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An abbreviated form of the Wechsler Intelligence Scale for children

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AN ABBREVIATED FORM OF THE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

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CHAPTER I

INTRODUCTION

Educators have become increasingly aware of the individual needs of children in the present educational situation. Recent years have seen the introduction of a great many programs for children of both superior and retarded intellectual development. One of the more pressing problems to be met in the establishment of specialized programs is the lack of a method of rapid and reliable identification of children who are in need of individualized educational programs. This is the problem with which this study is concerned.

I. THE PROBLEM

Statement of the problem. It is the purpose of this study to develop an abbreviated form of the Wechsler Intelligence Scale for Children which can, with satisfactory reliability, identify the child of superior, normal, or retarded intellectual development.

Justification of the problem. As mentioned in the introductory paragraph there is a pressing need for an abbreviated psychometric device which can identify the child of superior, normal, or retarded intelligence. The need is intensified by the ever increasing number of school age children in the society as well as a noticeable shortage of

practicing school psychologists and school psychometrists.

On October 31, 1960, the State of California had 4,020,295 pupils enrolled in its public schools. The Credentials Devision of the California State Department of Education had issued 785 Pupil Personnel credentials authorizing the holders to function as school psychometrists or school psychologists. Assuming that none of the credentials issued were renewals and that all of the people to whom credentials were issued were employed full time in California public schools, the ratio of public school pupils to psychometrists and psychologists was 5,121 to 1. An effective abbreviated form of the Wechsler Intelligence Scale for Children would increase the services provided by the school psychometrist and the school psychologist.[1]

Researchers Carelton and Stacey[2], Yalowitz and Armstrong[3],

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[1]The data presented in this paragraph were gained by means of a personal interview with William H. McCreary, Division of Educational Research, California State Department of Education, Sacramento, California, January, 1961.

[2]F. O. Carelton, and C. L. Stacey, "Evaluation of Selected Short Forms of the Wechsler Intelligence Scale for Children," Journal of Clinical Psychology, 10:258-261, 1955.

[3]J. M. Yalowitz, and Renate G. Armstrong, "Validity of Short Forms of the Wechsler Intelligence Scale for Children," Journal of Clinical Psychology, 11:275-277, 1955.

and Armstrong[4], have developed various abbreviated forms of the Wechsler Intelligence Scale for Children. However, the nature of their sampling has made the research of limited value to the educator. There is, therefore, a need for further research to develop an abbreviated form of the Wechsler Intelligence Scale for Children in which the sampling is more in accord with the general population found in schools.

Limitations of the study. This study is limited by the following circumstances; (1) the standardization sample used by Wechsler in the development of the Wechsler Intelligence Scale for Children was classified as 60.3 per cent urban, 37.2 per cent rural, and 2.5 per cent undetermined.[5] The sample used in this study was classified as approximately 71 per cent urban and 29 per cent rural: (2) the present sample was limited to children from age six through year twelve, whereas Wechsler's sample included children whose ages ranged from five years through fifteen years: (3) the sample used by Wechsler was representative of geographic areas determined by the percentage of population in the 1940 United States Census.

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[4]Renate G. Armstrong, "A Reliability Study of a Short Form of the Wechsler Intelligence Scale for Children Vocabulary Subtest," Journal of Clinical Psychology, 11:413-414, 1955.

[5]David Wechsler, Wechsler Intelligence Scale for Children (New York: Psychological Corporation, 1949), p. 8.

The geographic area sampled in the present study was restricted to one rather representative district of approximately 80 square miles in the Central Valley of California.

II. DEFINITIONS OF THE TERMS USED

Superior intelligence. A child receiving a Full Scale Wechsler Intelligence Scale for Children quotient within the range of 120 to 154 shall be classified as one of superior intelligence for the purpose of this study.[6]

Normal intelligence. A child receiving a Full Scale Wechsler Intelligence Scale for Children quotient within the range of 80 to 119 shall be classified as one of normal intelligence for the purpose of this study.[7]

Retarded intelligence. A child receiving a Full Scale Wechsler Intelligence Scale for Children quotient within the range of 46 to 79 shall be classified as one of retarded intelligence for the purpose of this study.[8]

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[6]Weighted scores were obtained in the usual manner as described in the Wechsler manual. David Wechsler, Wechsler Intelligence Scale for Children (New York: Psychological Corporation, 1949), p. 26.

[7]Ibid., p. 26.

[8]Ibid., p. 26.

Elementary school child. A male or female Caucasian child whose chronological age is within the range of year six to year twelve, eleven months, and who is presently enrolled in a public school shall be classified as an elementary school child for the purpose of this study.

Description of the Wechsler Intelligence Scale for Children. The Wechsler Intelligence Scale for Children grew from the Wechsler Bellevue Intelligence Scales used with adolescents and adults. Many of the items found in the Wechsler Intelligence Scale for Children are, in actuality, items from the Wechsler Bellevue Intelligence Scale, Form II. In addition, Wechsler added items of a lesser difficulty to the lower ranges of each subtest to make the subtest applicable to a population as young as five years. The Wechsler Intelligence Scale for Children was standardized during a five year period using 2,200 children, 1,100 boys and 1,100 girls. The sample was selected to include one hundred boys and one hundred girls at each year level from five years through fifteen years.

The source of the criteria used to determine the geographical area, population ratio, the urban-rural population ratio, and the occupational percentage ratio in establishing the sampling was the 1940 United States Census.

Wechsler, using a sample of one hundred boys and one hundred girls at each of three chronological ages, 7.5 years,

10.5 years, and 13.5 years, established the following reliability coefficients using the split-half technique with correction for the full test by the Spearman-Brown formula:[9]

Age	Verbal Score	Performance Score	Full Scale Score
7.5 years	r = .88	r = .86	r = .92
10.5 years	r = .96	r = .89	r = .95
13.5 years	r = .96	r = .90	r = .94

The Wechsler Intelligence Scale for Children consists of twelve subtests. Six subtests: Information, Comprehension, Arithmetic, Similarities, Vocabulary, and Digit Span constitute the Verbal Scale. The Digit Span subtest is not included in this study. Six subtests: Picture Completion, Picture Arrangement, Block Design, Object Assembly, Coding, and Mazes constitute the Performance Scale. The Mazes subtest is not included in this study. David Wechsler describes the areas measured by the subtests as follows:

"1. Information: Information from experience and education.

2. Comprehension: Practical knowledge and social judgement.

3. Arithmetic: Concentration and arithmetic reasoning.

4. Similarities: Logical and abstract thinking ability.

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[9]David Wechsler, Wechsler Intelligence Scale for Children (New York: Psychological Corporation, 1949), p. 13.

