

University of New Mexico

UNM Digital Repository

Teacher Education, Educational Leadership &
Policy ETDs

Education ETDs

Spring 2-3-1939

Sex and Cultural Differences on the New Mexico Statewide Test of Academic Achievement

Claude C. McDougal

Follow this and additional works at: https://digitalrepository.unm.edu/educ_teelp_etds



Part of the [Educational Administration and Supervision Commons](#), and the [Educational Assessment, Evaluation, and Research Commons](#)

Recommended Citation

McDougal, Claude C.. "Sex and Cultural Differences on the New Mexico Statewide Test of Academic Achievement." (1939). https://digitalrepository.unm.edu/educ_teelp_etds/156

This Thesis is brought to you for free and open access by the Education ETDs at UNM Digital Repository. It has been accepted for inclusion in Teacher Education, Educational Leadership & Policy ETDs by an authorized administrator of UNM Digital Repository. For more information, please contact disc@unm.edu.

UNIVERSITY OF NEW MEXICO-UNIVERSITY LIBRARIES



A14429 086791

MC DOUGAL

NEW
MEXICO
TESTS

378.

789

On 3 0mC

1939

Cap. 2

LIBRARY
of
THE UNIVERSITY OF
NEW MEXICO

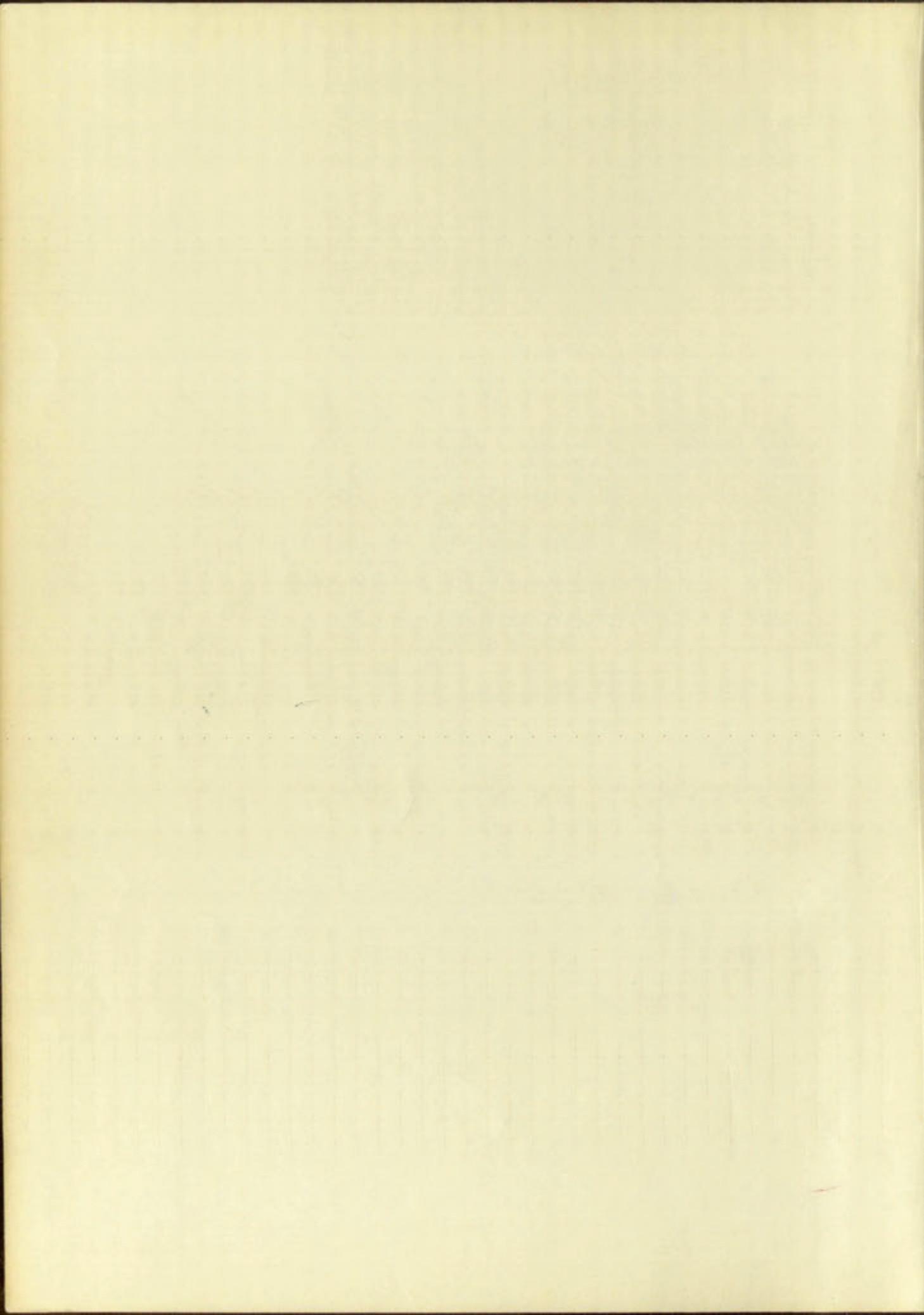


60635

CLASS
378.789

BOOK
Un30me
1939
cop. 2

SEP 25 11 UNM 20		
REC'D UNM OCT 3 '74		
DEC - 8 '74 UNM 20		
REC'D UNM DEC - 5 '74		
UN 22 '78		
REC'D UNM FEB 27 '78		
CAYLORD		PRINTED IN U.S.A.



UNIVERSITY OF NEW MEXICO LIBRARY

MANUSCRIPT THESES

Unpublished theses submitted for the Master's and Doctor's degrees and deposited in the University of New Mexico Library are open for inspection, but are to be used only with due regard to the rights of the authors. Bibliographical references may be noted, but passages may be copied only with the permission of the authors, and proper credit must be given in subsequent written or published work. Extensive copying or publication of the thesis in whole or in part requires also the consent of the Dean of the Graduate School of the University of New Mexico.

This thesis by ... Claude C. McDougal
has been used by the following persons, whose signatures attest their acceptance of the above restrictions.

A Library which borrows this thesis for use by its patrons is expected to secure the signature of each user.

NAME AND ADDRESS

DATE

Michael D. Goodall
Furman Univ.

Feb. 8, 1965

SEX AND CULTURAL DIFFERENCES ON THE
NEW MEXICO STATEWIDE TEST OF
ACADEMIC ACHIEVEMENT

A Thesis
Presented to
the Faculty of the School of Education
University of New Mexico

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts in Education

by
Claude C. McDougal
August 1938

THE UNIVERSITY OF CHICAGO
DIVISION OF THE PHYSICAL SCIENCES
DEPARTMENT OF CHEMISTRY

REPORT
SUBMITTED TO

THE BOARD OF THE UNIVERSITY OF CHICAGO
BY

ROBERT H. EMMETT

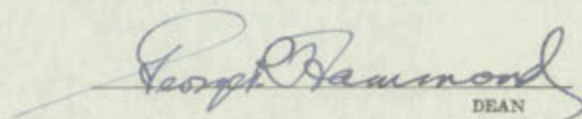
IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE
OF DOCTOR OF PHILOSOPHY

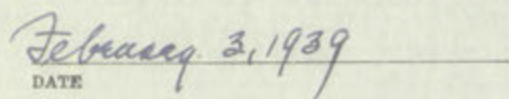
CHICAGO, ILLINOIS
1955

378.789
Un 30mc
1939
cop. 2

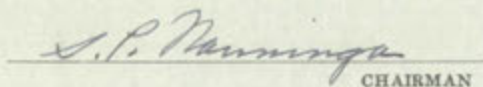
This thesis, directed and approved by the candidate's committee, has been accepted by the Graduate Committee of the University of New Mexico in partial fulfillment of the requirements for the degree of

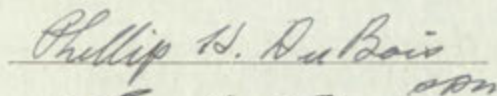
MASTER OF ARTS

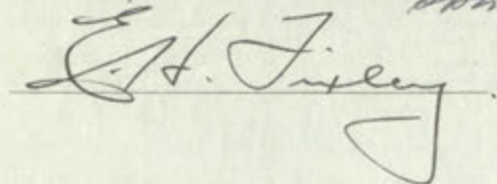

DEAN


DATE

Thesis committee


CHAIRMAN


MEMBER


MEMBER

This is a receipt for the sum of £100
which has been paid to the Treasurer of the
University of London for the purchase of
books for the library.

WITNESSED BY

[Signature]
Treasurer

[Signature]
21st May 1914

THOMAS ROBERTSON

[Signature]
Treasurer

[Signature]
21st May 1914

THOMAS ROBERTSON

ACKNOWLEDGMENTS

The writer wishes to express his appreciation to Dr. Philip H. DuBois for his helpful suggestions, criticisms, and guidance in writing the thesis. Acknowledgments are also due to Dr. J. C. Knode, who made available the cards, punched and ready for tabulation.

TABLE OF CONTENTS

CHAPTER	PAGE
I. THE PROBLEM AND DEFINITIONS OF TERMS USED . . .	1
The problem	1
Statement of the problem	1
Importance of the study	1
Definitions of terms used	3
Organization of remainder of the thesis . . .	4
II. REVIEW OF THE LITERATURE	6
Summary and limitations of studies	
reviewed	9
III. THE GROUPS STUDIED AND MATERIALS USED	10
Subjects	10
Tests	10
Reliability coefficients	12
Application of punched card method of	
machine computation	13
Code used for punching cards	16
Statistical procedure	18
IV. SEX AND CULTURAL DIFFERENCES IN ACHIEVEMENT . .	20
Sex and cultural differences on the	
examination	20
✓ Differences between Spanish males and	
Spanish females	22

CHAPTER

I. THE PROBLEM OF THE THEORY OF THE STATE	1
The problem	1
Statement of the problem	1
Importance of the study	1
Definitions of terms used	1
Organization of treatment of the subject	1
II. REVIEW OF THE LITERATURE	1
Summary and classification of theories	1
Theories	1
III. THE THEORY OF THE STATE	1
The state	1
The state as a social organization	1
The state as a political organization	1
The state as a legal organization	1
The state as a moral organization	1
The state as a religious organization	1
The state as a cultural organization	1
The state as a social organization	1
The state as a political organization	1
The state as a legal organization	1
The state as a moral organization	1
The state as a religious organization	1
The state as a cultural organization	1
The state as a social organization	1
IV. THE THEORY OF THE STATE	1
The state	1
The state as a social organization	1
The state as a political organization	1
The state as a legal organization	1
The state as a moral organization	1
The state as a religious organization	1
The state as a cultural organization	1
The state as a social organization	1
The state as a political organization	1
The state as a legal organization	1
The state as a moral organization	1
The state as a religious organization	1
The state as a cultural organization	1
The state as a social organization	1

CHAPTER

PAGE

✓ Differences between Spanish males and	
Anglo males	24
Differences between Spanish males and	
Anglo females	26
Differences between Spanish females and	
Anglo males	28
✓ Differences between Spanish females and	
Anglo females	30
Differences between Anglo males and	
Anglo females	32
Differences between Anglo males and	
Anglo females on the sub-tests	34
Summary	38
V. ANALYSIS OF CORRELATIONAL RESULTS	41
Preliminary treatment of correlations	41
Original correlations with the probable	
errors	49
Summary	62
VI. FACTOR ANALYSIS OF CORRELATIONAL RESULTS	64
History of factor methods	65
Analyses of the eleven variable tables	66
Analyses of the five variable tables	76
Summary	93
Applications of factor analysis	94

CHAPTER	PAGE
VII. SUMMARY AND CONCLUSIONS	96
Summary	96
Conclusions	96
BIBLIOGRAPHY	100

CHARTER

VII. TOWN OF CHARTER

CHARTER

CHARTER

CHARTER

CHARTER

CHARTER

LIST OF TABLES

TABLE	PAGE
I. Description of Tests	11
II. Reliability Coefficients of Test Totals and the Sub-Tests	14
III. The Reliability of the Differences between the Averages for the Four Groups on the Examination	21
IV. The Reliability of the Differences between the Averages of Spanish Males and Females on the Five Tests	23
V. The Reliability of the Differences between the Averages of Spanish Males and Anglo Males on the Five Tests	25
VI. The Reliability of the Differences between the Averages of Spanish Males and Anglo Females on the Five Tests	27
VII. The Reliability of the Differences between the Averages of Spanish Females and Anglo Males on the Five Tests	29
VIII. The Reliability of the Differences between the Averages of Spanish Females and Anglo Females on the Five Tests	31

TABLE

- I. Description of Test
- II. Reliability coefficients of Test Results
- III. The Reliability of the Difference between the averages for the two groups of the Examination
- IV. The Reliability of the Difference between the averages of Spanish words for females on the five tests
- V. The Reliability of the Difference between the averages of Spanish words for males on the five tests
- VI. The Reliability of the Difference between the averages of Spanish words for males and females on the five tests
- VII. The Reliability of the Difference between the averages of Spanish words for males and females on the five tests
- VIII. The Reliability of the Difference between the averages of Spanish words for males and females on the five tests

TABLE

PAGE

IX.	The Reliability of the Differences between the Averages of Anglo Males and Anglo Females on the Five Tests	33
X.	The Reliability of the Differences between the Averages of Anglo Males and Anglo Females on the Sub-Tests	36
XI.	Intercorrelations Corrected for Attenuation for Spanish Males	42
XII.	Intercorrelations Corrected for Attenuation for Anglo Females	43
XIII.	Intercorrelations with Variability Due to Age Held Constant for Spanish Males . . .	45
XIV.	Intercorrelations with Variability Due to Age Held Constant for Spanish Females . .	46
XV.	Intercorrelations with Variability Due to Age Held Constant for Anglo Males	47
XVI.	Intercorrelations with Variability Due to Age Held Constant for Anglo Females . . .	48
XVII.	Original Correlations of the Five Tests with the Probable Errors of Those Correlations for Spanish Males	50
XVIII.	Original Correlations of the Five Tests with the Probable Errors of Those Correlations for Spanish Females	52

TABLE

IX.	The Reliability of the Different Tests	1
X.	The Reliability of the Different Tests	1
XI.	Interrelationships between the Different Tests	1
XII.	Interrelationships between the Different Tests	1
XIII.	Interrelationships between the Different Tests	1
XIV.	Interrelationships between the Different Tests	1
XV.	Interrelationships between the Different Tests	1
XVI.	Interrelationships between the Different Tests	1
XVII.	Original Correlations of the Five Tests	1
XVIII.	Original Correlations of the Five Tests	1

TABLE

PAGE

XIX.	Original Correlations of the Five Tests with the Probable Errors of Those Correlations for Anglo Males	54
XX.	Original Correlations of the Five Tests with the Probable Errors of Those Correlations for Anglo Females	55
XXI.	Original Correlations of the Sub-Tests with the Probable Errors of Those Correlations for Anglo Males	57
XXII.	Original Correlations of the Sub-Tests with the Probable Errors of Those Correlations for Anglo Females	60
XXIII.	Factor Loadings and Communalities of the Eleven Sub-Tests (Three Factor Centroid Method) for Anglo Males	68
XXIV.	Factor Loadings and Communalities of the Eleven Sub-Tests (Three Factor Centroid Method) for Anglo Females	69
XXV.	Factor Loadings and Communalities from a Common Rotation of 35 Degrees for the Eleven Sub-Tests of the Anglo Males . . .	74
XXVI.	Factor Loadings and Communalities from a Common Rotation of 35 Degrees for the Eleven Sub-Tests of the Anglo Females . .	75

IX.	Original Collection of the 1st Series	1
X.	Original Collection of the 2nd Series	2
XI.	Original Collection of the 3rd Series	3
XII.	Original Collection of the 4th Series	4
XIII.	Original Collection of the 5th Series	5
XIV.	Original Collection of the 6th Series	6
XV.	Original Collection of the 7th Series	7
XVI.	Original Collection of the 8th Series	8
XVII.	Original Collection of the 9th Series	9
XVIII.	Original Collection of the 10th Series	10
XIX.	Original Collection of the 11th Series	11
XX.	Original Collection of the 12th Series	12
XXI.	Original Collection of the 13th Series	13
XXII.	Original Collection of the 14th Series	14
XXIII.	Original Collection of the 15th Series	15
XXIV.	Original Collection of the 16th Series	16
XXV.	Original Collection of the 17th Series	17
XXVI.	Original Collection of the 18th Series	18
XXVII.	Original Collection of the 19th Series	19
XXVIII.	Original Collection of the 20th Series	20
XXIX.	Original Collection of the 21st Series	21
XXX.	Original Collection of the 22nd Series	22
XXXI.	Original Collection of the 23rd Series	23
XXXII.	Original Collection of the 24th Series	24
XXXIII.	Original Collection of the 25th Series	25
XXXIV.	Original Collection of the 26th Series	26
XXXV.	Original Collection of the 27th Series	27
XXXVI.	Original Collection of the 28th Series	28
XXXVII.	Original Collection of the 29th Series	29
XXXVIII.	Original Collection of the 30th Series	30
XXXIX.	Original Collection of the 31st Series	31
XL.	Original Collection of the 32nd Series	32
XLI.	Original Collection of the 33rd Series	33
XLII.	Original Collection of the 34th Series	34
XLIII.	Original Collection of the 35th Series	35
XLIV.	Original Collection of the 36th Series	36
XLV.	Original Collection of the 37th Series	37
XLVI.	Original Collection of the 38th Series	38
XLVII.	Original Collection of the 39th Series	39
XLVIII.	Original Collection of the 40th Series	40
XLIX.	Original Collection of the 41st Series	41
L.	Original Collection of the 42nd Series	42
LI.	Original Collection of the 43rd Series	43
LII.	Original Collection of the 44th Series	44
LIII.	Original Collection of the 45th Series	45
LIV.	Original Collection of the 46th Series	46
LV.	Original Collection of the 47th Series	47
LVI.	Original Collection of the 48th Series	48
LVII.	Original Collection of the 49th Series	49
LVIII.	Original Collection of the 50th Series	50
LIX.	Original Collection of the 51st Series	51
LX.	Original Collection of the 52nd Series	52
LXI.	Original Collection of the 53rd Series	53
LXII.	Original Collection of the 54th Series	54
LXIII.	Original Collection of the 55th Series	55
LXIV.	Original Collection of the 56th Series	56
LXV.	Original Collection of the 57th Series	57
LXVI.	Original Collection of the 58th Series	58
LXVII.	Original Collection of the 59th Series	59
LXVIII.	Original Collection of the 60th Series	60
LXIX.	Original Collection of the 61st Series	61
LXX.	Original Collection of the 62nd Series	62
LXXI.	Original Collection of the 63rd Series	63
LXXII.	Original Collection of the 64th Series	64
LXXIII.	Original Collection of the 65th Series	65
LXXIV.	Original Collection of the 66th Series	66
LXXV.	Original Collection of the 67th Series	67
LXXVI.	Original Collection of the 68th Series	68
LXXVII.	Original Collection of the 69th Series	69
LXXVIII.	Original Collection of the 70th Series	70
LXXIX.	Original Collection of the 71st Series	71
LXXX.	Original Collection of the 72nd Series	72
LXXXI.	Original Collection of the 73rd Series	73
LXXXII.	Original Collection of the 74th Series	74
LXXXIII.	Original Collection of the 75th Series	75
LXXXIV.	Original Collection of the 76th Series	76
LXXXV.	Original Collection of the 77th Series	77
LXXXVI.	Original Collection of the 78th Series	78
LXXXVII.	Original Collection of the 79th Series	79
LXXXVIII.	Original Collection of the 80th Series	80
LXXXIX.	Original Collection of the 81st Series	81
LXXXX.	Original Collection of the 82nd Series	82
LXXXXI.	Original Collection of the 83rd Series	83
LXXXXII.	Original Collection of the 84th Series	84
LXXXXIII.	Original Collection of the 85th Series	85
LXXXXIV.	Original Collection of the 86th Series	86
LXXXXV.	Original Collection of the 87th Series	87
LXXXXVI.	Original Collection of the 88th Series	88
LXXXXVII.	Original Collection of the 89th Series	89
LXXXXVIII.	Original Collection of the 90th Series	90
LXXXXIX.	Original Collection of the 91st Series	91
LXXXXX.	Original Collection of the 92nd Series	92
LXXXXXI.	Original Collection of the 93rd Series	93
LXXXXXII.	Original Collection of the 94th Series	94
LXXXXXIII.	Original Collection of the 95th Series	95
LXXXXXIV.	Original Collection of the 96th Series	96
LXXXXXV.	Original Collection of the 97th Series	97
LXXXXXVI.	Original Collection of the 98th Series	98
LXXXXXVII.	Original Collection of the 99th Series	99
LXXXXXVIII.	Original Collection of the 100th Series	100

TABLE

XXVII.	Factor Loadings and Communalities of the Five Tests (Two Factor Centroid Method) for Spanish Males	79
XXVIII.	Factor Loadings and Communalities of the Five Tests (Two Factor Centroid Method) for Spanish Females	80
XXIX.	Factor Loadings and Communalities of the Five Tests (Two Factor Centroid Method) for Anglo Males	81
XXX.	Factor Loadings and Communalities of the Five Tests (Two Factor Centroid Method) for Anglo Females	82
XXXI.	Factor Loadings and Communalities from a Common Rotation of 25 Degrees of the Five Tests for the Spanish Males	88
XXXII.	Factor Loadings and Communalities from a Common Rotation of 25 Degrees of the Five Tests for the Spanish Females . . .	89
XXXIII.	Factor Loadings and Communalities from a Common Rotation of 25 Degrees of the Five Tests for the Anglo Males	90
XXXIV.	Factor Loadings and Communalities from a Common Rotation of 25 Degrees of the Five Tests for the Anglo Females	91

LIST OF FIGURES

FIGURE	PAGE
1. Differences between the Means for Anglo Males and Anglo Females on the Sub-Tests	37
2. Sex and Cultural Comparisons of the Means on the Tests	39
3. Plot of the Factor Loadings of the Eleven Sub- Tests of Table XXIII with Reference to the Centroid Axes I and II for Anglo Males	71
4. Plot of the Factor Loadings of the Eleven Sub- Tests of Table XXIV with Reference to the Centroid Axes I and II for Anglo Females	72
5. Plot of the Factor Loadings of the Five Tests of Table XXVII with Reference to the Cen- troid Axes I and II for Spanish Males	83
6. Plot of the Factor Loadings of the Five Tests of Table XXVIII with Reference to the Cen- troid Axes I and II for Spanish Females	84
7. Plot of the Factor Loadings of the Five Tests of Table XXIX with Reference to the Cen- troid Axes I and II for Anglo Males	85
8. Plot of the Factor Loadings of the Five Tests of Table XXX with Reference to the Cen- troid Axes I and II for Anglo Females	86

FIGURE

1. Differences between the two series and ratio between the two series
2. Box and whisker diagram of the data on the ratio
3. Plot of the factor loading of the first factor of Table VIII with reference to the control area I and II for each factor
4. Plot of the factor loading of the first factor of Table VIII with reference to the control area I and II for each factor
5. Plot of the factor loading of the first factor of Table VIII with reference to the control area I and II for each factor
6. Plot of the factor loading of the first factor of Table VIII with reference to the control area I and II for each factor
7. Plot of the factor loading of the first factor of Table VIII with reference to the control area I and II for each factor
8. Plot of the factor loading of the first factor of Table VIII with reference to the control area I and II for each factor

CHAPTER I

THE PROBLEM AND DEFINITION OF TERMS USED

For a number of years sex differences on many varied topics have been popular studies for investigations. The old belief that the female was definitely inferior to the male has largely disappeared, and the female is rapidly taking her place in the competitive fields alongside the male. Racial and cultural differences alike have been subjected to various investigations, mainly in the field of psychology, and to a lesser extent in education.

I. THE PROBLEM

Statement of the problem. The research to be reported here is concerned with (1) the investigation of sex and cultural differences in the statewide examination of academic achievement as indicated by differences in the means of each test; (2) the investigation of sex and cultural differences in the organization of abilities as indicated by (a) differences in the intercorrelation of the tests and (b) differences in loadings of the factors central to the tests.

Importance of the study. To know more about sex and cultural differences in school achievement among Anglo-Americans and Spanish-Americans for the State of New Mexico

THE PROBLEM OF THE NEGRO

For a number of years the Negro problem has been a subject of discussion. The old belief that the Negro was inferior is no longer held. The Negro is now being placed in the competitive field alongside the white man. Racial and cultural differences which have been emphasized in the past are now being ignored, and to a lesser extent is education.

I. THE PROBLEM

Statement of the problem The Negro problem is a complex one. It is not only a racial problem, but also a social and economic one. The Negro is a minority group in the United States, and as such he is subject to discrimination. He is also a group that has been historically oppressed. The problem of the Negro is therefore a problem of social and economic justice. It is a problem that has been discussed for many years, and it is a problem that is still being discussed today.

Importance of the study

The study of the Negro problem is important for many reasons. It is important for the Negro himself, for it is a study of his rights and his status in society. It is important for the white man, for it is a study of the social and economic conditions of the Negro. It is important for the whole of the United States, for it is a study of the problem of race relations.

would be of considerable theoretical interest, and should prove to be of practical importance in a number of situations. For instance, if it were known that the Spanish-Americans were lower in language achievement than were the Anglo-Americans, a greater emphasis on language for them would probably be justified. If other differences of significant magnitudes in achievement should be found among the sex and cultural groups, it should cause school administrators to be curious to know if the high school offerings in New Mexico are actually meeting the needs of a majority of those attending high school, or if more flexibility in the offerings is needed in comparison with the time spent in school and the amount of accomplishment. Then if the same examination, or one of comparable content and difficulty were administered on the same basis in any of the other states, it would make possible a comparison of the high school seniors of New Mexico with those of any one or more of such states. Such comparison could be both enlightening and challenging to education.

The facts revealed from this investigation will either strengthen or weaken the conclusions set forth in previous related studies. These are only a few of the several possibilities that might be revealed from this study. In many fields of activity, definite assumptions are being made in regard to existing sex and cultural differences. These

would be of course to establish a precedent, and would
prove to be of practical importance in a number of other
cases. For instance, it is well known that the
Americans were never in a position to make any
Anglo-American, or American-American, or American-American
would probably be justified. It is not difficult to
least mentioned in connection with the fact that the
set and critical groups, it should be noted, that
vote to be outside the scope of the first school district in
New Berlin are actually within the scope of a majority of
these students and school, or it was the result of the
offerings is needed in connection with the first school
school and the nature of the offerings. From the first
expansion, or one of the possible means of expansion, or
were admitted on the basis of the first school district
states, it would be possible to establish a precedent of the first
school district of New Berlin, or the first school district
of such states. It is not difficult to see the need for
and challenge to education.

The first revolution in the history of the world
afterwards or when the revolution was first in history
related studies. There are only a few of the world's most
difficult that might be revealed from this point of view.
fields of activity, and the students are the only ones
regard to making the first revolution in the world.

differences are prevalent in the social, political, and economic affairs of everyday life. To know the relationships which exist between the various tests for the sexes and cultures under consideration in this study should be of some practical interest and value to school administration, especially in New Mexico.

II. DEFINITIONS OF TERMS USED

Sex differences. Wherever this term occurs, it means differences between males and females in the functions measured on the statewide examination, or differences in the relationships of the functions.

Cultural differences. Throughout the report of this investigation, the term cultural differences connotes differences between Anglo-Americans and Spanish-Americans.

Anglo-Americans. In this study only the white races commonly known as descendants of the Anglo-Saxon races are used. All other nationalities were eliminated. For the sake of brevity these will be referred to as Anglos.

Spanish-Americans. For this classification, the nationality of the father was used. The questionnaire attached to each test asked the nationality of the father and the mother. When the nationality was not given, those with Spanish names were included. As a test of the accuracy of

this method the principal of the largest high school in New Mexico checked the pupils of his school and found the results to be correct. For the sake of brevity, those pupils will be referred to as Spanish.

Subjects. The students or groups are referred to as subjects.

Examination. This term refers to the grand total of the five major parts, English, Social Science, Mathematics, Science, and Reading and Language, of the statewide examination for academic achievement.

Test. Each of the five major parts of the examination is called a test.

Sub-test. The divisions of parts of the tests are referred to as sub-tests.

