SEX DIFFERENCES IN ABILITIES
AND IN ACHIEVEMENT

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CHAPTER I.

INTRODUCTION TO THE PROBLEM

Men and women have long been compared to one another in connection with their abilities. Yet comparatively few longitudinal studies have been made concerning sex differences in mental ability and development.

Marian Wozencraft cites that as early as 1910 Bonser reported boys to be superior to girls in arithmetic reasoning and computation while girls did better in certain language arts.[1] Studies following Bonser's have had similar results so there does seem to be some foundation for assuming that sex differences in ability and development do occur.

Terman and Tyler summarize many previous studies and elaborate somewhat on these differences. In the elementary grades boys are superior to girls in mechanical and athletic skills, in spatial and quantitative abilities, and in science and mathematics; while girls show their superiority in clerical aptitude as well as in verbal fluency and language achievement.[2]

Our society seems to expect more from girls while they are enrolled in elementary and secondary schools. Traditionally they are the

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[1]Marian Wozencraft, "Sex Comparisons of Certain Abilities," Journal of Educational Research, 57:22, September, 1963.

[2]L. M. Terman and L. E. Tyler, "Psychological Sex Differences," Manual of Child Psychology, L. Carmichael, editor. New York: Wiley, 1954, p. 1068.

ones who "like" school and therefore achieve better. On the other hand boys appear to be involved in more disciplinary action than do girls. They have more failures than girls do. In 1964-65 in the school being used for this study boys failed 192 subjects while girls failed only 114 in the years they had been in junior and/or senior high school. Yet we still expect boys to be the ones to go on to these professions demanding more lengthy, more technical, more difficult educational backgrounds.

Even today, when there is more nearly equality of opportunity for both sexes, girls find it difficult to enter the "men's" fields of medicine, engineering, etc. However, successful women in these fields indicate there are women who are of equal ability with the men. Reports coming out of communist Russia indicate that women outnumber men in the field of medicine and are found in great numbers in all other fields of science as well.

If we consider the history of one professional field we can see an indication of both sexes working toward an equality based on their abilities and achievements. Reading our nation's history we find that early in its development many school teachers were men who had failed at some other profession or used teaching as a fill-in until success in another venture was realized. Slowly women, some poorly trained and others with some preparation, took over this service to the youth; and as recently as twenty-five years ago trained women teachers dominated the teaching profession. Today more and more men are turning to the educational field. Both men and women are now well trained in the same institutions, in the same classes competing with one another; and they then enter a field where the two sexes receive more nearly equal opportunities. This would tend to indicate that both sexes have abilities, at least in this one area, that might be very nearly equal.

Academic equality or superiority may not always be welcome. Many older girls of superior intelligence find it more convenient to disguise their superiority.[3] In a recent re-study on sex roles it has been found that 25-30% of the college women interviewed at some time pretend intellectual inferiority to men. The original study indicated as many as 40% resorted to this.[4] The seven years which elapsed between the original study and the re-study have seen a change in the status of women--from the ultra-feminine to the "modern" woman striving for equality. Again this indicates what our society expects.

The apparent success of boys and girls in the same institutions of learning might serve to indicate that in general abilities and general achievement we can expect to find little differences between the sexes. But considering past studies and our cultural background, we may find there are significant differences of abilities and achievement in special areas.

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[3]Harold W. Bernard, Adolescent Development in American Culture, Yonkers-on-Hudson: World Book Co., 1957, p. 290.

[4]Paul Wallin, "Cultural Contradictions and Sex Roles," The Adolescent--A Book of Readings, Rev. Ed., Jerome M. Seidman, editor. New York: Holt, Rinehart and Winston, Inc., 1960, p. 276.

It is the purpose then of this longitudinal study to examine the problems of sex differences in ability and achievement, which have been suggested by previous writers, through the use of standardized test results. It is also hoped that the longitudinal aspect of this study will help clarify whether or not changes in these sex differences or lack of sex differences do occur during this period of adolescence; therefore the test results for students who have been tested in their seventh, eighth, ninth, and eleventh grades were used.

From the total seventh grade population a group of matched pairs were selected in order to make comparisons between the boys and girls when they were in grades eight, nine, and eleven. This study attempts to explore the null hypotheses that: (1) there is no significant difference between the general abilities of boys and the general abilities of girls, (2) there is no significant difference between the general achievement of boys and the general achievement of girls, and (3) there are no significant differences between boys and girls in the particular aptitudes or in special areas of achievement.