5. Vocabulary: Word knowledge from experience and education.

6. Digit Span: Attention and rote memory.

7. Picture Completion: Visual alertness and visual memory.

8. Picture Arrangement: Interpretations of social situations.

9. Block Design: Analysis and formation of abstract design.

10. Object Assembly: Putting together of concrete forms.

11. Coding: Speed of learning and writing symbols.

12. Mazes: Planning and following a visual pattern."[10]

The five Verbal subtest used in this study involve education, past experience, generalization, abstract and logical thinking, and conceptual mental functions. The administration of the Verbal subtests and the subject's responses are largely dependent upon verbal communication. The five Performance subtests used in this study are dependent upon the manual manipulation of concrete objects, with the exception of Picture Completion and Coding which are largely dependent upon perceptual skills. The scoring system used by David Wechsler is best described in the following manner: An independent score reflective of a child's success on each subtest is

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[10]David Wechsler, "Wechsler Intelligence Scale for Children Examination Report With Profile," Journal of Consulting Psychology, 382, October, 1951.

assigned to each subtest performance. The scores range from zero to twenty and are equated or z scores. A child's scaled score on one subtest can be compared directly with the scaled score received on any other one subtest.

III. A PREVIEW

The organization of the remainder of the dissertation. Chapter II is a presentation of pertinent studies which are to be found in the literature. Chapter III deals with the source of the data used in this study as well as the presentation of the research design and the statistical techniques applied to the problem.

Chapter IV deals with the results of the study. The mean chronological age, the mean grade placement, the mean, the standard deviation, the standard error of the mean of each of the ten Wechsler Intelligence Scale for Children subtests, the Verbal I.Q., the Performance I.Q., and the Full Scale I.Q. for each of the three subgroups and for the total sample will be found in this chapter. The chapter will include the Pearson product moment reliability coefficient of each of the ten subtests, the Verbal I.Q., and the Performance I.Q. with the Full Scale I.Q. for each of the three subgroups as well as the total sample.

A discussion of the ability of the subtests of the Wechsler Intelligence Scale for Children to discriminate

between children of superior, normal, and retarded intellect will be presented.

In addition, the chapter will include the Pearson product moment reliability coefficient of the abbreviated Wechsler Intelligence Scale for Children applied to the superior group, the normal group, and the retarded group.

Chapter V includes a restatement of the findings as expressed in previous chapters, a statement of the conclusions of the study, and recommendations for further study in the field.

The Appendix presents an explanation of work sheets designed to meet the needs of this study.

CHAPTER II

REVIEW OF THE LITERATURE

I. A REVIEW OF PREVIOUS INVESTIGATIONS

There have been, in the past, two studies which directly dealt with an abbreviated form of the Wechsler Intelligence Scale for Children. A third study dealt solely with the abbreviation of the Vocabulary subtest, which is a part of the Wechsler Intelligence Scale for Children.

Carelton and Stacey, in their study, dealt with 365 children whose ages ranged from 7 years to 16 years and whose mean chronological age was 12.25 years. The I.Q.'s of the children constituting the sample ranged from 46 to 91 with a Mean I.Q. of 67.82. The 365 children had been referred to the Syracuse State School as suspected mentally retarded children. In this study Carelton and Stacey introduced several different combinations of subtests reporting the correlation of these selected combinations with the Full Scale I.Q. reported for each child. They found that a combination of the Coding, Arithmetic, Block Design, Comprehension, and Picture Completion subtests rendered a reliability coefficient of .88. They found that a combination of Comprehension, Arithmetic, Similarities, Digit Span, and Picture Arrangement also provided a reliability coefficient of .88. A combination of Information, Picture Completion, Picture Arrangement, and Coding subtests

rendered a reliability coefficient of .88. The combination of Comprehension, Arithmetic, Block Design, and Coding rendered a reliability coefficient of .86. The combination of the Comprehension, Similarities, Digit Span, and Block Design subtests provided a reliability coefficient of .86. A combination of the Comprehension, Vocabulary, Block Design, and Picture Completion subtests rendered a reliability coefficient of .85. They found that when they combined the Information, Block Design, Similarities, and Vocabulary subtests the correlation coefficient of reliability fell to .82. On the basis of their study they recommended, for consideration, the use of either the combination of Comprehension, Arithmetic, Similarities, Digit Span, and Picture Arrangement subtests, or the combination of the Comprehension, Arithmetic, Block Design, Coding, and Picture Completion subtests, as an abbreviated form of the Wechsler Intelligence Scale for Children.[11]

Yalowitz and Armstrong administered a Wechsler Intelligence Scale for Children to 229 children who had been referred to the Rock Island County Guidance Conference. Fifty per cent of the children were referred for personality problems; 50 per cent were referred as school problems and

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[11]F. O. Carelton, and C. L. Stacey, "Evaluation of Selected Short Forms of the Wechsler Intelligence Scale for Children," Journal of Clinical Psychology, 11:275-277, 1955.

learning problems. The children used in this study ranged in age from five years, two months, to fifteen years, eleven months. The mean age of the group was ten years, five months. The children's I.Q. ranged from 51 to 143. The mean Full Scale I.Q. was 96.26. In this study the investigators found that the Vocabulary, Information, Similarities, Picture Arrangement, Object Assembly, and Block Design subtests had the highest correlation coefficient with the Full Scale I.Q. and the lowest mean deviations. Yalowitz and Armstrong reported the results of their design of three possible combinations of the Wechsler subtests to produce an abbreviated form. In their first suggested abbreviated form they combined the Information, Similarities, Vocabulary, Picture Arrangement, and Block Design subtests. This abbreviated form correlated with the Full Scale intelligence quotient with a reliability coefficient of .55. Secondly, they suggested the combination of the Information, Vocabulary, Block Design, and Picture Arrangement subtests. This abbreviated form correlated with the Full Scale I.Q. with a reliability coefficient of .57. Their third suggested abbreviated form was the combination of the Information, Arithmetic, Vocabulary, Picture Arrangement, and Block Design subtests. This abbreviated form correlated with the Full Scale I.Q. with a reliability coefficient of .61. It was the opinion of these researchers that an abbreviated form of the Wechsler Intelligence Scale for Children was not

feasible.[12]

Armstrong, in his study at East Moline State Hospital, investigated the possibility of shortening the Vocabulary subtest of the Wechsler Intelligence Scale for Children. The sampling consisted of two hundred children, one hundred boys and one hundred girls. The ages of the sampling ranged from five years to fourteen years, eleven months. Armstrong divided the sample into ten age groups with ten boys and ten girls in each group. In comparing the scores obtained on the even numbered words and the odd numbered words with the Full Scale Score he found a range of Pearson product moment correlation coefficients from .87 to .96 in the ten age groups and a Pearson product moment correlation coefficient of .94 for the total group. As a result of the study, Armstrong suggested the use of the shortened Vocabulary subtest as an indication of the Wechsler Intelligence Scale for Children Full Scale Intelligence Quotient.[13]

While there have only been three researches directly related to the Wechsler Intelligence Scale for Children, there

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[12]J. M. Yalowitz, and Renate G. Armstrong, "Validity of Short Forms of the Wechsler Intelligence Scale for Children," Journal of Clinical Psychology, 11:275-277, 1955.

