instruments for making comparisons between Negro and white groups. The study consisted of one hundred thirty-seven rural North Carolina children between the ages of six and sixteen who were suspected of being mentally retarded. All of them were voluntary referrals to a mental health clinic and came from the lowest socio-economic group according to most scales as reported by the investigator. The following conclusions were drawn:

1. Even with what might be believed to be relatively large standard errors of estimate, i.e., 8.67, 8.11, 10.79, and 7.88 for Negro-male, female, white-male, female respectively, the PPVT has a distinct advantage over group tests of intelligence for rural children.
2. For children like those used in the sample, the PPVT would serve as an adequate screening device when used in the schools or by personnel working in the community in conjunction with mental health clinics.

Carr and Brown (5) on pages 937-939 disagreed with this decision. The following quotation will clarify their point of view:

> A competent compassionate professional person working in the area of mental retardation could not help but know the seriousness and the gravity that a potential diagnosis of mental retardation can have for a child and his parents. Even the suggestion of such a diagnosis can wreak untold damage in the family milieu, especially today, in view of the much broader interpretation of the concept of mental retardation. To use the PPVT as a screening device on which to base recommendations for further testing--the implications being possible retardation--has been shown by Shaw et al to be a serious questionable practice.

Hughes (15) also alluded to predictable race and sex differences. According to the data, he suggested that when predicting WISC scores in the Negro sample the examiner must be willing, for the purposes of the evaluation, to accept an error of approximately eight I.Q. points plus or minus when predicting verbal WISC scores, nearly nine I.Q. points plus or minus when predicting full scale WISC scores, and about 11 points plus or minus when predicting performance scores on the WISC with the expectancy that he will be correct two-thirds of the time.

Neville (21) tested a group of one hundred forty-eight fifth graders in two city schools representing the upper, lower, and middle

class neighborhoods. The purpose of using the PPVT in this study was as a substitute for the WISC. An analysis of the data revealed no significant differences between the PPVT I.Q.'s of the total group and the WISC. Full scale I.Q. correlations between the two tests revealed values of .427, .650, and .660 for the good readers, average readers, and poor readers respectively. The investigator felt that the PPVT could serve as a substitute for the WISC, which is more difficult to administer.

Graubard (13) in a most recent study used twenty-three institutionalized emotionally disturbed boys with reading disability and found significant correlations of the PPVT with the WISC verbal (.59), full scale (.56), vocabulary (.69), and ITPA combined association test (.55). The hypothesis that the PPVT was a measure of receptive language was discredited since the PPVT did not correlate significantly with the auditory (.30) and visual decoding (.23) subtests of the ITPA. Graubard declared that the unitary value for intelligence which the PPVT yields does not give enough clinical information to justify using it as a tool for assessing intelligence and for planning programs for remedial instruction in reading. The possibility of using the easily administered PPVT as a rapport builder was recognized, but its statistical soundness was highly questionable. Correlation and prediction, according to Graubard, do not offer aid in bettering education and have not enhanced the quality of education.

Garrett (13) obtained data on a group of typical school students in order to check the validity of the PPVT. In a comparison with WISC and other instruments, she concluded that the PPVT appeared to be an effective instrument for measuring general intelligence. She also

hypothesized that the PPVT lacks sufficient ceiling for measuring bright children adequately, since twenty per cent of the sample obtained PPVT scores which were three standard deviations above the mean of the norming population.

A similar study by Ivanoff (16) in which he used one hundred fifty seventh graders indicated substantial correlations between the PPVT and the Henmon-Nelson Test of Mental Ability, and the California Achievement Test Battery. According to the results of this study, the PPVT can be used effectively in a typical school situation. It is an excellent screening device when a quick assessment for measuring intelligence is needed.

Weeks (32) administered equated forms of tests A and B of the PPVT to a random sample of two hundred forty Glassboro State College students representing all levels. The results showed a correlation of .87 when averaged for the twelve tested sections. It was indicated that the PPVT was a good screening device for obtaining verbal intelligence of college students. This conclusion was based on the fact that the testees had scored well above the established norms for eighteen year olds represented by the raw scores of one hundred nine and one hundred eleven for Forms A and B respectively.

Budoff (3) tested forty-six institutionalized adolescents between the ages of sixteen and seventeen. Forms A and B of the PPVT, and Forms L and LM of the S-B were used. The coefficients for the total PPVT with the upper and lower subgroups of the S-B were .45 and .80 respectively. Similar results were reported for the intercorrelations between the PPVT and the S-B therefore the desirability of using the PPVT with the high level patients was questioned.

Dunn (7) found evidence that the PPVT could be utilized effectively as a psychometric instrument for measuring the verbal intelligence of educable mentally retarded pupils of school age. He used three hundred seventy-one white educable mentally retarded children in the city schools of Nashville, Tennessee. The results showed a close relationship between Forms A and B of the PPVT. A medium relationship between the Revised S-B and the PPVT with the PPVT MA's 4.5 months lower than the S-B MA's; the PPVT I.Q.'s being on the average 2.1 points above Revised S-B I.Q.'s. Another project by Dunn (8) in which a systematic study of the usefulness of the PPVT with trainable children was made revealed reliability coefficients of .84 between the two forms of the test, a validity correlation of .66 between the Revised S-B, and the intercorrelation values of .39 to .60 for reading and writing achievement respectively. The conclusions were:

1. Alternate forms of the test have high reliability.
2. The order of difficulty was the same as it was for the original population.
3. The predictive validity of the instrument was questionable.

A study was undertaken by Tobias (27) to assess the validity of the PPVT with retarded adults, to check the correlation between vocabulary and intelligence and to see if the test could be used as a predictor of reading achievement. Data were secured on the PPVT, the WAIS, and the S-B for all subjects with a median age of twenty-three representing the entire population of two New York City centers for the retarded. The results revealed that the PPVT tended to yield higher scores than the WAIS. Similar discrepancies were also found between the S-B and the WAIS. The PPVT was superior to the WAIS as an

estimator of the reading skills for retarded adults. The following conclusions were drawn:

1. There is a significant relationship between the PPVT, the WAIS, and the S-B.
2. The PPVT overates the Mental Ages and the I.Q.'s of retarded adults.
3. The PPVT is more closely related to reading achievement for educable retarded adults than the WAIS.

Throne (26) investigated the relationship of the PPVT to other intelligence tests and to an academic achievement test for thirty-five educable retarded boys between the ages of eleven and fourteen-seven months. Significant correlations were found between the PPVT, the WISC, the S-B (L or M) but not for the Goodenough Draw A Person Test. A comparison of the PPVT with the Metropolitan Achievement Test revealed no predictability although some of the subjects' subtests did show some relationship. The conclusion drawn was that significant correlations among various intelligence tests does not necessarily mean that their ability to predict achievement will be significantly related.

Himelstein (14) examined the relationship between the PPVT and the WISC for a group of forty-eight emotionally disturbed children between the ages of six years two months and fourteen years eight months. Significant correlations beyond the .01 level were reported for the two tests and a standard error of estimate of eleven points, which indicated the possibility of using the PPVT for the WISC.

Summary of the Literature

A majority of the studies used subjects who manifested some degree of deviation from the norm. Most of them were related to the area of mental retardation although a few had to do with emotional and/or speech problems. Only four of the studies used normal or typical school subjects.

A notation was made of as many of these studies as possible in order to study various correlations of the PPVT with as many instruments as possible. Since Form A was used in this research it was felt that this could be justified on the bases of the findings reported in several studies which established equivalence between Forms A and B.

One study mentions Negroes specifically, even though it can be assumed that they were used in some of the research which was conducted in public schools or colleges.

It is interesting to note that the work which was begun in 1958, is steadily growing with the latest projects being reported for 1967.

CHAPTER III

ANALYSIS OF THE DATA

Procedure and Design

Permission was granted by the Board of Education of Oklahoma City, Oklahoma, for the writer to conduct this investigation in the public high schools of that city. Since more than seventy-five per cent of the Negro high school pupils of that city were in attendance at three schools--Douglass, Northeast, and Dunjee--the investigation was confined to these three schools.

However, for the purposes of this study, the totality of sixteen and seventeen year old Negro seniors at these three schools was not assumed to be one population. It was felt that performance of students in this total group might be in some way categorized in terms of the individual schools, and that a correlation between WAIS I.Q.'s and PPVT I.Q.'s existing at one school may not exist at another. For this reason, the investigation was designed on the basis of three distinct populations: the group of four hundred sixteen and seventeen year old Negro seniors at Douglass; the group of one hundred forty such seniors at Northeast; and the group of seventy such seniors at Dunjee. In this dissertation these three populations will be referred to as A, B, and C respectively.

A list of names of the students comprising these three populations was secured from the offices of these three schools, and by use

of the "Lotto" method twenty students were randomly selected from each population. This was done during the second week of the school term beginning in September of 1967.

During the first two months of this school term all the students in the three samples were individually tested in the conference room provided by the particular school. All of those in the sample from population A were tested first; B, second; and C, third. In each case the student was first given the WAIS test followed immediately by the PPVT; in each case the writer was the sole examiner. In the examinations administered at schools A and B the facilities were ideal, and not one attempt had to be rejected. In school C the facilities for such individual testing were not ideal, and in three cases were actually unsatisfactory in the judgment of the examiner. In these three cases the examiner felt that either the environment of the testing room itself or outside confusion had an apparent effect on the students' performance. In those three cases the tests were rejected and other students were randomly selected as replacements.

With the results of these two tests from the three samples at hand, the second step in the design of this research was to ascertain if, in fact, these three samples could be expected to represent the same one population with regard to the characteristic of intelligence as measured by the WAIS test.

The variance and means of the three sets of WAIS TOTAL RAW SCORES were computed and the F-ratio test was used to check for significance in the differences between the variances. It revealed no significant difference. Assuming, then, equal variances the significance of the difference in the means was checked by the t-test. In all instances

the tests were two-tailed, and the samples were assumed to have come from populations for which the WAIS TOTAL RAW SCORES were normally distributed.

Scatter diagrams in which WAIS TOTAL RAW SCORES were plotted against PEABODY RAW SCORES were drawn to see if a linear relationship might exist, and the Pearson Product Moment coefficient of correlation between WAIS TOTAL RAW SCORES and PEABODY RAW SCORES was found for each sample; each was tested for significance by Student's t-test; and the differences between respective coefficients of correlation for the various samples were checked for significance by the F-ratio test.

In order to have a more thorough study of the relationship of the PPVT SCORES to the WAIS, all the coefficients of correlation that exist pairwise between the various WAIS subtests and the PPVT were found. This was done by means of an IBM 1401 computer. All other computations in this study were done on a Monroe Epic 2000 electronic printing calculator.

The results of steps taken at this point were sufficient to answer the major problem under investigation involving the relationship between performance on the PPVT and performance on the WAIS.

The other problem under investigation concerned the area of prediction, and the design for the experiment was such that this problem would be attacked only if certain conditions could be established by the first part of the study. These conditions were that the coefficient of correlation between WAIS TOTAL RAW SCORES and PPVT RAW SCORES be sufficiently high and that at least two of the three samples were from the same population. Both conditions were satisfied.

As the variances and means of all three samples were found to

exhibit no significant differences in so far as the WAIS scores were concerned, this was sufficient reason to assume that the three actually were samples from the same one population in this regard. What was now needed was a single random sample to represent this population. By selecting at random proportionate numbers of students from the three original samples, a new sample consisting of 31 students was created. In this sample every student in the total population of the three original groups had the same chance of being selected.

By the method of least squares the line of regression to be used for prediction of WAIS scores from PPVT scores was constructed and the standard error of estimate was calculated.

Similar lines of regression were computed for Samples A, B, and C for purposes of cross-validation. Also toward this end another random sample was taken from the original set. The predicted WAIS scores and actual WAIS scores of this sample were compared, and the t-test was used to see if there was any significant difference in the means of these two sets of scores.

The analysis of the data thus collected led to conclusions regarding the questions raised concerning the use of the PPVT for purposes of prediction.

The Nature of the Four Samples

Let $\bar{X}_1$ denote the mean of the set of twenty total raw scores made by the students of sample A on the WAIS test; let $\bar{X}_2$ denote the mean of the corresponding scores by students of sample B; let $\bar{X}_3$ be the mean for sample C. Similarly denote the respective variances by S_1^2, S_2^2 and S_3^2.

$$\bar{X}_1 = 246.45 \qquad \bar{X}_2 = 240.25 \qquad \bar{X}_3 = 218.40$$

$$S^2_1 = 1926.3 \qquad S^2_2 = 1883.6 \qquad S^2_3 = 2157.6$$

For the first pair of sample variances, the variance ratio of F ratio is $F = \frac{1926.3}{1883.6} = 1.02$.

For the second and third the F ratio is $F = \frac{2157.6}{1883.6} = 1.14$.

In testing the significance of the difference between two variances, the null hypothesis $Ho: \frac{\sigma_1^2}{\sigma_2^2} = 1$ is assumed, and the critical values of F depend on the number of degrees of freedom involved in both numerator and denominator. In the cases at hand there are 19 degrees of freedom for each. The value of F necessary for significance at the .02 level is 3.00 and at the .10 level is 2.15.

As the obtained F ratios are smaller than the critical values, the null hypothesis may be accepted. That is, the evidence is insufficient to warrant the rejection of the null hypothesis. In other words, the small differences in the variances S_1^2, S_2^2 and S_3^2 do not imply that the variances of the populations from which the three samples were taken are different.

In terms of variances, then, the three samples could very well have come from populations with equal variances. The table of critical values of F used above was found in the Appendix of (9).

Assuming, then, that the three samples are from populations whose variances are the same, the t-test may be used to check for any significant difference in the means of these samples.