III. ORGANIZATION INTO CHAPTERS

The remainder of this study is divided into six chapters. Chapter II contains a review of the most closely related studies, with a brief section devoted to a summary and limitations of the studies reviewed. Chapter III is devoted to the groups studied and materials used. A description of the tests and the subjects tested is given. The method of procedure and a short discussion of the Hollerith punched

This method was applied to the subjects in the first series of experiments. The results showed that the subjects in the first series of experiments were able to be correct. For the sake of brevity, these results will be referred to as follows:

Subjects. The subjects of the first series of experiments were subjects.

Procedure. This series of experiments was conducted in the five major parts. The first part was the introduction of the subjects, the second part was the introduction of the subjects to the apparatus, the third part was the introduction of the subjects to the apparatus, the fourth part was the introduction of the subjects to the apparatus, and the fifth part was the introduction of the subjects to the apparatus.

Results. Each of the five major parts of the experiment then is called a test.

Conclusions. The results of the first series of experiments referred to as follows:

III. CONCLUSIONS FROM THE FIRST SERIES.
The results of this series of experiments are as follows: Chapter II contains a review of the first series of tests, with a brief mention of the results of the first series of tests. Chapter III contains a review of the second series of tests, with a brief mention of the results of the second series of tests. Chapter IV contains a review of the third series of tests, with a brief mention of the results of the third series of tests. Chapter V contains a review of the fourth series of tests, with a brief mention of the results of the fourth series of tests. Chapter VI contains a review of the fifth series of tests, with a brief mention of the results of the fifth series of tests.

card method of machine correlation are given. Chapter IV is devoted to sex and cultural differences as measured by the means and critical ratios for each test. Chapter V gives an analysis of the correlational results, with the preliminary treatment of correlations, and the sex and cultural differences as are measured by the intercorrelations of the tests. The application of factor analysis, and the weightings of the factors central to the examination are given in Chapter VI. A summary of the previous chapters with the conclusions of the study is presented in Chapter VII.

and method of machine construction, and the
designed to see and control different
means and critical cases for each case. In the
analysis of the control system, the first step
treatment of construction, and the second step
cases as are required by the instructions of the
The application of factor analysis, and the
the factor control to the analysis, and the
VI. A summary of the present study, and the
of the study is presented in Chapter VII.

CHAPTER II

REVIEW OF THE LITERATURE

Much has been written in regard to sex and cultural differences. The great majority of the studies have been limited to small groups at the elementary school level, and with very few variables. Since numerical and verbal abilities have not been generally recognized as distinct from "general intelligence," there are relatively few studies on sex differences in these abilities as such.¹ No studies were found that were closely related to this study. A brief summary of the more relevant studies will be given.

Gerberich² found very marked differences to exist between high school senior groups participating in the Iowa High School Survey, as well as between individual pupils.

Haney³ found as indicated by scores on the Hotz First Year Algebra Scales that when matched with girls on the basis of I. Q., boys excelled girls, the difference being par-

¹ Anne Anastasi, Differential Psychology (New York: The Macmillan Company, 1937), p. 424.

² J. R. Gerberich, A Personnel Study of 10,000 Iowa High School Seniors (University of Iowa Studies: Studies in Education, 5, No. 3. 1930), p. 112.

³ E. Victor Haney, Sex Differences in Algebra (Pennsylvania State Studies in Education, No. 12. 1935), pp. 25-26.

THE UNIVERSITY OF CHICAGO

THE UNIVERSITY OF CHICAGO
DIVISION OF THE PHYSICAL SCIENCES
DEPARTMENT OF PHYSICS
530 SOUTH EAST ASIAN AVENUE
CHICAGO, ILLINOIS 60607
TEL. 773-835-3100
FAX 773-835-3100
WWW.PHYSICS.UCHICAGO.EDU

THE UNIVERSITY OF CHICAGO
DIVISION OF THE PHYSICAL SCIENCES
DEPARTMENT OF PHYSICS
530 SOUTH EAST ASIAN AVENUE
CHICAGO, ILLINOIS 60607
TEL. 773-835-3100
FAX 773-835-3100
WWW.PHYSICS.UCHICAGO.EDU

ticularly significant in scores on the sections on graphs and problems. When matched on the basis of Orleans Algebra Prognosis Test Scales the same trends, but of lesser degree, were found.

Bells and Fox⁴ found boys superior to girls in achievement in high school Mathematics among 6,000 first year students in California junior colleges. While boys made slightly superior scores on the American Council On Education Psychological Examination, (138.0 to 136.8), they made greatly superior scores on the Mathematics section of the Iowa High School Contest Examination, (34.74 to 25.20), a difference of 9.54 ± 0.23 . When groups of boys and girls equalized as to age and high school preparation were selected for study, there was still a distinct and significant superiority of boys.

Pease⁵ made a study of sex differences in algebraic ability with data reported which seems to show a slight superiority in favor of girls.

Hankse⁶ made a study of 125 boys and 105 girls in

⁴ W. C. Bells and C. S. Fox, "Sex Differences in Mathematical Achievement of Junior College Students," Journal of Educational Psychology, 23:381-386, 1932.

⁵ G. R. Pease, "Sex Differences in Algebraic Ability," Journal of Educational Psychology, 21:712-714, 1930.

⁶ C. F. Hankse, "Sex Differences in High School Chemistry," Journal of Educational Research, 23:412-416, 1931.

Chemistry in the Emmerich Manual Training High School, Indianapolis. The results of a Terman Group Test of Mental Ability gave similar scores for the two groups. On the average, boys were five months older than the girls. Rich Chemistry tests and improvised inventory tests were administered. Before the course in Chemistry, the boys had the advantage of more extensive training in other sciences. In fifteen of the eighteen tests, the boys were found to be superior to the girls. In two tests, and probably in six others, the differences were found to be statistically significant.

Hurd⁷ made a comparative study with 134 pairs of high school boys and girls in achievement in Physical Science. The groups were matched in age. Boys were found superior in preliminary tests. After eighteen class periods of instruction, the difference was considerably smaller.

Kelly⁸ made an investigation of the reading abilities of Spanish and English speaking pupils. The Iowa Silent Reading Tests were given to 692 pupils, 303 of which were

⁷ A. W. Hurd, "Sex Differences in Achievements in Physical Science," Journal of Educational Psychology, 25-70, 1934.

⁸ V. H. Kelly, "The Reading Abilities of Spanish and English Speaking Pupils," Journal of Educational Research, 29:209-211, 1935.

Spanish speaking. The pupils ranged from the fourth to the eighth grade. The Spanish were below the normal for comprehension and below the English speaking group in such fields as vocabulary, selection of central ideas, reading of sentences, and reading rate.

Manuel⁹ says, "Intelligence tests and school records show that the Mexican child ranks below the average school child in Texas."

SUMMARY AND LIMITATIONS OF STUDIES REVIEWED

A general summary of the studies reviewed would indicate: (1) that very marked differences were found between high school senior groups as well as between individual pupils; (2) boys show a superiority over girls in Science and Mathematics; (3) English speaking pupils are superior to the Spanish in practically all subjects.

Limitations of the studies reviewed are: (1) some of them are not definitely related to the investigation under consideration; (2) the number of cases studied is too small in some instances to warrant substantial conclusions.

⁹ H. T. Manuel, "The Mexican Child in Texas," Southwest Review, 17:290-302, 1932.

CHAPTER III

THE GROUPS STUDIED AND MATERIALS USED.

I. SUBJECTS

Seniors representing fifty-seven New Mexico high schools took the statewide test of academic achievement of April 8, 1938. In some instances all members of the senior class took the examination. Only the students who were reported as standing in the upper half of the class and could be classified as Spanish or Anglo were used for this study. There were too few of the various other nationalities to justify a comparative study. After rejecting those nationalities, those of unknown ages, and those who could not be definitely classified, there remained 74 Spanish males, 89 Spanish females, 340 Anglo males, and 455 Anglo females to make a grand total of 958 subjects.

II. TESTS

Detailed information concerning the tests used, General Scholarship Test for High School Seniors, of the Ohio State Department of Education, is contained in Table I.

Test I--English--was composed of two parts, Practical English Usage Test and Literature by Dr. Tom Burns Haber, Department of English, The Ohio State University. Test II--

THE WHITE PAPER

1. INTRODUCTION

General introduction to the subject of the paper.

Section 1 of the White Paper deals with the general principles of the subject. It is divided into two parts. The first part deals with the general principles of the subject, and the second part deals with the specific details of the subject. The first part is divided into two sections. The first section deals with the general principles of the subject, and the second section deals with the specific details of the subject. The second part is divided into two sections. The first section deals with the general principles of the subject, and the second section deals with the specific details of the subject. The first part is divided into two sections. The first section deals with the general principles of the subject, and the second section deals with the specific details of the subject. The second part is divided into two sections. The first section deals with the general principles of the subject, and the second section deals with the specific details of the subject.

2. CONCLUSION

Section 2 of the White Paper deals with the conclusion of the subject. It is divided into two parts. The first part deals with the general principles of the subject, and the second part deals with the specific details of the subject. The first part is divided into two sections. The first section deals with the general principles of the subject, and the second section deals with the specific details of the subject. The second part is divided into two sections. The first section deals with the general principles of the subject, and the second section deals with the specific details of the subject. The first part is divided into two sections. The first section deals with the general principles of the subject, and the second section deals with the specific details of the subject. The second part is divided into two sections. The first section deals with the general principles of the subject, and the second section deals with the specific details of the subject.

TABLE I

DESCRIPTION OF TESTS

Test	Sub-Tests	No. of Items	Time	Scoring
1. English	1. Practical English Usage 2. Literature	40 40	45 min.	No. Right "
2. Functioning Social Science	1. The World 2. America 3. Current Social Problems	30 25 25	45 min.	No. Right " "
3. Mathematics	1. Mathematical Information 2. Computation 3. Problems	20 16 7	45 min.	No. Right Rights x 2 Rights x 4
4. Science	4. (General)	80	45 min.	No. Right
5. Reading and Language	1. A Functional Language test 2. A Functional Reading test 3. Poetry Appreciation	45 5 15 5	45 min.	No. Right Rights x 3 Rights No. Right

Date	Description	Amount		Total	Balance
		Debit	Credit		
1917	Jan 1				100.00
	Jan 2	10.00		110.00	
	Jan 3		20.00	90.00	
	Jan 4	5.00		95.00	
	Jan 5		15.00	80.00	
	Jan 6	12.00		92.00	
	Jan 7		18.00	74.00	
	Jan 8	8.00		82.00	
	Jan 9		22.00	60.00	
	Jan 10	15.00		75.00	
	Jan 11		10.00	65.00	
	Jan 12	20.00		85.00	
	Jan 13		12.00	73.00	
	Jan 14	18.00		91.00	
	Jan 15		25.00	66.00	
	Jan 16	10.00		76.00	
	Jan 17		14.00	62.00	
	Jan 18	22.00		84.00	
	Jan 19		16.00	68.00	
	Jan 20	14.00		82.00	
	Jan 21		11.00	71.00	
	Jan 22	16.00		87.00	
	Jan 23		19.00	68.00	
	Jan 24	11.00		79.00	
	Jan 25		13.00	66.00	
	Jan 26	19.00		85.00	
	Jan 27		17.00	68.00	
	Jan 28	13.00		81.00	
	Jan 29		15.00	66.00	
	Jan 30	21.00		87.00	
	Jan 31		18.00	69.00	
	Feb 1	17.00		86.00	
	Feb 2		14.00	72.00	
	Feb 3	15.00		87.00	
	Feb 4		12.00	75.00	
	Feb 5	18.00		93.00	
	Feb 6		16.00	77.00	
	Feb 7	12.00		89.00	
	Feb 8		10.00	79.00	
	Feb 9	20.00		99.00	
	Feb 10		18.00	81.00	
	Feb 11	14.00		95.00	
	Feb 12		11.00	84.00	
	Feb 13	16.00		100.00	
	Feb 14		14.00	86.00	
	Feb 15	11.00		97.00	
	Feb 16		13.00	84.00	
	Feb 17	19.00		103.00	
	Feb 18		17.00	86.00	
	Feb 19	13.00		99.00	
	Feb 20		15.00	84.00	
	Feb 21	21.00		105.00	
	Feb 22		19.00	86.00	
	Feb 23	17.00		103.00	
	Feb 24		15.00	88.00	
	Feb 25	15.00		103.00	
	Feb 26		13.00	90.00	
	Feb 27	23.00		113.00	
	Feb 28		21.00	92.00	
	Feb 29	19.00		111.00	
	Feb 30		17.00	94.00	
	Mar 1	15.00		109.00	
	Mar 2		15.00	94.00	
	Mar 3	13.00		107.00	
	Mar 4		13.00	94.00	
	Mar 5	21.00		115.00	
	Mar 6		19.00	96.00	
	Mar 7	17.00		113.00	
	Mar 8		17.00	96.00	
	Mar 9	25.00		121.00	
	Mar 10		23.00	98.00	
	Mar 11	21.00		119.00	
	Mar 12		19.00	100.00	
	Mar 13	19.00		119.00	
	Mar 14		17.00	102.00	
	Mar 15	27.00		129.00	
	Mar 16		25.00	104.00	
	Mar 17	23.00		127.00	
	Mar 18		21.00	106.00	
	Mar 19	25.00		131.00	
	Mar 20		23.00	108.00	
	Mar 21	27.00		135.00	
	Mar 22		25.00	110.00	
	Mar 23	25.00		135.00	
	Mar 24		23.00	112.00	
	Mar 25	29.00		141.00	
	Mar 26		27.00	114.00	
	Mar 27	27.00		141.00	
	Mar 28		25.00	116.00	
	Mar 29	29.00		145.00	
	Mar 30		27.00	118.00	
	Mar 31	27.00		145.00	

RECEIVED BY THE BANK

1917

Social Science, World, America, and Current Social Problems-- by J. W. Sherburne and J. H. Patsky, the Ohio State University. Test III--Mathematics--contained three sub-tests: Mathematical Information, Computation, and Problems, by Harry S. Pollard and H. C. Christofferson, Miami University. Test IV--Science--was made up of four unnamed parts, by A. W. Stewart, Kent State University, Kent, Ohio. Test V--Reading and Language--was composed of three parts: A Functional Language Test, A Functional Reading Test, and Poetry Appreciation, by Lucile D. Smith, Ph. D., Department of English, Wittenberg College, Springfield, Ohio.

III. RELIABILITY COEFFICIENTS

Every paper from the Spanish males and every fourth paper from the Anglo females was drawn for computation of reliability coefficients. The papers from the Anglo female group were drawn at random with the exception of being arranged by schools. The mean total score from the random sampling was 157.57 with a standard deviation of 39.10. The mean total score of the remaining Anglo female group was 158.93 with a standard deviation of 35.96. The slight difference of 1.36 justifies the use of the random sampling for statistical analysis. Scores on odd numbered items were correlated with scores on even numbered items for each part and the total of each test; there were two exceptions--Test

Social Science, 1914, vol. 1, no. 1, p. 1.
 by J. H. Stoddard and J. H. Stoddard, 1914, p. 1.
 fifty. Test IV--Stoddard--Stoddard, 1914, p. 1.
 Mathematical Information, 1914, p. 1.
 Henry S. Stoddard and J. H. Stoddard, 1914, p. 1.
 Test IV--Stoddard--Stoddard, 1914, p. 1.
 Stoddard, Henry S. Stoddard, 1914, p. 1.
 and language--was composed of three parts: a
 Language Test, a Functional Reading Test, and a
 Test, by Lucile H. Stoddard, 1914, p. 1.
 Stoddard College, Springfield, Ohio.

III. RELIABILITY COEFFICIENTS

Every paper from the Standard series was given to every
 paper from the same series and each for comparison
 reliability coefficients. The papers from the same series
 group were drawn at random with the exception of being
 arranged by schools. The mean total score from the series
 sampling was 127.57 with a standard deviation of 22.10. The
 mean total score of the remaining series was 127.57
 128.95 with a standard deviation of 22.14. The slight
 difference of 1.38 constitutes the use of the series sampling
 for statistical analysis. Scores on all individual items were
 correlated with scores on each language test for each
 and the total of each test; these gave the correlation-

IV--Science, where only the total was used, and Test V--Reading and Language, where parts II and III, both very short tests, were combined. The correlations obtained were corrected by the Spearman-Brown prophecy formula to give total reliabilities. The reliability, Test III--Mathematics, Part I, for Spanish males is very low. The reliabilities of the other parts of the examination are given in Table II.

IV. APPLICATION OF THE PUNCHED CARD METHOD OF MACHINE COMPUTATION

In recent years, tabulating machine equipment has been extremely useful in facilitating statistical work with psychological and educational tests. This study would not have been possible if it had not been for this equipment. Since 1931, the perfected progressive digit method has been used when an automatic multiplying punch is not available. The method eliminates the use of a calculator in getting the necessary sums of variables, sums of squares, and sums of products.

A brief discussion of the machine tabulation for this investigation would seem appropriate. The first step after the scoring of the papers and establishing the reliability coefficients for each test, which have been previously mentioned, was to punch a card for each pupil for each item

TABLE II
RELIABILITY COEFFICIENTS OF TEST
TOTALS AND THE SUB-TESTS

	SPANISH MALES	ANGLO FEMALES
Test	Reliability*	Reliability*
Test I Part I	.843	.773
" Part II	.917	.957
" Total	.914	.913
Test II Part I	.703	.632
" Part II	.546	.558
" Part III	.554	.637
" Total	.780	.822
Test III Part I	.768	.480
" Part II	.735	.784
" Part III	.757	.647
" Total	.843	.864
Test IV Total	.787	.891
Test V Part I	.885	.835
" Parts II-III	.569	.551
" Total	.853	.784

*Corrected by Spearman-Brown Prophecy Formula

TABLE II

RELIABILITY OF TESTS OF VARIOUS
TESTS AND THE TOTAL

RELIABILITY OF TESTS OF VARIOUS TESTS AND THE TOTAL		
Test	Reliability	Test
Test I Part I	.845	.775
" Part II	.815	.755
" Total	.815	.765
Test II Part I	.805	.755
" Part II	.805	.755
" Part III	.805	.755
" Total	.805	.755
Test III Part I	.805	.755
" Part II	.805	.755
" Part III	.805	.755
" Total	.805	.755
Test IV Total	.805	.755
Test V Part I	.805	.755
" Parts II-III	.805	.755
" Total	.805	.755

*Corrected by Spearman-Brown method formula

of information given in the following code, ranging in numbers from 1 to 43.

of information given in the following pages, and in the

reports from 1 to 10.

Code Used for Punching Cards

- 1-Study number
- 2,3-High School number
- 4,5,6-Pupil number
- 7-Coded: 0, All class did not take exam.; 1, upper half; 2, lower half.
- 8-Sex. To be coded: Male 1, Females 2.
- 9,10-Age in years
- 11,12-Test I Part I
- 13,14-Test I Part II
- 15,16-Test I Total
- 17,18-Test II Part I
- 19,20-Test II Part II
- 21,22-Test II Part III
- 23,24-Test II Total
- 25,26-Test III Part I
- 27,28-Test III Part II
- 29,30-Test III Part III
- 31,32-Test III Total
- 33,34-Test IV Total
- 35,36-Test V Part I
- 37,38-Test V Part II
- 39,40-Test V Total
- 41,42,43-Total score

The next procedure was to place the cards in the sorter and to separate the cards of each sex and cultural group.

The tabulating machine was wired for four variables at a time in most instances. While the cards for each sex and cultural group were sorted on each variable, the sort was correctly labeled on the tape of the tabulating machine. The cards were taken from the sorting machine in reverse order so as to present the cards bearing 9 in the column on which the sorting was done to the tabulator first, those bearing 8 second, and so on. If any digits were missing in the sorting process, blank cards were inserted for the missing digits in order that the missing digit would be printed the respective number of times necessary to retain the proper progressive total. This process was repeated until the cards had been sorted and progressively totaled on each column of each variable for each sex and cultural group. The accuracy of the work was checked constantly. The last number in each group of progressive totals must be the same for an entire column and must equal the grand total for that variable.

After the tabulating had been finished, the next step was, by use of the adding machine, to add each group of progressive totals, and then total those sums for each block after affixing one zero at the right of the sums for the

The next procedure was to place the subjects in the
center and to observe the effects of the various
groups.

The following procedure was used for the various
at a time in each instance. The subjects were
and various groups were tested in each instance. The
was correctly labeled on the left of the procedure and
The cards were taken from the center of the
order so as to present the cards in the same
which the testing was done by the subjects. The
bearing 6 seconds, and on the 11th and 12th cards
the testing procedure, since cards were labeled for the
missing digits in order that the subjects might know
placed the respective number of lines necessary to
the proper progressive totals. This was done and repeated
until the cards had been tested. The results were
each column of each variable for each and each variable.
The accuracy of the work was checked by repeating the
number in each group of progressive totals and in the
for an entire column and what each card was tested for
variable.

After the testing was completed, the results were
was by use of the adding machine, and the results were
progressive totals, and then the 11th and 12th cards were
after adding one more to the right of the first card.

first digit. A similar check was made for the sums of products to that of the progressive and grand totals mentioned above. The correlation coefficients (r 's), standard deviations, and all other measurements were calculated from those sums, sums of squares, and sums of products.

VI. STATISTICAL PROCEDURE

The remainder of the work was done with a calculating machine. The following calculations were performed:

1. A total of 192 intercorrelations were obtained; sixty of these were for the six-variable problem, five tests plus age, for the four groups. The sub-tests and age made the twelve variable problem, with 132 intercorrelations for the Anglo males and Anglo females.
2. A total of 192 probable errors of the correlations were computed.
3. Intercorrelations of 8 variables for the Spanish males and Anglo females were corrected for attenuation.
4. Forty partial correlations were computed for the four groups on the five tests, holding the variability due to age constant. Partial correlations were not computed for the sub-tests.
5. Forty-one comparisons, using critical ratios, were made for the four groups on examination totals, the five test totals, and for the Anglo groups on the sub-tests.

6. Factor analysis was applied to all the raw correlation coefficients of the tests and sub-tests.

7. The results of the six steps mentioned above were compiled into tables and figures for the interpretation as is given in the succeeding chapters.

6. Factor analysis was applied to all the variables
in the correlation matrix of the tests and sub-tests.
7. The results of the six factor analysis were
compared into tables and figures for the interpretation
is given in the preceding chapters.

57000
BY BOND

CHAPTER IV

SEX AND CULTURAL DIFFERENCES IN ACHIEVEMENT

The four groups--Spanish males, Spanish females, Anglo males, and Anglo females--are compared as to the reliability of the differences between the means for the examination and the five tests. The same comparison is given for the Anglo males and Anglo females for the sub-tests. The reliability of the difference between the means is presented in terms of the quotients of the differences, or the critical ratios. Detailed comparisons are recorded in Tables and Figures. All numbers in the tables have been rounded to two decimals.

I. SEX AND CULTURAL DIFFERENCES ON THE EXAMINATION

The six comparisons for the four groups on the examination are shown in Table III. Reliable differences were found for each comparison, with the exception of the comparison between the sexes of the Spanish groups. The difference between the means of 15.93 in favor of the males gave a critical ratio of 2.93, which lacked .07 being conventionally reliable. To insure practically complete reliability, a critical ratio of three or a quotient of three should be obtained between the difference of the means and the sigma

THE TWO-TEST METHOD IN RESEARCH

The two-test method is a method of research in which two tests are given to a group of subjects. The first test is given to the subjects and the results are recorded. The second test is given to the same subjects at a later date and the results are recorded. The difference between the two tests is then calculated. This method is used to determine the reliability of a test. The reliability of a test is the degree to which the test measures what it is supposed to measure. The two-test method is a simple and effective way to determine the reliability of a test. It is used in many fields of research, including psychology, education, and medicine. The two-test method is a method of research in which two tests are given to a group of subjects. The first test is given to the subjects and the results are recorded. The second test is given to the same subjects at a later date and the results are recorded. The difference between the two tests is then calculated. This method is used to determine the reliability of a test. The reliability of a test is the degree to which the test measures what it is supposed to measure. The two-test method is a simple and effective way to determine the reliability of a test. It is used in many fields of research, including psychology, education, and medicine.

ON THE RELIABILITY

The reliability of a test is the degree to which the test measures what it is supposed to measure. The two-test method is a simple and effective way to determine the reliability of a test. It is used in many fields of research, including psychology, education, and medicine. The two-test method is a method of research in which two tests are given to a group of subjects. The first test is given to the subjects and the results are recorded. The second test is given to the same subjects at a later date and the results are recorded. The difference between the two tests is then calculated. This method is used to determine the reliability of a test. The reliability of a test is the degree to which the test measures what it is supposed to measure. The two-test method is a simple and effective way to determine the reliability of a test. It is used in many fields of research, including psychology, education, and medicine. The two-test method is a method of research in which two tests are given to a group of subjects. The first test is given to the subjects and the results are recorded. The second test is given to the same subjects at a later date and the results are recorded. The difference between the two tests is then calculated. This method is used to determine the reliability of a test. The reliability of a test is the degree to which the test measures what it is supposed to measure. The two-test method is a simple and effective way to determine the reliability of a test. It is used in many fields of research, including psychology, education, and medicine.

of the difference. The order of rank as to the significance of the means was: Anglo males 183.65, Anglo females 158.70, Spanish males 144.43, and Spanish females 128.50. The greatest difference between the means was 55.15 between the Anglo males and the Spanish females.

TABLE III

THE RELIABILITY OF THE DIFFERENCES BETWEEN
THE AVERAGES FOR THE FOUR GROUPS
ON THE EXAMINATION

Group	Mean	S. D.	D*	Sigma D	$\frac{D}{\text{Sigma D}}$
Spanish M	144.43	36.41	15.93	5.48	2.93
Spanish F	128.40	32.18			
Spanish M	144.43	36.41			
Anglo M	183.65	43.39	39.22	4.83	8.11
Spanish M	144.43	36.41			
Anglo F	158.70	36.68	14.27	4.56	3.13
Spanish F	128.50	32.18			
Anglo M	183.65	43.39	55.15	4.14	13.31
Spanish F	128.50	32.18			
Anglo F	158.70	36.68	30.20	3.82	7.91
Anglo M	183.65	43.39	24.95	2.91	8.58
Anglo F	158.70	36.68			

*Difference in means

In favor of the males was not reliable. The males were

TABLE VII

THE RELATIVITY OF THE REFRACTIVE INDEX
 THE AVERAGE FOR THE TWO SERIES
 ON THE REFRACTION

Group	Series	1. 1.	1. 2.	1. 3.	1. 4.
Spanish 1	144.43	144.43	144.43	144.43	144.43
Spanish 2	143.43	143.43	143.43	143.43	143.43
Spanish 3	144.43	144.43	144.43	144.43	144.43
Spanish 4	143.43	143.43	143.43	143.43	143.43
Spanish 5	144.43	144.43	144.43	144.43	144.43
Spanish 6	143.43	143.43	143.43	143.43	143.43
Spanish 7	144.43	144.43	144.43	144.43	144.43
Spanish 8	143.43	143.43	143.43	143.43	143.43
Spanish 9	144.43	144.43	144.43	144.43	144.43
Spanish 10	143.43	143.43	143.43	143.43	143.43
Spanish 11	144.43	144.43	144.43	144.43	144.43
Spanish 12	143.43	143.43	143.43	143.43	143.43
Spanish 13	144.43	144.43	144.43	144.43	144.43
Spanish 14	143.43	143.43	143.43	143.43	143.43
Spanish 15	144.43	144.43	144.43	144.43	144.43
Spanish 16	143.43	143.43	143.43	143.43	143.43
Spanish 17	144.43	144.43	144.43	144.43	144.43
Spanish 18	143.43	143.43	143.43	143.43	143.43
Spanish 19	144.43	144.43	144.43	144.43	144.43
Spanish 20	143.43	143.43	143.43	143.43	143.43

DIFFERENCE IN DEGREE

of the difference.¹ The order of rank as to the magnitude of the means was: Anglo males 183.65, Anglo females 158.70, Spanish males 144.43, and Spanish females 128.40. The greatest difference between the means was 55.25 between the Anglo males and the Spanish females.