[13]Renate G. Armstrong, "A Reliability Study of a Short Form of the Wechsler Intelligence Scale for Children Vocabulary Subtest," Journal of Clinical Psychology, 11:413-414, 1955.

has been an abundance of research concerning short forms of other Wechsler Intelligence Tests. Although the following studies did not directly relate to the present investigation, it is well to realize that researchers have long seen the need for abbreviated forms of the present Wechsler Intelligence Scales.

Rabin applied a short form of the Wechsler Bellevue Intelligence Scale consisting of the Comprehension, Arithmetic, and Similarities subtests to 92 nurses whose ages ranged from 19 to 25 and whose Full Scale I.Q.'s ranged from 85 to 131, and to 200 patients of the New Hampshire State Hospital. The ages of the patients ranged from 15 to 36 and the Full Scale I.Q. range was from 39 to 122. Rabin found a Pearson product moment correlation coefficient of .80 between the Comprehension, Arithmetic, and Similarities, and the Full Scale I.Q. with the nurse sampling. He found a Pearson product moment correlation coefficient of .956 with the patient group.[14]

In a study of an abbreviated Wechsler Bellevue Scale applied to 250 unselected prisoners in Springfield, Missouri, Geil found that a combination of the Comprehension, Similarities, Digit Symbols, and Block Design subtests rendered a

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[14]A. I. Rabin, "A Short Form of the Wechsler Bellevue Test," Journal of Applied Psychology, 27:320-04, August, 1943.

Pearson product moment correlation coefficient of .966 with the Full Scale I.Q.[15]

Springer applied Rabin's Short Form, consisting of Comprehension, Arithmetic, and Similarities, to one hundred reportedly mentally retarded naval personnel whose ages ranged from twenty to twenty-four. He found that the Comprehension, Arithmetic, and Similarities subtests rendered the following correlation coefficients with the Verbal Scale I.Q. of .80 and the Full Scale I.Q. of .92.[16]

Gurvitz applied a short form consisting of the Digit Span and Picture Arrangement subtest to 523 prisoners. The I.Q. range of the group was 42 to 146; however, slightly less than 40 per cent of the sample fell within the mental retardation classification. The author found a Pearson product moment correlation coefficient of .90 between the combination of Digit Span and Picture Arrangement and the Full Scale I.Q.[17]

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[15] G. A. Geil, "A Clinically Useful Abbreviated Wechsler Bellevue Scale," Journal of Clinical Psychology, 20:101-08, July, 1945.

[16] N. N. Springer, "Short Form of the Wechsler Bellevue Test Applied to Naval Personnel," American Journal of Orthopsychiatry, 16:341-04, April, 1946.

[17] M. S. Gurvitz, "An Alternate Short Form of the Wechsler Bellevue Test," American Journal of Orthopsychiatry, 15:727-32, October, 1945.

Patterson, in his study of fifty closed ward psychiatric patients whose Full Scale I.Q. ranged from 51 to 116 and whose mean I.Q. was 77, found success with two abbreviated forms of the Wechsler Bellevue Intelligence Scale. The combination of the Vocabulary, Comprehension, Block Design, and Picture Completion subtests rendered a Pearson product moment correlation coefficient of .962 with the Full Scale I.Q. The combination of the Vocabulary, Comprehension, and Digit Symbol subtests rendered a Pearson product moment correlation coefficient of .934 with the Full Scale I.Q.[18]

Doppelt developed a short form of the Wechsler Adult Intelligence Scale consisting of the Arithmetic, Vocabulary, Block Design, and Picture Arrangement subtests. The short form was applied to the same national sampling used by Wechsler in the standardization of the Wechsler Adult Intelligence Scale. The reliability coefficient between the Doppelt Short Form and the Wechsler Adult Intelligence Scale was .96.[19]

Olim and Reznihoff applied the Doppelt Short Form to 107 psychiatric patients who were institutionalized at the

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[18] C. H. Patterson, "A Comparison of Various Short Forms of the Wechsler Bellevue Test," Journal of Consulting Psychology, 10:260-07, September-October, 1946.

[19] J. E. Doppelt, "Estimating the Full Scale Score on the Wechsler Adult Intelligence Scale from Scores on Four Subtests," Journal of Consulting Psychology, 20:63-66, 1956.

time of their study. The mean chronological age of the sample was 36.5 years with a range from 16 years to 69 years. The mean Wechsler Adult Intelligence Scale I.Q. was 108 with a range from 78 to 136. The reliability coefficient between the Wechsler Adult Intelligence Scale and the Doppelt Short Form was .925.[20]

Himelstein applied the Doppelt Short Form to fifty institutionalized psychiatric patients. The sample included thirty-five Caucasians and fifteen Negroes. The mean chronological age of the sample was 26.1 years. The chronological age range was from year 22 to year 63. The mean I.Q. received using the Wechsler Adult Intelligence Scale was 85.6. The mean I.Q. received using the Doppelt Short Form was 87.2. Himelstein's study established a reliability coefficient of .956 between the Full Scale Wechsler Adult Intelligence Scale and the Doppelt Short Form.[21]

This chapter has presented a review of literature directly and indirectly related to the present study. The literature directly related to the study was of limited value

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[20]T.D. Olim, and Marvin Reznihoff, "Use of Doppelt's Short Form of the Wechsler Adult Intelligence Scale with Psychiatric Patients," Journal of Consulting Psychology, 21:27-28, 1957.

[21]Philip Himelstein, "Evaluation of an Abbreviated Wechsler Adult Intelligence Scale in a Psychiatric Population," Journal of Clinical Psychology, 13:68-69, 1957.

on account of the uniqueness of the samplings upon which the studies were conducted.

The study conducted by Yalowitz and Armstrong was based upon a sampling of 229 children who had been referred as children with personality, behavior, or learning problems.[22]

Carelton and Stacey based their study upon a sample of 365 children who had been referred as suspected mental retardates.[23]

It is felt that it would be exceedingly unwise to apply the results of either study to a normal population.

The inclusion of those studies indirectly related to the present study were of value as they established the concern of researchers in developing abbreviated forms of other Wechsler Intelligence Scales.

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[22]J. M. Yalowitz, and Renate G. Armstrong, "Validity of Short Forms of the Wechsler Intelligence Scale for Children," Journal of Clinical Psychology, 11:275-277, 1955.

[23]F. O. Carelton, and C. L. Stacey, "Evaluation of Selected Short Forms of the Wechsler Intelligence Scale for Children," Journal of Clinical Psychology, 10:258-261, 1955.

CHAPTER III

THE PROCEDURE APPLIED TO THE PROBLEM

I. A STATEMENT OF THE SOURCE OF THE DATA

The cumulative records of several hundred elementary school children in the Rio Linda Union School District were reviewed to develop the sampling used in this study. The following criteria were used to determine the children who would constitute the final sample of 300 children:

1. The final sample would consist of 150 males and 150 females.

2. The final sample would consist of 300 children whose chronological ages ranged from six years up to and including twelve years. Each of the seven age levels in each of the three subgroups would contain approximately fourteen children, seven males and seven females.