According to standard formulas (See pages 167-168 of (9))

$$\underline{t} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S^2}{N_1} + \frac{S^2}{N_2}}}$$

Where $$S^2 = \frac{\Sigma^{N_1} (X-\bar{X}_1)^2 + \Sigma^{N_2} (X-\bar{X}_2)^2}{N_1 + N_2 - 2}$$

and where $\bar{X}_1$ and $\bar{X}_2$ are the means of two samples and N_1 and N_2 are the numbers of elements in these respective samples.

In the case of sample A compared with sample C, the two means under consideration are $\bar{X}_1 = 246.45$ and $\bar{X}_2 = 218.4$ while $N_1 = N_2 = 20$. The computations lead to $S^2 = 2149.3$ and $\underline{t} = \frac{28.05}{14.66} = 1.91$. Since this is a two-tailed test, and the number of degrees of freedom is 38, the critical value of $\underline{t}$ at the .05 level is 2.03. The obtained value of 1.91 is less than this critical value, and thus there is no significant difference between the two means at this level.

Since the test shows that the means of sample A and sample C are not significantly different, and since the mean of sample B is between these two, clearly there is no significant difference between any of the three means. This implies that the three samples may be interpreted as three independent samples from the same population.

Even if the three samples are theoretically from the same population in so far as performance on the WAIS test is concerned, no one of them may be considered a random sample of the entire set of 610 Negro seniors who are 16 or 17 years old and who attend the three schools. This is due to the fact that the chances of being chosen for the sample A are much less than the chances of being chosen for sample C.

To get a random sample to represent the entire population, consider the new sample consisting of all twenty students in sample A, of seven of the students randomly selected from sample B and of 4 of the students randomly selected from sample C. This new sample of 31 students is a random sample of the whole population because the probability that any particular student in the population be selected for this sample is approximately the same as that for any other student. A student from the first school has a probability of being selected of $\frac{20}{400}$; one from the second school has $\frac{7}{140}$ as the probability of being selected; from the smaller school the probability is $\frac{4}{70}$. These are all approximately equal to $\frac{1}{20}$.

In the remainder of this dissertation sample D will be used to denote this random sample of 31 which represents the total population of 610. The samples A, B, and C will be of continual interest, however, in that they represent their respective individual schools.

The study of the relationship between performance on the WAIS test and performance on the PPVT will be made on the three schools separately as well as on the population as a whole.

The next few pages of data analysis are concerned with the three schools separately and comparatively.

Comparative Performances of Samples A, B, and C on WAIS and PPVT

A perusal of the materials in the following section will indicate the strengths and weaknesses of the three schools represented by the original samples involved. The figures and tables in this section were prepared from raw score data except figures 4, 5, and 6 for which

scaled score data were used. For these three cases the raw scores were converted to scaled scores according to the directions in Wechsler's Manual (31). The scaled scores for each test were averaged for Samples A, B, and C. The resulting pattern presents a visualization of how a particular school compares with the standardization or norming population.

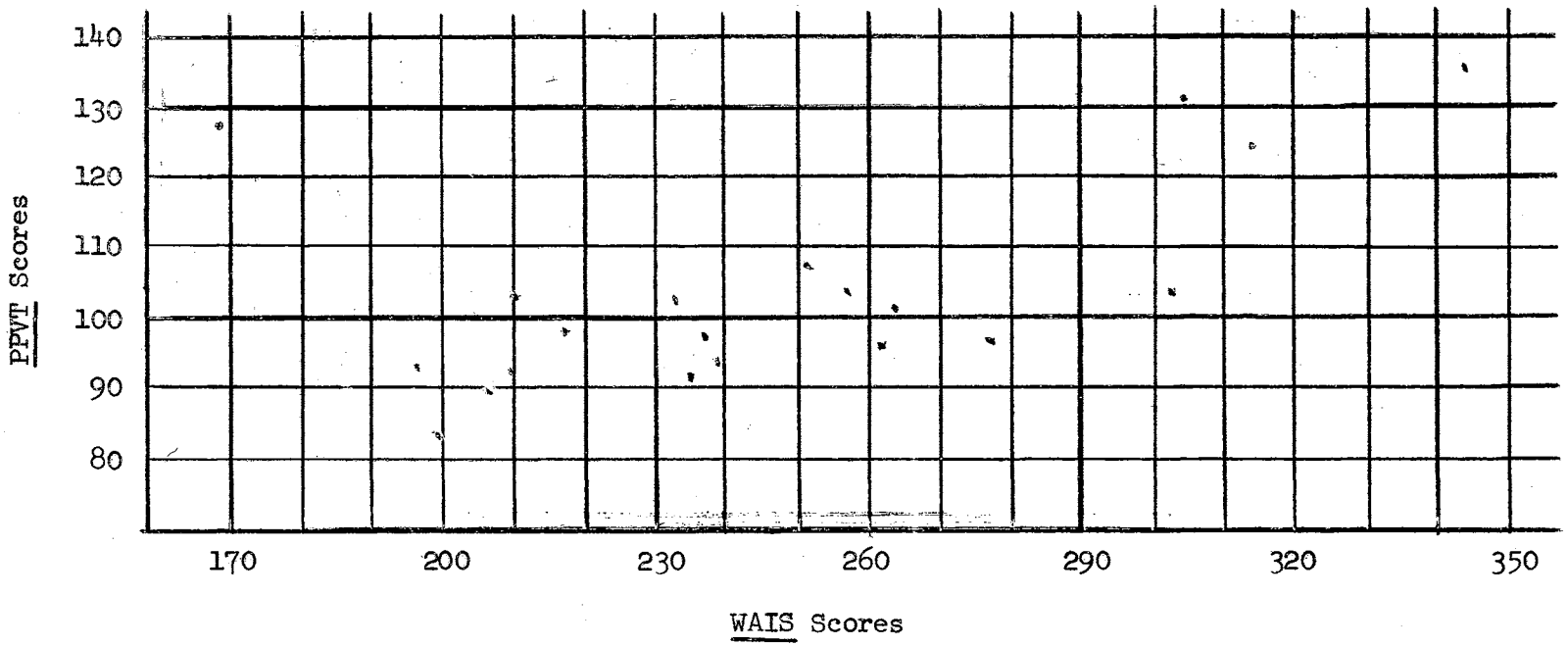


Figure 1. Scatter-diagram for PPVT and WAIS Scores for Sample A

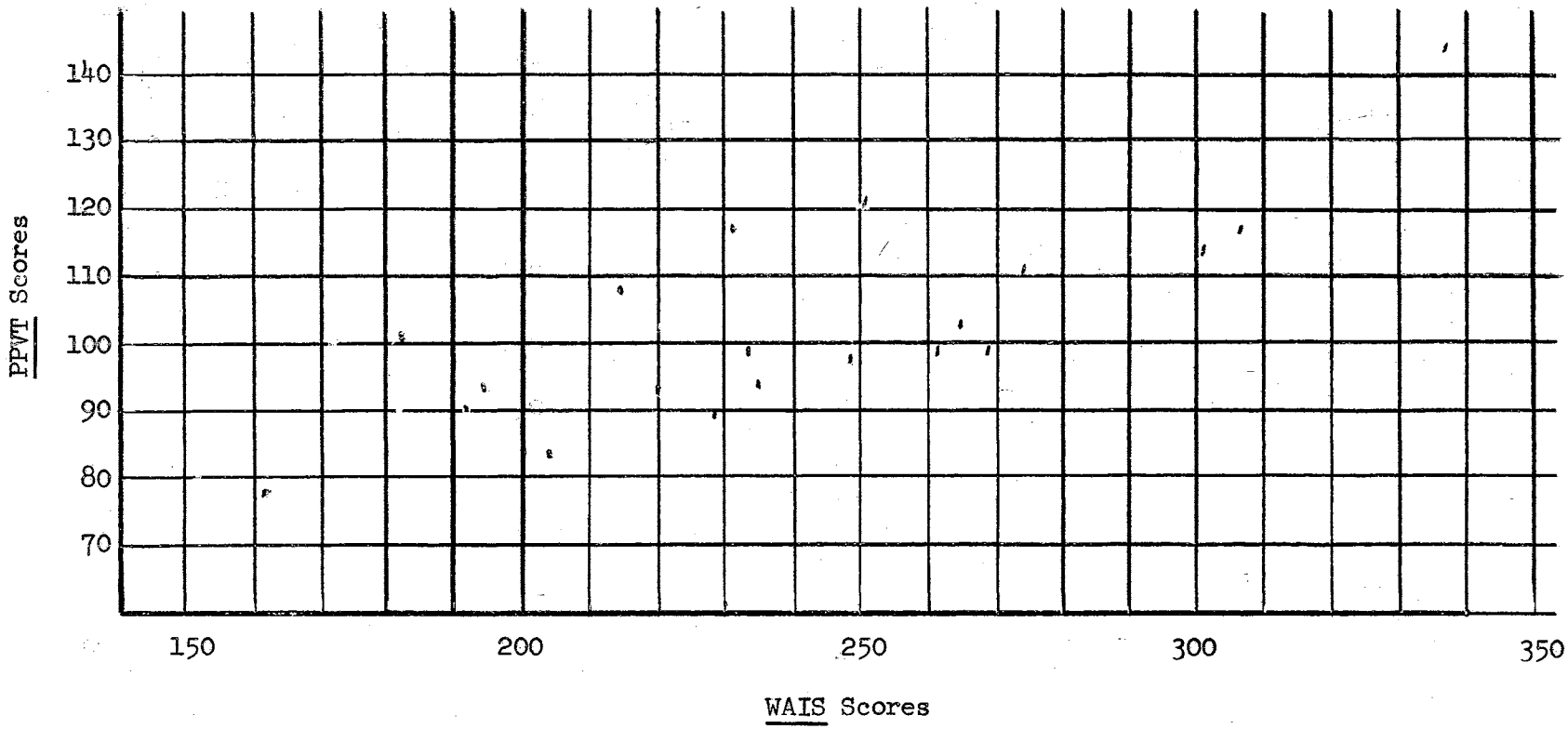


Figure 2. Scatter-diagram for PPVT and WAIS Scores for Sample B

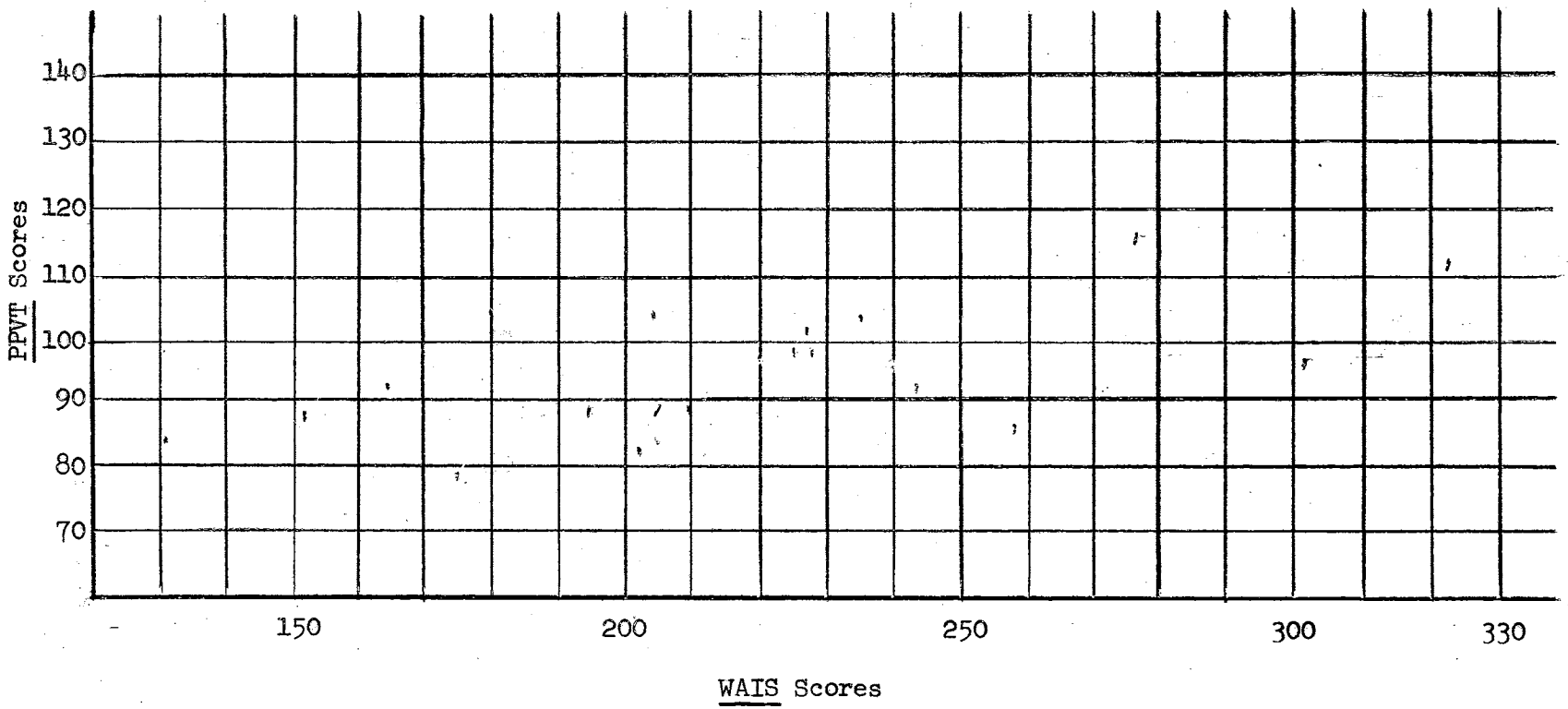


Figure 3. Scatter-diagram for PPVT and WAIS Scores for Sample C

TABLE I

CORRELATIONS BETWEEN THE PPVT SCORES, WAIS FULL SCALE SCORES, WAIS PERFORMANCE SCORES, AND WAIS VERBAL SCORES

Raw Data

	WAIS Verbal	WAIS Performance	WAIS Total	PPVT
SAMPLE A				
WAIS Verbal		.67**	.95**	.66**
WAIS Performance			.87**	.28
WAIS Full Scale				.55**
SAMPLE B				
WAIS Verbal		.46*	.87**	.75**
WAIS Performance			.84**	.54**
WAIS Full Scale				.76**
SAMPLE C				
WAIS Verbal		.69**	.90**	.68**
WAIS Performance			.94**	.42
WAIS Full Scale				.58**

** Significant at .01 level
* Significant at .05 level

A note on the significance of the coefficients of correlation:

When N = 20 there are 18 degrees of freedom associated with the coefficient of correlation.