II. DIFFERENCES BETWEEN SPANISH MALES AND SPANISH FEMALES

The differences in achievement between the Spanish males and the Spanish females for the five tests are shown in Table IV. The Spanish females were slightly superior to the Spanish males in English. The difference between the means was found to be 1.12, with a quotient of .67 between that difference and the sigma of the difference. The chances are approximately seventy-five in one hundred that the true difference was greater than zero. In Social Science, the males were superior to the females. The difference in the means was 2.42 with a critical ratio of 2.09. The chances are ninety-eight in one hundred that the true difference was greater than zero, yet the difference was not completely reliable. The difference found in the means for Mathematics in favor of the males was not reliable. The males were

¹ Henry E. Garrett, Statistics in Psychology and Education (New York: Longmans, Green and Company, 1935) p. 133.

of the difference. The order of means as to the difference
 the means was: male males 1.15, female 1.10, male 1.05,
 Spanish males 1.00, and female 0.95. The
 greatest difference between the means was 0.20 between the
 male males and the Spanish females.

II. DIFFERENCES BETWEEN THE SEXES

THE MALE SEX

The difference in behavior between the male
 males and the Spanish females for the five tests are shown
 in Table IV. The Spanish females were slightly superior to
 the Spanish males in all five. The difference between the
 means was found to be 1.15, with a standard error of 0.05.
 That difference and the error of the difference are shown
 are approximately equal. The difference between the means
 difference was greater than zero. In fact, the difference
 males were superior to the females. The difference in the
 means was 1.15 with a standard error of 0.05. The difference
 are almost equal in the number of the two sexes.
 greater than zero, for the difference was 1.15 with a standard
 reliable. The difference found in the number of the two sexes
 in favor of the males was 1.15 with a standard error of 0.05.

¹ Henry E. Garrett, *Psychology of Intelligence*, 1912, p. 100.
 edition (New York: Holt, Rinehart & Co., 1912).

TABLE IV

THE RELIABILITY OF THE DIFFERENCES BETWEEN THE
AVERAGES OF SPANISH MALES AND SPANISH
FEMALES ON THE FIVE TESTS

Variables	Groups compared	Means	S.D.	D*	Sigma D	D
						Sigma D
1. English	Spanish M	23.57	10.68			
	Spanish F	24.69	10.41	1.12	1.66	.67
2. Social Science	Spanish M	29.55	6.87	2.42	1.16	2.09
	Spanish F	27.13	7.98			
3. Mathematics	Spanish M	24.42	13.17	5.22	1.83	2.85
	Spanish F	19.20	9.42			
4. Science	Spanish M	29.34	9.60	6.96	1.30	5.33
	Spanish F	22.38	6.37			
5. Reading and Language	Spanish M	37.80	8.74	.45	1.45	.31
	Spanish F	37.35	9.81			

*Difference in means

THE UNIVERSITY OF THE SOUTH PACIFIC
SCHOOL OF DISTANCE EDUCATION
SUVA, FIJI

Enrolled	Group	Name	Age	Sex	Grade	Year	Month	Day	Time
1. English	English	John A. M. M. M.	20.00	M	10.00	10.00	10.00	10.00	10.00
2. Social Science	English	John A. M. M. M.	20.00	M	10.00	10.00	10.00	10.00	10.00
3. Mathematics	English	John A. M. M. M.	20.00	M	10.00	10.00	10.00	10.00	10.00
4. Science	English	John A. M. M. M.	20.00	M	10.00	10.00	10.00	10.00	10.00
5. History and Geography	English	John A. M. M. M.	20.00	M	10.00	10.00	10.00	10.00	10.00

*Differences in name

significantly superior to the females in Science with a difference in the means of 4.42. The difference resulted in a critical ratio of 5.33. In Reading and Language, a slight difference obtained in favor of the males. The critical ratio of .31 was the smallest difference found between the two groups. The Spanish females excelled the Spanish males only in English, and the difference was not significant. The males were superior in Social Science, Mathematics, Reading and Language, and Science. The only reliable difference found between the Spanish groups was the difference for Science.

III. DIFFERENCES BETWEEN SPANISH MALES AND ANGLO MALES

A comparison of the differences in the means between the Spanish males and the Anglo males is given in Table V. Reliable differences were found to obtain in favor of the Anglo males in all the tests. The greatest difference obtained for Mathematics. The difference in the means was 14.23, with a critical ratio of 8.10. The next greatest differences were noted for Science and Social Science. The differences in the means were 9.25 and 6.09 respectively. The least differences were noted for English and Language, yet those differences were completely reliable. More briefly, a reliable difference was found favoring the Anglo males

TABLE V

THE RELIABILITY OF THE DIFFERENCES BETWEEN THE
AVERAGES OF SPANISH MALES AND ANGLO
MALES ON THE FIVE TESTS

Variables	Groups	Means	S.D.	D*	Sigma D	$\frac{D}{\text{Sigma D}}$
1. English	Spanish M	23.57	10.06			
	Anglo M	27.70	10.10	4.13	1.36	3.05
2. Social Science	Spanish M	29.55	6.87			
	Anglo M	35.64	8.00	6.09	.91	6.70
3. Mathematics	Spanish M	24.42	13.17			
	Anglo M	38.64	15.88	14.23	1.76	8.10
4. Science	Spanish M	29.34	9.60			
	Anglo M	38.59	12.13	9.25	1.30	7.14
5. Reading and Language	Spanish M	37.80	8.74			
	Anglo M	42.88	9.24	5.09	1.13	4.49

*Difference in means

TABLE V

THE RELATIONSHIP OF THE DEGREE OF
POLARIZATION OF LIGHT TO THE
ANGLE OF INCIDENCE

Incidence Angle	Angle of Polarization	Angle of Incidence	Angle of Polarization	Angle of Incidence	Angle of Polarization
0°	0°	10°	10°	20°	20°
10°	10°	20°	20°	30°	30°
20°	20°	30°	30°	40°	40°
30°	30°	40°	40°	50°	50°
40°	40°	50°	50°	60°	60°
50°	50°	60°	60°	70°	70°
60°	60°	70°	70°	80°	80°
70°	70°	80°	80°	90°	90°
80°	80°	90°	90°		

* Difference in degrees

for all the tests. The greatest difference obtained in Mathematics. The least differences were found for the strictly verbal tests of English, and Reading and Language.

IV. DIFFERENCES BETWEEN SPANISH MALES AND ANGLO FEMALES

The differences between the Spanish males and the Anglo females for the five tests are recorded in Table VI. The Anglo females were reliably superior in achievement for English. The difference in the means was 5.67, and the critical ratio was 4.26. In Social Science, the Anglo females were significantly superior with a difference of 2.76 in the means. Less difference obtained for Social Science than did for English. No reliable differences were found between the two groups for Mathematics and Science. In terms of the differences in the means and critical ratios, less difference obtained for Science than for any other test. The Anglo females were found reliably superior in Reading and Language. The difference in the means of 4.97 was slightly smaller than the difference noted for English, but the critical ratio of 4.48 was the most reliable difference that existed between the two groups. The Anglo females excelled the Spanish males in all five of the tests. They were reliably superior in English, Social Science, and Reading and Language, but not in Mathematics or Science. The

TABLE VI

THE RELIABILITY OF THE DIFFERENCES BETWEEN THE
AVERAGES OF SPANISH MALES AND ANGLO
FEMALES ON THE FIVE TESTS

Variables	Groups compared	Means	S.D.	D*	Sigma D	$\frac{D}{\text{Sigma D}}$
1. English	Spanish M Anglo F	23.57 29.24	10.68 10.19	5.67	1.33	4.26
2. Social Science	Spanish M Anglo F	29.55 32.32	6.87 7.54	2.76	.87	3.16
3. Mathematics	Spanish M Anglo F	24.42 26.84	13.17 12.62	2.42	1.64	1.47
4. Science	Spanish M Anglo F	29.34 27.45	9.60 7.99	1.89	1.18	1.60
5. Reading and Language	Spanish M Anglo F	37.80 42.77	8.74 9.51	4.97	1.11	4.48

*Difference in means

TABLE II

THE RELIABILITY OF THE ALTIMETER METHOD FOR
MEASURING THE ALTITUDE OF MOUNTAINS
BY THE USE OF BAROMETERS

Station	Barometer	Altitude	Barometer	Altitude
1. English	Barometer 2 27.11 10.10	Altitude 7 27.11 10.10	Barometer 2 27.11 10.10	Altitude 7 27.11 10.10
2. Goulai	Barometer 2 27.11 10.10	Altitude 7 27.11 10.10	Barometer 2 27.11 10.10	Altitude 7 27.11 10.10
3. Kachin	Barometer 2 27.11 10.10	Altitude 7 27.11 10.10	Barometer 2 27.11 10.10	Altitude 7 27.11 10.10
4. Goulai	Barometer 2 27.11 10.10	Altitude 7 27.11 10.10	Barometer 2 27.11 10.10	Altitude 7 27.11 10.10
5. Kachin and Goulai	Barometer 2 27.11 10.10	Altitude 7 27.11 10.10	Barometer 2 27.11 10.10	Altitude 7 27.11 10.10

Difference in feet

greatest and most reliable differences were noted for the strictly verbal tests of English and Reading and Language, in that the differences in the means were greater than those for the other tests, and the critical ratios were also larger. The differences found between the Spanish males and the Anglo females were the opposite of those found between the Spanish males and the Anglo males where the least differences were found for the strictly verbal tests.

V. DIFFERENCES BETWEEN SPANISH FEMALES AND ANGLO MALES

The differences between the Spanish females and the Anglo males on the five tests are recorded in Table VII. For the test in English, the Anglo males were not reliably superior to the Spanish females. The difference in the means was 3.02 in favor of the Anglo males, and a critical ratio of 2.45 obtained. The chances are ninety-nine in one hundred that the true difference is greater than zero. In the other four tests, a reliable difference was found to obtain in favor of the Anglo males. The greatest difference noted was for Mathematics with a difference in the means of 18.67, and a critical ratio of 14.17. The most reliable difference existed for Science. The difference in the means was 16.20 with a critical ratio of 17.20. Those differences for Mathematics and Science were the greatest differences found

greatest and most reliable differences were found for the strictly verbal tests of English and Spanish. In that the differences in the means were greater than those for the other tests, and the critical ratios were also larger. The differences found between the Spanish males and the Anglo females were the opposite of those found between the Spanish males and the Anglo males where the least differences were found for the strictly verbal tests.

V. DIFFERENCES BETWEEN SPANISH FEMALES AND ANGLO MALES

The differences between the Spanish females and the Anglo males on the five tests are recorded in Table VII. For the test in English, the Anglo males were not reliably superior to the Spanish females. The difference in the means was 3.02 in favor of the Anglo males, and a critical ratio of 2.45 obtained. The chances are ninety-nine in one hundred that the true difference is greater than zero. In the other four tests, a reliable difference was found to exist in favor of the Anglo males. The greatest difference noted was for Mathematics with a difference in the mean of 15.87, and a critical ratio of 14.17. The most reliable difference existed for Science. The difference in the mean was 15.80 with a critical ratio of 17.50. Those differences for Mathematics and Science were the greatest differences found

TABLE VII

THE RELIABILITY OF THE DIFFERENCES BETWEEN THE
AVERAGES OF SPANISH FEMALES AND ANGLO
MALES ON THE FIVE TESTS

Variables	Groups compared	Mean	S.D.	D*	Sigma D	$\frac{D}{\text{Sigma D}}$
1. English	Spanish F	24.69	10.41			
	Anglo M	27.70	10.08	3.02	1.23	2.45
2. Social Science	Spanish F	27.13	7.98			
	Anglo M	35.64	8.00	8.51	.95	8.95
3. Mathematics	Spanish F	19.98	9.42			
	Anglo M	38.64	15.88	18.67	1.32	14.17
4. Science	Spanish F	22.38	6.37			
	Anglo M	38.59	12.13	16.20	.94	17.20
5. Reading and Language	Spanish F	37.35	9.81			
	Anglo M	42.88	9.24	5.53	1.15	4.80

*Difference in the means

TABLE III

THE RELATIONSHIP OF THE PHYSICAL PROPERTIES
OF POLYMER SOLUTIONS TO THE
STRUCTURE OF THE POLYMER

Variable	Group	Mean	S.D.	By	Group
Polymer					
1. Viscosity	Styrene	1.25	0.10	1.25	0.10
	Acrylic	1.25	0.10	1.25	0.10
2. Density	Styrene	1.05	0.02	1.05	0.02
	Acrylic	1.05	0.02	1.05	0.02
3. Refractive Index	Styrene	1.50	0.01	1.50	0.01
	Acrylic	1.50	0.01	1.50	0.01
4. Solubility	Styrene	1.00	0.05	1.00	0.05
	Acrylic	1.00	0.05	1.00	0.05
5. Melting and Boiling Points	Styrene	1.00	0.05	1.00	0.05
	Acrylic	1.00	0.05	1.00	0.05

*Differences in this table

in all the sex and cultural comparisons. In Social Science, the Anglo males were significantly superior, with a difference in the means of 8.51, and a critical ratio of 8.95. The critical ratio for Reading and Language of 4.80 gave a reliable difference favoring the Anglo males. The Anglo males were reliably superior to the Spanish females in achievement for Social Science, Mathematics, Science, and Reading and Language. The differences in the means were less for English and for Language than for the other tests. The critical ratios were also less for English and for Language; hence, the differences were not only greater, but they were also more reliable.

VI. DIFFERENCES BETWEEN SPANISH FEMALES AND ANGLO FEMALES

Table VIII contains the detailed differences found between the Spanish females and the Anglo females for the five tests. The Anglo females were reliably superior to the Spanish females in achievement for all the tests. The least difference was found for English. The difference in the means of 4.55, with a critical ratio of 3.79, showed the difference to be the least reliable also. As was true of the previous comparison of Spanish females and Anglo males, the greatest difference in terms of the magnitudes of the means occurred for Mathematics. The differences for Reading

in all the sex and cultural comparisons. In Social Science, the Anglo males were significantly superior, with a difference in the means of 8.51, and a critical ratio of 8.88. The critical ratio for Reading and Language of 4.80 gave a reliable difference favoring the Anglo males. The Anglo males were reliably superior to the Spanish females in achievement for Social Science, Mathematics, Science, and Reading and Language. The differences in the means were least for English and for Language than for the other tests. The critical ratios were also less for English and for Language; hence, the differences were not only greater, but they were also more reliable.

VI. DIFFERENCES BETWEEN SPANISH FEMALES AND ANGLO FEMALES

Table VIII contains the detailed differences found between the Spanish females and the Anglo females for the five tests. The Anglo females were reliably superior to the Spanish females in achievement for all the tests. The least difference was found for English. The difference in the means of 4.85, with a critical ratio of 5.75, showed the difference to be the least reliable also. As was true of the previous comparison of Spanish females and Anglo males, the greatest difference in terms of the magnitude of the means occurred for Mathematics. The differences for Reading

TABLE VIII

THE RELIABILITY OF THE DIFFERENCES BETWEEN THE
AVERAGES OF SPANISH FEMALES AND ANGLO
FEMALES ON THE FIVE TESTS

Variables	Groups compared	Mean	S.D.	D*	Sigma D	$\frac{D}{\text{Sigma D}}$
1. English	Spanish F	24.69	10.41			
	Anglo F	29.24	10.19	4.55	1.20	3.79
2. Social Science	Spanish F	27.13	7.98			
	Anglo F	32.32	7.54	5.18	.92	5.65
3. Mathematics	Spanish F	19.98	9.42			
	Anglo F	26.84	12.62	6.86	1.16	5.91
4. Science	Spanish F	22.38	6.37			
	Anglo F	27.45	7.99	5.07	.77	6.56
5. Reading and Language	Spanish F	37.35	9.81			
	Anglo F	42.77	9.51	5.42	1.13	4.79

*Difference in means

and Language ranked second to Mathematics, though the difference was not as reliable as the differences for Mathematics, Science, or Social Science. The most reliable difference obtained for Science, which was also true for the comparison between the Spanish females and the Anglo males, though the differences in the means and the critical ratios for the comparison between the Spanish females and the Anglo males were more than twice the magnitude of those for the comparison between the Spanish females and the Anglo females.

VII. DIFFERENCES BETWEEN ANGLO MALES AND ANGLO FEMALES

The differences between the sexes of the Anglo groups in achievement as measured by the five tests are shown in Table IX. One often hears the remark that the girls do better in school than the boys. The statement may be true for some of the grade levels, but the evidence, as is shown in Table IX, does not agree with the statement, with the exception of English. The same holds true for the sexes of the Spanish groups. The Anglo girls excelled the Anglo boys in English with a difference in the means of 1.54 to give a critical ratio of 2.17. The chances are ninety-eight in one hundred that the true difference is greater than zero. Practically no difference existed for Reading and Language; the result gave a critical ratio .17 in favor of the boys.

and language tended to account for the differences, though the latter was not as reliable as the differences for mathematics. Science or Social Science. The most reliable differences obtained for Science, which was also true for the comparison between the Spanish females and the Anglo males, though the differences in the means and the critical ratios for the comparison between the Spanish females and the Anglo males were more than twice the magnitude of those for the comparison between the Spanish females and the Anglo females.

VII. DIFFERENCES BETWEEN MALES

AND FEMALE

The differences between the sexes of the Anglo groups in achievement as measured by the five tests are shown in Table IX. One often hears the remark that the girls do better in school than the boys. The statement may be true for some of the grade levels, but the evidence, as is shown in Table IX, does not agree with the statement, with the exception of English. The same holds true for the scores of the Spanish groups. The Anglo girls excelled the Anglo boys in English with a difference in the means of 1.34 to give a critical ratio of 2.17. The Spanish girls were ninety-eight in the hundred that the language difference is greater than zero. Practically no differences existed for Reading and Language; the result gave a critical ratio .17 in favor of the boys.

TABLE IX

THE RELIABILITY OF THE DIFFERENCES BETWEEN THE
AVERAGES OF ANGLO MALES AND ANGLO
FEMALES ON THE FIVE TESTS

Variables	Groups compared	Means	S.D.	D*	Sigma D	$\frac{D}{\text{Sigma D}}$
1. English	Anglo M Anglo F	27.70 29.24	10.10 10.19	1.54	.73	2.17
2. Social Science	Anglo M Anglo F	35.64 32.32	8.00 7.54	3.33	.56	5.95
3. Mathematics	Anglo M Anglo F	38.64 26.84	15.88 12.62	11.81	1.04	11.32
4. Science	Anglo M Anglo F	38.56 27.45	12.13 7.99	11.14	.76	14.72
5. Reading and	Anglo M Anglo F	42.88 42.77	9.24 9.51	.11	.67	.17

*Difference in means

TABLE II

THE RELATIONSHIP OF THE CRYSTALLINITY OF
POLYETHYLENE TO ITS MECHANICAL PROPERTIES
AS A FUNCTION OF TEMPERATURE

Temperature, °C.	Crystallinity, %	Elongation at Break, %	Tensile Strength, psi	Modulus of Elasticity, psi
-100	95	100	10,000	1,000,000
-80	90	150	12,000	1,200,000
-60	85	200	14,000	1,400,000
-40	80	250	16,000	1,600,000
-20	75	300	18,000	1,800,000
0	70	350	20,000	2,000,000
20	65	400	22,000	2,200,000
40	60	450	24,000	2,400,000
60	55	500	26,000	2,600,000
80	50	550	28,000	2,800,000
100	45	600	30,000	3,000,000
120	40	650	32,000	3,200,000
140	35	700	34,000	3,400,000
160	30	750	36,000	3,600,000
180	25	800	38,000	3,800,000
200	20	850	40,000	4,000,000
220	15	900	42,000	4,200,000
240	10	950	44,000	4,400,000
260	5	1000	46,000	4,600,000
280	0	1050	48,000	4,800,000

*Determined in vacuum

The boys had a higher achievement for Social Science. The difference obtained from the means was 3.33, which gave a critical ratio of 5.95. Marked differences were noted for the superiority of the boys in Mathematics and Science. In the order of mention, the differences in the means were 11.81 and 11.14, but the critical ratios were in reverse order, with the more reliable difference in favor of the difference for Science. Some advance the view that probably the boys who do not achieve well in high school leave to find jobs. The fact that such situations do exist might account for the superiority of the boys over the girls in achievement, as was measured by all the tests with the exception of English, in which the girls excelled. The differences found for Mathematics agree with the findings of Eells and Fox,² mentioned in Chapter II. The differences found for Science agree with the findings of Hankse,³ though his study was for Chemistry alone.

VIII. DIFFERENCES BETWEEN ANGLO MALES AND ANGLO FEMALES ON THE SUB-TESTS

Very similar results were obtained from the comparisons of Anglo males and Anglo females from the sub-tests to

² Eells and Fox, op. cit.

³ Hankse, op. cit.

The boys had a higher sensitivity of taste than the girls. The differences observed from the 11.14 and 11.15, which were a critical taste of 2.55. These differences were found for the superiority of the boys in taste and texture. In the order of mention, the differences in the taste were 11.14 and 11.15, and the critical taste was in reverse order, with the taste differences in favor of the girls. Differences for texture. Some differences in the taste of the boys who do not receive well in high school taste to the boys. The fact that such differences do exist might account for the superiority of the boys over the girls in taste. None, as was mentioned by all the boys with the exception of English, in which the girls prevailed. The differences found for Mathematics agree with the findings of Jones and Jones mentioned in Chapter II. The differences in taste and texture agree with the findings of Jones, Jones and Jones, and Jones. Chemistry alone.

VIII. DIFFERENCES BETWEEN MALES AND FEMALES IN TASTE AND TEXTURE

Very similar results were obtained from the taste and texture of foods raised and raised from the same parents.

¹ Jones and Jones, 1915.
² Jones, 1915.

those obtained from the comparison on the five tests. These comparisons are shown in Table X, and in Figure I, page 37, which show the difference in the means for each of the eleven sub-tests. For English Usage the girls were reliably superior to the boys with an obtained critical ratio of 3.11. The girls were only slightly superior to the boys in Literature. The difference was not reliable. Reliable differences were found in favor of the boys over the girls in the three sub-tests in Social Science--the World, America, and Current Social Problems. Science was of a general nature with unclassified parts; therefore, the total test was used, and had been previously used for the four groups. Mathematics was composed of three sub-tests: Information, Computation, and Problems. The boys were significantly superior to the girls in all three of these with critical ratios more than three times as large as is necessary for complete reliability. The difference for Functional Language resulted in an unreliable critical ratio of 2.83 in favor of the boys. The girls were reliably superior to the boys in Functional Reading. The Anglo females were significantly superior to the Anglo males in all the English and Reading sub-tests with the exception of Language. The males were significantly superior to the females in all the sub-tests for Social Science, Mathematics, and Science. The same conclusions may be drawn from the sub-tests as may be drawn from the tests.

those obtained from the comparison on the five tests. These comparisons are shown in Table 2, and in Figure 1, page 23, which show the difference in the means for each of the eleven sub-tests. For English Usage the girls were reliably superior to the boys with an obtained critical ratio of 3.11. The girls were only slightly superior to the boys in Language. The difference was not reliable. Reliable differences were found in favor of the boys over the girls in the three sub-tests in Social Science--the World, America, and Current Social Problems. Balance was of a general nature with unclassified parts; therefore, the total test was used, and had been previously used for the four groups. Mathematics was composed of three sub-tests: Information, Computation, and Problems. The boys were significantly superior to the girls in all three of these with critical ratios more than three times as large as is necessary for complete reliability. The difference for Functional Language resulted in an unreliable critical ratio of 2.85 in favor of the boys. The girls were reliably superior to the boys in Functional Reading. The Anglo females were significantly superior to the Anglo males in all the English and Reading sub-tests with the exception of Language. The males were significantly superior to the females in all the sub-tests for Social Science, Mathematics, and Science. The same conclusions may be drawn from the sub-tests as may be drawn from the tests.

TABLE X

THE RELIABILITY OF THE DIFFERENCES BETWEEN THE
AVERAGES OF ANGLO MALES AND ANGLO
FEMALES ON THE SUB-TESTS

Variables	Groups compared	Means	S.D.	D*	Sigma D	$\frac{D}{\text{Sigma D}}$
1. English Usage	Anglo M Anglo F	17.27 18.50	5.55 5.55	1.23	.40	3.11
2. Literature	Anglo M Anglo F	10.43 10.71	6.15 6.47	.27	.45	.60
3. Social S. World	Anglo M Anglo F	10.88 9.48	3.81 3.48	1.40	.26	5.33
4. Social S. American	Anglo M Anglo F	11.88 10.68	3.28 3.15	1.20	.23	5.19
5. Social S. Problems	Anglo M Anglo F	12.86 12.16	3.24 3.22	.70	.23	3.22
6. Mathematics Information	Anglo M Anglo F	10.58 8.10	3.63 3.11	2.48	.24	10.13
7. Mathematics Computation	Anglo M Anglo F	18.17 13.89	5.67 6.17	4.29	.46	9.25
8. Mathematics Problems	Anglo M Anglo F	9.89 4.84	7.93 5.95	5.05	.51	9.86
9. Science	Anglo M Anglo F	38.56 27.45	12.13 7.99	11.14	.76	14.72
10. Functional Language	Anglo M Anglo F	24.18 22.86	6.46 6.56	1.32	.47	2.83
11. Functional Reading	Anglo M Anglo F	18.70 19.89	3.40 8.03	1.19	.27	4.37

*Difference in means

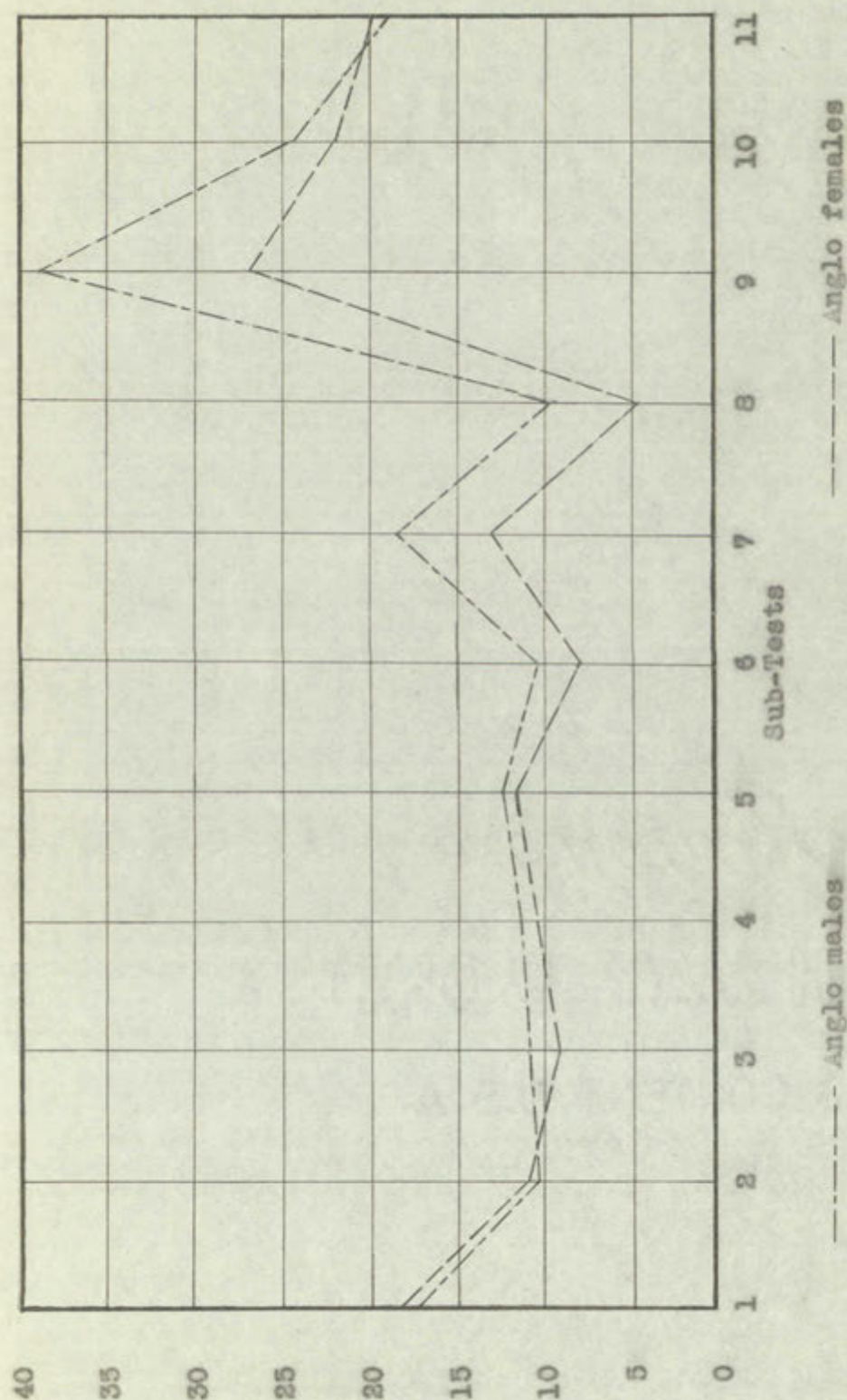
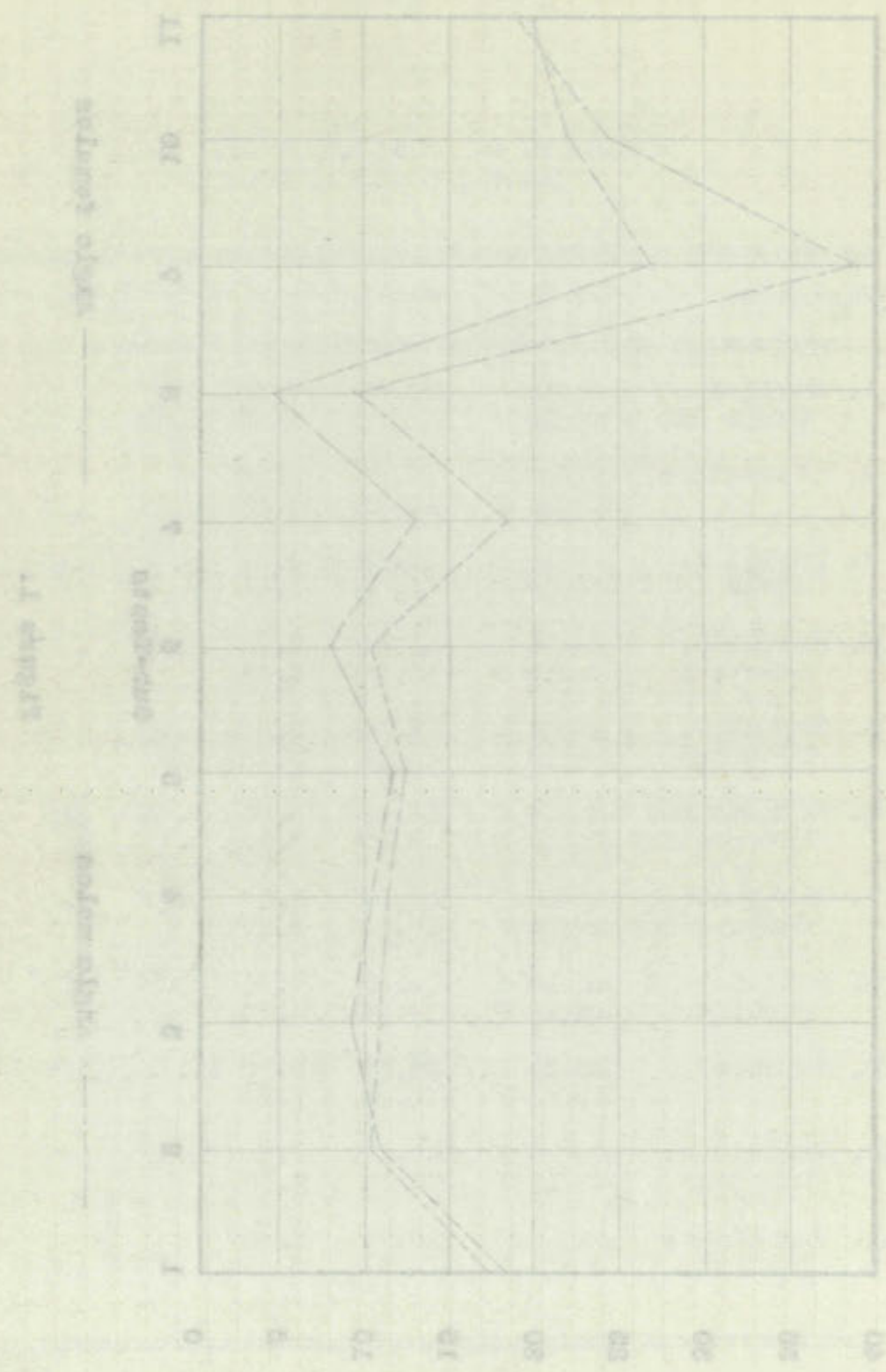


Figure 1.