CHAPTER II.

A REVIEW OF THE LITERATURE

Some feel that educational research is surprisingly "empty on academic growth of boys and girls."[5] But upon examining the literature we find a number of early studies on specific subject areas, particularily mathematics and language arts. The results of these early studies are referred to and summarized by nearly all later authors. This chapter will review some of this literature, particularily that which has not only summarized but added to the fund of information on this subject.

Sex Differences in General Abilities and Achievement

Studies by Lincoln, Olson, and Stroud and Lindquist all seem to lead later researchers to believe that girls achieve higher and sooner.[6]

Stroud and Lindquist in their study of grades three through eight in 1932-1939 have stated that when using the Iowa Every Pupil Basic Skills Testing Program they found girls maintained a consistent and, on the whole, significant superiority over boys.[7] The only exception was in arithmetic

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[5] Scarvia B. Anderson and Milton H. Maier, "34,000 Pupils and How They Grow," *Journal of Teacher Education*, 14:212, 1963.

[6] Marvin Powell, et. al., "Are There Really Sex Differences in Achievement?" *Journal of Educational Psychology*, 57:210, December, 1963.

[7] Iowa Basic Skills Tests cover achievement in the general areas of language arts, mathematics, and study skills which include map, graph, and chart interpretation.

where a small, but not sifnificant, difference favored the boys. They continued their study in the high school using the Iowa Every Pupil High School Testing Program and found that here the advantage had definitely shifted to the boys with two exceptions. In algebra and in reading comprehension the girls were favored, but not significantly.[9]

Three studies were done in Ohio schools--two by Powell and his associates and one by Wozencraft. In Powell's first study he and his co-workers used 2651 boys and 2369 girls from Ohio urban and suburban schools. They assumed sex differences but upon the administration of five I. Q. tests they found no significant difference on general abilities; and after four achievement tests they concluded there were no significant sex differences on general achievement either.[10] The second Powell study will be discussed later.

Marian Wozencraft has made a fairly recent study of 564 third graders and 603 sixth grade students from Cleveland, Ohio. The third grade was tested by using the Kuhlmann-Anderson Test, and the Cleveland Classification Test was given to the sixth grade. After dividing the grades into three ability groups--low, average, high--they were compared by sexes in these ability groups and in the total group. She found no

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[8]J. B. Stroud and E. F. Lindquist, "Sex Differences in Achievement in the Elementary and Secondary Schools," Journal of Educational Psychology, XXXIII:665, 1942.

[9]Ibid., p. 666.

[10]Powell, op. cit., pp. 210-212.

significance in the difference of mental ages in the total group as well as in all sub groups. From this she went onto consider chronological ages, and in the third grade she found the girls to be younger in the total group and in the average group; boys were younger in the high ability group; and there was no age difference in the low group. The sixth grade chronological ages indicated the girls were again younger in the total and average groups, but here no differences occurred in either the high or low groups. The author felt this might confirm the belief that girls are ready for school before boys.[11] Olson reports that differences might not be sex differences but maturity differences, and suggests that some advocate boys staying in kindergarten longer or starting school later in order to compensate for this later maturing.[12]

In Hobson's study of 265 boys and 260 girls in the ninth grade he found, through use of the Kuhlmann-Anderson I. Q. Test, that girls showed a significant superiority.[13]

Several studies including Stroud and Lindquist's have evidenced a change from girls' superiority to boys' superiority as they grow older. They felt this might be due to the high school curriculum which was geared

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[11]Wozencraft, op. cit., pp. 24-27.

[12]W. C. Olson. Child Development, Second Ed., Boston: D. C. Heath and Co., 1959, p. 155.

[13]J. R. Hobson, "Sex Differences in Primary Mental Abilities," Journal of Educational Research, 41:128, 1947.

closer to the interests of boys.[14] One study indicated that pre-school girls were superior to pre-school boys; during early childhood there was no difference between the sexes; during pre-adolescence the girls again showed superiority; but thereafter until the end of the teens the boys were superior on composite test scores.[15] Terman felt that ability differences were most apparent at older age levels.[16]

We have discussed general intelligence and achievement but the differences between the sexes on particular abilities tend to be larger and more significant than the differences on tests of general intelligence.[17] Garrett concurs in that he feels that abstract intelligence breaks down at high school and college levels into a number of relatively independent factors and he would prefer tests designed to measure special abilities rather than those designed to measure general abilities.[18] Let us then examine two special fields in particular, language arts and mathematics.