An r of .378 is required for significance of a 1-tailed test at .05 level

An r of .516 at .01 level (by Fisher-Yates Table on page 413 of (9)).

TABLE II

SIGNIFICANCE OF THE DIFFERENCE OF CORRELATION COEFFICIENTS FOR SAMPLES A, B, AND C

Sample		WAIS Verbal with W. Per	WAIS Verbal with W. Total	WAIS Verbal with PPVT	Performance with Total	Performance with PPVT	WAIS Full with PPVT
A	r_1	.67	.95	.66	.87	.28	.55
B	r_2	.46	.87	.75	.84	.54	.76
C	r_3	.69	.90	.68	.94	.42	.58
A	Zr_1	.811	1.832	.793	1.333	.288	.618
B	Zr_2	.497	1.333	.973	1.221	.604	.996
C	Zr_3	.848	1.472	.829	1.738	.448	.662
	$S_{Zr_1 - Zr_2} = \sqrt{\frac{1}{17} + \frac{1}{17}} = \sqrt{\frac{2}{17}} = .343$						
	$Zr_1 - Zr_2$	.314	.499	.180	.112	.316	.378
	$Zr_1 - Zr_3$	.037	.360	.436	.405	.160	.044
	$Zr_2 - Zr_3$	.351	.139	.144	.517	.156	.334
	Corresponding values of z	.915 .108 1.02	1.455 1.049 .40	.525 .104 .42	.326 1.18 1.50	.921 .47 .45	1.10 .13 .97

A value of 1.96 for z is required for significance at the .05 level.
A value of 2.58 for z is required for significance at the .01 level.

To test whether r_1 is significantly different from r_2, null hypothesis is Ho: $\rho_1 = \rho_2$

Convert r_1 and r_2 to Z- scores by Table, page 412 of (9).

Standard error of the distribution of Zr is $S_{Zr} = \frac{1}{\sqrt{N-3}}$

Standard error of the difference between two values of Zr is given by:

$$S_{Zr_1 - Zr_2} = \sqrt{\frac{1}{N_1-3} + \frac{1}{N_2-3}}$$

$$z = \frac{Zr_1 - Zr_2}{S_{Zr_1 - Zr_2}}$$ (See p. 189 of (9))

* Coefficients of correlation refer to those of p. 34.

Summary:

All values are less than 1.96.

Hence in no case is there sufficient evidence to reject the hypothesis Ho: $\rho_1 = \rho_2$ at the .05 level. i.e., There is no significant difference between the correlation coefficients for the three schools. This agrees with previous findings that the three samples may be considered as samples from the same population.

TABLE III

CORRELATIONS BETWEEN PPVT SCORES AND WAIS SUBTEST SCORES

Raw Data

WAIS Subtest	SAMPLE A Coefficient of correlation with PPVT	SAMPLE B Coefficient of correlation with PPVT	SAMPLE C Coefficient of correlation with PPVT
Information	.41*	.69**	.53**
Comprehension	.44*	.54**	.69**
Arithmetic	.78**	.30	.43*
Similarities	.46*	.51*	.41*
Digit Span	.48*	.35	.28
Vocabulary	.64**	.78**	.74**
Digit Symbol	.37	.38*	.00
Picture Completion	.35	.78**	.75**
Block Design	.16	.59**	.37
Picture Arrangement	.10	.00	.54*
Object Assembly	-.17	.33	.37

** Significant at .01 level
* Significant at .05 level

One-tailed Test

TABLE IV

INTERCORRELATIONS AMONG WAIS SUBTESTS--SAMPLE A

Raw Data

	PPVT	I	C	A	S	DSP	V	DSY	PC	BD	PA	OA
PPVT		.41*	.44*	.78**	.46*	.48*	.64**	.37	.35	.16	.10	-.17
Information			.69**	.45*	.52**	.31	.78*	.70**	.36	.24	.37	-.10
Comprehension				.52**	.74**	.17	.76**	.66**	.21	.31	.39*	.11
Arithmetic					.56**	.29	.52**	.36	.62**	.36	.28	-.29
Similarities						.13	.49*	.58**	.17	.35	.19	-.08
Digit Span							.38*	.35	.15	.04	.23	.08
Vocabulary								.65**	.25	.29	.44*	.00
Digit Symbol									.13	.01	.13	-.28
Picture Completion										.48*	.55**	-.16
Block Design											.60**	.51*
Picture Arrangement												.38*
Object Assembly												

** Significant at .01 level
* Significant at .05 level

One-tailed Test

TABLE V

INTERCORRELATIONS AMONG WAIS SUBTESTS--SAMPLE B

Raw Data

	PPVT	I	C	A	S	DSP	V	DSY	PC	BD	PA	OA
PPVT		.69**	.54**	.30	.51*	.35	.78**	.38*	.78**	.59**	.00	.33
Information			.63**	.58**	.76**	.32	.84**	.26	.66**	.52**	.01	.29
Comprehension				.28	.69**	-.03	.73**	.00	.44*	.57**	-.31	.00
Arithmetic					.38*	.39*	.40*	.33	.61**	.44*	.23	.34
Similarities						.17	.74**	.03	.42*	.48*	-.03	.30
Digit Span							.29	.04	.43*	-.06	.46*	.03
Vocabulary								.33	.72**	.54**	-.11	.30
Digit Symbol									.50*	.46*	.12	.59**
Picture Completion										.65**	.05	.36
Block Design											-.11	.52**
Picture Arrangement												.13
Object Assembly												

** Significant at .01 level
* Significant at .05 level

One-tailed Test

TABLE VI

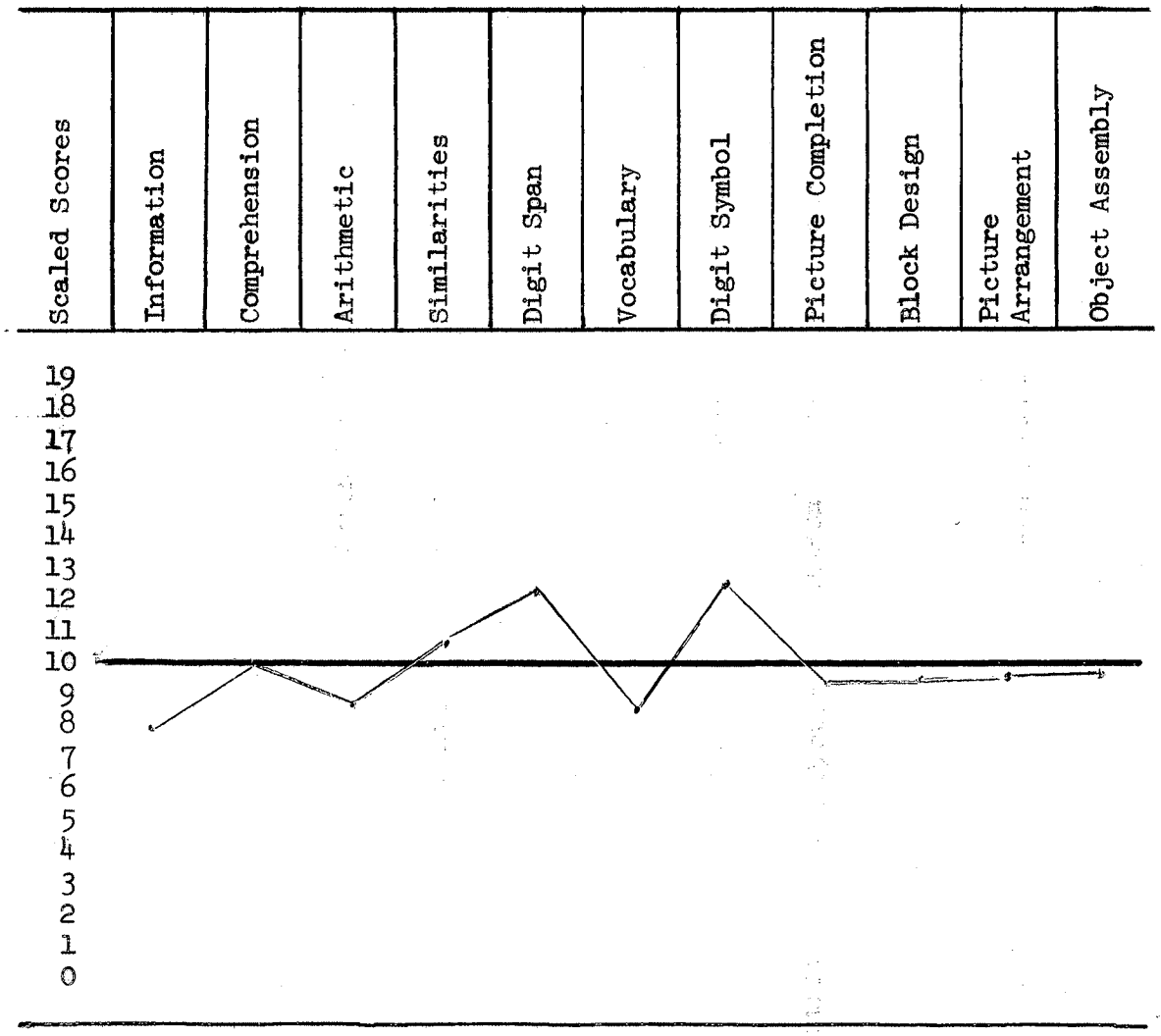
INTERCORRELATIONS AMONG WAIS SUBTESTS--SAMPLE C

Raw Data

	PPVT	I	C	A	S	DSP	V	DSY	PC	BD	PA	OA
PPVT		.53**	.69**	.43*	.41*	.28	.74**	.00	.75**	.37	.54**	.37
Information			.55**	.55**	.47*	.12	.65**	.53*	.69**	.48*	.61**	.38*
Comprehension				.40*	.55**	.40*	.77**	.19	.62**	.26	.39*	.17
Arithmetic					.68**	.43*	.59**	.61**	.62**	.43*	.50*	.39*
Similarities						.48*	.51*	.59**	.64**	.51*	.50*	.52**
Digit Span							.36	.19	.27	.05	.49*	.24
Vocabulary								.32	.64**	.32	.59**	.19
Digit Symbol									.18	.31	.28	.18
Picture Completion										.64**	.62**	.50*
Block Design											.33	.40*
Picture Arrangement												.24
Object Assembly												

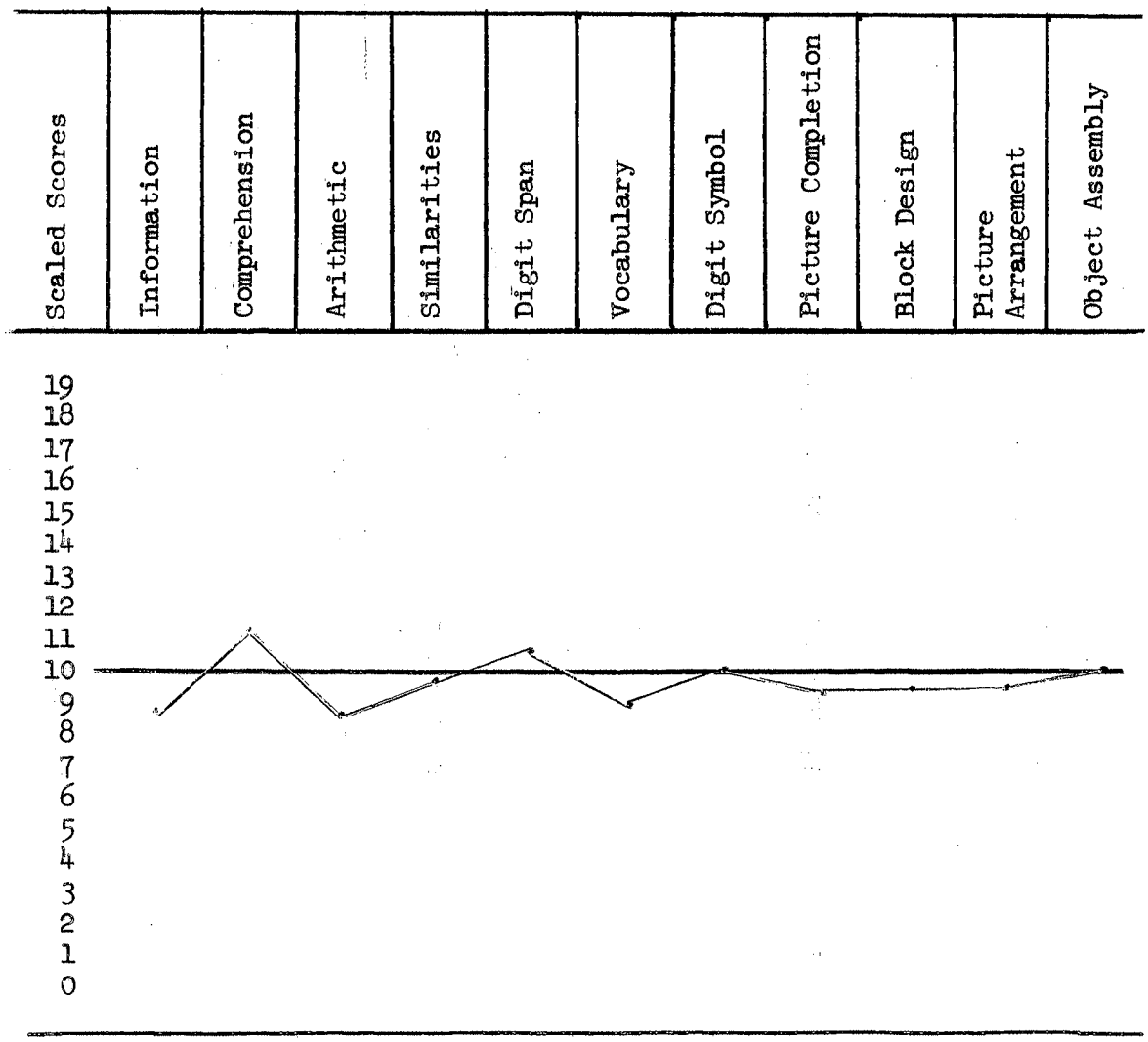
** Significant at .01 level
* Significant at .05 level