Differences Between the Means for Anglo Males and
Anglo Females on the Sub-Tests.

Wien, 1890. In der 1. Auflage.
 Die 1. Auflage ist die 1. Auflage.



IX. SUMMARY

The six sets of comparisons for sex and cultural differences in achievement for the five tests and the eleven sub-tests are given in terms of the differences between the means of each test, and the critical ratios of the differences between the means and the standard deviation differences, for the four groups. A comparison of the magnitude of the means for the four groups on the five tests is shown graphically in Figure 2.

Reliable sex differences in achievement for Science were found in favor of the Spanish males over the Spanish females. The comparisons between the Spanish males and the Anglo males showed reliable differences in favor of the Anglo males for each of the five tests. The greatest and most reliable differences obtained for Mathematics, Science, and Social Science. The greatest difference was noted for Mathematics, while the most reliable difference in terms of the critical ratio was noted for Science. The Anglo females were found reliably superior to the Spanish males in English, Language, and Social Science. The Anglo males were significantly superior to the Spanish females in achievement for Mathematics, Science, Social Science, and Language. Reliable differences obtained in favor of the Anglo females over the Spanish females for each of the five tests. The Anglo males

The six sets of comparisons for each and every

difference in relationship for the five tests and the mean
and standard error of the difference between the
means of each test, and the critical ratios of the differ-
ences between the means and the standard deviation of the
means, for the four groups. A comparison of the results
of the means for the four groups on the five tests is shown
graphically in Figure 2.

Reliable sex differences in relationship for balance

were found in favor of the Spanish males over the English
males. The correlations between the Spanish males and the
English males showed reliable differences in favor of the
English males for each of the five tests. The correlations
most reliable differences obtained for relationship, balance,
and social balance. The greatest differences were noted for
relationship, while the most reliable difference in favor of
the English males was noted for balance. The only test
where found reliable difference to the Spanish males in English,
language, and social balance. The English males were slightly
superior to the Spanish females in relationship for
relationship, balance, social balance, and language. Reliable
differences obtained in favor of the English females over the
Spanish females for each of the five tests. The English females

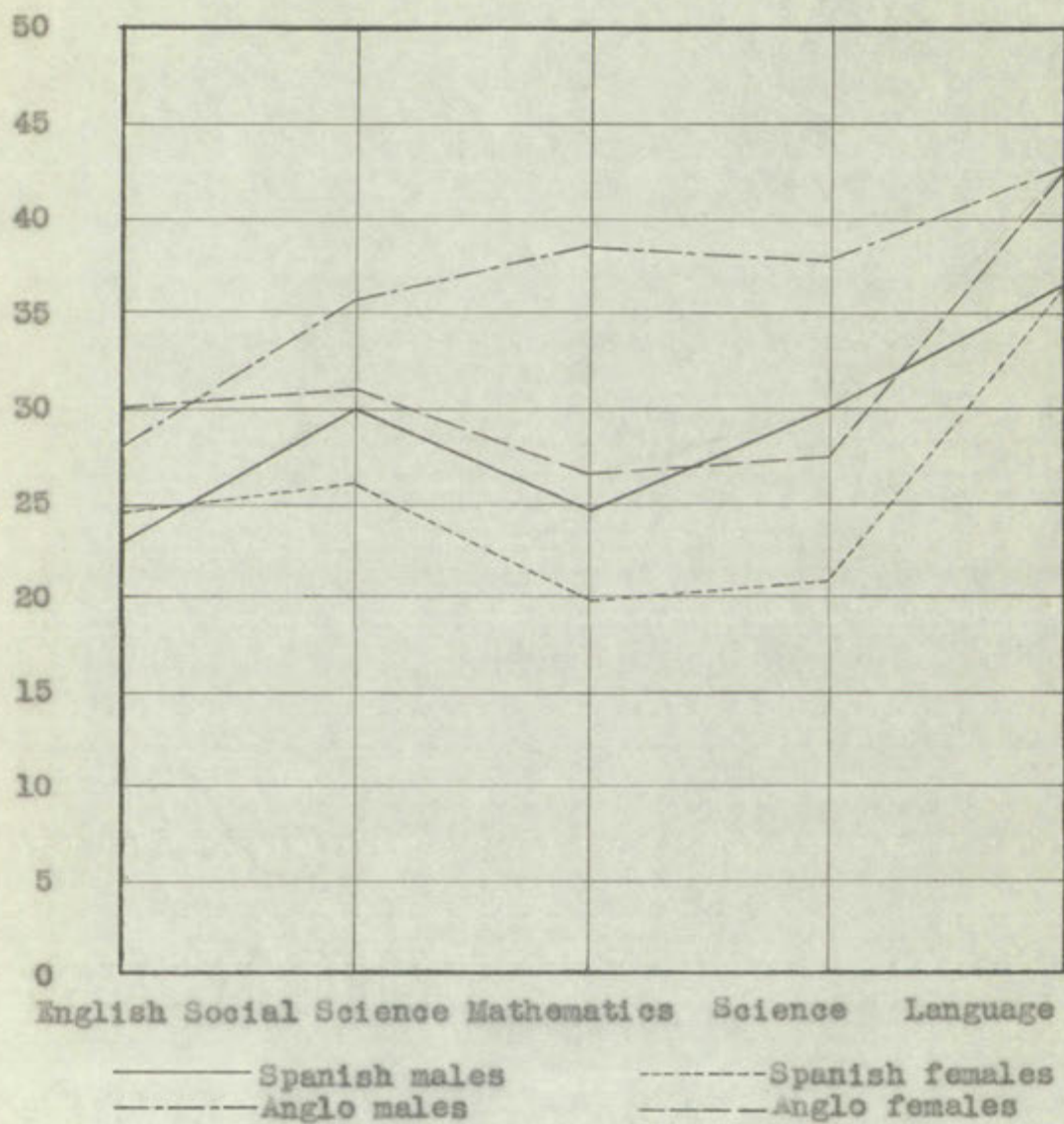


Figure 2.

Sex and Cultural Comparisons of
the Means on the Tests.

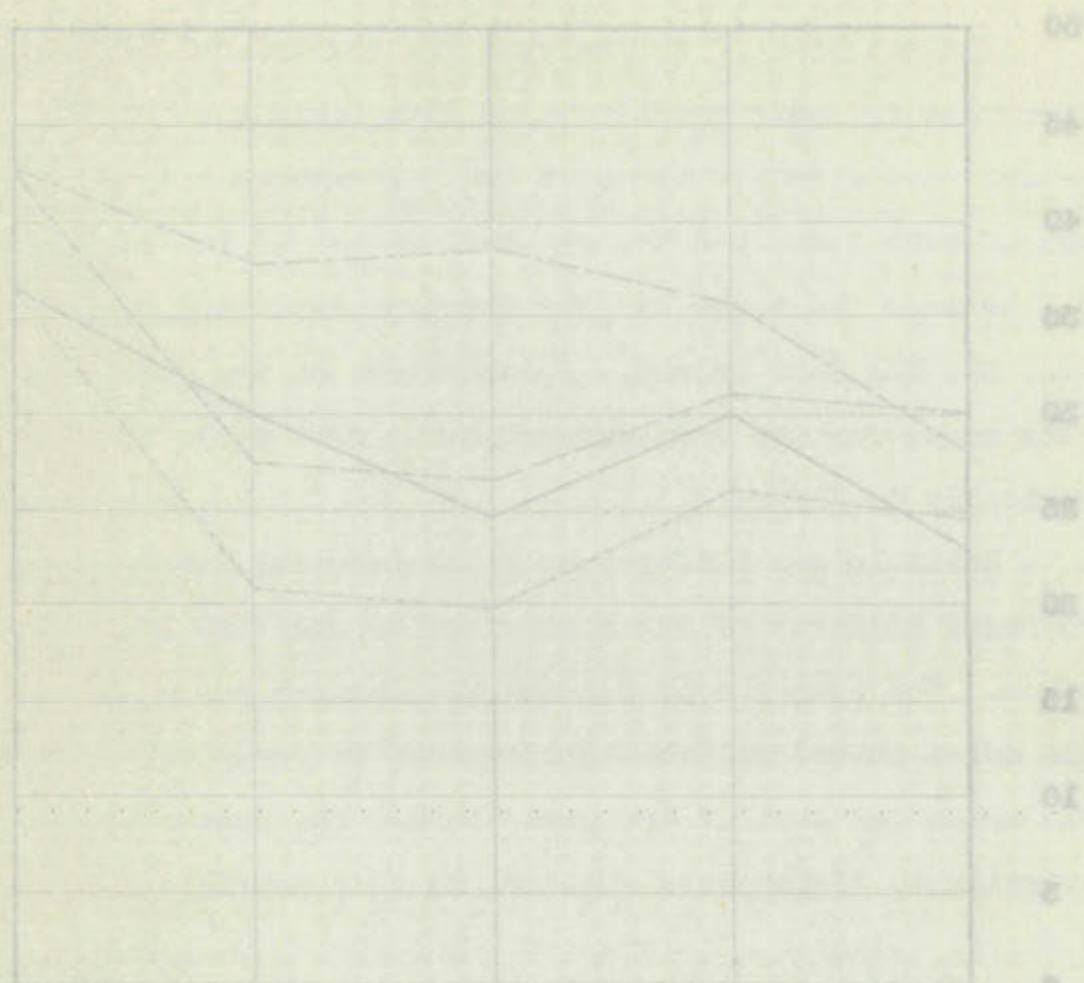


Figure 2.
Sex and Marital Status of the Population in England and Wales, 1901-1931.

were reliably superior to the Anglo females in Mathematics, Science, and Social Science in both the tests and the sub-tests. Reliable differences were found in favor of the Anglo females over the Anglo males for the sub-tests, English Usage, Literature, and Functional Reading.

were reliably superior to the Anglo females in Mathematics,
Science, and Social Studies in both the lower and the sec-
ondary. Reliable differences were found in favor of the
Anglo females over the Anglo males for the sec-
ondary English Usage, Literature, and Translating Reading.

CHAPTER V

ANALYSIS OF CORRELATIONAL RESULTS

The intercorrelations for both the tests and the subtests of the five tests are presented in this Chapter. All probable errors of the raw coefficients are contained in the various correlation tables. Intercorrelations on six variables for the Spanish males and the Anglo females are shown corrected for attenuation. Partial correlations, with the variability due to age held constant, are presented for each of the four groups, Spanish males, Spanish females, Anglo males, and Anglo females, for five variables.

I. PRELIMINARY TREATMENT OF CORRELATIONS

The intercorrelations of the five tests for the Spanish males and the Anglo females corrected for attenuation are shown in Tables XI and XII respectively. When corrected for attenuation, the coefficients obtained for those tests of high reliability showed a smaller amount of increase than did those of low reliability. For the Spanish males the highest coefficient, English correlated with Reading and Language, changed from .6825 to .8067. The lowest coefficient, Social Science correlated with Mathematics, changed from .2576 to .3057. A similar increase was noted

ANALYSIS OF CORRELATIONAL RESULTS

The intercorrelations for each of the tests and the tests of the five tests are presented in this chapter. The probable errors of the raw coefficients are contained in the various correlation tables. Intercorrelations on all variables for the Spanish males and the Anglo females are shown corrected for attenuation. Partial correlations, when the variability due to age held constant, are presented for each of the four groups, Spanish males, Spanish females, Anglo males, and Anglo females, for five variables.

1. PRELIMINARY TREATMENT OF CORRELATIONS

The intercorrelations of the five tests for the Spanish males and the Anglo females corrected for attenuation are shown in Tables XI and XII respectively. When corrected for attenuation, the coefficients obtained for those tests of high reliability showed a smaller amount of increase than did those of low reliability. For the Spanish males the highest coefficient, English corrected with English and language, changed from .6825 to .5057. Social Science coefficient, Social Science corrected with language, changed from .5075 to .3057. A similar decrease was noted

TABLE XI
INTERCORRELATIONS CORRECTED FOR ATTENUATION
FOR SPANISH MALES

Variable	1	2	3	4	5
A. Age	-.2927	-.0802	-.2467	-.1542	-.2236
1. English		.5185	.6091	.3336	.8067
2. Social Science			.3057	.3387	.4949
3. Mathematics				.5773	.6687
4. Science					.5901
5. Reading and Language					

TABLE XI

INTERCORRELATIONS COMPUTED FOR ASSOCIATION
FOR SPANISH MALES

Variable	1	2	3	4	5
1. Age	-.2927	-.0902	-.1667	-.1543	-.1833
2. English	.5185	.0001	.3350	.3887	.3887
3. Social Science		.3097	.3387	.3387	.3387
4. Mathematics			.5775	.5775	.5775
5. Science					.5001
6. Reading and Language					

TABLE XII
INTERCORRELATIONS CORRECTED FOR ATTENUATION
FOR ANGLO FEMALES

Variable	1	2	3	4	5
A. Age	-.2103	-.1807	-.1153	-.0210	-.1503
1. English		.7221	.4802	.5259	.7922
2. Social Science			.3638	.5719	.7200
3. Mathematics				.5456	.4081
4. Science					.5691
5. Reading and Language					

TABLE 1

INTERPOLATION OF DATA FOR FOR AGING STUDIES

Variable	1	2	3	4	5
A. Age	1910	1920	1930	1940	1950
B. Sex	Male	Male	Male	Male	Male
C. Social Status	1910	1920	1930	1940	1950
D. Mathematics	1910	1920	1930	1940	1950
E. Science	1910	1920	1930	1940	1950
F. Reading and Language	1910	1920	1930	1940	1950

for the Anglo females. The highest coefficient, which was between English and Reading and Language, increased from .6995 to .7922. The lowest coefficient, as was true also for the Spanish males, was the correlation between Social Science and Mathematics. The coefficient changed from .2950 to .3658. Had the increases been compared by a percentage method, they probably would have been somewhat proportional.

The reader will recall, as it was stated in Chapter III, that the test scores of all the Spanish males, and every fourth one of the test scores, or the complete examination for one-fourth of the total number of Anglo females, were used in establishing the reliability coefficients of the five tests and the sub-tests. Subsequent analyses, however, were based solely on the raw correlations.

The partialing out of Age produced only minor modifications, as is revealed in a comparison of Table XIII for the Spanish males, Table XIV for the Spanish females, Table XV for the Anglo males, and Table XVI for the Anglo females. In some instances, the correlations were higher with Age partialled out, while in others, the correlations were lower. As a general rule, when Age was partialled out the correlations tended to become lower than the original correlations. The greatest changes noted were less than .04 for any one group. From the above facts, it can probably be held that if seniors of all the same age within each group had been

for the Anglo families. The highest coefficient, which was
between English and Spanish and Portuguese, increased from
.5995 to .7982. The lowest coefficient, as was true also for
the Spanish males, was the correlation between Italian females
and Mathematics. The coefficient changed from .2850 to
.3438. Had the instances been compared by a percentage
method, they probably would have been somewhat lower.
The reader will recall, as it was stated in Chapter
III, that the test scores of all the Spanish males, and
every fourth one of the test scores, of the complete sam-
ples for one-fourth of the total number of male females
were used in establishing the reliability coefficients of
the five tests and the sub-tests. Independent analysis, how-
ever, were based solely on the raw coefficients.
The partitioning out of age produced only minor differ-
ences, as is revealed in a comparison of Table III for
the Spanish males, Table XIV for the Spanish females, Table
IV for the Anglo males, and Table V for the Anglo females.
In some instances, the correlations were higher with age
partitioned out, while in others, the partitions were lower.
As a general rule, when age was partitioned out a corre-
lation tended to become lower than the original correlations.
The greatest changes noted were less than .04 for any one
group. From the above facts, it can probably be said that
it remains of all the same age within each group and for

TABLE XIII
INTERCORRELATIONS WITH VARIABILITY
DUE TO AGE HELD CONSTANT
FOR SPANISH MALES

Variable	2	3	4	5
1. English	.4474	.4981	.2740	.6664
2. Social Science		.2478	.2829	.3914
3. Mathematics			.4913	.5293
4. Science				.4786
5. Reading and Language				

TABLE VIII

INTERCORRELATIONS WITH VARIATION
DUE TO AGE AND SEX
FOR CHINESE MALES

Variable	1	2	3	4	5
1. English	1.000				
2. Social Science	.474	1.000			
3. Mathematics	.375	.375	1.000		
4. Science	.375	.375	.375	1.000	
5. Reading and Language	.375	.375	.375	.375	1.000

TABLE XIV
INTERCORRELATIONS WITH VARIABILITY
DUE TO AGE HELD CONSTANT
FOR SPANISH FEMALES

Variable	2	3	4	5
1. English	.4797	.4658	.2968	.6528
2. Social Science		.2752	.2242	.5590
3. Mathematics			.3299	.4694
4. Science				.4590
5. Reading and Language				

TABLE XIV

INTERCORRELATIONS WITH VARIABILITY
DUE TO AGE AND CONSTANT
FOR SPANISH FEMALES

Variable	1	2	3	4	5
1. English					
2. Social Science	.4797				
3. Mathematics	.4656	.3978			
4. Science	.3986	.3648	.3379		
5. Reading and Language	.3521	.3379	.3379	.3379	

TABLE XV
INTERCORRELATION WITH VARIABILITY
DUE TO AGE HELD CONSTANT
FOR ANGLO MALES

Variable	2	3	4	5
1. English	.5836	.4794	.4952	.6473
2. Social Science		.3703	.4933	.5627
3. Mathematics			.6253	.4952
4. Science				.5365
5. Reading and Language				

INSTITUTIONAL AND COMMUNITY
FOR THE DEAF
AND MUTE

Tribute			
1. English	1900	1901	1902
2. Social Studies	1903	1904	1905
3. Mathematics	1906	1907	1908
4. Science	1909	1910	1911
5. Geography and History	1912	1913	1914

TABLE XVI
INTERCORRELATIONS WITH VARIABILITY
DUE TO AGE HELD CONSTANT
FOR ANGLO FEMALES

Variable	2	3	4	5
1. English	.5934	.4035	.4515	.6923
2. Social Science		.2834	.4510	.5781
3. Mathematics			.4450	.3366
4. Science				.4684
5. Reading and Language				

TABLE XVI

INTERCORRELATIONS WITH VARIABILITY
HOW TO USE THIS TABLE
FOR AVOID ERRORS

Variable	1	2	3	4
1. English	1.000	.850	.750	.650
2. Social Science		1.000	.800	.700
3. Mathematics			1.000	.900
4. Science				1.000
5. Reading and Language				

used for this investigation, the correlation coefficients would have been a negligible amount smaller.

The average ages in terms of whole years at the time the examination was given were as follows: Spanish males 18.283, Spanish females 17.606, Anglo males 17.305, and Anglo females 17.096. A comparison of the sexes for the two groups, Spanish and Anglos, as to age, revealed or disclosed that the Spanish males were practically one year older than the Anglo males. The Spanish females were one-half year older than the Anglo females.

II. ORIGINAL CORRELATIONS WITH THE PROBABLE ERRORS

The original correlations of the test totals for the Spanish males with the probable errors of those correlations are contained in Table XVII. All correlations with Age were negative, and were too low in comparison with the probable errors to denote the presence of any real relationship in most instances. To be reasonably sure that there is some correlation present, an obtained correlation should be at least four times its probable error.¹ The correlation between English and Reading and Language was highest, .6825

¹ Ibid, p. 133.

used for this investigation, the correlation coefficients would have been a negligible amount smaller. The average ages in terms of whole years at the time the examination was given were as follows: Spanish males 18.265, Spanish females 17.695, Anglo males 17.305, and Anglo females 17.095. A comparison of the scores for the two groups, Spanish and Anglo, as to age, revealed or disclosed that the Spanish males were practically one year older than the Anglo males. The Spanish females were one-half year older than the Anglo females.

II. ORIGINAL CORRELATIONS WITH THE PROBABLE ERRORS

The original correlations of the test scores for the Spanish males with the probable errors of those correlations are contained in Table XVII. All correlations with age were negative, and were too low in comparison with the probable errors to denote the presence of any real relationship in most instances. To be reasonably sure that there is some correlation present, an obtained correlation should be at least four times its probable error.¹ The correlation between English and Reading and Language was highest, .583.

¹ Ibid., p. 153.

TABLE XVII

ORIGINAL CORRELATIONS OF THE FIVE TESTS WITH THE
PROBABLE ERRORS OF THOSE CORRELATIONS
FOR SPANISH MALES

Variable	1	2	3	4	5
A. Age	-.2795 ±.0723	-.0745 ±.0780	-.2294 ±.0743	-.1456 ±.0769	-.1979 ±.0753
1. English		.4492 ±.0626	.5410 ±.0555	.3009 ±.0713	.6825 ±.0419
2. Social Science			.2576 ±.0732	.2899 ±.0718	.3973 ±.0660
3. Mathematics				.5065 ±.0583	.5504 ±.0546
4. Science					.4929 ±.0593
5. Reading and Language					

TABLE VIII

ORIGINAL CORRELATIONS OF THE FIVE TYPES WITH THE
PROGRAM KNOWN OF THEIR CORRELATIONS
FOR SPANISH MALES

Variable	1	2	3	4	5
A. Age	-.3795 +.0723	-.0745 +.0700	-.3294 +.0743	-.1434 +.0769	-.1401 +.0713
I. Reading	+.0222 +.0222	+.0222 +.0222	+.0222 +.0222	+.0222 +.0222	+.0222 +.0222
B. Social Science			+.0732 +.0732	+.0712 +.0712	+.0712 +.0712
C. Mathematics				+.0222 +.0222	+.0222 +.0222
D. Science					+.0222 +.0222
E. Reading and Language					

with a probable error of $\pm .0419$. Social Science correlated highest with English; Mathematics, with English and Reading and Language. Science correlated highest with Mathematics and Reading and Language. The lowest correlations were obtained from Social Science correlated with Mathematics, and from Social Science correlated with Science.

The original correlations of the five tests for the Spanish females with the probable errors of those correlations are presented in Table XVIII. All correlations with Age as a variable were negative. The correlation between Age and Social Science of $-.3235$, with a probable error of $\pm .0640$ indicated a low degree of relationship. All the other relationships with Age as a variable were less than four times their probable errors, and no relationship obtained. English correlated highest with Reading and Language, $.6494$ with a probable error of $\pm .0413$. Both Social Science and Mathematics had their highest correlations with English and Reading and Language. Science had a low correlation with Mathematics, English, and Social Science, and $.4620$ with a probable error of $\pm .0562$ with Reading and Language.

For the Anglo males as with the other groups, all original correlations with Age were negative. However, the correlations ranged from five to ten times the probable

with a probable error of ± 0.015 . Social balance correlated
highest with English; Mathematics with English and Social
and Language. Balance correlated highest with Mathematics

and Reading and Language. The lowest correlations were
obtained from Social Balance correlated with English
and from Social Balance correlated with English.

The original correlations of the five tests for the
Spanish females with the probable errors of these correla-
tions are presented in Table VIII. All correlations were

age as a variable were negative. The correlation between
age and Social Balance of -0.305 with a probable error of
 ± 0.050 indicated a low degree of relationship. All the

other relationships with age as a variable were less than
four times their probable errors, and no relationship
obtained. English correlated highest with Reading and

Language, 0.444 with a probable error of ± 0.015 . Social
Balance and Mathematics had their highest correlations with
English and Reading and Language. Balance and a low cor-

relation with Mathematics, English, and Social Balance and
 0.400 with a probable error of ± 0.021 with Reading and
Language.

For the Anglo males as with the other groups all
original correlations with age were negative. However,
the correlations ranged from five to ten times the probable

TABLE XVIII

ORIGINAL CORRELATIONS OF THE FIVE TESTS WITH
PROBABLE ERRORS OF THOSE CORRELATIONS
FOR SPANISH FEMALES

Variable	1	2	3	4	5
A. Age	-.2426 *.0673	-.3235 *.0640	-.1892 *.0689	-.0753 *.0711	-.0733 *.0711
1. English		.5188 *.0523	.4985 *.0537	.3054 *.0648	.6494 *.0413
2. Social Science			.5168 *.0643	.2559 *.0675	.5515 *.0498
3. Mathematics				.3373 *.0634	.4735 *.0555
4. Science					.4620 *.0562
5. Reading and Language					

TABLE XVII

ORIGINAL CORRELATIONS OF THE FIVE TESTS WITH
 PROBABLE KINDS OF THEIR CORRELATIONS
 FOR SPANISH FEMALES

Variable	1	2	3	4	5
A. Age	-.3423 +.0273	-.3222 +.0260	-.1892 +.0202	-.0722 +.0271	-.0222 +.0211
I. English		.8122 +.0222	.4922 +.0227	.3222 +.0222	.2222 +.0212
S. Social Science			.8122 +.0222	.3222 +.0222	.2222 +.0212
S. Mathematics				.3222 +.0222	.2222 +.0212
A. Solitaire					.2222 +.0212
S. Reading and Language					

errors, as is shown in Table XIX. Again English was most highly correlated with Reading and Language. The second highest correlation was for Mathematics with Science .6562 with a probable error of $\pm .0208$. Reading and Language ranked next to Science with its relation to Mathematics, and also ranked second to Mathematics in relation to Science. Social Science was most highly correlated with English, and second with Reading and Language. The lowest correlation for the Anglo males was for Social Science with Mathematics, .4000 with a probable error of $\pm .0307$.