3. The final sample would consist, as nearly as possible, of an equal number of males and females from each of the six grade levels from first through sixth inclusively.

4. The final sample would consist, as nearly as possible, of an equal number of children at equal ages and grade placement from each of the twelve schools within the school district.

5. Any child suspected of being, or classified as being, emotionally disturbed or physically handicapped could not be included in the sampling.

6. The sample would be restricted to Caucasian children in whose homes English was the only spoken language.

7. The final sample would consist of fifty males and fifty females in each of the following Full Scale Intelligence quotient ranges: (1) 46-79; (2) 80-119; (3) 120-154. The California Tests of Mental Maturity would be used

as a screening device prior to the administration of the Wechsler Intelligence Scale for Children.

On the basis of the above criteria, 300 children were chosen to constitute the sampling used in this study. At the time of this study there were 6,900 children enrolled in the Rio Linda Union School District. The sample of 300 children represented 4.35 per cent of the school districts' total pupil population. The size of the sample was determined on the basis of the difference in a t score which would be significant at the 5 per cent and the 1 per cent level for a universe and an arbitrarily chosen sample. The difference in t scores significant at the 5 per cent level for a sample of 300 and a universe is .008. The difference in t scores significant at the 1 per cent level between a sample of 300 and a universe is .025.

It was felt that a sample of 300 children would render representative data which would meet the needs of this study.

The sample was stratified with respect to sex, age, and grade level in an effort to make the sample as representative of the total school district as possible.

The total sample was selected in equal numbers from each of the schools within the district in an effort to maintain a representative urban-rural balance.

The selection of the individual child who met all criteria was on a chance basis. A table of random numbers

was not used. Each child who met the criteria had an equal opportunity to be included in the sample by the chance selection of his cumulative folder.

The children included in this study reside within the Rio Linda Union School District which is located ten miles northeast of the city of Sacramento, California. In 1950, the school district was classified as a rural district. There was one school in the district with a total pupil population of 765 children. The total district population in 1950 was 4,215.

The districts' growth is related to the growth of McClellan Air Force Base which lies within the school district. There were, at the time of this study, 14,500 civilian employees and 5,000 military personnel attached to the base. The annual payroll at McClellan Air Force Base is $103,300,00.00. A majority of the civilian employees reside within the Rio Linda Union School District. The military dependent children living on the base attend school in the Rio Linda Union School District.

The school district has no major civilian industrial development however, McClellan Field, functioning in its present capacity, employs personnel in all of the trades found in an industrial community. The school districts' population, at the time of this study, was 38,025. There were 6,900 children enrolled in the twelve schools within the district.

Approximately 71 per cent of the population resides in the urban and suburban area and approximately 29 per cent of the population resides in the rural area. The rural area is dependent upon poultry production, dairy farming, and general agriculture.

The occupational classification of the fathers of the children included in the sample was approximately the same as the 1950 United States Census with the exception of a slightly larger percentage of parents falling in the professional and semi-professional classifications. It was felt that the trimodality of the total sample, which resulted from the combination of three separate groups, was responsible for this slight deviation in the occupations of the fathers.[24]

II. AN EXPLANATION OF THE PROCEDURE USED

A sample of 300 children who met the above criteria was divided into three groups of one hundred on the basis of the Full Scale Wechsler Intelligence Scale for Children I.Q. The first group's I.Q. ranged from 46-79; the second group's I.Q.'s ranged from 80-119; and the third group's I.Q.'s ranged from 120-154.

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[24]The statistics included in the description of the Rio Linda Union School District were gained through an interview with Mr. J. Jay Walton, a representative of the Sacramento City-County Chamber of Commerce and the records of pupil population in the Rio Linda Union School District, January, 1961.

The test data were treated to determine the mean, standard deviation, and the standard error of the mean of each of the ten subtests; the Verbal I.Q., the Performance I.Q., and the Full Scale I.Q. for each of the three subgroups, and the total group.

Each of the ten subtests, the Verbal I.Q., the Performance I.Q., were then correlated with the Full Scale I.Q. in each of the three subgroups, and the total group.

The t tests were then calculated between each of the ten subtests, the Verbal I.Q., and the Performance I.Q., comparing the retarded group to the normal group, the normal group to the superior group, and the retarded group to the superior group.

Five of the ten subtests that constitute the usually administered Wechsler Intelligence Scale for Children were chosen to constitute the proposed abbreviated form on the basis of the following criteria:

1. A combination of five subtests which could be administered in thirty minutes or less.

2. A combination of five subtests which would provide the greatest amount of information of a broad academic nature which could be used by the classroom teacher.

3. A combination of five subtests which correlated highly with the Full Scale I.Q. of the normal group and met the above two criteria.

The five subtests chosen were Information, Arithmetic, Vocabulary, Picture Arrangement, and Block Design.

The possibility of applying the Wherry-Doolittle technique to determine the best fit was considered. However, there was reasonable doubt concerning the ability of this technique to select subtests that would meet the first two of the above three criteria.

The Total Scaled Score received by each child using the Abbreviated Form was doubled to give the Abbreviated Score a numerical value comparable with the Full Scale Total Scaled Score. The Abbreviated Scaled Score was converted into an I.Q. using the table of conversion established by Wechsler.[25]

The I.Q. received by using the Abbreviated Form was then correlated with the I.Q. received using the Full Scale. This correlation was accomplished by using the Pearson product moment technique. The correlation between the Abbreviated Form I.Q. and the Full Scale I.Q. was computed for each of the three subgroups, the superior, the normal, and the retarded.

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[25]David Wechsler, Wechsler Intelligence Scale for Children (New York: Psychological Corporation, 1949), p. 26.

CHAPTER IV

THE RESULTS OF THE STUDY

I. PRESENTATION OF THE DATA

Full Scale Intelligence Quotient. Table I presents information concerning the performance of the sample population in terms of the Full Scale I.Q.:

TABLE I

THE MEAN, THE STANDARD DEVIATION, AND THE STANDARD ERROR OF THE MEAN OF THE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

FULL SCALE INTELLIGENCE QUOTIENT	N	MEAN SCALED SCORE	S.D.	S.E. MEAN
Total	300	98.88	24.06	1.394
Superior	100	129.38	6.70	.670
Normal	100	98.95	13.16	1.320
Retarded	100	68.32	7.85	.786

The mean score of the normal group fell very near the expected mean score of 100. The mean score of the superior group was somewhat lower than expected and the mean score of the retarded group was somewhat higher than expected.

It was felt that the mean scores of the superior and retarded groups resulted from the fact that these two groups

consisted of near representative universes, whereas the normal group consisted of a representative sample.

The Standard Deviation of the total sample was influenced by the tri-modal distribution of the total sample.