One-tailed Test



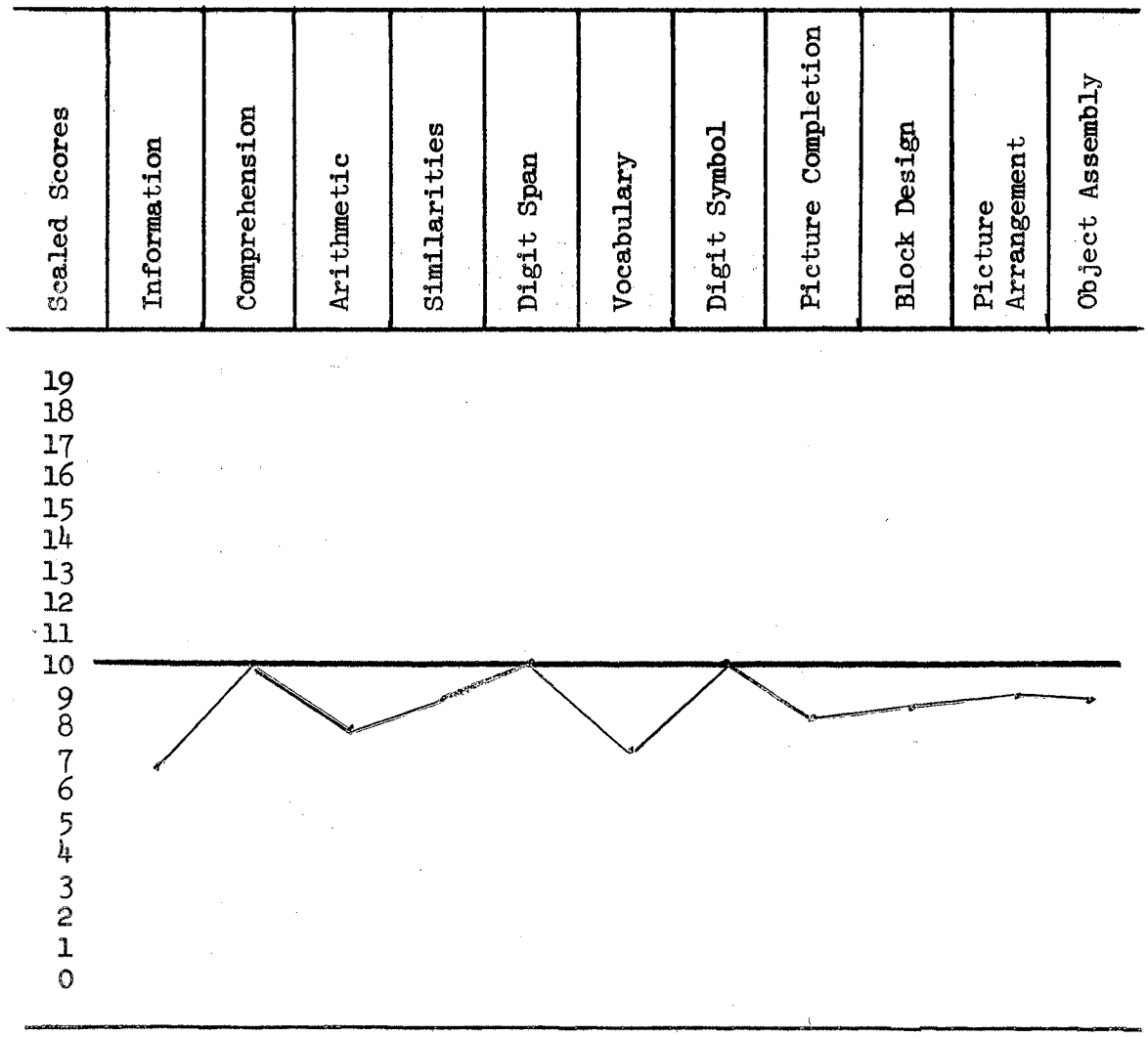
Standardization sample scaled score mean is 10.

Figure 4. WAIS Scaled-Score Profile for Sample A



Standardization sample scaled score mean is 10.

Figure 5. WAIS Scaled-Score Profile for Sample B



Standardization sample scaled score mean is 10.

Figure 6. WAIS Scaled-Score Profile for Sample C

TABLE VII

COMPARISON OF MEAN I.Q. SCORES--WAIS AND PPVT

Sample	WAIS Verbal I.Q.	WAIS Performance I.Q.	WAIS Full Scale I.Q.	PPVT I.Q.
A	101.75	97.95	100.15	96.6
B	101.45	97.35	99.75	95.10
C	96.15	92.35	94.15	88.35

Note that in every case the WAIS I.Q. score is higher than the PPVT I.Q. score.

Comparative Performance of the Whole Population on WAIS and PPVT

The need for and the construction of a sample to represent the entire population of Negro seniors in the designated age bracket at the three schools involved were discussed in a previous section. In this section this sample, to be referred to as Sample D, will be investigated for the purpose of making inferences about the relationship of performance on the WAIS test to that on the PPVT. It is important to stress that only this sample can be used for this purpose since this is the only random sample in this study which represents the entire population.

In the first table that follows the students who were selected randomly to comprise this sample are listed by number. (A-2 indicates

student number 2 from School A.) The raw scores on all tests are shown so as to avoid the necessity of going back to the appendix for this information.

Next comes a scattergram indicating that a linear relation exists between WAIS Full Scale raw scores and PPVT scores; and this is followed by tables showing all the coefficients of correlation of concern in this study.

Tables XII and XIII, however, the last two tables in this section, do not refer to Sample D. In fact, they are not to be used for statistical inferences about the population. They consist of certain noticeable characteristics about the performance of the group of sixty people used in the study when considered for what it is--simply a group of sixty people who happen to be 16 and 17 year-old Negro seniors of three Oklahoma City high schools.

TABLE VIII

SAMPLE D DATA

Student	TVRS	TPS	WFRS	PPVT	I	C	A
A-1	164	180	344	137	22	27	16
A-18	135	180	315	127	11	25	12
A-17	148	157	305	131	22	24	11
A-2	122	179	301	104	21	23	12
A-16	106	171	277	97	14	21	11
B-11	130	145	275	111	21	24	9
B-12	115	154	269	99	16	14	11
A-20	113	150	263	101	17	19	11
A-14	99	162	261	96	13	20	10
A-15	97	161	258	105	7	22	11
A-13	103	148	251	108	10	25	10
B-11	119	131	250	121	15	24	8
A-12	66	174	240	94	6	11	6
A-9	101	137	238	98	13	20	4
A-10	88	146	234	91	7	17	8
A-11	88	145	233	103	12	15	10
B-8	95	137	232	99	12	21	8
C-13	102	126	228	99	11	26	8
A-8	85	133	218	99	10	15	10
A-6	80	130	210	104	7	12	10
C-9	78	132	210	89	6	16	12
A-7	76	134	210	92	5	17	7
C-7	78	129	207	105	11	18	7
A-5	64	143	207	90	8	15	5
B-3	73	131	204	83	4	15	7
A-4	73	127	200	83	10	13	5
A-3	55	141	196	93	6	4	5
B-5	77	118	195	94	6	20	6
B-10	59	123	182	101	8	8	4
A-19	57	111	168	128	2	8	13
C-1	65	87	152	87	6	20	5
Mean	93.90	142.65	236.55	102.23	10.94	18.03	8.77
S.D.	26.86	20.97	43.17	13.53	5.38	5.65	2.92

N = 31

TABLE VIII (Continued)

Student	S	DSP	V	DSY	PC	BD	PA	OA
A-1	19	14	66	71	16	34	32	27
A-18	19	12	56	61	10	43	26	40
A-17	17	13	61	72	11	29	18	27
A-2	17	12	37	67	16	36	27	33
A-16	17	11	32	65	12	36	26	32
B-11	18	12	46	51	13	28	26	27
B-12	17	15	42	50	12	25	32	35
A-20	9	11	46	60	15	28	27	20
A-14	17	11	28	67	13	36	22	24
A-15	12	12	33	60	13	30	22	36
A-13	16	9	33	60	13	26	22	27
B-11	17	10	45	46	14	28	18	25
A-12	10	11	22	48	16	43	28	39
A-9	13	12	39	77	6	16	13	25
A-10	12	13	31	56	10	29	22	29
A-11	15	11	25	65	12	30	14	24
B-8	12	10	32	53	12	28	14	30
C-13	11	11	35	55	10	28	22	11
A-8	16	11	23	64	10	28	12	19
A-6	16	11	24	53	15	24	22	16
C-9	11	10	23	69	7	20	16	20
A-7	15	10	22	53	5	26	20	30
C-7	8	9	25	60	6	16	20	27
A-5	13	13	10	47	9	26	22	39
B-3	14	12	21	51	9	20	20	31
A-4	10	9	26	37	8	30	16	36
A-3	6	12	22	54	9	24	23	31
B-5	9	11	25	34	10	24	24	26
B-10	6	10	23	57	8	20	14	34
A-19	10	12	12	43	12	24	10	22
C-1	4	15	15	37	6	8	16	20
Mean	13.10	11.45	31.61	56.23	10.90	27.19	20.84	27.81
S.D.	4.03	1.52	13.22	10.45	3.10	7.27	5.58	6.88

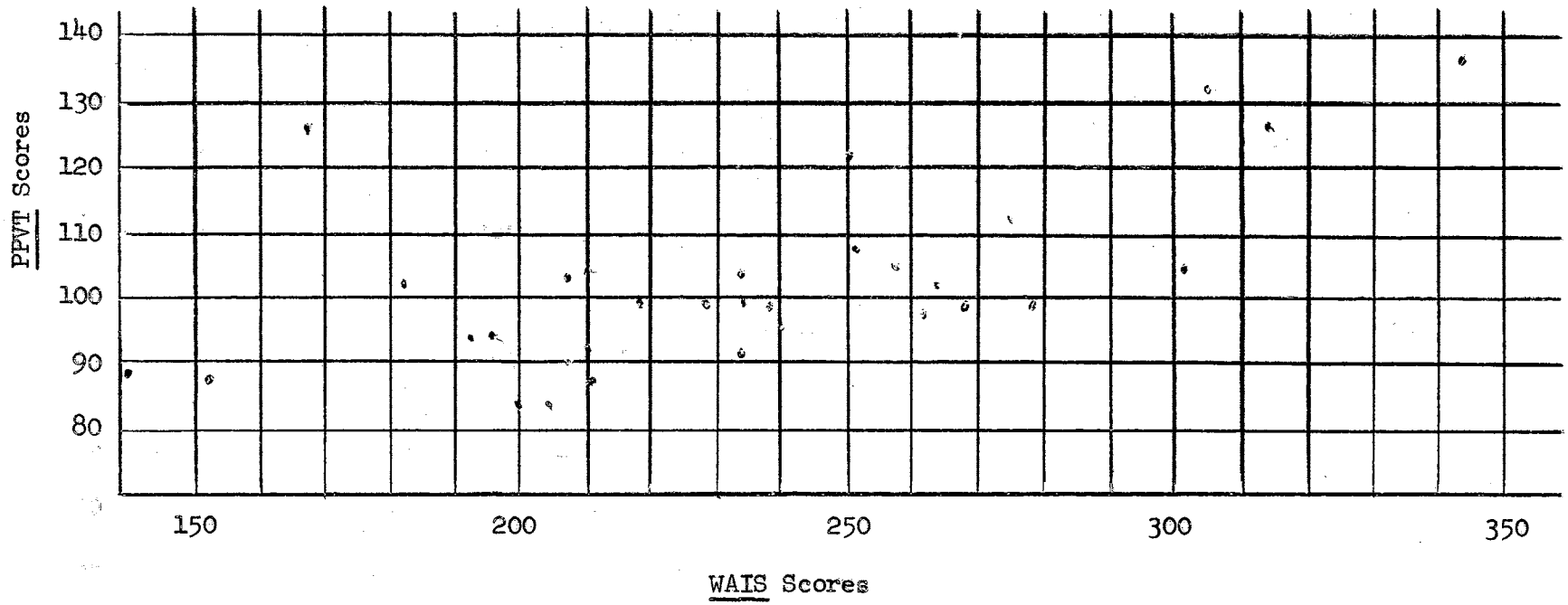


Figure 7. Scatter-diagram for PPVT and WAIS Raw Scores for Sample D

TABLE IX

INTERCORRELATIONS FOR SAMPLE D

	PPVT	WAIS Verbal	WAIS Performance	WAIS Full Scale
PPVT		.67**	.35*	.58**
WAIS Verbal			.62**	.92**
WAIS Performance				.87**
WAIS Full Scale				

Note that the PPVT score has highest correlation with the WAIS verbal scores.