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[14] Stroud, _op. cit._, p. 666

[15] Frieda Kiefer Merry and Ralph Vickers Merry. _The First Two Decades of Life_, Second Ed. New York: Harper and Brothers, 1958, p. 261.

[16] Terman, _loc. cit._

[17] David P. Ausubel. _Theory and Problems of Child Development_. New York: Greene and Stratton, 1958, p. 290.

[18] H. E. Garrett, "A Developmental Theory of Intelligence," _Psychological Studies of Human Development_, Raymond G. Kuhlen and George B. Thompson, editors. New York: Appleton-Century-Crofts, Inc., 1952, p. 184.

Sex Differences in Language Arts

Nearly all studies show that there is a significant difference favoring the girls in reading, vocabulary, English usage, etc. This sex difference is apparent in some language arts areas as early as ten months of age when girls may begin to talk; boys usually begin later.[19] They maintain throughout life this superiority gained by early speaking.[20] This verbal fluency is further evidenced in that it is known there are many more boys who stutter than there are girls.[21]

Powell's second study of 3551 children from Ohio's small urban schools in grades four through eight indicated that in one-fifth of the comparisons made using the California Test of Mental Maturity and the California Achievement Test Battery the boys were favored, but few significantly. All those with I. Q.'s below 75 were eliminated in this study. Girls excelled in reading. Because the sample was divided into under-, average, and over-achievers this might then be explained "that under-achieving girls did not under-achieve as much as did under-achieving boys."[22]

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[19] Ibid.

[20] Bernard, loc. cit.

[21] Terman, op. cit., p. 1072.

[22] Marvin Powell, Henry O'Connor, and Kenneth M. Parsley, Jr., "Further Investigation of Sex Differences in Achievement of Under-, Average, and Over-Achieving Students Within Five I. Q. Groups in Grades Four Through Eight," Journal of Educational Research, 57:268-270, January, 1964.

Although Lincoln does not show statistics concerning his data he contends that girls are superior by a small margin in reading and spelling at the elementary level, and that they have a decided advantage in language and composition in both the elementary and high school levels.[23] Olson corroborates this, finding that girls surpass boys in reading comprehension, vocabulary, and basic language skills on the elementary level and in reading on the secondary level.[24] Girls continue this superiority through college.[25] In a number of investigations of library circulation it was found that girls read many more books than boys do.[26] We can not, however, say whether this is a cause or an effect of their reported superiority in reading.

Only one study was found by this writer that contradicted the above findings. Jordan in his study of 19,000 students from North Carolina, using the High School Senior Examination, found there was no significant difference between the sexes in reading on the high school level; the sexes were found to be equal on their knowledge of literature; but girls did excel in English usage where only 29% of the boys were equal to or better than all girls.[27]

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[23]E. A. Lincoln. Sex Differences in the Growth of American School Children. Baltimore: Warwick and York, 1927, p. 138.

[24]Olson, loc. cit.

[25]Merry, op. cit., p. 262.

[26]Luella Cole. Psychology of Adolescence. New York: Rinehart and Co., Inc., 1954, p. 562.

Ausubel felt that language differences between the sexes were more pronounced in lower socio-economic groups than in the higher socio-economic groups.

An explanation for this superiority might be the fact that in our society boys are encouraged at an early age to go outside and participate in active play while girls often stay inside where there is apt to be a greater question-answer companionship between mother and daughter than between either parent and son.[29]

Caution is needed in the interpretation of the results of reading tests cited because most reading investigations showing girls superior are made with speed reading tests. In other kinds of tests girls are superior in verbal fluency rather than in verbal meanings.[30]

Sex Differences in Mathematics and Other Fields

Boys have usually been cited as being superior in ability and achievement in mathematics. Research findings do vary as to the ages of superiority and they also differ somewhat on achievement in the various branches of mathematics.

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[28]Ausubel, op. cit., p. 528.

[29]Dorothea McCarthy, "Some Possible Explanations of Sex Differences in Language Development and Disorders," The Journal of Psychology, 35:157-158, 1953.