Verbal Scale Intelligence Quotient. Table II presents information concerning the performance of the total sample in terms of the Verbal I.Q.:

TABLE II

THE MEAN, THE STANDARD DEVIATION, THE STANDARD ERROR OF THE MEAN, AND THE CORRELATION COEFFICIENT OF THE VERBAL SCALE INTELLIGENCE QUOTIENT WITH THE FULL SCALE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

VERBAL SCALE INTELLIGENCE QUOTIENT	N	MEAN SCALED SCORE	S.D.	S.E. MEAN	r
Total	300	98.29	25.53	1.442	.971
Superior	100	126.15	9.16	.917	.721
Normal	100	98.56	15.56	1.560	.928
Retarded	100	70.16	7.87	.788	.718

The correlation coefficient between the Verbal Scale I.Q. and the Full Scale I.Q. showed a very dependable relationship for the normal group and a marked relationship for the superior and retarded groups.

The t score obtained in comparison of the retarded to the normal was 16.51. The t score obtained in comparison of the normal to the superior was 15.24. The t score obtained in comparison of the retarded to the superior was 57.47.

Performance Scale Intelligence Quotient. Table III presents information concerning the performance of the total sample in terms of the Performance I.Q.:

TABLE III

THE MEAN, THE STANDARD DEVIATION, THE STANDARD ERROR OF THE MEAN, AND THE CORRELATION COEFFICIENT OF THE PERFORMANCE SCALE INTELLIGENCE QUOTIENT WITH THE FULL SCALE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

PERFORMANCE SCALE INTELLIGENCE QUOTIENT	N	MEAN SCALED SCORE	S.D.	S.E. MEAN	r
Total	300	99.70	24.88	1.442	.927
Superior	100	127.31	8.83	.884	.619
Normal	100	99.72	11.85	1.190	.661
Retarded	100	72.12	10.80	1.081	.833

The correlation coefficient between the Performance Scale I.Q. and the Full Scale I.Q. showed a marked relationship for the retarded group and a substantial relationship for the normal and superior groups.

The t score obtained in comparison of the retarded to

normal was 17.14. The t score obtained in comparison of the normal to superior was 18.64. The t score obtained in comparison of the retarded to superior was 39.28.

Information. Table IV presents data concerning the performance of the total sample in terms of the Information subtest:

TABLE IV

THE MEAN, THE STANDARD DEVIATION, THE STANDARD ERROR OF THE MEAN, AND THE CORRELATION COEFFICIENT OF THE INFORMATION SUBTEST WITH THE FULL SCALE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

INFORMATION SUBTEST	N	MEAN SCALED SCORE	S.D.	S.E. MEAN	r
Total	300	9.68	4.60	.266	.927
Superior	100	14.47	2.29	.230	.664
Normal	100	9.57	3.21	.322	.752
Retarded	100	4.97	1.62	.163	.537

The correlation coefficients between the Information subtest and the Full Scale I.Q. showed a substantial relationship for the superior and the retarded groups and a marked relationship was shown for the normal group.

The t score in comparison of the retarded group to the normal group was 12.74. The t score in comparison of the

normal group to the superior group was 12.37. The t score in comparison of the retarded group to the superior group was 33.69. The three t scores are significant at the 1 per cent level.

Comprehension. Table V presents data concerning the performance of the total sample in terms of the Comprehension subtest:

TABLE V

THE MEAN, THE STANDARD DEVIATION, THE STANDARD ERROR OF THE MEAN, AND THE CORRELATION COEFFICIENT OF THE COMPREHENSION SUBTEST WITH THE FULL SCALE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

COMPREHENSION SUBTEST	N	MEAN SCALED SCORE	S.D.	S.E. MEAN	r
Total	300	9.83	4.11	.238	.854
Superior	100	13.86	2.57	.258	.456
Normal	100	9.78	2.70	.271	.645
Retarded	100	5.84	2.17	.218	.454

There was a substantial relationship between the Comprehension subtest and the Full Scale I.Q. for the normal group however, the correlation coefficient for both the superior and the retarded group was in lower ranges of the moderate correlation classification.

The t score in comparison of the retarded group to the normal group was 10.72. The t score in comparison of the normal group to the superior group was 10.91. The t score in comparison of the retarded group to the superior group was 23.73. The three scores are significant at the 1 per cent level.

Arithmetic. Table VI presents data concerning the performance of the total sample in terms of the Arithmetic subtest:

TABLE VI

THE MEAN, THE STANDARD DEVIATION, THE STANDARD ERROR OF THE MEAN, AND THE CORRELATION COEFFICIENT OF THE ARITHMETIC SUBTEST WITH THE FULL SCALE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

ARITHMETIC SUBTEST	N	MEAN SCALED SCORE	S.D.	S.E. MEAN	r
Total	300	9.78	4.28	.248	.893
Superior	100	13.77	2.24	.225	.368
Normal	100	10.42	2.97	.298	.795
Retarded	100	5.14	1.85	.186	.444

The correlation coefficient between the Arithmetic subtest and the Full Scale I.Q. showed a marked relationship for the normal group. The correlation coefficients for the

superior and retarded groups showed a definite but small relationship.

The t score in comparison of the retarded group to the normal group was 15.04. The t score in comparison of the normal group to the superior group was 8.98. The t score in comparison of the retarded group to the superior group was 29.55. The three t scores are significant at the 1 per cent level.

Similarities. Table VII presents data concerning the performance of the total sample in terms of the Similarities subtest:

TABLE VII

THE MEAN, THE STANDARD DEVIATION, THE STANDARD ERROR OF THE MEAN, AND THE CORRELATION COEFFICIENT OF THE SIMILARITIES SUBTEST WITH THE FULL SCALE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

SIMILARITIES SUBTEST	N	MEAN SCALED SCORE	S.D.	S.E. MEAN	r
Total	300	9.83	4.53	.263	.690
Superior	100	14.48	2.41	.242	.337
Normal	100	9.00	3.17	.318	.665
Retarded	100	5.30	1.90	.191	.429

The correlation coefficient between the Similarities subtest and the Full Scale I.Q. showed a substantial relation-

ship for the normal group and a definite but small relationship for the superior and retarded groups.

The t score in comparison of the retarded group to the normal group was 9.98. The t score in comparison of the normal group to the superior group was 13.70. The t score in comparison of the retarded group to the superior group was 29.31. The three t scores are significant at the 1 per cent level.

Vocabulary. Table VIII presents data concerning the performance of the total sample in terms of the Vocabulary subtest:

TABLE VIII

THE MEAN, THE STANDARD DEVIATION, THE STANDARD ERROR OF THE MEAN, AND THE CORRELATION COEFFICIENT OF THE VOCABULARY SUBTEST WITH THE FULL SCALE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

VOCABULARY SUBTEST	N	MEAN SCALED SCORE	S.D.	S.E. MEAN	r
Total	300	9.54	4.37	.253	.919
Superior	100	14.19	2.19	.220	.588
Normal	100	9.32	2.86	.286	.786
Retarded	100	5.12	1.81	.182	.482

There was a marked relationship between the Vocabulary subtests and the Full Scale I.Q. for the normal group and a

substantial relationship established by the superior and retarded groups.