An r of .301 is required for significance at the .05 level for a one-tailed test.

An r of .416 is required for significance at the .01 level.

** Significant at .01 level
* Significant at .05 level

TABLE X

INTERCORRELATIONS BETWEEN WAIS SUBTEST SCORES--SAMPLE D

Raw Data

	PPVT	I	C	A	S	DSP	V	DSY	PC	BD	PA	OA
PPVT		.50**	.40*	.64**	.47**	.16	.67**	.32*	.44**	.31*	.13	-.06
Information			.60**	.43**	.57**	.20	.81**	.48**	.46**	.33*	.41*	-.01
Comprehension				.39*	.52**	.07	.67**	.32*	.23	.24	.30	-.14
Arithmetic					.60**	.20	.52**	.45**	.58**	.44**	.32*	-.17
Similarities						.11	.58**	.44**	.46**	.56**	.34*	.09
Digit Span							.22	-.01	.10	-.07	.34*	.08
Vocabulary								.47**	.41*	.40*	.46**	.04
Digit Symbol									.12	.21	.04	-.11
Picture Completion										.63**	.51**	.02
Block Design											.49**	.40*
Picture Arrangement												.32*
Object Assembly												

** Significant at .01 level
* Significant at .05 level

One-tailed Test

TABLE XI

MEAN I.Q.'S OF SAMPLE D

WAIS Verbal	WAIS Performance	WAIS Full Scale	PPVT
100.77	95.00	98.23	95.03

This table indicates that PPVT I.Q. is lower than the I.Q. suggested by WAIS.

The previous table indicates that the PPVT has higher correlation with verbal than with performance or Full Scale WAIS score; among all subtests PPVT has higher correlation with vocabulary followed closely by arithmetic.

To complete the comparative study, the relationship between PPVT, performance, and WAIS performance was examined with respect to high, medium and low WAIS scores.

The entire set of 60 students was considered as one clinical population and arbitrarily divided into three groups--those with WAIS total raw scores over 300, those with scores between 200 and 300, and those with scores under 200.

There were 9 students in the high group, 12 in the low and 39 in the medium. The correlation coefficients are given in the next Table. It is seen that the highest correlation between PPVT and WAIS occurs in the high-score pupils and this correlation is highest for verbal and for vocabulary.

In the medium group, the coefficients were generally lower but highest was still with verbal.

In the lowest group there was generally no correlation, and indeed the only significant coefficient of correlation was with respect to picture completion.

TABLE XII

COEFFICIENTS OF CORRELATION BETWEEN
PPVT SCORES AND WAIS TESTS

Raw Data			
	For I	For II	For III
Verbal	.92**	.59**	-.01
Performance	-.59	.01	.21
Full Scale	.71*	.45**	.17
Information	.43	.41**	-.53
Composition	.77**	.49**	-.32
Arithmetic	.08	.35*	.37
Similarities	.28	.29*	.13
Digit Span	.21	.18	.20
Vocabulary	.99**	.53**	.12
Digit Symbol	-.49	-.16	-.04
Picture Completion	-.15	.55**	.76**
Block Design	-.31	.07	.31
Picture Arrangement	-.35	.21	-.24
Object Assembly	.17	-.20	.22

* Significant at .05 level
** Significant at .01 level

I: Students with WAIS total scores over 300

II: Students with WAIS total scores of 200-300

III: Students with WAIS total scores under 200

In the final table below, the questions of how many students high on WAIS test were high on the PPVT, are answered.

Here, the total group of 60 considered as one clinical population were arbitrarily divided into PPVT high, medium and low groups if their PPVT scores were 117-137, 96-116, and 75-95 respectively.

They were considered high, medium and low with regard to the WAIS test if their WAIS total scores were over 300, 200-300, and under 200 respectively.

TABLE XIII

PPVT-WAIS HIGH-MEDIUM-LOW CELL RELATIONSHIPS

		PPVT			
		High	Medium	Low	Totals
WAIS	High	5	4	0	9
	Medium	2	23	14	39
	Low	1	2	9	12
	Totals	8	29	23	60

The numbers in each cell indicate the number of students who satisfied both requirements of that cell.

Prediction of WAIS Scores from PPVT Scores

In this final section of this chapter attention will be given to the possibility of using PPVT scores as estimates or predictors of WAIS scores.

As the WAIS scores have been considered throughout the paper to comprise the independent variable and the PPVT scores, the dependent variable, the letters X and Y will refer to WAIS scores and PPVT scores respectively.

The WAIS scores assumed the nature of the independent variable by virtue of the fact that they have been accepted as giving satisfactory measures of the intelligence of Negroes as well as of white people. The previous part of this study has been concerned with the relationship of PPVT scores to these accepted WAIS scores.

Now, however, a rather different point of view is to be taken. The concern is whether a given set of PPVT scores can be used adequately to estimate the WAIS scores. That is, once a teacher had administered the PPVT test, can she rely on the results as being indicative of results that would occur on the WAIS test?

Toward the end of gathering information needed to answer this question several estimating equations or regression lines have been computed in this section. The regression lines for estimating WAIS raw scores from PPVT scores were first found for sample D and for samples A, B, C. Finally the regression line for estimating WAIS I.Q. scores themselves from PPVT I.Q. scores was computed.

The section ends with a table listing the actual WAIS scores made by all sixty students involved in this investigation as well as the

predicted WAIS scores as estimated by using PPVT scores and regression lines.

It should be apparent that the terms "regression line," "best-fitting line" and "prediction line" are used as synonymous.

$x' = b_{xy}y + a_{xy}$ is the equation of the line used to predict scores of the WAIS test from those of the PPVT.

$$b_{xy} = \frac{\Sigma xy - \frac{\Sigma x \Sigma y}{N}}{\Sigma y^2 - \frac{(\Sigma y)^2}{N}} \qquad a_{xy} = \frac{\Sigma x - b_{xy}\Sigma y}{N}$$

$\Sigma xy = 760,198$

$\Sigma x = 7,333$

$\Sigma y = 3,169$

$\Sigma y^2 = 329,629$

$(\Sigma y)^2 = 10,042,561$

$N = 31$

$r = .58$

$$b = \frac{760,198 - 749,621.8}{329,629 - 323,953.6} = \frac{10,576}{5,675} = 1.86$$

$$a = \frac{7,333 - 1.86\ (3,169)}{31} = 46.4$$

$$x' = 1.86y + 46.4$$

This value of r is significant at the .01 level .

Standard error of estimate is $\sqrt{S_{xy}^2} = S_x \sqrt{1-r^2}$

$$= 43.17 \sqrt{1 - .58^2} = (43.17) \sqrt{.665} = 35.2$$

that is, the estimated range on either side of the line of estimation within which 68.27 per cent of the items are expected to fall. About 95 per cent should fall within the band $\pm 2(35.2)$

The equation $x' = 1.86y + 46.4$ is the line of estimation of WAIS scores x given PPVT scores y for all elements in the population for

which sample D is a random sample. For above formulas see Chapter 8 of (9).

TABLE XIV

REGRESSION LINES OF X ON Y

	Sample A	Sample B	Sample C
Σxy	519,959	498,119	420,351
Σy^2	220,823	210,995	182,478
Σx	4,929	4,805	4,368
Σy	2,081	2,037	1,900
N	20	20	20
$(\Sigma y)^2$	4,330,561	4,149,369	3,610,000
S_x	43.9	43.4	46.4
r	.55	.76	.58
b_{xy}	1.65	2.48	2.72
a_{xy}	$\frac{4929 - 3433.6}{20} = 75$	-12.3	-40.5
x'	1.65y + 75	x' = 2.48y - 12.3	x' = 2.72y - 40.5
$S_x\sqrt{1-r^2}$	36.7	28.2	37.8

These equations are the "best fitting" lines of x on y for the samples A, B, and C, and as such could be used to predict WAIS scores from PPVT scores for students in the respective schools. As on the

preceding page, x is the WAIS score, y the PPVT score, and x' the predicted WAIS score.

The prediction lines for WAIS scores given PPVT scores for Samples A, B, and C are:

A: $x' = 1.65\,y + 75$ with S.E. of 36.7

B: $x' = 2.48y - 12.3$ with S.E. of 28.2

C: $x' = 2.72y - 40.5$ with S.E. of 37.8

D: $x' = 1.86y + 46.4$ with S.E. of 35.2

In Figure 8, page 60, the prediction line $x' = 1.86y + 46.4$ is plotted on the scatter-diagram for Sample D.

In Figure 9, page 61, the prediction lines for all four samples are plotted on the scatter-diagram for the total group of 60 pupils.