The original correlations of the test totals for the Anglo females together with the probable errors of those correlations are shown in Table XX. The relationships between Age and Mathematics, and between Age and Science were less than four times their probable errors, and are therefore unreliable. The other relationships with Age as a variable were too low to insure any correlation. To be certain of a low degree of correlation a correlation coefficient should be five or six times its probable error.² English was most highly correlated with Reading and Language. Social Science correlated highest with English and second with Reading and Language. Mathematics correlated highest with Science and

² Ibid., p. 170

errors, as is shown in Table XIX. Again English was most highly correlated with Reading and Language. The second highest correlation was for Mathematics with Science. Last with a probable error of ± 0.0003 . Reading and Language were next to Science with its relation to Mathematics, and then ranked second to Mathematics in relation to Science. Science was most highly correlated with English, and second with Reading and Language. The lowest correlation for the English reader was for Social Studies with Mathematics, with a probable error of ± 0.0007 .

The original correlations of the same series for the Anglo families together with the probable errors at these correlations are shown in Table XX. The relationships between Age and Mathematics, and between Age and Science were less than four times their probable errors, and the other relationships. The other relationships with Age as a variable were too low to insure any correlation. To be certain of a low degree of correlation a correlation coefficient would be five or six times its probable error. English was most highly correlated with Reading and Language, second to Science, and third with English and second with Reading and Language. Mathematics correlated highest with Science and

TABLE XIX

ORIGINAL CORRELATIONS OF THE FIVE TESTS WITH THE
PROBABLE ERRORS OF THOSE CORRELATIONS
FOR ANGLO MALES

Variable	1	2	3	4	5
A. Age	-.2070 ±.0350	-.1864 ±.0353	-.2629 ±.0341	-.3290 ±.0326	-.2118 ±.0350
1. English		.5995 ±.0234	.5027 ±.0274	.5256 ±.0265	.6684 ±.0202
2. Social Science			.4000 ±.0307	.5190 ±.0267	.5798 ±.0243
3. Mathematics				.6562 ±.0208	.5226 ±.0266
4. Science					.5648 ±.0249
5. Reading and Language					

TABLE XIX

ORIGINAL DOCUMENTS OF THE FIVE YEARS WITH THE
 REMARKS AND OF THE COMPARISON
 OF THE SAME

Variable	I	II	III	IV	V
A. Age	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000
B. Religion	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000
C. Social Status	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000
D. Education	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000
E. Health and Language	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000	1.0000 1.0000

TABLE XX

ORIGINAL CORRELATIONS OF THE FIVE TESTS WITH THE
PROBABLE ERRORS OF THOSE CORRELATIONS
FOR ANGLO FEMALES

Variable	1	2	3	4	5
A. Age	-.2010 ±.0303	-.1596 ±.0308	-.1058 ±.0312	-.0186 ±.0316	-.1387 ±.0310
1. English		.6097 ±.0199	.4215 ±.0260	.4460 ±.0253	.6995 ±.0161
2. Social Science			.2950 ±.0287	.4481 ±.0253	.5873 ±.0207
3. Mathematics				.4444 ±.0254	.3461 ±.0278
4. Science					.4663 ±.0247
5. Reading and Language					

TABLE XX

ORIGINAL COMPARISONS OF THE FIVE TYPES WITH THE
 REMARKABLE NUMBER OF THEIR COMPARISONS
 FOR WHICH THERE IS

Variable	1	2	3	4	5
A. Age	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000
B. Height	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000
C. Social Science	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000
D. Mathematics	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000
E. Science	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000
F. Reading and Language	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000	1910-1915 1.0000

second with English; this was also true for the Anglo males, but for the two Spanish groups Mathematics had a higher relationship with both English and Reading and Language than it had with Science. Science had its highest correlation with Reading and Language, .4663 with a probable error of $\pm .0247$. This was true for the Spanish females also, while with both the Anglo males and Spanish males, Science correlated highest with Mathematics.

The original correlations for the sub-tests for the Anglo males together with the probable errors of those correlations are shown in Table XXI. For each sub-test, those having the highest correlation with it are given in descending order in the following discussion. The three tests having the highest correlation with English Usage were Functional Language, Literature, and Science. With Literature, the three were Functional Language, Social Science-World, and English Usage. With Social Science-World, the three were Literature, Functional Language, and Science. Science should probably not be compared with the sub-tests as the correlations for them were lower than for the tests used as wholes. With Social Science-America, Functional Language, Social Science-World, and Literature ranked highest. English Usage, Social Science-World, and Mathematical Problems had the highest relationships with Social Science-Current Problems. Mathematical Information correlated

second with English; this was also true for the third group
but for the two Spanish groups the correlation was a little
relationship with both English and Spanish and Spanish with
it had with Spanish. Spanish and the highest correlation
with reading and language. Also with a Spanish group of
+0.857. This was true for the Spanish group also with
with both the English and Spanish groups. Spanish with
least highest with Mathematics.

The original correlation for the two-level group
English sales together with the previous group of three groups
Latin are shown in Table III. For each group, the
having the highest correlation with the other in the
and order in the following dimension. The three groups
having the highest correlation with English were
Functional Language, Literature, and Science. With Literature
two, the three were Functional Language, Social Science
World, and English Usage. With Social Science-World, the
three were Literature, Functional Language, and Science.
Science should probably not be compared with the other
as the correlations for them were lower than for Literature
used as whole. With Social Science-Science, Functional
Language, Social Science-World, and Literature were
English Usage, Social Science-World, and Mathematical
Language had the highest relationships with Social Science-
Current Problems. Mathematical Language correlation

TABLE XXI

ORIGINAL CORRELATIONS OF THE SUB-TESTS WITH THE
PROBABLE ERRORS OF THOSE CORRELATIONS
ANGLO MALES N = 340

Variable	1	2	3	4	5	6	7	8	9	10	11
A. Age	-.1450	-.2090	-.1456	-.1499	-.1422	-.1721	-.2679	-.2219	-.1316	-.2036	-.1420
	±.0358	±.0350	±.0358	±.0358	±.0359	±.0355	±.0340	±.0348	±.0360	±.0351	±.0359
1. English Usage	.4834	.3678	.3600	.4447	.4158	.4449	.3541	.4637	.5889	.3309	
	±.0280	±.0316	±.0319	±.0294	±.0303	±.0294	±.0320	±.0287	±.0239	±.0326	
2. Literature	.5505	.4694	.3195	.3487	.3630	.3579	.4448	.5716	.3686		
	±.0255	±.0285	±.0329	±.0321	±.0318	±.0319	±.0294	±.0246	±.0316		
3. Social Science World	.4564	.3927	.3350	.2892	.2984	.4847	.5180	.3097			
	±.0290	±.0510	±.0325	±.0335	±.0333	±.0280	±.0268	±.0331			
4. Social Science America	.3469	.3103	.2515	.1927	.3491	.4780	.2453				
	±.0322	±.0331	±.0345	±.0352	±.0321	±.0282	±.0344				
5. Social Science Problems	.3532	.2277	.2676	.3523	.3425	.2459					
	±.0320	±.0347	±.0340	±.0321	±.0323	±.0344					
6. Mathematical Information	.7357	.5949	.6585	.4471	.2451						
	±.0279	±.0236	±.0207	±.0293	±.0344						
7. Mathematical Computation	.5803	.5883	.3984	.3712							
	±.0243	±.0239	±.0308	±.0316							

Continued

TABLE XXI (continued)

ORIGINAL CORRELATIONS OF THE SUB-TESTS WITH THE
PROBABLE ERRORS OF THOSE CORRELATIONS
ANGLO MALES N = 340

Variable	1	2	3	4	5	6	7	8	9	10	11
8. Mathematical Problems									.5169 ±.0268	.4056 ±.0306	.2896 ±.0335
9. Science										.5775 ±.0244	.3294 ±.0326
10. Functional Language											.3980 ±.0308
11. Functional Reading											

highest with Mathematical Computation, Science, and Mathematical Problems. The highest correlation for any of the sub-tests was between Mathematical Information and Mathematical Computation with a correlation coefficient of .7357. Mathematical Computation was most highly correlated with Mathematical Information, Science, and Mathematical Problems. With Mathematical Problems, Mathematical Information, Mathematical Computation and Science ranked highest. Science and Mathematics were closely related for the males. With Science, the relationships ranked Mathematical Information, Mathematical Computation, and Functional Language. The highest correlations for Functional Reading were Literature, English Usage, and Functional Language.

The original correlations of the sub-tests for the Anglo females are shown in Table XXII. English Usage ranked highest with the other sub-tests of English and with Social Science-World. Both the sub-tests, Social Science-World and Social Science-America, were most highly correlated with the sub-tests of English in the order of Literature, Functional Language, and English Usage. Social Science-Problems was most highly correlated with Functional Language, Science, and Social Science-America. Mathematical Information had the same relationships for the females as for the males, with different coefficients however. For Mathematical computation, the order of the coefficients were Mathematical

highest with Mathematical Computation, Science, and Social National Problems. The highest correlation for any of the sub-tests was between Mathematical Information and Mathematical Computation at 0.70, a correlation coefficient of 0.70. Mathematical Computation was most highly correlated with Mathematical Information, Science, and Mathematical Problems. With Mathematical Problems, Mathematical Information, Mathematical Computation and Science ranked highest. Science and Mathematics were closely related for the major. With Science the relationships between Mathematical Information, Mathematical Computation, and Functional Language. The highest correlations for Functional Reading were between Science, Language, and Functional Language.

The original correlations of the sub-tests for the eight factors are shown in Table XII. English Usage ranked highest with the other sub-tests of English and with Social Science-World. Both the sub-tests, Social Science-World and Social Science-Matter, were most highly correlated with the sub-tests of English in the order of Literature, Functional Language, and English Usage. Social Science-World was most highly correlated with Functional Language, Science, and Social Science-Matter. Mathematical Information had the same relationships for the factors as for the other sub-tests with different coefficients however. For Mathematical Information, the order of the coefficients was Functional

TABLE XXII

ORIGINAL CORRELATIONS OF THE SUB-TESTS WITH THE
PROBABLE ERRORS OF THOSE CORRELATIONS
ANGLO FEMALES N = 455

Variable	1	2	3	4	5	6	7	8	9	10	11
A. Age	-.2001 ±.0303	-.1622 ±.0308	-.1267 ±.0311	-.1238 ±.0311	-.0834 ±.0314	-.0900 ±.0316	-.0550 ±.0315	-.1620 ±.0308	-.0254 ±.0316	-.1320 ±.0310	-.0572 ±.0315
1. English Usage		.4401 ±.0255	.4110 ±.0263	.3959 ±.0266	.3844 ±.0269	.2870 ±.0290	.2188 ±.0300	.2438 ±.0297	.3664 ±.0274	.6057 ±.0200	.2613 ±.0294
2. Literature			.4144 ±.0262	.4011 ±.0265	.3713 ±.0272	.2919 ±.0289	.3134 ±.0285	.2860 ±.0290	.3896 ±.0268	.5369 ±.0225	.4318 ±.0257
3. Social Science World				.3789 ±.0271	.3703 ±.0273	.3052 ±.0287	.2581 ±.0295	.1758 ±.0306	.3847 ±.0269	.5108 ±.0234	.1751 ±.0306
4. Social Science America					.3908 ±.0268	.1367 ±.0310	.1502 ±.0309	.1394 ±.0310	.2489 ±.0296	.4428 ±.0254	.1327 ±.0310
5. Social Science Problems						.2666 ±.0294	.2415 ±.0298	.1564 ±.0308	.3934 ±.0267	.4172 ±.0261	.1583 ±.0308
6. Mathematical Information							.5870 ±.0207	.4440 ±.0254	.4966 ±.0238	.2856 ±.0289	.1316 ±.0311
7. Mathematical Computation								.5035 ±.0236	.3978 ±.0266	.2952 ±.0288	.1508 ±.0309

Continued

Information, Mathematical Problems, and Science, while for Mathematical Problems the rank was Mathematical Computation, Mathematical Information, and Science. Science was most highly correlated with Mathematical Information, Functional Language, and Mathematical Computation. The highest correlations for Functional Language were English Usage, Literature, and Science. Functional Reading correlated highest with the three sub-tests of Literature, English Usage, and Functional Language.

III. SUMMARY

When corrections were made for attenuation, inter-correlations were raised an appreciable amount.

Partial correlation, with the variability due to Age held constant, had little effect on the original correlations. In some instances, the correlation coefficients were raised, but in general they were lowered.

For the intercorrelations of the test totals of the five tests, and for the four groups, the highest correlations for each variable contained either Reading and Language or English. Again one exception was noted; Mathematics correlated highest with Science for the Spanish males, the Anglo males, and the Anglo females. Correlations with Science as a variable were low for the Spanish females. Low correlations were obtained between Social Science and Mathematics,

Information, Mathematical Problems, and Science, while for Mathematical Problems the rank was Mathematical Computation, Mathematical Information, and Science. Science was most highly correlated with Mathematical Information, Functional Language, and Mathematical Computation. The highest correlations for Functional Language were English Usage, Literature, and Science. Functional Reading correlated highest with the three sub-tests of Literature, English Usage, and Functional Language.

III. SUMMARY

When corrections were made for attenuation, inter-correlations were raised on appreciable amount. Partial correlation, with the variability due to age held constant, had little effect on the original correlations. In some instances, the correlation coefficients were raised but in general they were lowered. For the intercorrelations of the test totals of the five tests, and for the four groups, the highest correlations for each variable contained either Reading and Language or English. Again one exception was noted; Mathematical Computation related highest with Science for the Spanish males, the English males, and the Anglo females. Correlations with Science for a variable were low for the Spanish females. Low correlations were obtained between Social Science and Mathematical

and between Social Science and Science for each group. Science correlated highest with Mathematics for the males of both the Spanish and the Anglo groups and the Anglo females, while with the Spanish females Science correlated highest with Functional Language. For the intercorrelations of the sub-tests practically the same conclusions may be drawn. Seven of the eleven variables had their highest correlations with Functional Language. Due to the frequency of the highest correlations with either Functional Language or English as variables, Language and English should be strong factors in achievement for each of the four sex and cultural groups. The proof for the above statement will be found in the next chapter from the application of factor analysis to the intercorrelations.

and between Social Science and Science for each group. Science correlated highest with Mathematics for the males of both the Spanish and the Anglo groups and the Anglo females, while with the Spanish females Science correlated highest with Functional Language. For the intercorrelations of the sub-tests practically the same conclusions may be drawn. Seven of the eleven variables had their highest correlations with Functional Language. Due to the frequency of the highest correlations with either Functional Language or English as variables, Language and English should be strong factors in achievement for each of the four sex and cultural groups. The proof for the above statement will be found in the next chapter from the application of factor analysis to the intercorrelations.

CHAPTER VI

FACTOR ANALYSIS OF CORRELATIONAL RESULTS

The intercorrelations of a group of tests do not reveal a pattern of the organization of the abilities measured by the tests. Tests seldom measure primary abilities, but are rather conglomerates which require a variety of abilities for successful performance. Some of the abilities are undoubtedly specific to the individual tests, but others are measured to some degree at least by other tests in the battery. The mere affixation of a unitary label to a test is no guarantee that the test is a measure of a unitary function.

The presence of significant correlations among the tests studied in the present investigation indicated that the functions measured were not completely independent, but that there were "factors" which entered into the different tests in different proportions. It was therefore logical to attempt to isolate the factors which were responsible for the intercorrelations of the tests. Since the tests had been given to members of different cultural groups and to different sexes, it was perhaps possible to determine how the central abilities entered into the tests in different proportions with the four groups, since it had already been

CHAPTER VI

FACTOR ANALYSIS OF CORRELATIONAL RESULTS

The intercorrelations of a group of tests do not reveal a pattern of the organization of the abilities measured by the tests. Tests seldom measure purely additive, but are rather characterized which require a variety of abilities for successful performance. Some of the abilities are undoubtedly specific to the individual tests, and others are measured to some degree at least by other tests in the battery. The mere existence of a battery itself is a test is no guarantee that the test is a measure of a unitary function.

The presence of significant correlations among the tests studied in the present investigation indicates that the functions measured were not completely independent, and that there were "factors" which entered into the different tests in different proportions. It was therefore desired to attempt to isolate the factors which were responsible for the intercorrelations of the tests. Since the tests had been given to members of different cultural groups and in different areas, it was perhaps possible to determine how central abilities entered into the tests in different proportions with the four groups, and to find already some

observed that the tables of correlations varied somewhat with males and females, and with Spanish Americans and Anglos. The fact that attainment as measured by the means of the several tests did not vary evenly from group to group gave further support to the hypothesis that the abilities might be somewhat differently organized.

I. HISTORY OF FACTOR METHODS

Probably the earliest attempt to isolate a primary factor underlying a table of correlations was that of Spearman,¹ who proposed hierarchy, intercolumnar correlation, and finally tetrad analysis, as ways of demonstrating that a unitary trait was to be found in varying proportions in tests that measured the higher intellectual functions. Spearman's technique of tetrad analysis is intimately bound up with his "two factor" theory of intelligence, which states that in all abilities of the intellectual sort, a common "g" factor runs throughout. Spearman admits the presence of factors specific to each type of test as well as factors which enter into a limited number of tests such as "o" or oscillation factor, and "w" or will factor. The tetrad technique, while valid, has serious limitations in

¹ C. Spearman, The Abilities of Man (New York: The Macmillan Company, 1927)

observed that the tables of correlations varied somewhat with males and females, and with Spanish Americans and Anglos. The fact that attainment as measured by the means of the several tests did not vary evenly from group to group gave further support to the hypothesis that the abilities might be somewhat differently organized.

I. HISTORY OF FACTOR METHODS

Probably the earliest attempt to isolate a primary

factor underlying a table of correlations was that of Spearman,¹ who proposed hierarchy, intercorrelation, and finally tetrad analysis, as ways of demonstrating that unitary traits was to be found in varying proportions in tests that measured the higher intellectual functions. Spearman's technique of tetrad analysis is intimately bound up with his "two factor" theory of intelligence, which states that in all abilities of the intellectual sort, a common "g" factor runs throughout. Spearman admits the presence of factors specific to each type of test as well as factors which enter into a limited number of tests such as "o" or oscillation factor, and "w" or will factor. The tetrad technique, while valid, has serious limitations in

¹ I. C. Spearman, The Abilities of Man (New York: The Macmillan Company, 1927).

that with some correlation tables its application reveals little or nothing, and that at best only one central factor may be conveniently located by its use.

Hotelling, Kelley, and Thurstone have been foremost in devising other techniques by which factors central to a group of tests may be located. For the analysis of the intercorrelations of the statewide examination, Thurstone's centroid method was chosen, since it was the one most generally familiar and perhaps the easiest to apply and interpret. Furthermore, the method does not hold to the position that the factors found are uncorrelated. To the writer, this last point seems to be especially important in the analysis of educational tests, since it is reasonable to believe that the factors in such tests may display considerable unity without being entirely unrelated. The details of the procedure are described by Thurstone² and Guildford.³

II. ANALYSES OF THE ELEVEN VARIABLE TABLES

The first step was to apply factor analysis to the intercorrelations of the eleven variables of the examination

² L. L. Thurstone, The Vectors of Mind (Chicago: The University of Chicago Press, 1935) 266 pp.

³ J. P. Guilford, Psychometric Methods (New York: McGraw-Hill Book Company, Incorporated, 1936) pp. 457-516.

that with some correlation tables the significant results
little or nothing, and that at best only one general factor
may be conveniently located by its use.

Hoselink, Kelley, and Thurstone have been concerned
in devising other techniques by which factors common to a
group of tests may be located. For the analysis of the
intercorrelations of the eleven variables, Thurstone's
control method was chosen, since it was the one most generally
familiar and perhaps the easiest to apply and interpret.
Furthermore, the method does not hold for the position that
the factors found are uncorrelated. To the writer, this last
point seems to be especially important in the analysis of
educational tests, since it is reasonable to believe that the
factors in such tests may display considerable unity without
being entirely unrelated. The details of the procedure are
described by Thurstone² and Guilford.³

II. ANALYSIS OF THE ELEVEN VARIABLE TABLE

The first step was to apply factor analysis to the
intercorrelations of the eleven variables of the examination

² L. L. Thurstone, The Vector of Mind (Chicago: The University of Chicago Press, 1934) 286 pp.

³ J. P. Guilford, Psychometric Methods (New York: McGraw-Hill Book Company, Incorporated, 1935) pp. 257-282.

for the two Anglo groups. Zero order coefficients were used, since, as has already been demonstrated, the correlations were not greatly changed when the variability due to Age was held constant. The Anglo groups were selected in preference to the Spanish groups for this part of the analysis as there were more subjects for the Anglo groups, and the correlations of the short sub-tests would probably be more significant.

Three central factors were found as are shown in Tables XXIII and XXIV, but only two are large enough to be of much significance. The residuals after the extraction of the second factor did not seem to be of appreciable size, and after the extraction of the third factor were still less significant. By a conventional standard,⁴ it was not necessary to extract the third factor as the standard deviation of the second factor residuals for the female group was .029, which was less than the standard deviation of the average of the original correlations of .041. The same general condition held for the male group.

With the male group, the first factor accounted for 43 per cent of the variance; the second factor, 8 per cent; and the third factor, only 2 per cent, while with the female group the first factor accounted for 35 per cent of the variance; the second factor, 10 per cent; and the third factor,

⁴ Ibid. p. 494.

For the two Anglo groups. Two other coefficients were found since, as has already been demonstrated, the correlations were not greatly changed when the variability due to age was held constant. The Anglo groups were selected in preference to the Spanish groups for this part of the analysis as there were more subjects for the Anglo groups, and the correlations of the short sub-tests would probably be more significant.

Three central factors were found as are shown in Tables XIII and XIV, but only two are large enough to be of much significance. The residuals after the extraction of the second factor did not seem to be of appreciable size and after the extraction of the third factor were still less significant. By a conventional standard, it was not necessary to extract the third factor as the standard deviation of the second factor residuals for the female group was .027, which was less than the standard deviation of the average of the original correlations of .041. The same general conclusion held for the male group.

With the male group, the first factor accounted for 43 per cent of the variance; the second factor, 3 per cent; and the third factor, only 2 per cent, while with the female group the first factor accounted for 35 per cent of the variance; the second factor, 10 per cent; and the third factor,

TABLE XXIII

FACTOR LOADINGS AND COMMUNALITIES OF THE ELEVEN
SUB-TESTS (THREE FACTOR CENTROID METHOD)
ANGLO MALES N = 340

Variable	K ₁	K ₂	K ₃	K ₁ ²	K ₂ ²	K ₃ ²	H ²
1. English Usage	.6795	.1431	-.2704	.4617	.0205	.0731	.5553
2. Literature	.6803	.2833	.1539	.4628	.0803	.0237	.5668
3. Social Science-World	.6388	.2693	.2053	.4081	.0725	.0421	.5227
4. Social Science-America	.5524	.2987	.0037	.3051	.0892	.0000	.3943
5. Social Science-Problems	.5244	.1756	-.1888	.2750	.0308	.0356	.3414
6. Mathematical Information	.7268	-.4701	.1063	.5282	.2210	.0113	.7605
7. Mathematical Computation	.6995	-.4512	.1722	.4893	.2036	.0297	.7226
8. Mathematical Problems	.6247	-.3429	.1628	.3903	.1176	.0265	.5344
9. Science	.7609	-.2011	-.0084	.5790	.0404	.0000	.6194
10. Functional Language	.7456	.2126	-.1320	.5559	.0452	.0174	.6185
11. Functional Reading	.4955	.0945	.0362	.2455	.0089	.0013	.2557
Sum K ²				4.7009	.9300	.2607	5.8916
Sum K ² N				.4274	.0845	.0237	.5356

TABLE XXIV

FACTOR LOADINGS AND COMMUNITIES OF THE ELEVEN
SUB-TESTS (THREE FACTOR CENTROID METHOD)
ANGLO FEMALES N = 455

Variable	K ₁	K ₂	K ₃	K ₁ ²	K ₂ ²	K ₃ ²	H ²
1. English	.6592	.2490	-.008	.4345	.0620	.0000	.4965
2. Literature	.6894	.2282	-.2533	.4735	.0521	.0641	.5897
3. Social Science-World	.6084	.1644	.2156	.3702	.0270	.0465	.4437
4. Social Science-America	.5092	.3427	.0646	.2593	.1174	.0042	.3809
5. Social Science-Problems	.5572	.1409	.2348	.3105	.0199	.0551	.3855
6. Mathematical Information	.5966	-.4784	-.0085	.3559	.2289	.0000	.5848
7. Mathematical Computation	.5785	-.4730	.0980	.3347	.2237	.0096	.5680
8. Mathematical Problems	.4766	-.4076	.1855	.2271	.1660	.0344	.4275
9. Science	.6427	-.1516	.2007	.4131	.0230	.0403	.4764
10. Functional Language	.7194	.2894	.0664	.5175	.0838	.0044	.6057
11. Functional Reading	.3667	.2182	-.3089	.1345	.0476	.0954	.2775
Sum K ²				3.8303	1.0514	.3540	5.2362
Sum K ² N				.3482	.0956	.0322	.4760

3 per cent. By the Thurstone method the first factors extracted cannot be interpreted psychologically until the axes are rotated and the new factor loadings of all the tests are computed.

As the third factor was very small and might be simply an artifact developed during computations, the decision was made that for the purpose of this investigation the two principal factors would account for whatever was common to the intercorrelations. The reasonableness of this assumption has been indicated above. The plots of the factor loadings are shown in Figures 3 and 4, which represent an attempt to envisage the eleven sub-tests in terms of two fundamental factors. These diagrams were constructed by plotting the factor weights of each test in I and II as the X and Y coordinates with reference to the centroid axes I and II.

From the diagrams, it will be apparent that a rotation of 35 degrees in the counter clockwise direction was necessary to make all projections on the new axes of like sign and have at least one projection zero. For the females, sub-test 4 projected on the new axis II' was approximately zero. All projections on axis I' were positive, and all the projections on axis II' were negative. By reflection of the whole trait vector, all projections on axis II' may be taken as positive.

As will be apparent from the diagrams, the sub-tests were separated into two groups. The first group was composed

5 per cent. By the Thomson method the three factors are treated cannot be interpreted satisfactorily until the axes are rotated and the new factor loadings of all the tests are computed.