The t score in comparison of the retarded group to the normal group was 12.69. The t score in comparison of the normal group to the superior group was 13.49. The t score in comparison of the retarded group to the superior group was 32.41. The three t scores are significant at the 1 per cent level.

Picture Completion. Table IX presents data concerning the performance of the total sample in terms of the Picture Completion subtest:

TABLE IX

THE MEAN, THE STANDARD DEVIATION, THE STANDARD ERROR OF THE MEAN, AND THE CORRELATION COEFFICIENT OF THE PICTURE COMPLETION SUBTEST WITH THE FULL SCALE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

PICTURE COMPLETION SUBTEST	N	MEAN SCALED SCORE	S.D.	S.E. MEAN	r
Total	300	10.02	4.06	.235	.815
Superior	100	14.09	2.55	.256	.272
Normal	100	9.69	2.62	.263	.395
Retarded	100	6.27	2.30	.231	.453

The correlation coefficient between the Picture Completion subtest and the Full Scale I.Q. showed a definite but

small relationship for all three sample groups.

The t score in comparison of the retarded group to the normal group was 9.77. The t score in comparison of the normal group to the superior group was 11.98. The t score in comparison of the retarded group to the superior group was 22.67. The three t scores are significant at the 1 per cent level.

Picture Arrangement. Table X presents data concerning the performance of the total sample in terms of the Picture Arrangement subtest:

TABLE X

THE MEAN, THE STANDARD DEVIATION, THE STANDARD ERROR OF THE MEAN, AND THE CORRELATION COEFFICIENT OF THE PICTURE ARRANGEMENT SUBTEST WITH THE FULL SCALE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

PICTURE ARRANGEMENT SUBTEST	N	MEAN SCALED SCORE	S.D.	S.E. MEAN	r
Total	300	9.72	4.52	.262	.861
Superior	100	13.97	2.92	.293	.292
Normal	100	10.09	2.80	.281	.618
Retarded	100	5.10	2.30	.231	.607

The correlation coefficient between the Picture Arrangement subtest and the Full Scale I.Q. showed a substantial relationship for the normal and retarded groups. The correlation

coefficient for the superior group showed a definite but small relationship.

The t score in comparison of the retarded group to the normal group was 13.71. The t score in comparison of the normal group to the superior group was 9.56. The t score in comparison of the retarded group to the superior group was 23.78. The three t scores are significant at the 1 per cent level.

Block Design. Table XI presents data concerning the performance of the total sample in terms of the Block Design subtest:

TABLE XI

THE MEAN, THE STANDARD DEVIATION, THE STANDARD ERROR OF THE MEAN, AND THE CORRELATION COEFFICIENT OF THE BLOCK DESIGN SUBTEST WITH THE FULL SCALE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

BLOCK DESIGN SUBTEST	N	MEAN SCALED SCORE	S.D.	S.E. MEAN	r
Total	300	10.11	4.21	.244	.911
Superior	100	14.57	1.94	.195	.372
Normal	100	9.91	2.29	.230	.545
Retarded	100	5.85	2.15	.216	.951

The correlation coefficient between the Block Design subtest and the Full Scale I.Q. showed a very dependable re-

lationship for the retarded group, a substantial relationship for the normal group, and a definite but small relationship for the superior group.

The t score in comparison of the retarded group to the normal group was 12.85. The t score in comparison of the normal group to the superior group was 15.43. The t score in comparison of the retarded group to the superior group was 29.97. The three t scores are significant at the 1 per cent level.

Object Assembly. Table XII presents data concerning the performance of the total sample in terms of the Object Assembly subtest:

TABLE XII

THE MEAN, THE STANDARD DEVIATION, THE STANDARD ERROR OF THE MEAN, AND THE CORRELATION COEFFICIENT OF THE OBJECT ASSEMBLY SUBTEST WITH THE FULL SCALE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

OBJECT ASSEMBLY SUBTEST	N	MEAN SCALED SCORE	S.D.	S.E. MEAN	r
Total	300	9.90	4.02	.233	.816
Superior	100	13.79	2.49	.250	.294
Normal	100	9.69	2.44	.245	.471
Retarded	100	6.22	2.58	.259	.539

There was a substantial relationship between the Object

Assembly subtest and the Full Scale I.Q. for the retarded and normal groups. The correlation coefficient for the superior group showed a small but definite relationship.

The t score in comparison of the retarded group to the normal group was 9.72. The t score in comparison of the normal group to the superior group was 11.71. The t score in comparison of the retarded group to the superior group was 21.03. The three t scores are significant at the 1 per cent level.

Coding. Table XIII presents data concerning the performance of the total sample in terms of the Coding subtest:

TABLE XIII

THE MEAN, THE STANDARD DEVIATION, THE STANDARD ERROR OF THE MEAN, AND THE CORRELATION COEFFICIENT OF THE CODING SUBTEST WITH THE FULL SCALE WECHSLER INTELLIGENCE SCALE FOR CHILDREN

CODING SUBTEST	N	MEAN SCALED SCORE	S.D.	S.E. MEAN	r
Total	300	9.87	3.85	.223	.779
Superior	100	13.52	2.49	.250	.240
Normal	100	10.36	2.86	.287	.509
Retarded	100	6.28	2.71	.272	.605

There was a substantial relationship between the Coding subtest and the Full Scale I.Q. for the retarded and normal

groups. The correlation coefficient for the superior group showed a small but definite relationship.

The t score in comparison of the retarded group to the normal group was 10.33. The t score in comparison of the normal group to the superior group was 8.29. The t score in comparison of the retarded group to the superior group was 19.42. The three t scores are significant at the 1 per cent level.

The mean chronological age of the total sample was 9.12 years. The mean chronological age of the superior group was 9.20 years. The mean chronological age of the normal group was 9.01. The mean chronological age of the retarded group was 9.15. The mean grade placement of the total group was 3.51.

The Abbreviated Form. The Pearson product moment correlations between the Abbreviated Scale I.Q. and the Full Scale I.Q. for each of the three groups were;

Superior, I.Q. 120-154 ..... r = .77

Normal, I.Q. 80-119 ..... r = .93

Retarded, I.Q. 46-79 ..... r = .81

In a comparison of the I.Q.'s received using the Abbreviated Form with the I.Q.'s received using the Full Scale Wechsler Intelligence Scale for Children, the Abbreviated Form misclassified twelve superior, I.Q. 120-154, children. Ten

children who were classified as superior, on the basis of the Full Scale Wechsler Intelligence Scale for Children I.Q., were classified in the 115-119 I.Q. range by the Abbreviated Form. One child received an I.Q. in the 110-114 range and one child received an I.Q. in the 105-109 range.

The Abbreviated Form misclassified sixteen children in the normal group, I.Q. 80-119. Five children obtained Abbreviated Form I.Q.'s of 120-124; two children obtained Abbreviated Form I.Q.'s in the 125-129 range; and, one child obtained an Abbreviated Form I.Q. in the 140-144 range. There were five children who were classified in the 75-80 range by the Abbreviated Form and three children who were classified in the 70-74 range.