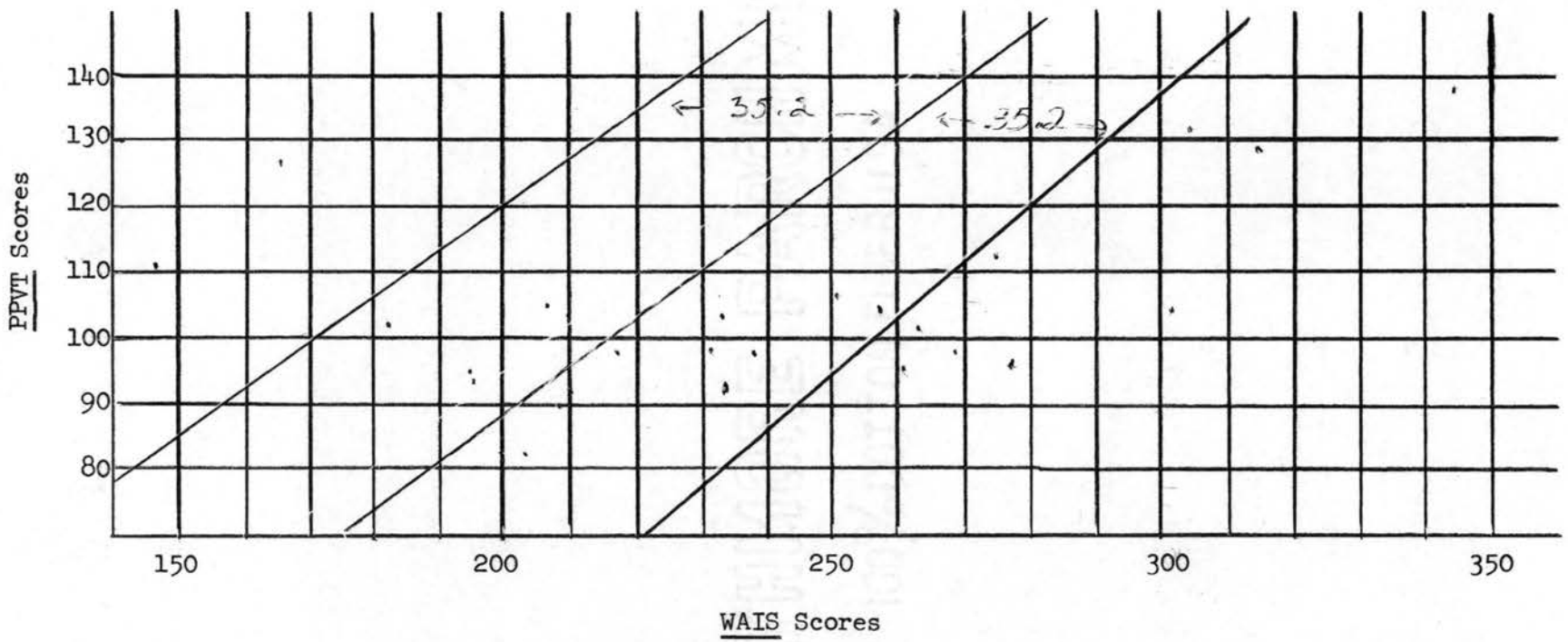


Figure 8. Scatter-diagram for Sample D--Prediction Line

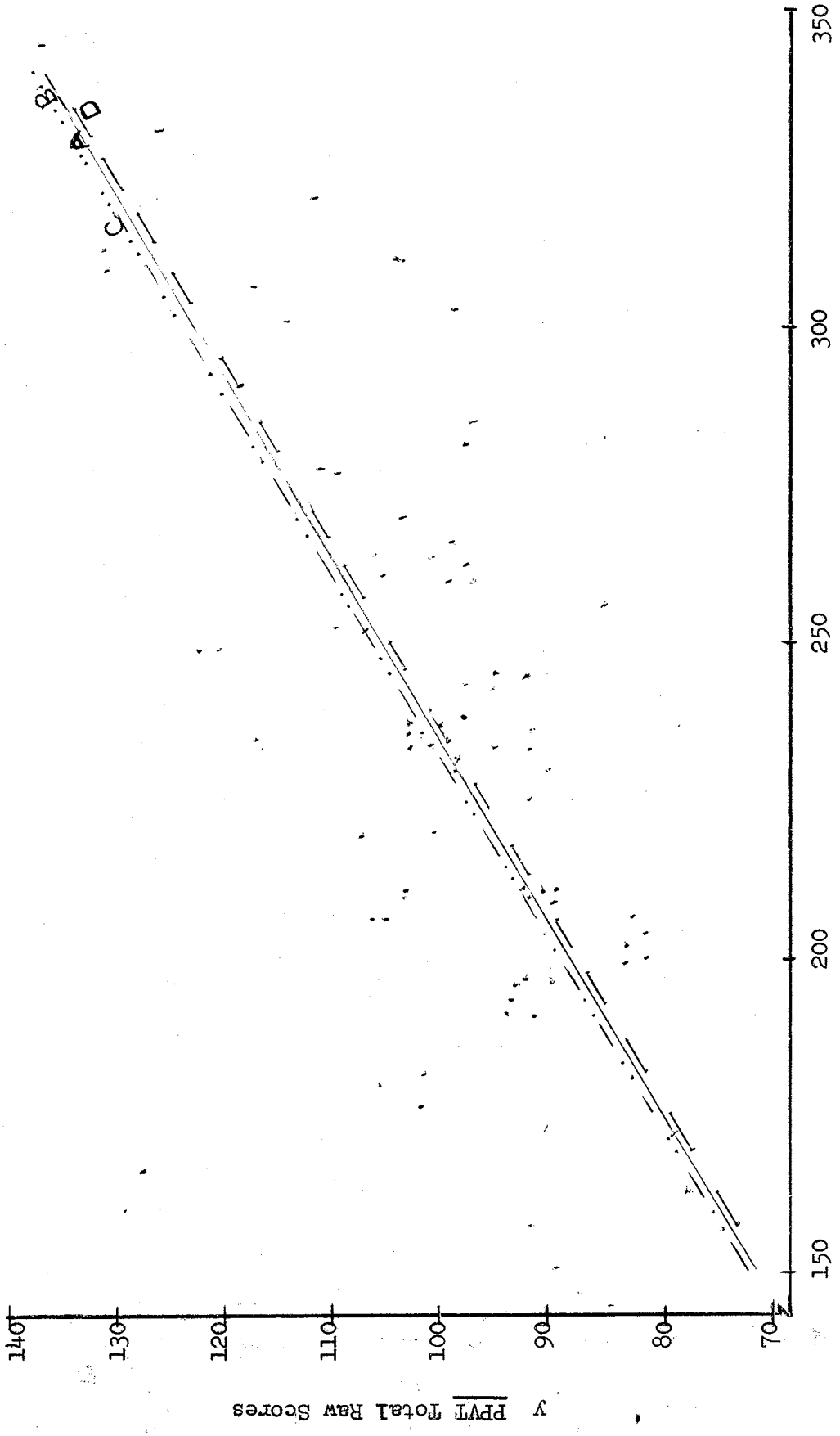


Figure 9. Regression Lines of x on y

As a step toward cross-validation of the estimates predicted by the Sample D regression lines a sample of 15 was taken from the total group of 60. By taking 10 from Sample A, 3 from Sample B, and 2 from Sample C this new selection of 15 is approximately a random sample from the original population but not independent of the earlier sample. Prediction results regarding this sample are shown in Table XV, page 64.

To test the significance of the difference between the means of the predicted and actual values of x, consider the following method. (See page 169 of (9)).

Let $\bar{x} - \bar{x}'$ be denoted by $\bar{D}$

Then $\bar{D} = 8.87$

Let $S_D^2 = \frac{\Sigma (D - \bar{D})^2}{N - 1} = \frac{12,985.7}{14} = 927.55$

Let $S_{\bar{D}}^2 = \frac{S_D^2}{N} = \frac{927.55}{15} = 61.84$

$$\underline{t} = \frac{\bar{D}}{S_{\bar{D}}} = \frac{8.87}{7.86} = 1.13$$

A $\underline{t}$ of 2.145 is required for significance at the .05 level for a two-tailed test when the number of degrees of freedom is 14 as in the case at hand. Since the observed value of $\underline{t} = 1.13$ is less than the critical value, there is no evidence to support the hypothesis that the difference in the means is significant.

That is, the mean of the fifteen actual WAIS scores is not significantly different from the mean of the WAIS scores which were predicted from the PPVT scores by use of the regression line of x and y for Sample D.

Note also that four of the actual values fall outside of the band of width 35.2 on either side of the regression line while the other

eleven values fall inside. This agrees with the expectation that about two thirds of the actual values should lie within one standard error of their respective predicted values.

Because of the similarities of the three regression lines for the samples A, B, and C to that of Sample D as shown in Figure 9, it is reasonable to accept the equation $X' = 1.86y + 46.4$ as a suitable prediction instrument for the entire population.

Thus, for PPVT scores between 70 and 140, this equation yields WAIS scores; 68 per cent of the time the predictive scores will lie within 35 points of the actual scores; and 95 per cent of the time the predicted scores will be within 70 points of the actual scores.

TABLE XV

PREDICTION RESULTS OF SAMPLE D

y = PPVT Score	x' = estimate x' = 1.86y + 46.4	x = actual WAIS Score	Difference x - x'
94	221.24	240	18.76
96	224.96	261	36.04
97	226.82	277	50.18
104	239.84	301	61.16
91	215.66	234	18.34
93	219.38	196	-23.38
105	241.7	258	16.30
98	228.68	238	9.32
131	290.06	305	14.94
103	237.98	233	- 4.98
99	230.54	232	1.46
121	271.46	250	-21.46
111	252.86	275	22.14
89	211.94	208	- 3.94
105	241.70	180	-61.70
	$\bar{x}' = 239.99$	$\bar{x} = 245.86$	$\bar{x} - \bar{x}' = 8.87$

TABLE XVI

PREDICTED AND ACTUAL WAIS RAW SCORES
FOR 60 STUDENTS

Student	PPVT Score	x' = Predicted WAIS Raw Score	x = Predicted WAIS Raw Score	Difference x - x'
A1	137	301.22	344	42.78
A2	127	282.62	315	32.38
A3	104	239.84	301	61.16
A4	131	290.06	305	14.94
A5	97	226.82	277	50.18
A6	105	241.70	258	16.30
A7	96	224.96	261	36.04
A8	101	234.26	263	28.74
A9	108	247.28	251	3.72
A10	94	221.24	240	18.76
A11	98	228.68	238	9.32
A12	91	215.66	234	18.34
A13	103	237.98	233	- 4.98
A14	99	230.54	218	- 12.54
A15	90	213.80	207	- 6.8
A16	104	239.84	210	- 29.84
A17	92	217.52	210	- 7.52
A18	83	200.78	200	- .78
A19	93	219.38	196	- 23.38
A20	128	284.48	168	-116.48
B1	133	293.78	339	45.22
B2	113	256.58	301	44.42

TABLE XVI (Continued)

Student	PPVT Score	x' = Predicted WAIS Raw Score	x = Predicted WAIS Raw Score	Difference x - x'
B3	117	264.02	306	41.98
B4	102	236.12	265	28.88
B5	99	230.54	269	38.46
B6	111	252.86	275	22.14
B7	121	271.46	250	- 21.46
B8	99	230.54	260	29.46
B9	94	221.24	233	11.76
B10	96	224.96	247	22.04
B11	117	264.02	231	- 33.02
B12	99	230.54	232	1.46
B13	108	247.28	214	- 33.28
B14	90	213.80	229	15.20
B15	92	217.52	220	2.48
B16	90	213.80	191	- 22.80
B17	83	200.78	204	3.22
B18	94	221.24	195	- 26.24
B19	78	191.48	162	- 29.48
B20	101	234.26	182	- 52.26
C1	112	254.72	322	67.28
C2	97	226.82	301	74.18
C3	116	262.16	277	14.84
C4	85	204.50	258	53.50
C5	92	217.52	244	26.48

TABLE XVI (Continued)

Student	PPVT Score	x' = Predicted WAIS Raw Score	x = Predicted WAIS Raw Score	Difference x - x'
C6	103	237.98	237	- .98
C7	99	230.54	228	- 2.54
C8	103	237.98	228	- 9.98
C9	99	230.54	227	- 3.54
C10	96	224.96	220	- 4.96
C11	89	211.94	210	- 1.94
C12	89	211.94	208	- 3.94
C13	105	241.70	207	- 34.70
C14	81	197.06	203	5.94
C15	88	210.08	195	- 15.08
C16	105	241.70	180	- 61.70
C17	79	193.34	174	- 19.34
C18	91	215.66	166	- 49.66
C19	87	208.22	152	- 56.22
C20	84	202.64	131	- 71.64

$x' = 1.86y + 46.4$

S.E. = 35.2

$r = .58$

With regard to the I.Q. scores the best-fitting line of WAIS scores on PPVT scores is given by the equation $x' = .424y + 57.9$ where again y is a PPVT I.Q. score and x' is the value of the WAIS I.Q. estimated by the given relationship.

The standard error is 7.86 I.Q. points. $r = .61$.

Table XVII shows the actual WAIS I.Q.'s of all sixty students and the WAIS I.Q.'s predicted by the use of the best-fitting line.

TABLE XVII

PREDICTED AND ACTUAL WAIS I.Q.'S
FOR 60 STUDENTS

Student	PPVT I.Q. Score y	WAIS I.Q. Score x	Predicted WAIS I.Q. Score x'	Differences x - x'	x - y
A1	137	125	116	9	-12
A2	95	114	98	16	19
A3	87	86	95	- 9	- 1
A4	77	89	90	- 1	12
A5	84	93	93	0	9
A6	85	93	94	- 1	8
A7	86	92	94	- 2	6
A8	94	94	98	- 4	0
A9	89	97	96	1	8
A10	82	96	93	3	14
A11	94	96	98	- 2	2
A12	88	98	95	3	10

TABLE XVII (Continued)

Student	PPVT I.Q. Score y	WAIS I.Q. Score x	Predicted WAIS I.Q. Score x'	Differences x - x'	Differences x - y
A13	103	101	102	- 1	- 2
A14	87	103	95	8	16
A15	100	103	100	3	3
A16	88	108	95	13	20
A17	122	112	110	2	-10
A18	123	115	110	5	- 8
A19	119	85	108	-23	-34
A20	92	103	97	6	11
B1	84	94	93	1	10
B2	83	92	93	- 1	9
B3	74	91	89	2	17
B4	81	91	92	- 1	10
B5	88	90	95	- 5	2
B6	103	94	102	- 8	- 9
B7	108	99	104	- 5	- 9
B8	94	97	98	- 1	3
B9	71	84	88	- 4	13
B10	92	84	97	-13	- 8
B11	106	108	103	5	2
B12	90	108	96	12	18
B13	112	102	105	- 3	-10
B14	94	102	98	4	8
B15	90	100	96	4	10

TABLE XVII (Continued)

Student	PPVT I.Q. Score y	WAIS I.Q. Score x	Predicted WAIS I.Q. Score x'	Differences x - x'	Differences x - y
B16	88	100	95	5	12
B17	104	113	102	11	9
B18	113	112	106	6	- 1
B19	130	125	113	12	- 5
B20	97	109	99	10	12
C1	81	83	92	- 9	2
C2	82	81	93	-12	- 1
C3	100	85	100	-15	-15
C4	72	81	88	- 7	9
C5	82	90	93	- 3	8
C6	74	88	89	- 1	14
C7	100	89	100	-11	-11
C8	80	86	92	- 6	6
C9	83	91	93	- 2	8
C10	87	95	95	0	8
C11	94	99	98	1	5
C12	98	97	99	- 2	- 1
C13	94	99	98	1	5
C14	98	98	99	- 1	0
C15	79	102	91	11	23
C16	83	100	93	7	17
C17	107	113	103	10	6
C18	91	115	96	9	24

TABLE XVII (Continued)

Student	PPVT I.Q. Score y	WAIS I.Q. Score x	Predicted WAIS I.Q. Score x'	Differences x - x'	Differences x - y
C19	107	118	103	15	11
C20	75	73	90	-17	- 2

CHAPTER IV

INTERPRETATIONS AND CONCLUSIONS

A study of the first half of the preceding chapter leads to certain immediate conclusions regarding the comparative performances of the three schools involved in this investigation.

Although there were no significant differences between the means or the variances of the distributions of WAIS scores, the mean performance of school C was lower than that of the other schools and the variance at school C was more than that of the other two.

In each case, however, there was evidence of a linear relationship between WAIS performance and PPVT performance--a fact indicated by figures 1, 2, and 3 of pages 31, 32, and 33.

The coefficient of correlation between WAIS scores and PPVT scores was in each case above .5; the highest correlation in all three cases was that between the WAIS verbal scores and the PPVT; and the coefficient of correlation for this latter relationship was in every case greater than .6. (Tables I and II, pages 34 and 36).

Regarding the individual WAIS subtests and their relationship to the PPVT, it should be noted that at school A the PPVT performance was most highly correlated with Arithmetic performance; at school B, with Vocabulary; and at school C, with Picture Completion. (See Table III of page 38). Most noticeable in this regard, however, is the fact that of all three schools the PPVT relationship with the WAIS Vocabulary

was always high, and in fact the corresponding coefficient of correlation was always greater than .6.

Such results as these warrant the conclusion that the simple-to-administer PPVT is more a measure of vocabulary and verbal intelligence than of the other types considered by the WAIS. This conclusion regarding this all Negro population agrees with previous results on all white populations.

One final word on the performances of the three individual schools should be noted. When the mean performance on each of the eleven subtests is compared with the mean of the norming population, schools A and B fall a little below average on seven subtests while school C is below average on eight.

If one seeks to compare the three schools with each other with respect to the notion of performance on intelligence tests even though the three schools are not statistically different in this respect--one must conclude that school C is somewhat behind schools A and B.

The values for determining whether the hypotheses are accepted or are rejected are found in the material in the preceding chapter--in particular, Tables VIII and IX of pages 47 and 50, concerning the relationship between WAIS performance and PPVT performance for the population as a whole.

Fisher-Yate's Table of critical values of the correlation coefficient for a one-tailed test with 29 degrees of freedom (required for the sample under investigation) was utilized to check the null-hypotheses which led to the acceptance or rejection of the experimental hypotheses. An r of .301 is necessary for significance at the .05 level.

Hypothesis I. There is a positive significant correlation between the WAIS Full Scale raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .58

Hypothesis I is accepted at the .05 level of significance.