As the third factor was very small and might be simply an artifact developed during computation, the decision was made that for the purpose of this investigation the two principal factors would account for whatever was common to the interpretation. The reasonableness of this assumption has been indicated above. The plots of the factor loadings are shown in Figures 3 and 4, which represent an attempt to envisage the eleven sub-tests in terms of two independent factors. These diagrams were constructed by plotting the factor weights of each test in I and II on the X and Y axes respectively with reference to the centroid axes I and II. From the diagrams, it will be apparent that a rotation of 35 degrees in the counter clockwise direction was necessary to make all projections on the new axes of like sign and have at least one projection zero. For the Thomson method, 4 degrees projected on the new axis II' was approximately zero. All projections on axis I' were positive, and all the projections on axis II' were negative. By reflection of the whole series vector, all projections on axis II' may be taken as positive. As will be apparent from the diagrams, the sub-factors were separated into two groups. The first group was composed

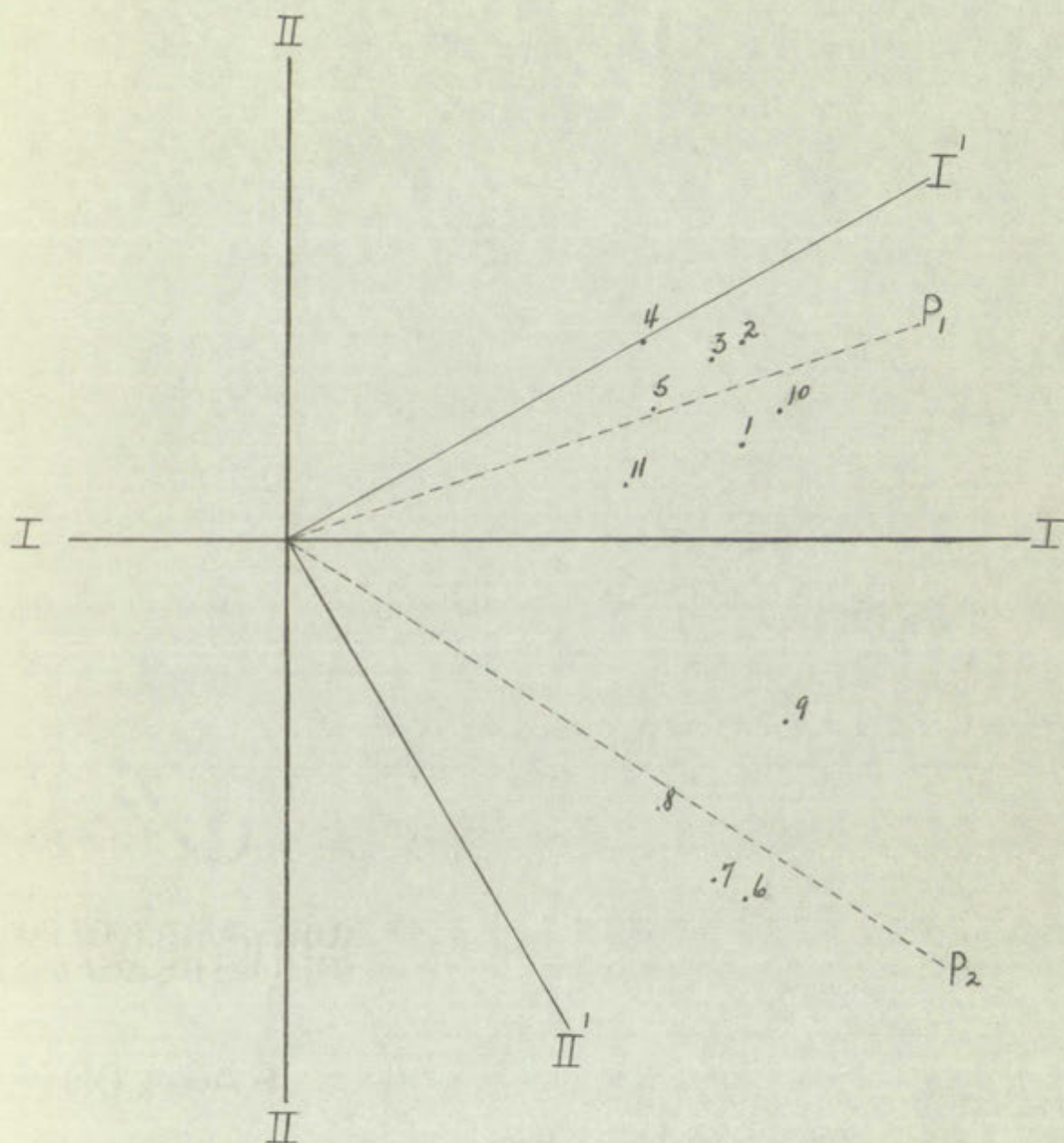


Figure 3.

Plot of the Factor Loadings of the Eleven Sub-Tests of Table XXIII with Reference to the Centroid Axes I and II for Anglo Males.

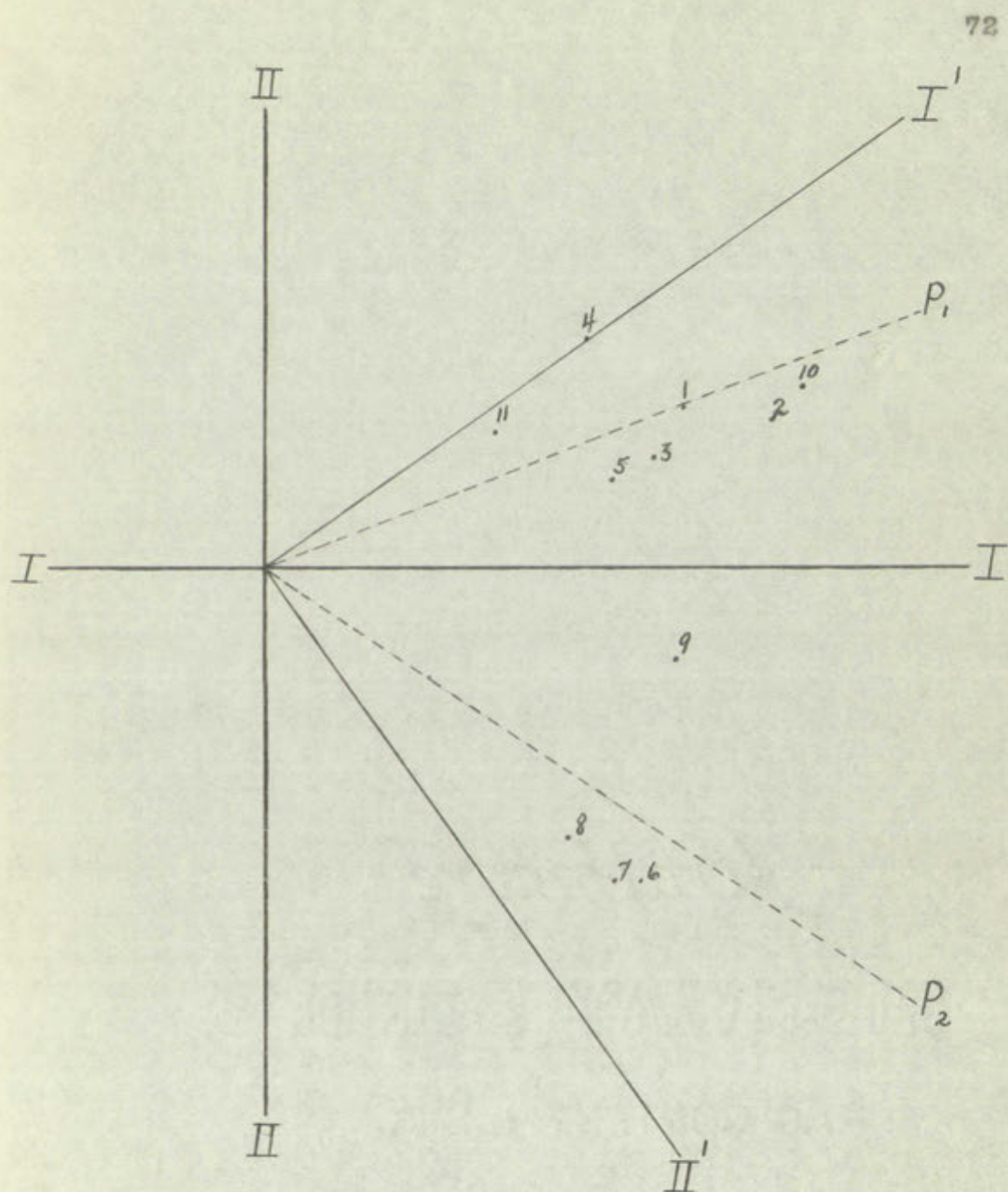


Figure 4.

Plot of the Factor Loadings of the Eleven Sub-Tests
of Table XXIV with Reference to the Centroid
Axes I and II for Anglo Females.

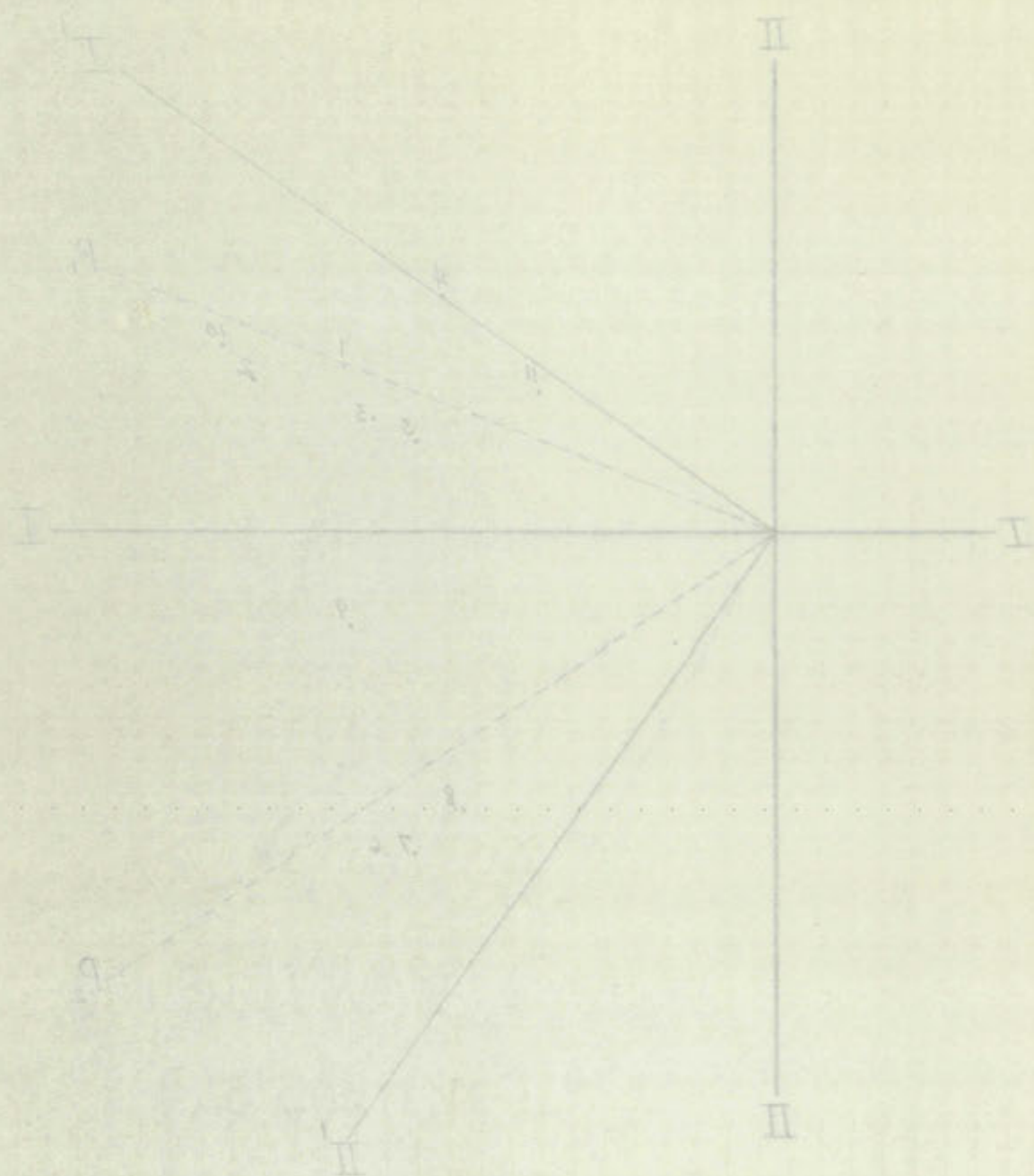


Figure 4

Plot of the factor loadings of the first two factors of Table XIV with reference to the principal components I and II for angles 1 and 2.

of sub-tests 1, 2, 3, 4, 5, 10, and 11; the second group was composed of sub-tests 6, 7, 8, and 9. The first group contained English, Language, Reading, and Social Science. The second group contained Mathematics and Science. Trait I' can be identified as the ability which entered more especially into the verbal sub-tests, and trait II' as the ability which entered more especially into the sub-tests of Mathematics and Science. Those seemed to be traits which had a high degree of unity as was shown by their tendency to cluster, and at the same time to contain a fair degree of independence as shown by the cosines of the angles between the lines of best fit. For the males the cosine was .71, and for the females .57, which showed that the two abilities measured by the examination as a whole were more closely allied for the females than for the males.

The new factor loadings of each sub-test together with the communalities are shown in Tables XXV and XXVI. The column $K_1'^2$ shows the amount of variance in each sub-test to be ascribed to trait I', and the column $K_2'^2$ shows the amount of variance in each sub-test to be attributed to trait II', or the correlation between the sub-test and the trait or factor. The column H^2 is the sum of $K_1'^2$ and $K_2'^2$, and shows the amount of variance in each sub-test to be attributed to the two traits taken together. For both males and females trait I', shown under the heading K_1' , loaded the verbal sub-

of sub-tests 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11; the second group was composed of sub-tests 6, 7, 8, and 9. The first group contained English, Language, Reading, and Social Science. The second group contained Mathematics and Science. Trait I' can be identified as the ability which entered more especially into the verbal sub-tests, and Trait II' as the ability which entered more especially into the sub-tests of Mathematics and Science. Those scores to be treated which had a high degree of unity as was shown by their tendency to cluster, and at the same time to contain a fair degree of independence as shown by the analysis of the matrix between the lines of best fit. For the males the scores were 7.1, and for the females, 5.7, which showed that the two abilities measured by the examination as a whole were more closely allied for the females than for the males.

The new factor loadings of each sub-test together with the communalities are shown in Tables XIV and XV. The column K_1^2 shows the amount of variance in each sub-test to be ascribed to Trait I', and the column K_2^2 shows the amount of variance in each sub-test to be attributed to Trait II'. The correlation between the sub-test and the trait or factor. The column R^2 is the sum of K_1^2 and K_2^2 , and shows the amount of variance in each sub-test to be attributed to the two traits taken together. For both males and females Trait I', shown under the heading K_1^2 , loaded the verbal sub-

TABLE XXV

FACTOR LOADINGS AND COMMUNALITIES FROM A COMMON ROTATION OF 35 DEGREES
FOR THE ELEVEN SUB-TESTS OF THE ANGLO MALES

Variable	K_1'	K_2'	$K_1'^2$	$K_2'^2$	H^2
1. English Usage	.6397	.2674	.4079	.0764	.4843
2. Literature	.7198	.1581	.5181	.0250	.5413
3. Social Science-World	.6778	.1458	.4594	.0213	.4807
4. Social Science-America	.6238	.0721	.3891	.0052	.3943
5. Social Science-Problems	.5303	.1570	.2812	.0246	.3058
6. Mathematical Information	.3258	.8020	.1061	.6432	.7493
7. Mathematical Computation	.3142	.7708	.0987	.5941	.6928
8. Mathematical Problems	.3150	.6391	.0992	.4084	.5076
9. Science	.5080	.6011	.2581	.3613	.6194
10. Functional Language	.7327	.2535	.5368	.0643	.6011
11. Functional Reading	.4601	.3068	.2117	.0428	.2545
Sum K'^2			3.3663	2.2566	5.6329
Sum $\frac{K'^2}{N}$.3060	.2061	.5121

TABLE XXVI

FACTOR LOADINGS AND COMMUNALITIES FROM A COMMON ROTATION OF 35 DEGREES
FOR THE ELEVEN SUB-TESTS OF THE ANGLO FEMALES

Variable	K_1'	K_2'	$K_1'^2$	$K_2'^2$	H^2
1. English Usage	.6825	.1721	.4662	.0303	.4965
2. Literature	.6956	.2085	.4839	.0435	.5274
3. Social Science-World	.5927	.2143	.3513	.0459	.3972
4. Social Science-America	.6137	.0114	.3766	.0001	.3769
5. Social Science-Problems	.5372	.2042	.2866	.0417	.3303
6. Mathematical Information	.2143	.6541	.0459	.4278	.4737
7. Mathematical Computation	.2026	.7193	.0410	.5174	.5584
8. Mathematical Problems	.1567	.6070	.0246	.3684	.3930
9. Science	.4395	.4928	.1932	.2429	.4361
10. Functional Language	.7553	.1755	.5705	.0308	.6013
11. Functional Reading	.4256	.0316	.1811	.0010	.1821
Sum K'^2			3.0229	1.7498	4.7727
$\frac{\text{Sum } K'^2}{N}$.2748	.1591	.4339

tests more heavily, while trait II', shown under the heading K_2' loaded the Mathematics sub-tests more heavily. The Science test was weighted by the two factors almost evenly, with a slight predominance of trait II'. For the males the amount of variance in the eleven sub-tests that resulted from trait I' varied from 10 per cent to 54 per cent, while with the females the range was from 3 per cent to 57 per cent. The variance for trait II' ranged from 1 per cent to 59 per cent for the males, and from 0 per cent to 52 per cent for the females. The amount of variance to be attributed to the two traits together ranged from 31 per cent to 75 per cent for the males, and from 33 per cent to 60 per cent for the females. The remainder of the variance for each of the sub-tests was ascribed to the very small third factor, which was not identified, factors specific to the sub-tests and chance errors.

III. ANALYSES OF THE FIVE VARIABLE TABLES

The analyses of the eleven variable tables served as a general orientation. The two factors found were sufficient to account for a large proportion of the intercorrelations observed, and for the fact that the two factors were somewhat differently organized for the male and female Anglo groups. The weightings of the sub-tests in each test showed little variation. The weights of the two factors in variables 1 and 2, the sub-tests of English; in variables 3, 4, and 5, the

tests were heavily, while trait II, above under the heading X_2 loaded the Mathematics sub-tests more heavily. The sub-test was weighted by the two factors almost equally, with a slight predominance of trait II. For the males the amount of variance in the eleven sub-tests that resulted from trait I, varied from 19 per cent to 34 per cent, while with the females the range was from 3 per cent to 37 per cent. The variance for trait II, ranged from 1 per cent to 32 per cent for the males, and from 0 per cent to 33 per cent for the females. The amount of variance to be attributed to the two traits together ranged from 31 per cent to 73 per cent for the males, and from 33 per cent to 69 per cent for the females. The remainder of the variance for each of the sub-tests was ascribed to the very small third factor, which was not identified, factors specific to the sub-tests and of minor importance.

III. ANALYSIS OF THE FIVE VARIABLE FACTORS

The analysis of the eleven variable factors derived as a general orientation. The two factors found were attributed to account for a large proportion of the intercorrelations observed, and for the fact that the two factors were somewhat differently organized for the male and female groups. The weighting of the sub-tests in each test showed little variation. The weights of the two factors in variables 1 and 2, the sub-tests of English; in variables 3, 4, and 5, the

sub-tests of Social Science, and in variables 5, 6, and 7 of the sub-tests of Mathematics, were all much alike. The weightings of the variables 10 and 11, sub-tests of Reading and Language, varied considerably, but as sub-test 11 was not particularly reliable the variance may not be a matter of importance. The general uniformity in the weightings in the sub-tests leads to the belief that a factor analysis based on the intercorrelations of the five main tests, if carried out for the four groups, Spanish males, Spanish females, Anglo males, and Anglo females, would suffice to indicate in clear fashion any sex and cultural differences in the organization of traits measured by the statewide examination.

Thurstone's centroid method was accordingly applied to the correlations based on the five variables for the four groups. Since the number of tests was small, the error resulting from using guessed communalities in the diagonals of the correlation tables was greater than in the case of the eleven variable problem. Accordingly, the location of the first factors was carried out twice, using the communalities calculated from the first process as the estimated communalities during the second process.⁵ As the analyses for the eleven variable problem had revealed only two factors in any way important, only two factors were isolated in the five

⁵ Ibid. p. 488.

sub-jects of Social Science, and in Variables 3, 6, and 7 on the sub-jects of Mathematics, with all such alike. The weightings of the variables 10 and 11, sub-jects of Reading and Language, varied considerably, but as sub-ject 11 was not particularly reliable the variance may not be a matter of importance. The general uniformity in the weightings in the sub-jects leads to the belief that a factor analysis based on the interpretations of the five main factors, as varied out for the four groups, Spanish main, Spanish co-main, Anglo main, and Anglo female, would suffice to indicate in clear fashion any real and actual differences in the organization of traits measured by the standard examination. Thurstone's centroid method was accordingly applied to the correlations based on the five variables for the four groups. Since the number of tests was small, the error resulting from using rounded communalities in the diagonal of the correlation tables was greater than in the case of the eleven variable problem. Accordingly, the location of the first factor was carried out twice, using the communalities calculated from the first process as the estimated communalities during the second process.⁶ As the analyses for the eleven variable problem had revealed only two factors in any way important, only two factors were isolated in the five

⁶ Ibid. p. 468.

variable problem. Tables XXVII, XXVIII, XXIX, and XXX show the weights of the two factors first extracted for each of the five tests in the four groups.

Figures 5, 6, 7, and 8 on pages 83, 84, 85, and 86 show the plots of the two factors on the arbitrary reference axes. The largest angle of rotation called for in any of the diagrams was one of 25 degrees in the case of the Spanish females. Accordingly that rotation was carried out in counter clockwise direction for all four groups. The rotation made the weight of trait I' in all the tests positive, and the weight of trait II' negative. Trait II' was reflected, and the weightings of this trait appear in the various tables as positive.

The evidence for a sex difference in the relationship of the two primary abilities based on the difference in the angle of the primary trait vectors that was found in the eleven variable problem did not appear in the five variable problem of the main tests. The angles of the lines of best fit, together with the corresponding cosine, which are to be interpreted as correlations were as follows: Spanish males 40 degrees and cosine .64; Spanish females 37 degrees and cosine .60; Anglo males 39 degrees and cosine .63; Anglo females 42 degrees and cosine .70. The greatest difference was between the Spanish females and the Anglo females. The two male groups showed practically the same relationship

variable problem. Tables XVII, XVIII, XIX, and XX show the weights of the two factors for each of the five tests in the four groups.

Figures 1, 2, 3, and 4 on pages 50, 51, 52, and 53 show the plots of the two factors on the arbitrary axes. The largest angle of rotation called for in any of the diagrams was one of 35 degrees in 2 of the 4 groups. Incidentally, that rotation was decided on in counter clockwise direction for all four groups. The rotation made the weight of factor I in all the tests positive and the weight of factor II, negative. Table XI, on page 54, and the weighting of each factor appear in the various tables as positive.

The evidence for a sex difference in the relationship of the two primary abilities based on the differences in the angle of the primary factor vectors was found in the eleven variable problems. It was found that the two variable problems of the main factor. The angles of the lines of best fit, together with the corresponding angles, which are to be interpreted as correlations were as follows: Group 1, 40 degrees and cosine .64; Group 2, 35 degrees and cosine .82; Group 3, 35 degrees and cosine .82; Group 4, 35 degrees and cosine .82. The greatest difference was between the Group 1 females and the Group 1 males. Two male groups showed practically the same relationship.

TABLE XXVII
 FACTOR LOADINGS AND COMMUNALITIES OF THE FIVE
 TESTS (TWO FACTOR CENTROID METHOD)
 FOR SPANISH MALES

Variable	K_1	K_2	K_1^2	K_2^2	H^2
1. English	.7847	.3138	.6158	.0985	.7143
2. Social Science	.5043	.2152	.2543	.0463	.3006
3. Mathematics	.7060	-.2620	.4984	.0686	.5670
4. Science	.6128	-.3077	.3755	.0947	.4702
5. Language	.8162	.0867	.6662	.0075	.6737
Sum K^2			2.4102	.3156	2.7258
$\frac{\text{Sum } K^2}{N}$.4820	.0631	.5452

TABLE XVII

FACTOR LOADINGS AND COMMUNITIES OF THE FIVE
TESTS (TWO FACTOR CIRCULAR METHOD)
FOR SPANISH MALES

Variable	F_1	F_2	F_1^2	F_2^2	R^2
1. English	.7847	.3133	.6158	.0982	.7140
2. Social Science	.5045	.3133	.2563	.0982	.3545
3. Mathematics	.7060	-.3880	.4984	.0882	.5866
4. Science	.3133	-.7077	.2733	.0982	.3715
5. Language	.3133	.0807	.0882	.0075	.0957
Sum F_1^2			2.4102		2.7326
Sum F_2^2			.6820		.3682

TABLE XXVIII
 FACTOR LOADINGS AND COMMUNALITIES OF THE FIVE
 TESTS (TWO FACTOR CENTROID METHOD)
 FOR SPANISH FEMALES

Variable	K_1	K_2	K_1^2	K_2^2	H^2
1. English	.7776	.1749	.6047	.0306	.6353
2. Social Science	.6342	.2866	.4022	.0821	.4843
3. Mathematics	.6101	-.2046	.3722	.0419	.4141
4. Science	.5043	-.2666	.2543	.0711	.3254
5. Language	.8377	.0561	.7017	.0031	.7048
Sum K^2			2.3351	.2238	2.5589
$\frac{\text{Sum } K^2}{N}$.4670	.0458	.5128

TABLE XXVIII

FACTORS INVOLVED IN COMMERCIALIZATION OF THE FISH
INDUSTRY (TWO FACTOR SYSTEM METHOD)
FOR SEVERAL YEARS

Variable	K_1	K_2	K_1^2	K_2^2	$K_1 K_2$
1. Fishes	7775	1749	6045	3050	4500
2. Social Science	8248	2888	6803	8340	4400
3. Mathematics	6101	1000	3721	1000	1900
4. Science	3000	1000	900	1000	1000
5. Language	6277	1000	3939	1000	1000
Sum K_1					23301
Sum K_2					5880
Sum K_1^2					13774
Sum K_2^2					5880
Sum $K_1 K_2$					13774

TABLE XXIX
 FACTOR LOADINGS AND COMMUNALITIES OF THE FIVE
 TESTS (TWO FACTOR CENTROID METHOD)
 FOR ANGLO MALES

Variable	K_1	K_2	K_1^2	K_2^2	H^2
1. English	.7866	.2420	.6187	.0586	.6773
2. Social Science	.7071	.2483	.5000	.0617	.5617
3. Mathematics	.7171	-.3473	.5142	.1206	.6348
4. Science	.7788	-.2765	.6065	.0765	.6830
5. Language	.7897	.1655	.6236	.0274	.6510
Sum K^2			2.8630	.3448	3.2078
$\frac{\text{Sum } K^2}{N}$.5726	.0690	.6416

TABLE XVII

FACTOR LOADINGS AND COMMUNITIES OF THE FIVE
TESTS (TWO FACTOR DISTRICT METHOD)
FOR ANGLO MALES

Variable	F_1	F_2	F_3	F_4	F_5
1. English	.7855	.8420	.8107	.6033	.5773
2. Social Science	.7071	.8423	.8000	.6017	.5317
3. Mathematics	.7171	-.3473	.5132	.1202	.5512
4. Science	.7753	-.5753	.5003	.5753	.5333
5. Language	.7357	.1333	.5333	.0753	.5333
Sum F_1^2			2.5333	.5443	2.5073
Sum F_2^2			.3373	.0883	.5113

TABLE XXX

FACTOR LOADINGS AND COMMUNALITIES OF THE FIVE
TESTS (TWO FACTOR CENTROID METHOD)
FOR ANGLO FEMALES

Variable	K_1	K_2	K_1^2	K_2^2	H^2
1. English	.8224	.2149	.6763	.0462	.7225
2. Social Science	.7141	.1905	.5099	.0363	.5462
3. Mathematics	.5357	-.3108	.2870	.0966	.3836
4. Science	.6483	-.2320	.4203	.0795	.4998
5. Reading-Language	.7937	.2240	.6300	.0502	.6802
Sum K^2			2.5235	.3088	2.8323
$\frac{\text{Sum } K^2}{N}$.5047	.0618	.5665

TABLE IX

FACTOR LOADINGS AND CORRELATIONS OF THE FIVE
TESTS (TWO FACTOR DIAGONAL METHOD)
FOR FIVE PUPILS

Variable	F_1	F_2	F_3	F_4	F_5
1. English	.8884	.2125	.0785	.0434	.7592
2. Social Science	.7141	.1905	.3024	.0530	.1121
3. Mathematics	.8357	-.3123	.1870	.0781	.1470
4. Science	.6285	-.4830	.4503	.0730	.3271
5. Reading-Language	.7377	.3240	.0700	.0001	.4100
ΣF_1^2	2.7055				
ΣF_2^2		.0615			

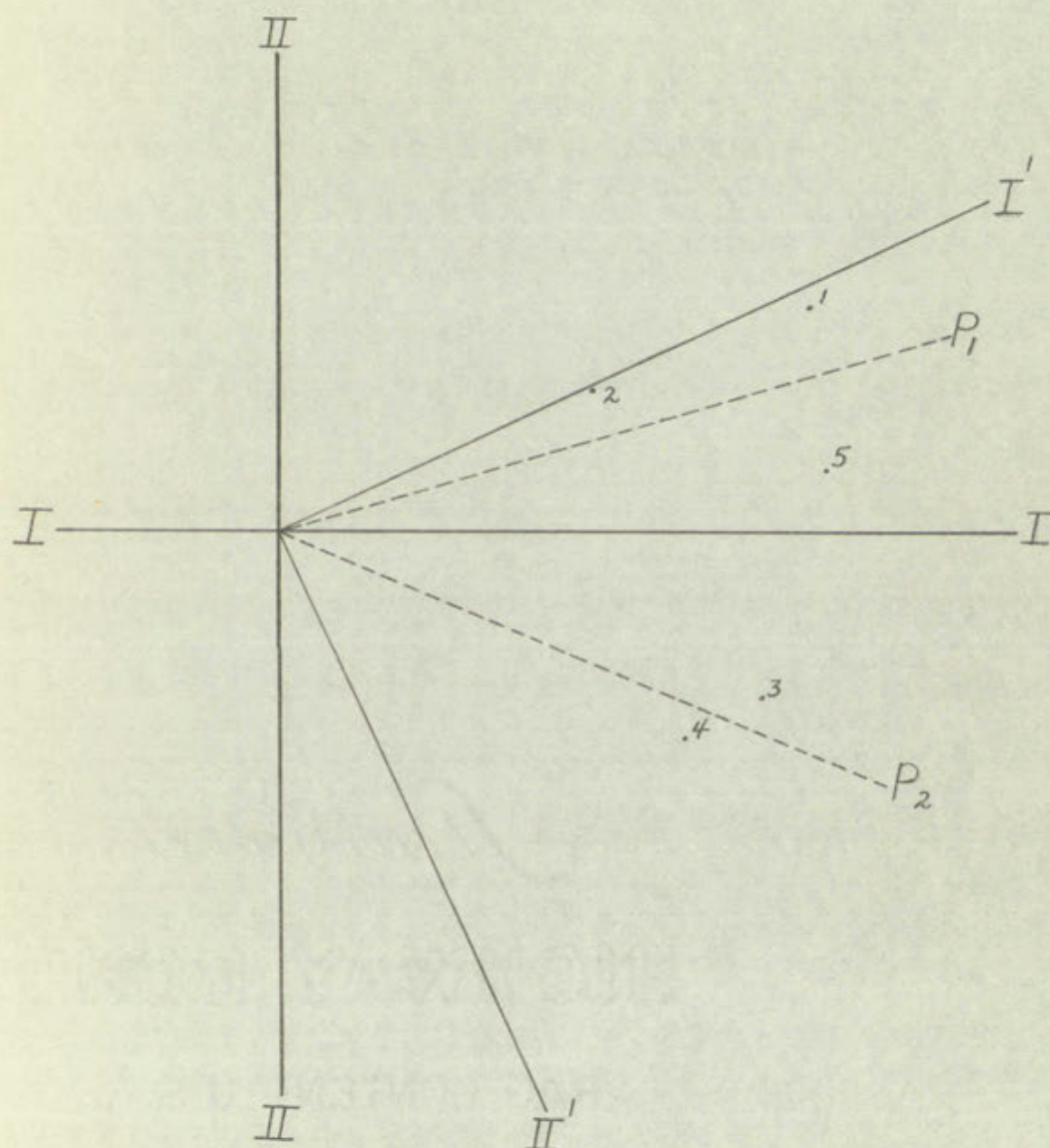


Figure 5.