In applying the Abbreviated Form to the retarded group, there were five children who were misclassified. All five of the misclassified children's Abbreviated Form I.Q.'s were in the 80-84 range.

II. INTERPRETATION OF THE DATA

The ability of the subtests of the Wechsler Intelligence Scale for Children to differentiate between the mental levels of the sample included in this study was evidenced by the consistency of the t scores which were all significant at the 1 per cent level.

The Block Design and Picture Arrangement subtests correlated most highly with the Full Scale I.Q. for the retarded

group. The Similarities and Arithmetic subtests showed the least correlation for this group.

The Arithmetic and Vocabulary subtests correlated most highly with the Full Scale I.Q. for the normal group. The correlation coefficients for the Picture Completion and Object Assembly subtests were the lowest for this group.

The Vocabulary and Information subtests correlated most highly with the Full Scale I.Q. for the superior group while the Coding and Picture Completion subtests showed the least correlation.

A total of thirty-three children were misclassified as a result of applying the Abbreviated Form of the Wechsler Intelligence Scale for Children. The range of the error for thirteen of the children was from 1 to 5 I.Q. points. The range of error for sixteen of the children was from 6 to 10 I.Q. points, and the range of error for three of the children was 10 to 24 I.Q. points.

The subtest profiles of these thirty-three children were evaluated in an effort to determine the reason for the difference between the Full Scale I.Q. and the Abbreviated I.Q.

There was no significant pattern found in the profiles of the five retarded children who were incorrectly classified as normal. It was interesting to note, however, that three of the five children obtained Abbreviated I.Q.'s of 80 and the

remaining two obtained Abbreviated I.Q.'s of 81. The range of error was from 2 to 7 points. The average error was 4 points.

In the evaluation of the subtest profiles of the normal children who were misclassified as retarded by the Abbreviated Form, it was discovered that seven of the eight children had noticeably higher scaled scores on the Picture Completion subtest in comparison to their remaining subtest performances. Four of the eight children also obtained higher scaled scores on the Coding subtest. The Picture Completion and Coding subtests were not included in the Abbreviated Form. The range of error was from 4 to 10 points and the average error was 7.25 points.

Eight of the children who were classified as superior by the Abbreviated Form were classified in the normal group by the Full Scale Wechsler Intelligence Scale for Children. The range of error was from 4 to 24 points and the average error was 9.12 points. The average error was greatly influenced by the one child who obtained an Abbreviated I.Q. 24 points above the Full Scale I.Q. This child's profile showed extremely low scaled scores in the Picture Completion, Object Assembly, and Coding subtests, none of which are included in the Abbreviated Form.

The profiles of the twelve superior children who were incorrectly classified as normal by the Abbreviated Form

showed lower Picture Arrangement subtest scores in five cases and lower Information subtest scores in eight cases in comparison to their total subtest performances.

The range of error was from 1 to 14 I.Q. points. The average error was 6 I.Q. points for the superior group.

The majority of classification errors were within the range of probable error of the instrument.

CHAPTER V

SUMMARY AND CONCLUSIONS

I. SUMMARY

It was the intent of this study to develop an abbreviated form of the Wechsler Intelligence Scale for Children which could, with satisfactory reliability, identify children of superior, normal, or retarded intellectual development.

The study was limited by the geographic area from which the sample was taken as well as the exclusion from the sample of children whose ages ranged between thirteen and fifteen years. Children classified as physically handicapped, emotionally disturbed, or bilinqual members of ethnic groups were also excluded from the sample.

There have been three studies which have dealt with abbreviated forms of the Wechsler Intelligence Scale for Children. The uniqueness of the samplings limited the value of the research directly related to the present study. The concern of researchers for an abbreviated form of other Wechsler Intelligence Scales was pointed out by the inclusion of several studies which were indirectly related to the present study.

The sample of 300 children of superior, normal, and retarded intellectual development was grouped on the basis of the Full Scale I.Q. received by each child.

The data were treated to determine the mean chronological age of each subgroup and the total group, the mean grade placement of the total group, the mean subtest scaled scores, the mean Verbal, mean Performance, and the mean Full Scale I.Q. The data were further treated to determine the standard deviation, the standard error of the mean for each of the subtests, the Verbal I.Q., the Performance I.Q., and the Full Scale I.Q.

The Pearson product moment correlation coefficients were calculated between each subtest, the Verbal I.Q., the Performance I.Q., and the Full Scale I.Q. The t scores were derived by comparing each mental group with the two remaining groups. This was done for each subtest, the Verbal I.Q., and the Performance I.Q.

Five of the ten Wechsler Intelligence Scale for Children subtests were chosen on the basis of the criteria presented in Chapter III to constitute an abbreviated form of the Wechsler Intelligence Scale for Children.

The total of the Subtest scaled scores received by each child using the Abbreviated Form was doubled to give it a numerical value comparable to the total of the Full Scale scaled scores. The adjusted Abbreviated Form score was then converted to an I.Q. using Wechsler's conversion table. A Pearson product moment correlation was computed between the I.Q. received using the Abbreviated Form and the I.Q. received

using the Full Scale Wechsler Intelligence Scale for Children. The Pearson product moment correlation was computed for each of the three groups in the sample with the following results:

Superior	.77
Normal	.93
Retarded	.81

II. CONCLUSIONS

It was concluded that an abbreviated form consisting of the Information, Arithmetic, Vocabulary, Picture Arrangement, and Block Design Subtests can identify children of superior, normal, or retarded intelligence when applied to children who are comparable to the sample upon which this study was based.

The Abbreviated Form of the Wechsler Intelligence Scale for Children may be used as a superior screening instrument, but it should not be considered a substitute for the Full Scale Wechsler Intelligence Scale for Children in the final classification of children for the purposes of individual educational programming, unless employed in a broader clinical battery.

III. RECOMMENDATIONS FOR FURTHER STUDY

It is recommended that an extension of this study be conducted which would include children who are classified as

physically handicapped, emotionally disturbed, or bilinqual members of ethnic groups.

It is also recommended that the study be extended to include a representative universe instead of a representative sample as was the case in the present study.

It is further recommended that a study be conducted which would include a sample drawn from an area unlike the area from which the present sample was drawn.

It is additionally recommended that the study be extended to include minority groups who speak English, for example, most American negroes.

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APPENDIX

AN EXPLANATION OF THE WORK SHEETS

Application of the work sheets. The first work sheet presented was the original data work sheet. This work sheet was used to tabulate the information which was to be used as a basis of all the statistical analysis which was to follow. The original data work sheet included the five Verbal subtests, the Verbal I.Q., and the Full Scale I.Q. A second sheet of like design could be used to tabulate the information concerning the Performance subtests. The possibility of computational error was reduced by collecting all of the data on one extra length work sheet which included both the Verbal and Performance data.