Hypothesis II. There is a positive significant correlation between the WAIS Performance Scale raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .35

Hypothesis II is accepted at the .05 level of significance.

Hypothesis III. There is a positive significant correlation between the WAIS Verbal Scale raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .67

Hypothesis III is accepted at the .05 level of significance.

Hypothesis IV. There is a positive significant correlation between the WAIS I.Q. scores and the PPVT I.Q. scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .61

Hypothesis IV is accepted at the .05 level of significance.

Hypothesis V. There is a positive significant correlation between the WAIS Information test raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .50

Hypothesis V is accepted at the .05 level of significance.

Hypothesis VI. There is a positive significant correlation between the WAIS Comprehension test raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .40

Hypothesis VI is accepted at the .05 level of significance.

Hypothesis VII. There is a positive significant correlation between the WAIS Arithmetic test raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .64

Hypothesis VII is accepted at the .05 level of significance.

Hypothesis VIII. There is a positive significant correlation between the WAIS Similarities test raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .47

Hypothesis VIII is accepted at the .05 level of significance.

Hypothesis IX. There is a positive significant correlation between the WAIS Digit Span test raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .16

Hypothesis IX is rejected at the .05 level of significance.

Hypothesis X. There is a positive significant correlation between the WAIS Vocabulary test raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .64.

Hypothesis X is accepted at the .05 level of significance.

Hypothesis XI. There is a positive significant correlation between the WAIS Digit Symbol test raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .32

Hypothesis XI is accepted at the .05 level of significance.

Hypothesis XII. There is a positive significant correlation between the WAIS Picture Completion test raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .44

Hypothesis XII is accepted at the .05 level of significance.

Hypothesis XIII. There is a positive significant correlation between the WAIS Block Design test raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .31

Hypothesis XIII is accepted at the .05 level of significance.

Hypothesis XIV. There is a positive significant correlation between the WAIS Picture Arrangement test raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .13

Hypothesis XIV is rejected at the .05 level of significance.

Hypothesis XV. There is a positive significant correlation between the WAIS Object Assembly test raw scores and the PPVT scores.

Null-Hypothesis: $r \leq 0$

Calculation of r yields r = .06

Hypothesis XV is rejected at the .05 level of significance.

Perhaps more important for an overall generalization regarding the PPVT-WAIS relationship is that the total performance expresses quite vividly higher correlations between PPVT and the two subtests of Arithmetic and Vocabulary (See Table X on page 51).

Also noteworthy is the conclusion reached through Table XI that the I.Q. estimated by use of the PPVT is somewhat lower than that estimated by the WAIS.

Tables XII and XIII indicate that generally there is higher correlation between PPVT and WAIS Performance for students who have WAIS raw scores above 300 than for other students, and generally those students who do not fall very low on one test do not fall very low on the other.

Finally, page 68 also provides an answer to Hypothesis IV. It should be accepted. There is indeed a high positive significant correlation between the WAIS I.Q. scores and the PPVT I.Q. scores.

It may be well to preface the concluding remarks of this chapter with remarks about the use of the PPVT as a predictor--with a quotation from (22) on page 306.

> The fact is that less is known by statisticians about the theory of estimation in situations in which both variables are subject to sampling error than is known about the case in which only one variable is a source of such error.

In the present investigation both PPVT scores and WAIS scores are subject to sampling errors.

It must also be noted that there is a difference between the terms "significant" and "important." To say that a value of the

coefficient of correlation is significant is to say that the sample value of the correlation coefficient is too large to have come by chance from a population in which there was no relationship between the two variables. That this value is important in any other sense is not implied. Hence any decision about the importance of a relationship between PPVT and WAIS performance must be based on some additional information.

In lieu of another available large sample for purposes of cross-validation, Figure 9 shows that the lines of regression to be used for predicting WAIS scores from PPVT scores are much the same for the three individual schools as for the population under investigation. But since the standard error of estimate is 35.2 points, the possibility of the use of predictions remains subject to further consideration. A larger value of r would have resulted in a smaller standard error of estimate and thereby would have given a more worthwhile prediction equation.

Although (Table XV) there is no significant difference between the means of the predicted scores and actual scores, there still remain very important differences between the means of the predicted and actual scores of various individuals. For example, how worthwhile is the prediction equation when a student has an actual WAIS score of 180 and a predicted score of 241? On the other hand, consider the following students. (As listed in the Appendix): student 8 of school A, student 8 of school B, and student 11 of school C. All have PPVT raw scores of 99.

By use of the prediction line, their predicted WAIS scores would be 230.5. In reality their WAIS scores were 218, 232, and 227.

Certainly the predicted score was close enough--particularly since it was on the basis of a single quick-screening test.

A safe conclusion would be that the possibility of using the PPVT to predict or to estimate WAIS scores for this population of Negro seniors does exist. The standard error of estimate is so large, however, that such use must ultimately depend upon the particular reasons for wanting to know the WAIS scores in the particular situations--that is, upon how the knowledge of the predicted score is to be used.

If a teacher wants a reasonable estimate of a particular individual's I.Q., then he should not expect to get it from the PPVT. Table XVII, for example, shows several students whose WAIS I.Q.'s are too far away from the PPVT values. Student A-19 whose actual I.Q. is 85 would have been expected to have an I.Q. of 119. For this particular student then, the use of the estimated score might be harmful.

If, however, the teacher is interested in estimates for a group of individuals rather than a particular person, he could use the estimates determined by the PPVT with the expectation for most of them he would be within 8 I.Q. points of the correct value.

The findings of this investigation justify the use of the PPVT with a group like the one used in this study, i.e., Negro high school seniors of normal intelligence in the Southwest. This does not imply that the instrument should be used for Negro samples which are different from this group.

It can be assumed that if a student is capable of reaching high school seniority, his need for remedial help might be limited, therefore there is no reason to believe that the findings herein would indicate that the PPVT should be used for planning remedial programs in

reading. However, if the PPVT is used as a quick screening device, it should be followed up as soon as it is feasible to do so with a tool which yields more differential information. The PPVT yielded consistently high relationships with WAIS verbal scores especially for vocabulary, and lower values for WAIS performance scores. For instance, a correlation of .35 was obtained between the PPVT and WAIS performance for Sample D. Experience has shown that some of the problems which baffle educators today are possibly concealed within this area. The unitary value which was obtained on the PPVT did not reveal useful information which can be utilized in related areas.

Similar studies should be conducted for Negro high school seniors in different parts of the country, and for primary, elementary, and junior high school samples where criterion tests are available for such groups.

SELECTED BIBLIOGRAPHY

(1) Abrams, Jules C. "Tests for Evaluating Achievement in Reading." Reading as an Intellectual Activity, International Reading Association Proceedings, VIII, Miami, 1963.

(2) Brown, Louis F., and James A. Rice. "The Peabody Picture Vocabulary Test: Validity for EMRs." American Journal of Mental Deficiency, LXXI (May, 1967).

(3) Budoff, Milton and Purseglove, E. M. "Peabody Picture Vocabulary Test Performance of Institutionalized Mentally Retarded Adolescents." American Journal of Mental Deficiency (March, 1963).

(4) Burnett, Alastair. "Comparison of Peabody Picture Vocabulary Test Wechsler Bellevue, and Stanford-Binet on Educable Retardates." American Journal of Mental Deficiency, LXIX (March, 1965).

(5) Carr, Donald L., et al. "The PPVT in the Assessment of Language Deficits." American Journal of Mental Deficiency, LXXI (May, 1967).

(6) Dunn, Lloyd M. Expanded Manual Peabody Picture Vocabulary Test, American Guidance Service Incorporated, Minneapolis, Minnesota, 1965.

(7) Dunn, Lloyd M. and Sayde T. Brooks. "Peabody Picture Vocabulary Test Performance of Educable Mentally Retarded Children." Training School Bulletin, LVII (August, 1960).

(8) Dunn, Lloyd and John V. Hottel. "Peabody Picture Vocabulary Test Performance of Trainable Mentally Retarded Children." American Journal of Mental Deficiency, LXV (January, 1961).

(9) Ferguson, George A. Statistical Analysis in Psychology and Education. New York: McGraw-Hill, 1966.

(10) Gage, Gerald E. and Theodore F. Naumann. "Correlation of the Peabody Picture Vocabulary Test and the Wechsler Intelligence Scale for Children." Journal of Educational Research, LVIII, No. 10 (July-August, 1965).

(11) Games, Paul A. and George R. Klare. Elementary Statistics--Data Analysis for the Behavioral Sciences. New York: McGraw-Hill, 1967.

(12) Garret, Jane. "Comparison of the Peabody Picture Vocabulary Test and the Wechsler Intelligence Scale for Children." Division of Human Development and Guidance of the Graduate School George Peabody College for Teachers, Nashville, 1959.

(13) Gaubard, Paul S. "The Use of the Peabody Picture Vocabulary Test in the Prediction and Assessment of Reading Disability in Disturbed Children." Journal of Educational Research, LXI, No. 1 (September, 1967).

(14) Himelstein, Philip and James D. Herndon. "Comparison of the Wechsler Intelligence Scale for Children and the Peabody Picture Vocabulary Test with Emotionally Disturbed Children." Journal of Clinical Psychology, XVIII (1962).

(15) Hughes, Robert B. and Ken Lessler. "A Comparison of the Wechsler Intelligence Scale for Children and the Peabody Picture Vocabulary Test Scores of Negro and White Rural School Children." American Journal of Mental Deficiency, LXXIX (July, 1964-May, 1965).

(16) Ivanoff, John M. "Effectiveness of the Peabody Picture Vocabulary Test with Seventh Grade Pupils," Journal of Educational Research, LVIII (September, 1964-August, 1965).

(17) Kerlinger, Fred N. Foundations of Behavioral Research. New York: Holt, Rhinehart and Winston, 1965.

(18) Lloyd, Lyle L. "Performance of Hearing Impaired and Normal Retardates on Selected Language Measures." American Journal of Mental Deficiency, LXXI (May, 1967).

(19) Mazurkiewicz, Albert J. "What Does a Test Battery Tell a Teacher." Readings on Reading Instruction. Edited by Albert A. Harris, David McKay, Incorporated, New York: 1964.

(20) Mein, R. "Use of the Peabody Picture Vocabulary Test with Severely Subnormal Patients." American Journal of Mental Deficiency, LXVII (September, 1962).

(21) Neville, Donald. "The Relationship Between Reading Skills and Intelligence Test Scores." Reading Teacher, XVIII, No. 10 (January, 1965).

(22) O'Toole, A. L. Elementary Practical Statistics. New York: Macmillan Company, 1964.

(23) Plant, Walter T. and Celia Lynd. "A Validity Study on a College Freshman Norm Group for the Wechsler Adult Intelligence Scale." Personnel and Guidance Journal, XXXVII (April, 1959).

(24) Scoggins, Betty Jo. "A Comparative Study of the Full-Range Picture Vocabulary Test and the Peabody Picture Vocabulary Test." Unpublished Master's dissertation, Vanderbilt

University, Nashville, 1960.

(25) Shipe, Dorothy M. "Discrepancies Between the Peabody Picture Vocabulary Test and the Wechsler Intelligence Scale for Children as Related to Emotional Disturbance in Children of Retarded and Normal Intelligence." Unpublished Doctor's dissertation, Psychological Clinic, George Peabody College for Teachers, Nashville, 1962.

(26) Throne, Frances M., et al. "The Peabody Picture Vocabulary Test in Comparison with other Intelligence Tests and an Achievement Test in a Group of Mentally Retarded Boys." Educational and Psychological Measurement, XXV, PT. 1, (Spring-Summer, 1965).

(27) Tobias, Jack and Jack Gorelick. "The Validity of the Peabody Picture Vocabulary Test as a Measure of Intelligence of Retarded Adults." Training School Bulletin, LVIII (November, 1961).

(28) Travers, Robert M. An Introduction to Educational Research. Second Edition. New York: Macmillan Company, 1964.

(29) Van Dalen, Deobold B. and William J. Meyer. Understanding Educational Research. New York: McGraw-Hill, 1966.

(30) Webb, Allen B. "A Longitudinal Comparison of the Wechsler Intelligence Scale for Children and WAIS with Educable Mentally Retarded Negroes." Journal of Clinical Psychology, XIX (January, 1963).

(31) Wechsler, David. WAIS, Wechsler Adult Intelligence Scale. The Psychological Corporation, New York, 1955.

(32) Weeks, Richard W. "Effectiveness of the Peabody Picture Vocabulary Test with College Students." Journal of Educational Research, XXII, No. 2 (October, 1961).