Plot of the Factor Loadings of the Five Tests of
Table XXVII with Reference to the Centroid
Axes I and II for Spanish Males.

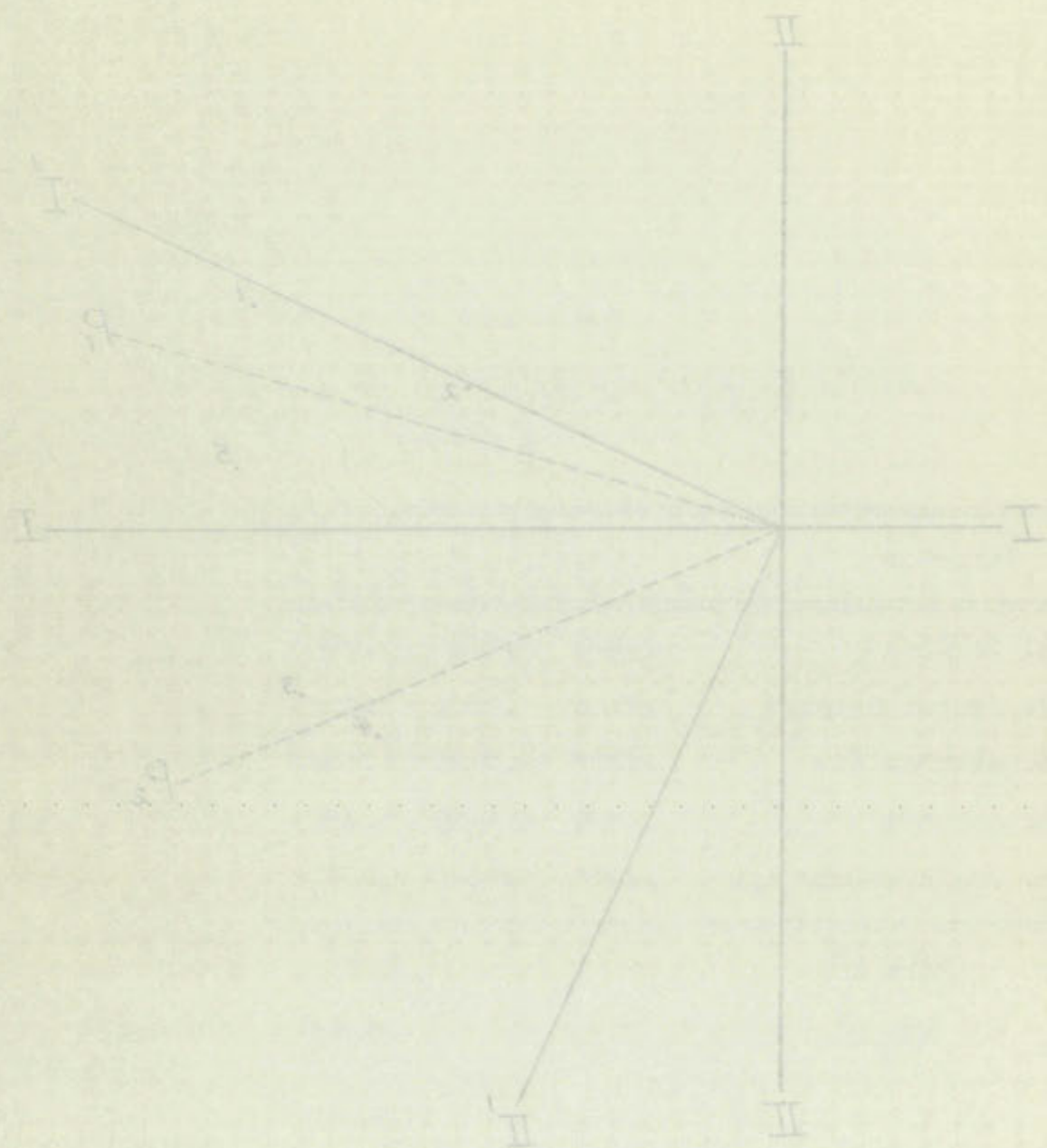


Figure 5.

First of the factor loadings of the five tests of
Table XVII with reference to the centroid.
Axis I and II for Spanish Notes.

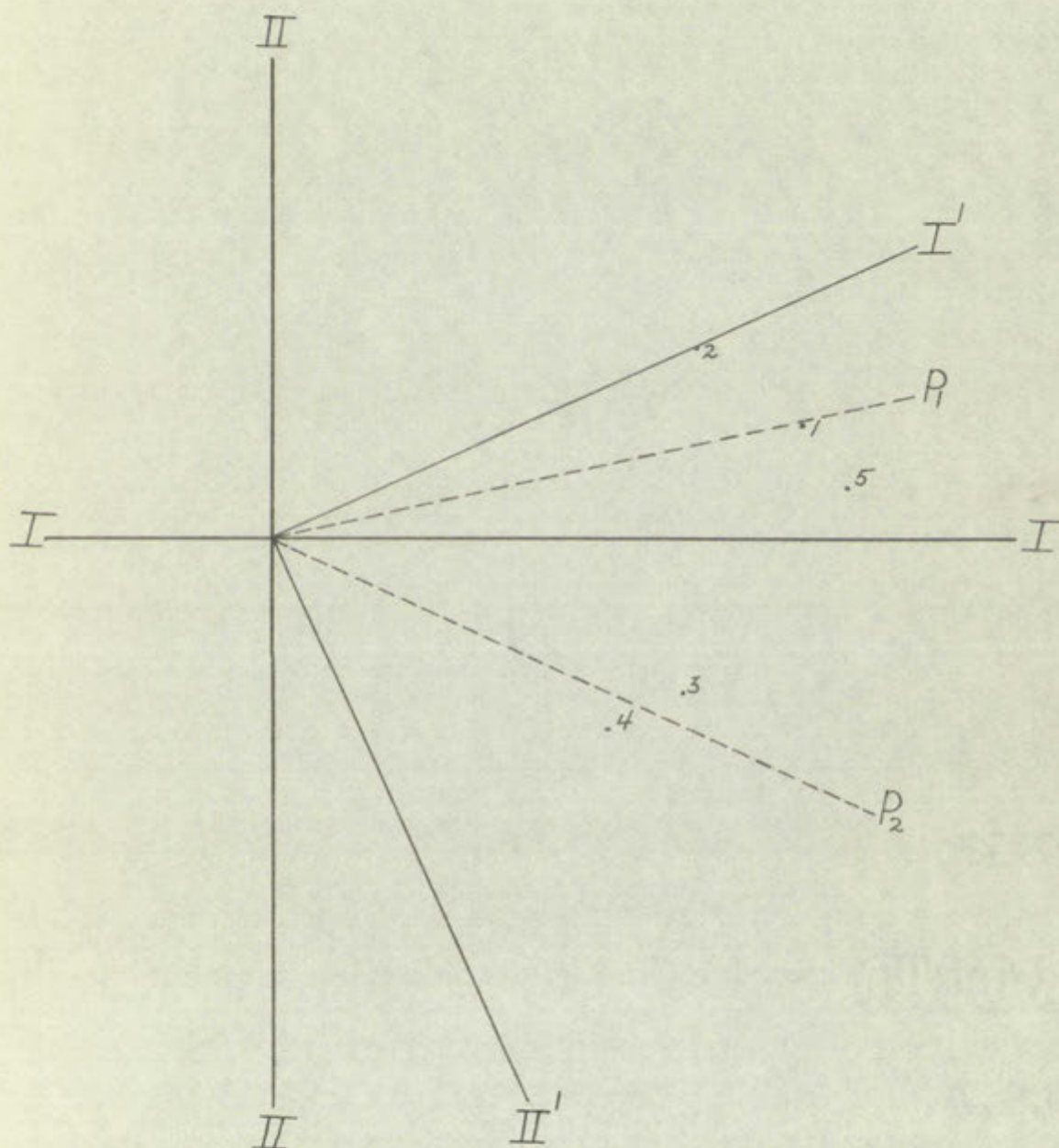


Figure 6.

Plot of the Factor Loadings of the Five Tests of
Table XXVIII with Reference to the Centroid
Axes I and II for Spanish Females.

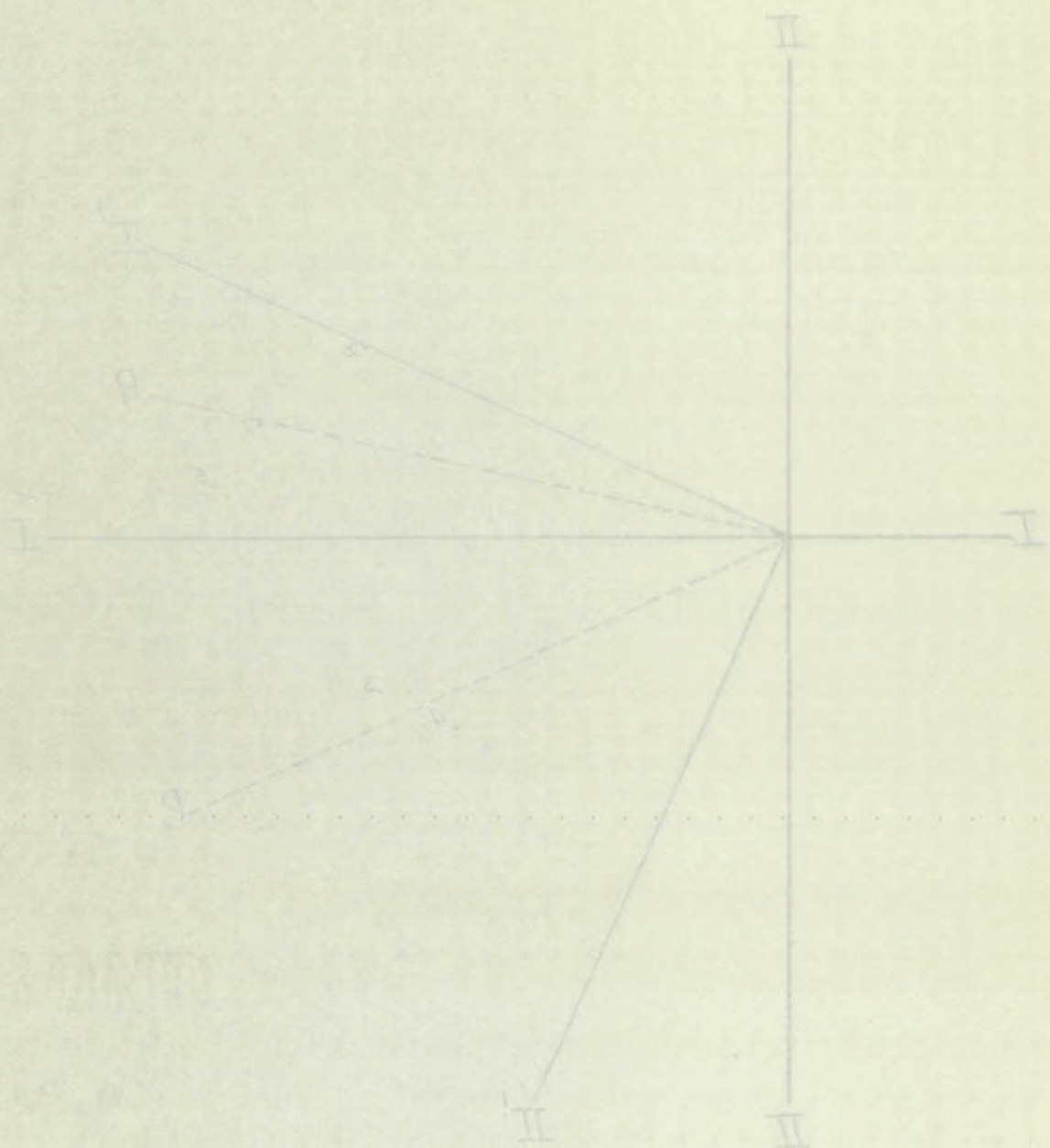


Figure 2.

Plot of the factor loadings of the five tests of
Table XVIII with reference to the centroid.
Axis I and II for Spanish samples.

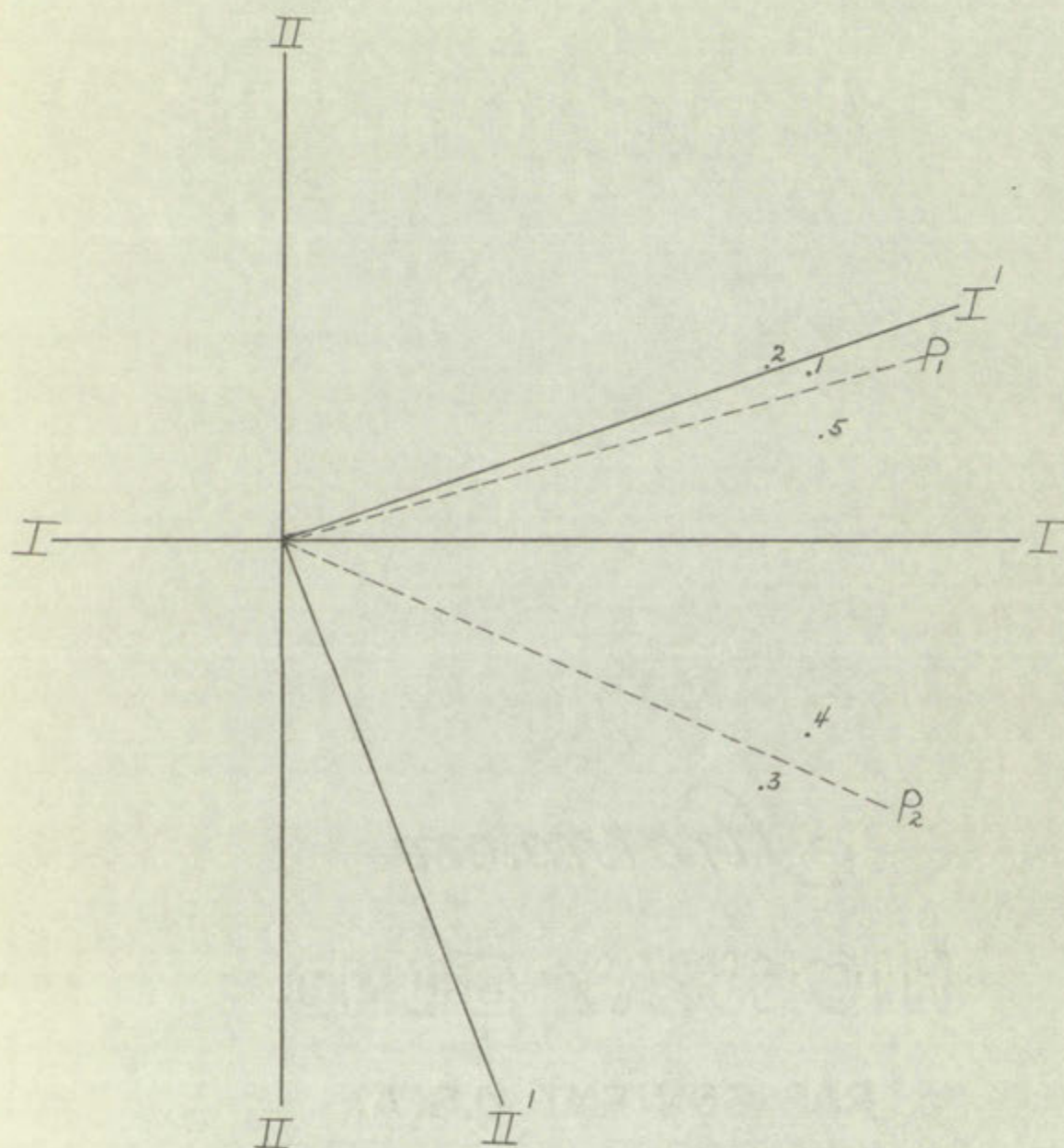


Figure 7.

Plot of the Factor Loadings of the Five Tests of
Table XXIX with Reference to the Centroid
Axes I and II for Anglo Males.

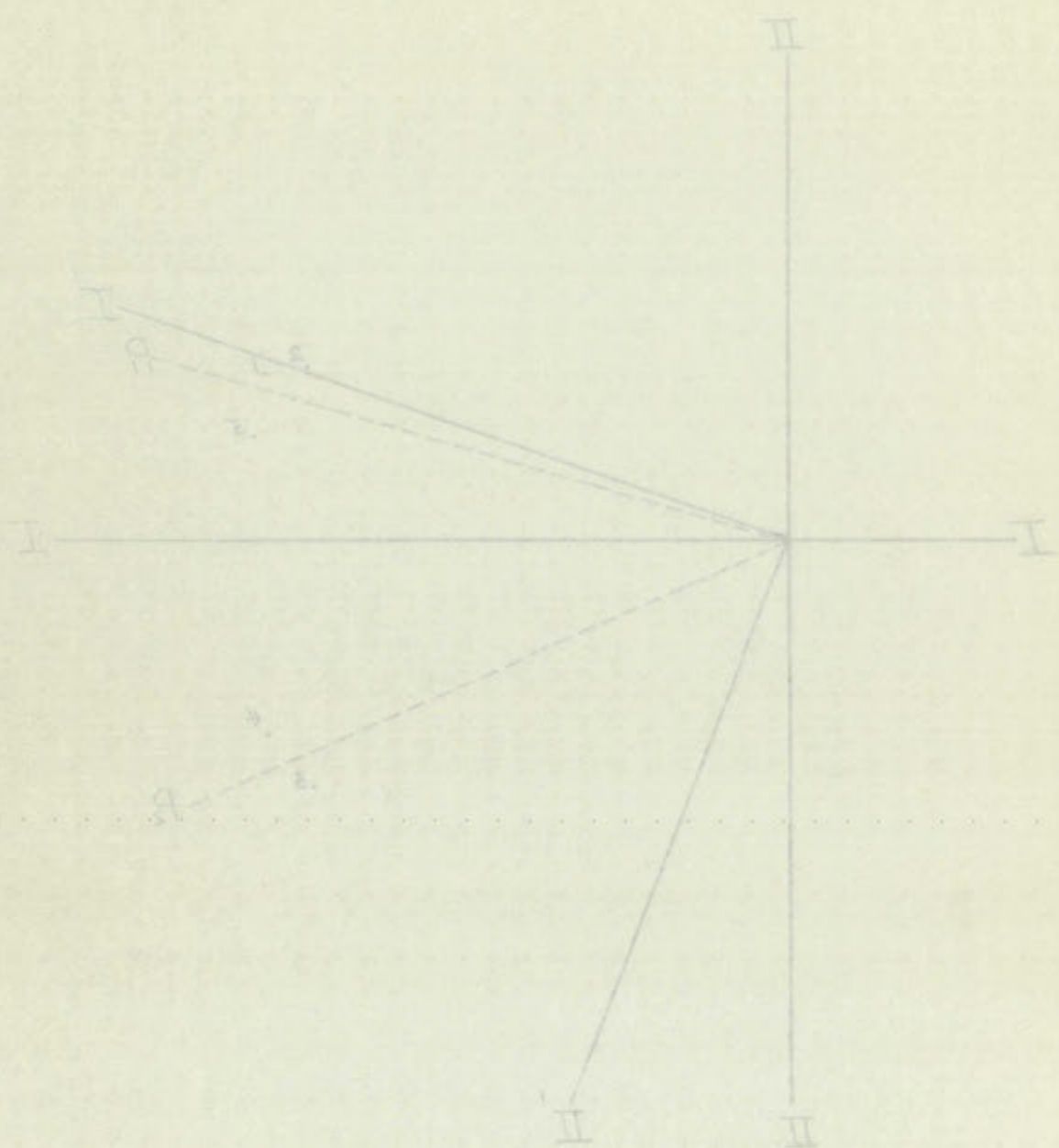


Figure 7.

Plot of the Factor Loadings of the Five Tests of
 Table XII with Reference to the Centroid
 Axes I and II for Angle Measures.

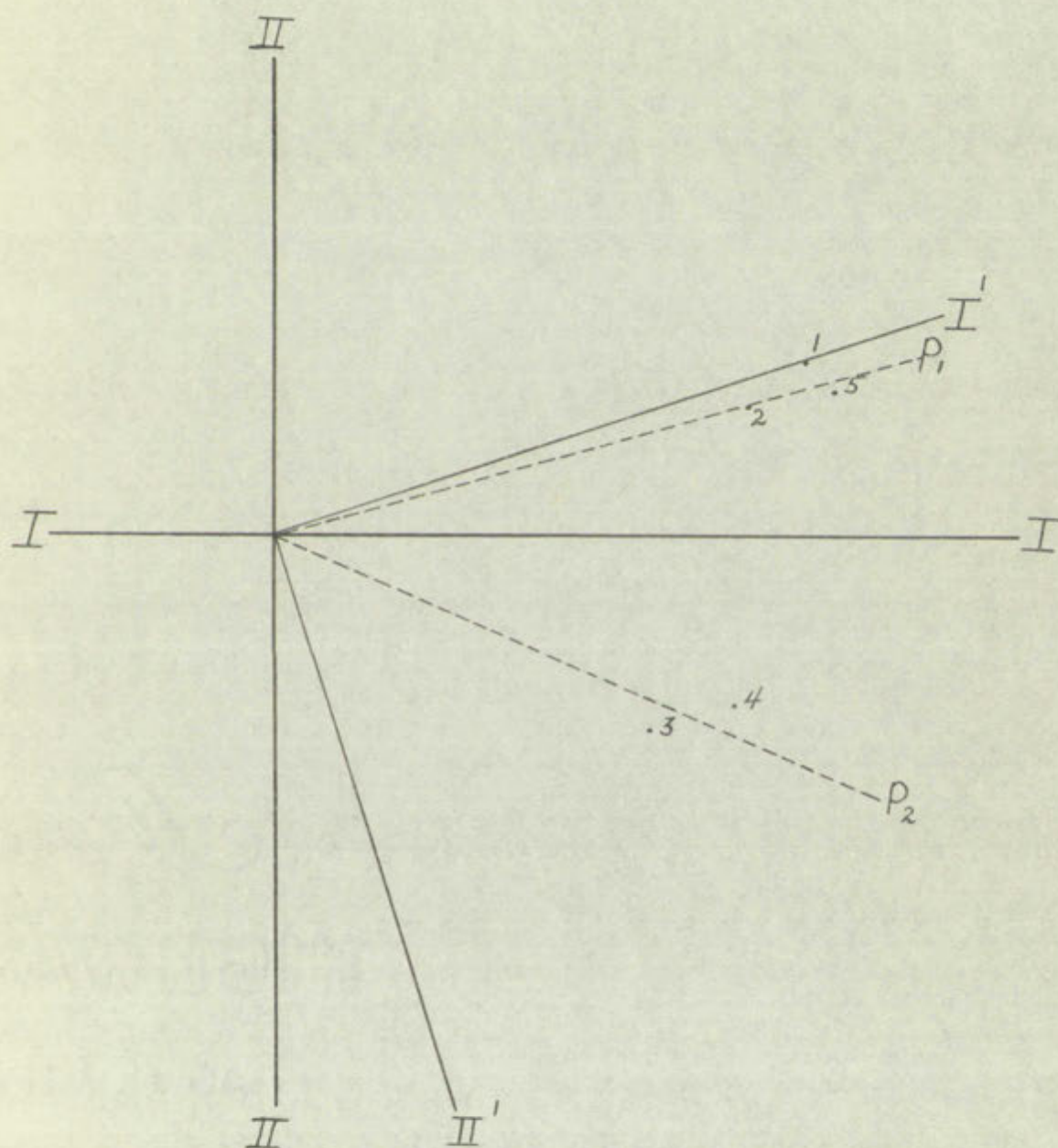


Figure 8.

Plot of the Factor Loadings of the Five Tests of
Table XXX with Reference to the Centroid
Axes I and II for Anglo Females.