The first column under the Information subtest heading was labeled X. The subtest scaled score was recorded in this column. The second column was labeled X^2. The subtest scaled score squared was recorded in this column. The third column was labeled XY. The product of the subtest scaled score and the Full Scale I.Q. was recorded in this column. The entries in each of the three columns were totaled to give the sum of X, the sum of X^2, and the sum of XY.

The second work sheet was a summary sheet upon which was recorded a summarization of the data accumulated on a number of original data work sheets. In the present study, it was necessary to record the sum of X, the sum of X^2, and the sum of XY, separately for each of the three subgroups and the

Case	Info.			Comp			Arith.			Simil.			Vocab.			V.I.C.			F.S.I.C.	
	X	X^2	XY	X	X^2	XY	X	X^2	XY	X	X^2	XY	X	X^2	XY	X	X^2	XY	Y	Y^2
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

FIGURE 1

ORIGINAL WORK SHEET

													Y
X	Inf.	Com.	Ari.	Sim.	Voc.	P.C.	P.A.	B.D.	O.A.	Cod.	VIQ.	PIQ.	FSIQ.
Group A													
Group B													
Group C													
Total Group													

													Y^2
X^2	Inf.	Com.	Ari.	Sim.	Voc.	P.C.	P.A.	B.D.	O.A.	Cod.	VIQ.	PIQ.	FSIQ.
Group A													
Group B													
Group C													
Total Group													

XY	Inf.	Com.	Ari.	Sim.	Voc.	P.C.	P.A.	B.D.	O.A.	Cod.	VIQ.	PIQ.
Group A												
Group B												
Group C												
Total Group												

FIGURE 2

SUMMARY WORK SHEET

total group.

The third work sheet was used to compute the mean, the standard deviation, the standard error of the mean, and the Pearson product moment correlation.

The first step on the computational work sheet was to find $N\Sigma Y^2 - (\Sigma Y)^2$, the information necessary to compute this data was found in the column to the extreme right on the summary work sheet.

The second step was to find the square root of $N\Sigma Y^2 - (\Sigma Y)^2$. Step one and step two were computed first as Y remained constant throughout the process and did not need to be re-calculated for each subtest, the Verbal I.Q., or the Performance I.Q.

Step three was to find $N\Sigma X^2 - (\Sigma X)^2$. This was done by finding the ΣX^2 for each subtest in each subgroup and the total group on the summary sheet. The sum of X^2 was multiplied by N. The sum of X quantity squared was then calculated and subtracted from $N\Sigma X^2$. This was done for each of the subtests, the Verbal I.Q., and the Performance I.Q.

The fourth step was to find the square root of $N\Sigma X^2 - (\Sigma X)^2$.

Step five called for the multiplication of the sum of XY by N. The sum of XY was found in the third group of data on the summary work sheet. Step five also called for the sum of X multiplied by the sum of Y which was to be subtracted

from $N\Sigma XY$. The sum of X was found in the first group of data on the summary work sheet under each subtest heading. The sum of Y was found in the last column to the extreme right on the summary work sheet.

Step six was the multiplication of step two, ($\sqrt{N\Sigma Y^2 - (\Sigma Y)^2}$) by step four ($\sqrt{N\Sigma X^2 - (\Sigma X^2)}$). Step six was necessary to complete step seven, which was the division of step five by step six resulting in the Pearson product moment correlation.

Steps five, six, and seven were dependent upon the Pearson product moment formula, $\frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{(N\Sigma X^2 - (\Sigma X)^2)(N\Sigma Y^2 - (\Sigma Y)^2)}}$ presented by Edwards.[19]

Step eight was the division of the sum of X by N to find the mean, $(\frac{\Sigma X}{N})$.

Step nine was the division of step four, ($\sqrt{N\Sigma X^2 - (\Sigma X)^2}$) by N to find the standard deviation. This procedure was based on an alternate formula to the formula presented by Guilford, ($\sigma = \frac{1}{N}\sqrt{N\Sigma X^2 - (\Sigma X)^2}$).[20]

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[19]Allen L. Edwards, Statistical Analysis (New York: Rinehart and Company, Inc., 1946), p. 91.

[20]J. P. Guilford, Fundamental Statistics in Psychology and Education (New York: McGraw-Hill Book Company, Inc., 1956), p. 94.

Step ten was the computation of the standard error of the mean applying the formula, $\sigma_m = \frac{\sigma}{\sqrt{N - 1}}$ presented by Edwards.[21]

A computational work sheet was done for each of the three subgroups and the total sample.

The fourth work sheet was used to compute t. Step one was the transferance of M_b from step eight of the third work sheet (group B). Step two was the transferance of M_a from step eight of the third work sheet (group A). The third step was the subtraction of M_a from M_b. The fourth step was the squaring of the σ_{m_b} taken from step ten of the third work sheet (group B). The fifth step was the squaring of the σ_{m_a} taken from step ten of the third work sheet (group A). The sixth step was the addition of σ_{m_a} to σ_{m_b}. Step seven was the finding of the square root of step six, $(\sigma_{m_a}^2 + \sigma_{m_b}^2)$. Step eight was the division of step three, $(M_b - M_a)$ by step seven, $(\sqrt{\sigma_{m_b}^2 + \sigma_{m_a}^2})$ to find t applying Edward's formula, $t = \frac{M_1 - M_2}{\sigma_{m_d}}$.[22] The $\sqrt{\sigma_{m_b}^2 + \sigma_{m_a}^2}$ being equal to σ_{m_d}.

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[21] Allen L. Edwards, Statistical Analysis (New York: Rinehart and Company, Inc., 1946), p. 158.

[22] Ibid., p. 177.

	Inf.	Com.	Ari.	Sim.	Voc.	P.C.	P.A.	R.D.	O.A.	Cod.	VIQ.	PIQ.	FSIQ.
1. $N\Sigma Y^2 - (\Sigma Y)^2$													
2. $\sqrt{N\Sigma Y^2 - (\Sigma Y)^2}$													
3. $N\Sigma X^2 - (\Sigma X)^2$													
4. $\sqrt{N\Sigma Y^2 - (\Sigma X)^2}$													
5. $N\Sigma XY - (\Sigma X)(\Sigma Y)$													
6. (Step 2)(Step 4)													
7. $\frac{\text{Step 5}}{\text{Step 6}} = r$													
8. $M = \frac{\Sigma X}{N}$													
9. $\sigma = \frac{\text{Step 4}}{N}$													
10. $\sigma_m = \frac{\sigma}{\sqrt{N-1}}$													

FIGURE 3

COMPUTATIONAL WORK SHEET

	Inf.	Com.	Ari.	Sim.	Voc.	P.C.	P.A.	R.D.	O.A.	Cod.	VIQ.	PIQ.
1. M_b												
2. M_a												
3. $M_b - M_a$												
4. $\sigma_{m_b}^2$												
5. $\sigma_{m_a}^2$												
6. $\sigma_{m_b}^2 + \sigma_{m_a}^2$												
7. $\sqrt{\text{Step 6}}$												
8. $\frac{M_b - M_a}{\text{Step 7}}$												

FIGURE 4

THE t WORK SHEET