APPENDIX

WAIS DATA (SCHOOL A)

I-Information S-Similarities TVRS-Total Verbal Raw Score

C-Comprehension DSP-Digit Span

A-Arithmetic V-Vocabulary

Student	I	C	A	S	DSP	V	TVRS
1	22	27	16	19	14	66	164
2	21	23	12	17	12	37	122
3	6	4	5	6	12	22	55
4	10	13	5	10	9	26	73
5	8	15	5	13	13	10	64
6	7	12	10	16	11	24	80
7	5	17	7	15	10	22	76
8	10	15	10	16	11	23	85
9	13	20	4	13	12	39	101
10	7	17	8	12	13	31	88
11	12	15	10	15	11	25	88
12	6	11	6	10	11	22	66
13	10	25	10	16	9	33	103
14	13	20	10	17	11	28	99
15	7	22	11	12	12	33	97
16	14	21	11	17	11	32	106
17	22	24	11	17	13	61	148
18	11	25	12	19	12	56	135
19	2	8	13	10	12	12	57
20	17	19	11	9	11	46	113
$\bar{x}$	11.15	17.65	9.35	13.95	11.50	32.40	96.00
S.D.	5.58	5.94	3.07	3.51	1.24	14.62	28.77

WAIS DATA (SCHOOL A)

DSY-Digit Symbol

PC-Picture Completion

BD-Block Design

PA-Picture Arrangement

OA-Object Assembly

TPS-Total Performance Score

Student	DSY	PC	BD	PA	OA	TPS
1	71	16	34	32	27	180
2	67	16	36	27	33	179
3	54	9	24	23	31	141
4	37	8	30	16	36	127
5	47	9	26	22	39	143
6	53	15	24	22	16	130
7	53	5	26	20	30	134
8	64	10	28	12	19	133
9	77	6	16	13	25	137
10	56	10	29	22	29	146
11	65	12	30	14	24	145
12	48	16	43	28	39	174
13	60	13	26	22	27	148
14	67	13	36	22	24	162
15	60	13	30	22	36	161
16	65	12	36	26	32	171
17	72	11	29	18	27	157
18	61	10	43	26	40	180
19	43	12	24	10	22	111
20	60	15	28	27	20	150
$\bar{x}$	59.00	11.55	29.90	21.20	28.80	150.45
S.D.	9.95	3.14	6.42	5.71	6.80	19.11

WAIS DATA (SCHOOL A)

WFRS-WAIS Full Scale Raw Scores

WPSI.Q.-WAIS Performance Scale I.Q.'s

WVSI.Q.-WAIS Verbal Scale I.Q.'s

WFSI.Q.-WAIS Full Scale I.Q.'s

Student	WFRS	WVSI.Q.	WPSI.Q.	WFSI.Q.
1	344	133	111	125
2	301	116	109	114
3	196	82	94	86
4	200	89	91	89
5	207	91	96	93
6	210	95	91	93
7	210	94	90	92
8	218	98	90	94
9	238	100	92	97
10	234	97	95	96
11	233	99	92	96
12	240	88	112	98
13	251	105	95	101
14	261	105	100	103
15	258	104	102	103
16	277	108	107	108
17	305	121	99	112
18	315	117	111	115
19	168	88	83	85
20	263	105	99	103
$\bar{x}$	246.45	101.75	97.95	100.15
S.D.	43.89	12.36	8.12	10.16

WAIS DATA (SCHOOL B)

I-Information S-Similarities TVRS-Total Verbal Raw Score

C-Comprehension DSP-Digit Span

A-Arithmetic V-Vocabulary

Student	I	C	A	S	DSP	V	TVRS
1	9	15	8	14	8	23	77
2	4	22	7	8	9	27	77
3	4	15	7	14	12	21	73
4	7	12	7	9	12	13	60
5	6	20	6	9	11	25	77
6	10	16	9	10	14	32	91
7	9	16	9	12	13	19	78
8	12	21	8	12	10	32	95
9	7	16	7	11	11	15	67
10	8	8	4	6	10	23	59
11	21	24	9	18	12	46	130
12	16	14	11	17	15	42	115
13	15	24	8	17	10	45	119
14	9	15	10	13	10	25	82
15	10	12	14	7	11	27	81
16	12	14	14	8	14	19	81
17	16	20	11	17	11	39	114
18	17	23	9	13	12	45	119
19	20	27	13	20	15	63	158
20	20	28	14	20	10	41	133
$\bar{x}$	11.60	18.10	9.25	12.75	11.50	31.10	94.30
S.D.	5.18	5.26	2.75	4.21	1.88	12.51	26.62

WAIS DATA (SCHOOL B)

DSY-Digit Symbol

PC-Picture Completion

BD-Block Design

PA-Picture Arrangement

OA-Object Assembly

TPS-Total Performance Score

Student	DSY	PC	BD	PA	OA	TPS
1	55	7	28	26	36	152
2	55	9	34	18	27	143
3	51	9	20	20	31	131
4	42	11	28	20	30	131
5	34	10	24	24	26	118
6	50	13	24	22	14	123
7	49	11	29	30	34	153
8	53	12	28	14	30	137
9	38	4	10	22	21	95
10	57	8	20	14	34	123
11	51	13	28	26	27	145
12	50	12	25	32	35	154
13	46	14	28	18	25	131
14	73	13	33	23	36	178
15	67	14	24	25	36	166
16	57	12	26	28	29	152
17	65	14	42	23	43	187
18	81	14	34	24	34	187
19	65	17	36	19	44	181
20	42	12	37	12	29	132
$\bar{x}$	54.05	11.45	27.90	22.00	31.05	145.95
S.D.	11.41	2.89	6.90	5.14	6.79	24.08

WAIS DATA (SCHOOL B)

WFRS-WAIS Full Scale Raw Scores

WPSI.Q.-WAIS Performance Scale I.Q.'s

WVSI.Q.-WAIS Verbal Scale I.Q.'s

WFSI.Q.-WAIS Full Scale I.Q.'s

Student	WFRS	WVSI.Q.	WPSI.Q.	WFSI.Q.
1	229	92	99	94
2	220	93	92	92
3	204	93	90	91
4	191	89	95	91
5	195	94	87	90
6	214	100	86	94
7	231	96	102	99
8	232	100	92	97
9	162	92	75	84
10	182	83	89	84
11	275	115	96	108
12	269	110	103	108
13	250	109	92	102
14	260	96	109	102
15	247	97	104	100
16	233	101	99	100
17	301	108	117	113
18	306	110	112	112
19	339	130	116	125
20	265	121	92	109
$\bar{x}$	240.25	101.45	97.35	99.75
S.D.	43.40	11.36	10.41	10.18

WAIS DATA (SCHOOL C)

I-Information S-Similarities TVRS-Total Verbal Raw Score

C-Comprehension DSP-Digit Span

A-Arithmetic V-Vocabulary

Student	I	C	A	S	DSP	V	TVRS
1	6	20	5	4	15	15	65
2	6	12	5	4	10	17	54
3	6	15	5	6	9	16	57
4	6	14	10	7	7	10	54
5	7	13	9	11	11	15	66
6	4	17	5	15	12	20	73
7	11	18	7	8	9	25	78
8	8	18	5	10	8	20	95
9	6	16	12	11	10	23	78
10	5	18	8	13	13	17	74
11	9	16	12	12	14	26	89
12	12	20	11	11	11	29	94
13	11	26	8	11	11	35	102
14	7	19	13	10	13	41	103
15	14	14	11	11	10	19	79
16	10	16	10	17	12	21	86
17	10	27	14	21	13	32	117
18	12	18	15	19	15	27	106
19	18	26	12	16	11	44	127
20	4	8	4	4	8	11	39
$\bar{x}$	8.60	17.55	9.05	11.05	11.10	23.15	81.80
S.D.	3.54	4.63	3.35	4.72	2.23	9.10	22.16

WAIS DATA (SCHOOL C)

DSY-Digit Symbol

PC-Picture Completion

BD-Block Design

PA-Picture Arrangement

OA-Object Assembly

TPS-Total Performance Score

Student	DSY	PC	BD	PA	OA	TPS
1	37	6	8	16	20	87
2	44	6	22	26	14	112
3	38	12	28	14	31	123
4	62	6	24	8	20	120
5	45	8	25	14	37	129
6	74	3	18	10	25	130
7	60	6	16	20	27	129
8	35	12	24	18	24	113
9	69	7	20	16	20	132
10	44	9	43	18	32	146
11	50	10	20	27	31	138
12	56	12	29	14	23	134
13	55	10	28	22	11	126
14	51	11	24	22	26	134
15	81	10	35	20	33	179
16	61	12	25	28	32	158
17	54	17	32	24	33	160
18	90	14	37	30	24	195
19	70	17	42	29	37	195
20	35	5	26	12	14	92
$\bar{x}$	55.55	9.65	26.30	19.40	25.70	136.60
S.D.	15.14	3.75	8.33	6.34	7.42	28.37

WAIS DATA (SCHOOL C)

WFRS-WAIS Full Scale Raw Scores

WPSI.Q.-WAIS Performance Scale I.Q.'s

WVSI.Q.-WAIS Verbal Scale I.Q.'s

WFSI.Q.-WAIS Full Scale I.Q.'s

Student	WFRS	WVSI.Q.	WPSI.Q.	WFSI.Q.
1	152	92	74	83
2	166	82	83	81
3	180	83	90	85
4	174	82	82	81
5	195	91	91	90
6	203	93	85	88
7	207	92	87	89
8	208	87	86	86
9	210	95	87	91
10	220	94	96	95
11	227	103	94	99
12	228	102	90	97
13	228	106	89	99
14	237	104	90	98
15	258	96	108	102
16	244	99	102	100
17	277	119	104	113
18	301	113	115	115
19	322	116	119	118
20	131	74	75	73
$\bar{x}$	218.40	96.15	92.35	94.15
S.D.	46.45	11.55	11.67	11.58

PPVT TEST DATA (SCHOOL A)

Student	PPVT Raw Scores	PPVT I.Q.'s
1	137	137
2	104	95
3	93	87
4	83	77
5	90	84
6	104	85
7	92	86
8	99	94
9	98	89
10	91	82
11	103	94
12	94	88
13	108	103
14	96	87
15	105	100
16	97	88
17	131	122
18	127	123
19	128	119
20	101	92
$\bar{x}$	104.05	96.6
S.D.	14.65	15.75

PPVT TEST DATA (SCHOOL B)

Student	PPVT Raw Scores	PPVT I.Q.'s
1	90	84
2	92	83
3	83	74
4	90	81
5	94	88
6	108	103
7	117	108
8	99	94
9	78	71
10	101	92
11	111	106
12	99	90
13	121	112
14	99	94
15	96	90
16	94	88
17	113	104
18	117	113
19	133	130
20	102	97
$\bar{x}$	101.85	95.10
S.D.	13.28	13.98

PPVT TEST DATA (SCHOOL C)

Student	PPVT Raw Scores	PPVT I.Q.'s
1	87	81
2	91	82
3	105	100
4	79	72
5	88	82
6	81	74
7	105	100
8	89	80
9	89	83
10	96	87
11	99	94
12	103	98
13	99	94
14	103	98
15	85	79
16	92	83
17	116	107
18	97	91
19	112	107
20	84	75
$\bar{x}$	95.00	88.35
S.D.	9.94	10.55

PROGRAM FOR COEFFICIENT OF CORRELATION

```
 1 Format (4F5.0, 11F4.0)
 2 Format (I3, 4F6.3, 11F5.2)
 3 Format (I3, 4F7.2, 11F6.2)
 4 Format (I3, F4.0)
   Dimension   X(3,15)
   Read (1,4) N, XN
   Do 6J = 1,15
   X(2,J) = 0.0
 6 X(3,J) = 0.0
   Do 8I = 1,N
   Read (1,1) (X(1,L),L = 1,15)
   Do 7J = 1,15
   X(2,J) = X(2,J) + X(1,J)
 7 X(3,J) = X(3,J) + X(1,J)*X(1,J)
 8 Write (3,3) I, (X(1,L),L = 1,15)
   Do 9J = 1,15
   X(2,J) = X(2,J)/XN
   X(3,J) = (X(3,J)/XN)-(X(2,J)*X(2,J))
 9 X(3,J) = X(3,J)**0.5
   Write (3,3) I, (X(2,L),L=1,15)
   Write (3,3) I, (X(3,L),L=1,15)
   Dimension CC(14,15)
20 Format (I3,I3,F10,5)
   Do 10J = 1,14
   Do 11 K=1,15
11 CC(J,K)=0.0
10 Continue
   Do 12 I=1,N
   Read (1,1)(X(1,L),L=1,15)
   Do 13J=1,15
13 X(1,J)=(X(1,J)-X(2,J))/X(3,J)
   Write (3,2) I, (X(1,L),L=1,15)
   Do 14 J=1,14
   M=J+1
   Do 15 K=M,15
15 CC (J,K)=CC(J,K)+X(1,J)*X(1,K)
14 Continue
12 Continue
   Do 16J=1,14
   M=J+1
   Do 17 K=M,15
   CC(J,K)=CC(J,K)/XN
17 Write (3,20) J,K,CC(J,K)
16 Continue
   Stop
   End
```

VITA

Mary Winstead Bonner

Candidate for the Degree of

Doctor of Education

Thesis: A COMPARATIVE STUDY OF THE PERFORMANCE OF NEGRO SENIORS OF OKLAHOMA CITY HIGH SCHOOLS ON THE WECHSLER ADULT INTELLIGENCE SCALE AND THE PEABODY PICTURE VOCABULARY TEST

Major Field: Elementary Education

Area of Specialization: Reading

Biographical:

Personal Data: Born in Nash County, North Carolina, April 20, 1924, the daughter of Charles and Mason Winstead.

Education: Attended public schools in Rocky Mount, North Carolina, Brooklyn, New York, New York City, and Emporia, Virginia; graduated from Greensville County Training School (now E. W. Wyatt High School) in 1942; received the Bachelor of Science degree from St. Paul's College in Lawrenceville, Virginia in 1946 with a major in elementary education; received the Master of Science degree from Virginia State College, Petersburg, Virginia in 1952 with a major in elementary education; attended Oklahoma State University, Stillwater, Oklahoma from June 1964, until May 1968.

Professional Experience: Was a teacher-principal at the Diamond Grove School (three room) in Greensville County, Virginia from 1946-1952; taught grades five, six and seven; was a supervising teacher at the Southern University Laboratory School Baton Rouge, Louisiana from 1952-1957; was a teacher in the St. Louis Public Schools from 1957-1964; was a supervising teacher and assistant professor of education at the Butcher Children's School, Kansas State Teachers College, Emporia, Kansas from 1964-1966; served as graduate assistant at Oklahoma State University, Stillwater, Oklahoma during the 1965 and 1966 summer sessions; completed requirements for the Doctor of Education Degree at Oklahoma State University in May, 1968.