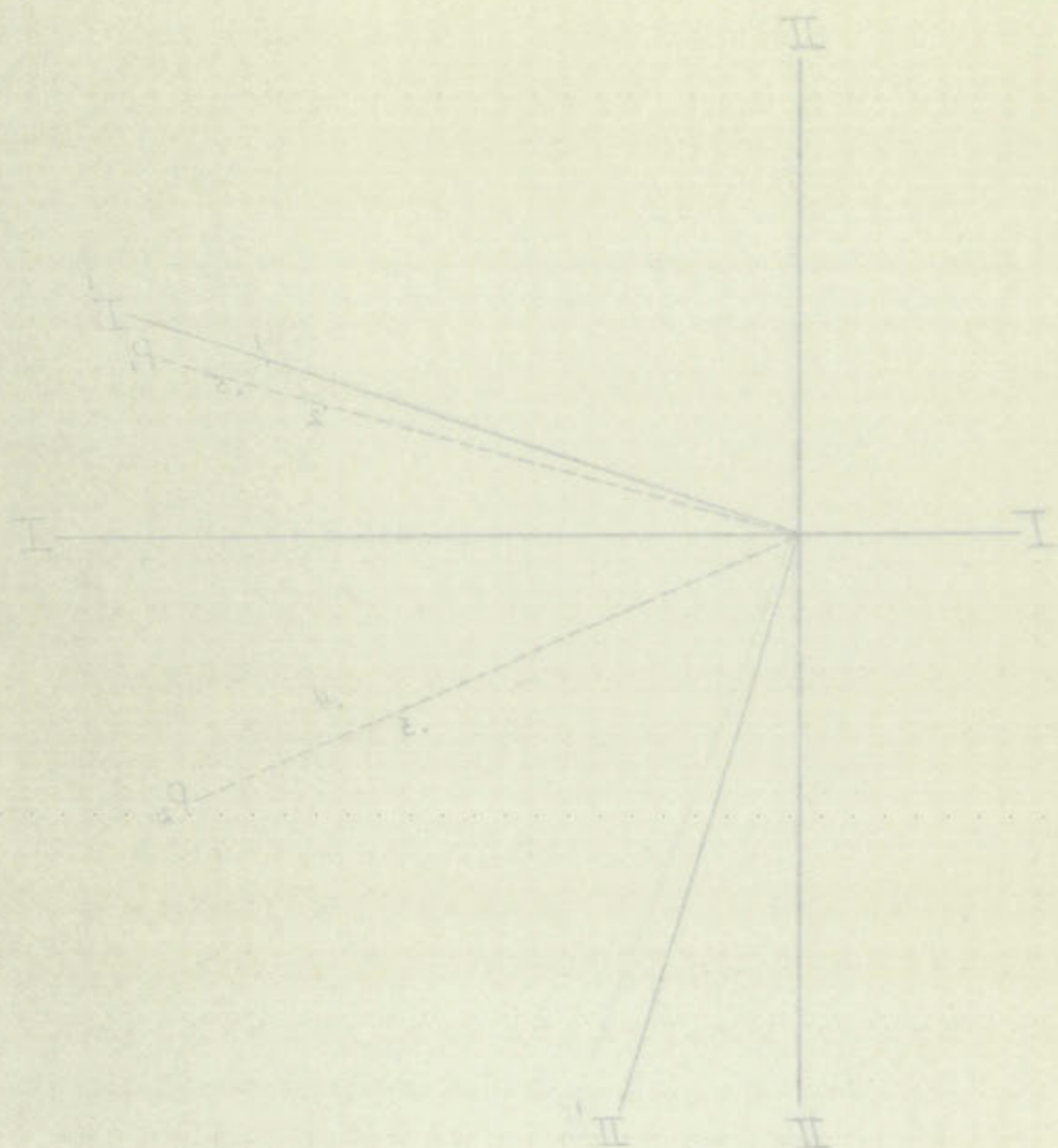


Figure 8.

Plot of the vector loading of the five tubes of
Table XX with reference to the controls
axes I and II for angle 100°.

between the two primary traits. It was found, however, that with the Spanish groups the verbal tests showed more scatter in the plots than with the Anglo groups.

Tables XXXI, XXXII, XXXIII, and XXXIV show the factor weightings of the primary traits in each of the five tests for the four groups, and is to be read in the same fashion as Tables XXV and XXVI, but cannot be directly compared with them as the angle of rotation is different. In general, however, the evidence afforded in both sets of tables agrees, and the comparisons extend to cultural groups. With all groups Tests I and V were found to be the best measures of trait I', which was identified as a Language or a verbal factor. The difference found in the weighting of Tests I and V in any group was probably not reliable, and the greatest difference was only .07 with the Spanish males. The best measures of trait II' were Tests III and IV, Mathematics and Science. The greatest difference was .04 with the Anglo males, which was hardly to be regarded as reliable. Trait II' was identified as a Mathematics-Science factor, although not purely so as it entered into other tests to some degree, especially Test V, but with the Anglo females the relationship was low. Perhaps the nature of trait II' is somewhat akin to analytical thinking.

The division of $K_1'^2$ and $K_1'^2$ by H^2 in each part of the tables gave the relative proportions of the variance resulting

between the two primary factors. It was found, however, that with the Spanish groups the verbal tests showed more deviation in the place than with the Anglo groups.

Tables XXI, XXII, XXIII, and XXIV show the factor

weightings of the primary factors in each of the five tests for the four groups, and as to be read in the same fashion as Tables XIV and XVI, but cannot be directly compared with them as the angle of rotation is different. In general, however, the evidence afforded in both sets of tables agrees, and the comparisons extend to individual groups. With all groups Tests I and V were found to be the best measures of trait I, which was identified as a language or a verbal factor. The difference found in the weighting of Tests I and V in any group was probably not reliable, and the greatest difference was only .07 with the Spanish males. The best measures of trait II were Tests III and IV, Mathematics and Science. The greatest difference was .06 with the Anglo males, which was hardly to be regarded as reliable. Trait II was identified as a Mathematics-Science factor, although not purely so as it entered into other tests to some degree, especially Test V, but with the Anglo females the relationship was low. Perhaps the nature of trait II is somewhat akin to analytical thinking.

The division of $K_1'^2$ and $K_2'^2$ by K_3 in each part of the tables gave the relative proportions of the variance consisting

TABLE XXXI

FACTOR LOADINGS AND COMMUNALITIES FROM A COMMON
 ROTATION OF 25 DEGREES OF THE FIVE
 TESTS FOR THE SPANISH MALES

Variable	K_1'	K_2'	$K_1'^2$	$K_2'^2$	H^2
1. English	.8438	.0472	.7120	.0022	.7142
2. Social Science	.5480	.0181	.3003	.0003	.3006
3. Mathematics	.5292	.5359	.2801	.2872	.5673
4. Science	.4254	.5379	.1810	.2893	.4703
5. Reading-Language	.7763	.2663	.6026	.0709	.6735
Sum K'^2			2.0760	.6499	2.7259
$\frac{\text{Sum } K'^2}{N}$.4152	.1300	.5452

TABLE XXV

FACTORS INVOLVED IN THE DETERMINATION OF THE EFFECTS OF THE FIVE TESTS FOR THE SEVERAL GROUPS

Variable	F_1	F_2	F_3	F_4	F_5
1. English	.6435	.6472	.7192	.6435	.7192
2. Social Science	.6435	.6472	.6435	.6435	.6435
3. Mathematics	.6435	.6472	.6435	.6435	.6435
4. Science	.6435	.6472	.6435	.6435	.6435
5. Reading-Language	.6435	.6472	.6435	.6435	.6435
Sum F_1 's	3.2175	3.2360	3.2175	3.2175	3.2175
Sum F_2 's	3.2175	3.2360	3.2175	3.2175	3.2175

TABLE XXXII
 FACTOR LOADINGS AND COMMUNALITIES FROM A COMMON
 ROTATION OF 25 DEGREES OF THE FIVE
 TESTS FOR THE SPANISH FEMALES

Variable	K_1'	K_2'	$K_1'^2$	$K_2'^2$	H^2
1. English	.7786	.1701	.6062	.0289	.6351
2. Social Science	.6959	.0083	.4843	.0001	.4844
3. Mathematics	.4664	.4432	.2175	.1964	.4139
4. Science	.3444	.4547	.1186	.2068	.3254
5. Reading-Language	.7829	.3032	.6129	.0919	.7048
Sum K'^2			2.0395	.5241	2.5636
$\frac{\text{Sum } K'^2}{N}$.4079	.1048	.5127

TABLE XVII

FACTOR LOADINGS AND COMMUNITIES FROM A COMMON
ROTATION OF 22 VARIABLES BY THE FIVE
TESTS FOR THE SPINER ANALYSIS

Variable	F_1	F_2	F_1^2	F_2^2	R^2
1. English	.7762	.1701	.6025	.0289	.6314
2. Social Science	.6989	.0083	.4884	.0001	.4885
3. Mathematics	.4884	.4483	.2375	.1999	.4374
4. Science	.5444	.4547	.2964	.2058	.5022
5. Reading-Language	.7082	.3028	.5015	.0916	.5931
<hr/>					
	Sum R^2		2.6003	0.4261	3.0264
	Sum F^2		1.076	0.408	1.484

TABLE XXXIII

FACTOR LOADINGS AND COMMUNALITIES FROM A COMMON
 ROTATION OF 25 DEGREES OF THE FIVE
 TESTS FOR THE ANGLO MALES

Variable	K_1'	K_2'	$K_1'^2$	$K_2'^2$	H^2
1. English	.8152	.1131	.6646	.0128	.6774
2. Social Science	.7457	.0738	.5561	.0054	.5615
3. Mathematics	.5031	.6178	.2531	.3817	.6348
4. Science	.5889	.5797	.3468	.3361	.6829
5. Reading-Language	.8315	.3089	.6914	.0954	.7868
Sum K'^2			2.5120	.8314	3.3434
$\frac{\text{Sum } K'^2}{N}$.5024	.1663	.6687

TABLE XXIII

FACTOR LOADINGS AND CORRELATIONS WITH A COMMON
 ROTATION OF 25 DEGREES OF THE FIVE
 TESTS FOR THE ABOVE MEANS

Variable	R_1	R_2	R_3	R_4	R_5
1. English	.8182	.1181	.8446	.6183	.4774
2. Social Science	.7997	.0728	.8882	.6034	.5810
3. Mathematics	.8031	.8198	.8521	.7187	.5818
4. Science	.8055	.0797	.8498	.6201	.4830
5. Reading-Language	.6219	.8009	.4018	.0322	.7088
Sum R^2	2.5180	2.5180	2.5180	2.5180	2.5180
Sum R^2	2.5180	2.5180	2.5180	2.5180	2.5180

TABLE XXXIV

FACTOR LOADINGS AND COMMUNALITIES FROM A COMMON
 ROTATION OF 25 DEGREES OF THE FIVE
 TESTS FOR THE ANGLO FEMALES

Variable	K_1'	K_2'	$K_1'^2$	$K_2'^2$	H^2
1. English	.8361	.1528	.6991	.0233	.7224
2. Social Science	.7277	.1291	.5295	.0167	.5462
3. Mathematics	.3541	.5481	.1254	.3004	.4258
4. Science	.4684	.5296	.2194	.2805	.4999
5. Reading-Language	.8140	.1324	.6626	.0175	.6801
Sum K'^2			2.2360	.6384	2.8744
$\frac{\text{Sum } K'^2}{N}$.4472	.1277	.5749

TABLE XXIV

FACTOR LOADINGS AND COMMUNITIES WHEN A CORRELATION
ROTATION OF 25 DEGREES OF THE FIVE
TESTS FOR THE ANGLO FEMALLES

Variable	R^2_1	R^2_2	R^2_3	R^2_4	R^2_5
1. English	.6261	.1538	.0991	.0383	.7234
2. Social Science	.7277	.1591	.0325	.0157	.0439
3. Mathematics	.3241	.0491	.1934	.3504	.4283
4. Science	.4994	.0225	.2194	.2905	.4979
5. Reading-Language	.6140	.1534	.0282	.0770	.2907
Sum R^2	1.8280	0.5008	0.5290	0.7042	2.2763
$\frac{\text{Sum } R^2}{5}$.4472	.1002	.1058	.1408	.4553

from the two traits to be ascribed to each trait. A summary for the percentage of variance ascribed to each trait follows:

	Trait I'	Trait II'
Spanish males	76	24
Spanish females	80	20
Anglo males	75	25
Anglo females	78	22

The above summary may be interpreted as showing that for the females the examination is more heavily weighted with the Language or verbal factor than for the males. No noticeable cultural difference is indicated.

The two primary traits accounted for a greater proportion of the total variance of the tests with the two Anglo groups than was the case with the two Spanish groups. This may indicate that with the Spanish groups there is a third factor in attainment that is more important than with the Anglos. Since the tables were not analyzed for a third factor with the Spanish groups, the statement cannot be definitely stated as true.

In general, the organization of abilities for the two sex and cultural groups were found to follow much the same pattern. The similarities outweighed the differences. Probably an important condition in producing the similarities in the organization of the traits measured by the examination

from the two groups to be compared to each other. A summary
for the percentages of variance accounted for is given in Table I.

Table I	Table II
Spanish males	75
Spanish females	80
Anglo males	75
Anglo females	75

The above summary may be interpreted as showing that for the
Spanish the organization is more heavily weighted with the
language or verbal factor than for the Anglo. No significant
cultural differences are indicated.

The two primary factors accounted for a variance of 75-80
percent of the total variance of the data with the two groups
groups than was the case with the two groups. This
may indicate that with the Spanish group there is a higher
factor in attainment than in rate of improvement with the
Anglo. Since the tables were not analyzed for this
factor with the Spanish group, the statement cannot be
definitely stated as true.

In general, the organization of abilities for the two
sex and cultural groups were found to follow much the same
pattern. The similarities outweighed the differences.
Probably an important addition in providing the statistical
in the organization of the data is needed by the organization

was the fact that the curricula for all the groups had been much the same. Had the curricula been widely different, there would probably have been greater differences in trait organization. The differences in the weighting of traits I' and II' for the males and females were in harmony with the differences found in the means of the tests presented in Chapter IV, and with the general finding that girls tend to be superior in verbal tests while the boys tend to be superior in measures of Mathematics and Science.

IV. SUMMARY

Thurstone's centroid method of factor analysis was applied to the eleven variable problem, with all the tests except Science split into the component sub-tests, and showed for the Anglo groups a marked difference in the relation of the two primary abilities, which were identified as a Language or verbal factor, and a Mathematics-Science factor. The same relationship was found for both the Anglo and Spanish groups when factor analysis was applied to the inter-correlations of the five main tests.

The general patterns of organization of the two primary traits which were isolated showed no marked cultural differences, although the two primary factors accounted for a greater percentage of the total variance with the Anglo groups than with the Spanish. The examination was more

heavily weighted with the verbal factor for the females of both the Anglo and Spanish groups than for the males.

V. APPLICATIONS OF FACTOR ANALYSIS

Many generalizations about sex differences, age differences, cultural and racial differences are conflicting and unjust because no one knows just what abilities the tests are sampling. In the mental testing program there can no longer be any excuses for basing conclusions concerning mental growth or achievement without specifying the functions or variables from which conclusions are made. In both the fields, psychological and educational, factor analysis has two avenues of approach. The first is the application of factor analysis to the construction of tests, which will enable constructors of tests to specify which functions or abilities a test measures. In the second place, until the time when tests are constructed by such a scientific method, factor analysis may be applied to the interrelationships derived from administering such tests to determine the proper factor weightings.

With the development of the method of factor analysis and its proper application, educational and vocational guidance will become much more objective and scientific; hence, many of the unfits in the various vocations and avenues of educational pursuit will be reduced to a minimum and thus a

heavily weighted with the verbal factor for the purpose of both the Anglo and Spanish groups than for the negroes.

V. APPLICATIONS OF FACTOR ANALYSIS

Many generalizations about test differences, age differences, cultural and racial differences are conflicting and unjust because no one knows just what abilities the tests are measuring. In the mental testing program there can no longer be any excuse for testing conclusions concerning mental growth or achievement without specifying the functions or variables from which conclusions are made. In both the fields, psychological and educational, factor analysis has two avenues of approach. The first is the application of factor analysis to the construction of tests, which will enable construction of tests to specify which functions or abilities a test measures. In the second place, until the time when tests are constructed by such a scientific method, factor analysis may be applied to the interpretation of data derived from administering such tests to determine the proper factor weightings.

With the development of the method of factor analysis and its proper application, educational and vocational guidance will become much more objective and scientific; hence, many of the myths in the various vocations and avenues of educational pursuits will be reduced to a minimum and thus a

contribution to the happiness and well-being of this and future generations will result. Guilford says, "Indeed the range of usefulness of the factor methods is so extensive that another generation of psychologists may well devote its time to their exploitation."⁶

⁶ Ibid., p. 512.

contribution to the happiness and well-being of the
future generations will result. Unethical acts, viewed in
terms of usefulness of the future generation is an extensive
that another generation of psychologists may well devote
time to their exploration.

W. D. DILLON, JR.

CHAPTER VII

SUMMARY AND CONCLUSIONS

I. SUMMARY

Seniors representing fifty-seven New Mexico high schools took the statewide test of academic achievement April 8, 1938. In some instances, the entire class took the examination. Only those students who were reported as standing in the upper half of the class and could be definitely classified as Spanish-Americans and Anglo-Americans were used for this investigation. The problem was (1) the investigation of sex and cultural differences in academic achievement as measured by the differences in the means of the examination, the tests, and the sub-tests; (2) the investigation of sex and cultural differences in the organization of the abilities as indicated by differences in the intercorrelations of the tests and sub-tests, and the differences in the loadings of the factors central to the tests. The punched card method of machine computation was used to facilitate the various statistical procedures.

II. CONCLUSIONS

The interpretation of the analyses of the statistical procedures in this investigation warrant the following con-

CHAPTER VII

SUMMARY AND CONCLUSIONS

I. SUMMARY

Factors representing fifty-seven New Mexico high schools took the statewide test of academic achievement April 8, 1938. In some instances, the entire class took the examination. Only those students who were reported as attending in the upper half of the class and could be definitely classified as Spanish-American and Anglo-American were used for this investigation. The problem was (1) the investigation of sex and cultural differences in academic achievement of sex and cultural differences in the means of the examination, the tests, and the sub-tests; (2) the investigation of sex and cultural differences in the organization of the abilities as indicated by differences in the investigations of the tests and sub-tests, and the differences in the findings of the factors central to the tests. The punched card method of machine computation was used to facilitate the various statistical procedures.

II. CONCLUSIONS

The interpretation of the analyses of the statistical procedures in this investigation warrant the following con-

clusions:

The order of rank as to the magnitude of the means for the examination was: Anglo males, Anglo females, Spanish males, and Spanish females.

A reliable difference was found in favor of the Spanish males over the Spanish females for Science.

The Anglo males were found to be reliably superior to the Spanish males in English, Social Science, Mathematics, Science, and Reading and Language.

Reliable differences were found favoring the Anglo females over the Spanish males in English, Social Science, and Reading and Language.

The Anglo males were found significantly superior to the Spanish females in achievement for Social Science, Mathematics, Science, and Reading and Language. The greatest and most reliable differences obtained for Mathematics and Science.

The Anglo females were reliably superior to the Spanish females in English, Social Science, Mathematics, Science, and Reading and Language.

Reliable differences in achievement were obtained from the comparison of the Anglo groups. The boys were superior in Social Science, Mathematics, Science, and Reading and Language. The difference in English in favor of the girls was not entirely reliable.

analysis:

The order of rank as to the magnitude of the mean for the examination was: Anglo males, Anglo females, Spanish males, and Spanish females.

A reliable difference was found in favor of the Spanish males over the Spanish females for Science.

The Anglo males were found to be reliably superior to the Spanish males in English, Social Science, Mathematics, Science, and Reading and Language.

Reliable differences were found favoring the Anglo females over the Spanish males in English, Social Science, and Reading and Language.

The Anglo males were found significantly superior to the Spanish females in achievement for Social Science, Science, Science, and Reading and Language. The Spanish and most reliable differences obtained for Mathematics and Science.

The Anglo females were reliably superior to the Spanish females in English, Social Science, Mathematics, Science, and Reading and Language.

Reliable differences in achievement were obtained from the comparison of the Anglo groups. The boys were superior in Social Science, Mathematics, Science, and Reading and Language. The differences in English in favor of the girls was not entirely reliable.

The Anglo females were found reliably superior to the Anglo males for the sub-tests of English Usage, Literature, and Functional Reading. Marked differences were found in favor of the males on all the sub-tests of Social Science, Mathematics, and Science.

Low correlations were found to exist between Social Science and Science, and between Social Science and Mathematics for each sex and cultural group. Mathematics was most highly correlated with Science for each group, with the exception of the Spanish females, when Mathematics was most highly correlated with Reading and Language. Aside from the relationships between Mathematics and Science, English, and Reading and Language had the highest correlations with the other variables. The same general relationships were found for the sub-tests as for the tests.

The application of factor analysis to the eleven variable problem showed for the Anglo groups a marked difference in the relation of the two primary abilities, which were identified as a Language or verbal factor, and a Mathematics-Science factor. The same relationship was found for both the Anglo and Spanish groups when factor analysis was applied to the intercorrelations of the five main tests.

The general patterns of organization of the two primary traits which were isolated showed no marked cultural differences, although the two primary factors accounted for

The Anglo females were found reliably superior to the Anglo males for the sub-tests of English Usage, Literature, and Mathematical Reading. Marked differences were found in favor of the males on all the sub-tests of Social Balance, Mathematics, and Science.

Low correlations were found to exist between Social Balance and Science, and between Social Balance and Mathematics for each sex and cultural group. Mathematics was most highly correlated with Science for each group, with the exception of the Spanish females, when Mathematics was most highly correlated with Reading and Language. Aside from the relationships between Mathematics and Science, English, and Reading and Language had the highest correlations with the other variables. The same general relationships were found for the sub-tests as for the tests.

The application of factor analysis to the eleven variable problem showed for the Anglo groups a marked difference in the relation of the two primary abilities, when were identified as a Language or Verbal factor, and a Math-Math-Social factor. The same relationship was found for both the Anglo and Spanish groups when factor analysis was applied to the intercorrelations of the five main tests. The general patterns of organization of the two primary traits which were isolated showed no marked cultural differences, although the two primary factors accounted for

a greater percentage of the total variance with the Anglo groups than with the Spanish. The examination was more heavily weighted with the verbal factor for the females of both the Anglo and Spanish groups than for the males.

a greater percentage of the total variance with the Anglo
groups than with the Spanish. The examination was more
heavily weighted with the verbal factor for the Spanish of
both the Anglo and Spanish groups than for the Anglo.

BIBLIOGRAPHY

YERASOOLJIE

- Anastasi, Anne, Differential Psychology. New York: The Macmillan Company, 1937. 424 pp.
- Burington, Richard Stevens, Handbook of Mathematical Tables and Formulas. Sandusky, Ohio: Handbook Publishers, Incorporated, 1933. 251 pp.
- Kells, W. C., and Fox, C. S., "Sex Differences in Mathematical Achievement of Junior College Students," Journal of Educational Psychology, 24:381-86, May, 1932.
- Garrett, Henry E., Statistics in Psychology and Education. New York: Longmans, Green and Company, 1930. 317 pp.
- _____, Differential Mental Traits: The Psychological Record. Bloomington, Indiana: The Principia Press, Incorporated, Vol. II, No. 9, June, 1938. pp. 259-98.
- Gerberich, J. R., A Personnel Study of 10,000 Iowa High School Seniors, University of Iowa Studies in Education, Vol. V, No. 3. Iowa City: University of Iowa, 1930. 112 pp.
- Guilford, J. P., Psychometric Methods. New York: McGraw-Hill Book Company, Incorporated, 1936. 566 pp.
- Haney, Victor, E., Sex Differences in Algebra. Pennsylvania State Studies in Education, No. 12. Philadelphia: University of Pennsylvania, 1935. pp. 25-26.
- Hankse, C. F., "Sex Differences in High School Chemistry," Journal of Educational Research, 23:412-16, 1931.
- Hurd, A. W., "Sex Differences in Achievement in Physical Science," Journal of Educational Psychology, 25:70, 1934.
- Kelley, Truman L., Essential Traits of Human Life. Cambridge: Harvard University Press, Harvard Studies in Education, Vol. 26, 1935. 145 pp.
- Kelly, V. H., "The Reading Abilities of Spanish and English Speaking Pupils," Journal of Educational Research, 29: 209-211, 1935.
- Manuel, H. T., "The Mexican Child in Texas," Southwest Review, 17:290-302, 1932.
- Pease, G. R., "Sex Differences in Algebraic Ability," Journal of Educational Psychology, 21:712-14, 1930.

Practical Applications of the Punched Card Method in Colleges and Universities. New York: Columbia University Press, 1935. 442 pp. - xxi.

Sorenson, Herbert, Statistics for Students of Psychology and Education. New York: The McGraw Hill Book Company, Incorporated, 1936. 373 pp.

Spearman, C., The Abilities of Man. New York: The Macmillan Company, 1937.

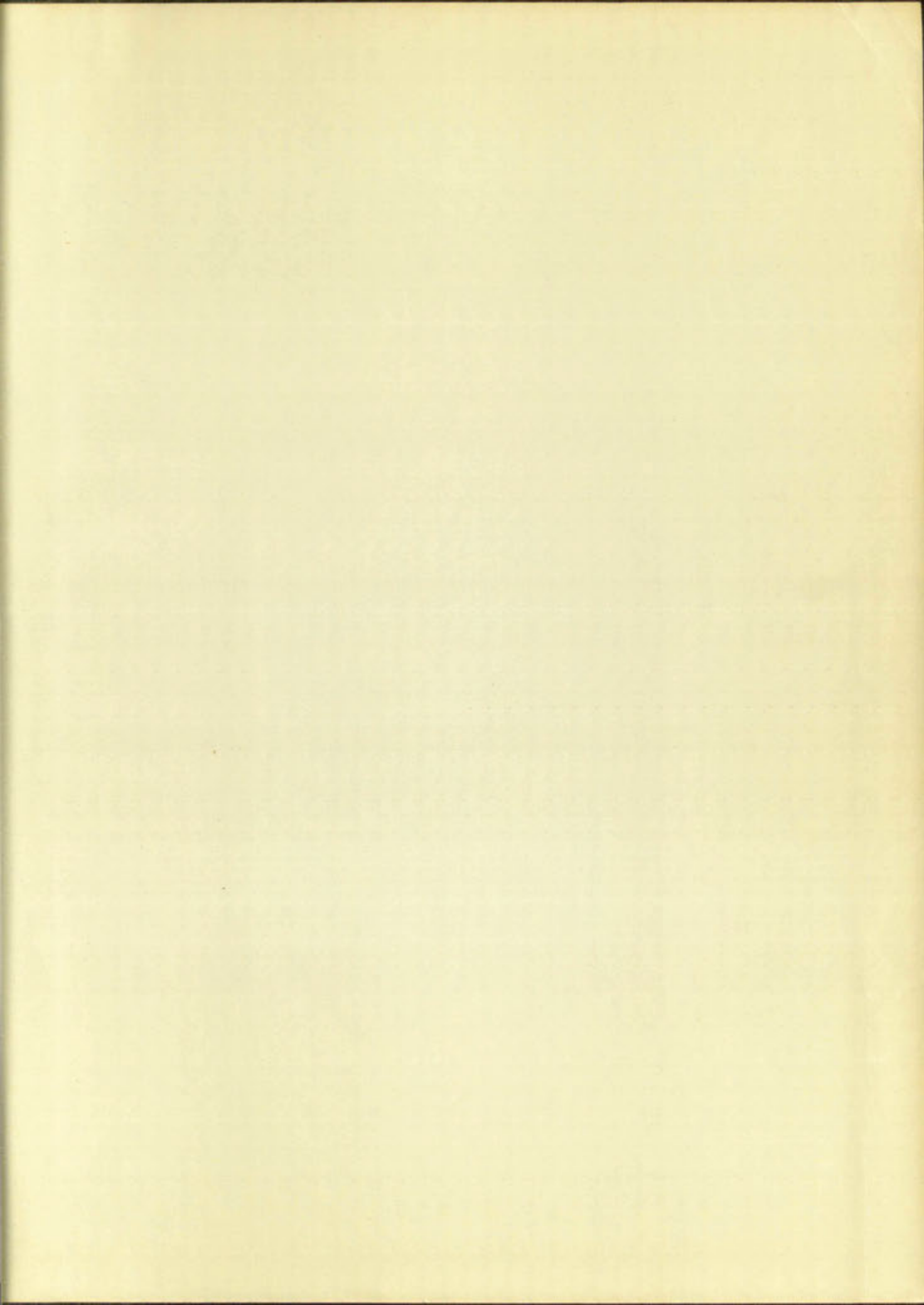
Thurstone, L. L., The Vectors of Mind. Chicago: The University of Chicago Press, 1935. 266 pp.

Psychical Investigations of the Purported Card Method in Colloids
and Universities. New York: Columbia University Press,
1935. 432 pp. - md.

Johnson, Herbert. Statistics for Students of Psychology and
Education. New York: The McGraw-Hill Book Company,
Incorporated, 1934. 375 pp.

Johnson, C. The Abolition of Man. New York: The Macmillan
Company, 1933.

Thurstone, L. L. The Vector of Mind. Chicago: The Univer-
sity of Chicago Press, 1934. 382 pp.



IMPORTANT!

Special care should be taken to prevent loss or damage of this volume. If lost or damaged, it must be paid for at the current rate of typing.