[30]Terman, op. cit., p. 1071.

The least complicated results are the findings by the Merrys which indicate that boys in primary grades begin to excel the girls not only in mathematics but in spatial relations and mechanical ability as well, and that their superiority continues through college.[31]

Boys are favored in arithmetic according to Powell and Olson;[32] Bernard disagrees in that his findings indicate at the age of eight girls excel the boys in mathematics and that by age fifteen the boys catch up and then excel. He also judges boys superior in space relations and mechanical reasoning.[33]

Lincoln finds the sexes are equal in both arithmetic and algebra; but that the boys show their superiority in geometry.[34] In the North Carolina high school study the difference in algebra and geometry was found to be very small, but favoring the boys; there were also indications of the boys excelling in general science and history.[35]

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[31]Merry, loc. cit.

[32]Powell, O'Connor, and Parsley, loc. cit.; Olson, loc. cit.

[33]Bernard, loc. cit.

[34]Lincoln, loc. cit.

[35]Jordan, loc. cit.

Several authors[36] feel that the most important conclusion that can be drawn from all studies concerning sex differences is that the difference between the sexes is much less than the difference within each sex.

Why Sex Differences?

History has recorded names and achievements of large numbers of men, but very few women, who have been successful in their chosen fields; yet all studies of school achievement show girls have better records than boys. Several reasons for this are advanced: our culture has not given women an equal opportunity; the inborn nature of girls makes them superior along verbal, not action, lines; the fact that girls mature earlier shows on school grades, or the girls natural "feminine" traits of docility and submissiveness help them in school but hinder them in affairs of the world.[37] Perhaps one or a combination of these reasons explains sex differences of achievement; but,

> until more evidence is available it is impossible to decide to what extent sex differences in variability are attributable to such genuine determinants as genic and relevant environmental factors, on one hand, and to purely extraneous considerations, on the other hand.[38]

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[36]Leona E. Tyler, The Psychology of Human Differences. New York: Appleton-Century-Crofts, Inc., 1956, p. 255; Bernard, op. cit., p. 289; Merry, op. cit., p. 261.

[37]Tyler, op. cit., pp. 248-250.

[38]Ausubel, op. cit., p. 591

Others are concerned with the reason for sex differences; Bernard feels that they might better be attributed to differences in interests and activities rather than to a direct biological cause.[39]

One theory which is interesting suggests the possibility of chemical differences in male and female brains. Another theory is that "the same thinking apparatus housed in a female might work differently from the way it would housed in a male."[40]

Earlier studies then indicate that there is little difference between the general ability of girls and the general ability of boys. If there is some superiority of achievement of girls the boys catch up or surpass the girls later on. Girls show superiority in reading and language while boys appear better in science and mathematics, especially in later school years. The differences which do occur do not seem to have any general explanation although theories indicate both physical and social reasons.

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[39] Bernard, *op. cit.*, p. 290.

[40] Amram Scheinfeld. *The New You and Heredity.* Philadelphia: J. B. Lipincott, Co., 1950, p. 345.

CHAPTER III.

METHODS AND PROCEDURES

In order to examine the problems of sex differences in ability and achievement over a period of years it was necessary to select a population in which some measurements of abilities and achievements were available.

Students at the Hermantown High School, Duluth, Minnesota, Independent School District #700, were used in this study. The school participates in the Minnesota Statewide Testing Program and has data available on the Lorge-Thorndike Intelligence Test, the Differential Aptitude Test, and the Iowa Tests of Educational Development.

In view of the problem of obtaining measures of abilities and achievement over a period of years, the data available and used in this study to determine whether or not sex differences do occur in abilities and achievement as indicated by standardized test results are restricted to the above mentioned tests.

Selection of Sample

Students at the Hermantown Schools attend a consolidated school with a grade enrollment of about 1300 and a junior-senior high school enrollment of 700. This independent school district, located in a rural-suburban area just beyond the city limits of Duluth, draws its students from many types of homes. A small portion comes from homes where agriculture is still the main source of income; about an equal number comes from homes where the father may be classified as a professional. Another small group of families own and operate their own businesses in the community. A large number of the students are children of United States Air Force personnel with varied educational, social, and cultural backgrounds. The greater portion of students come from the "middle class" wage-earner type of home. A few Indians and Negroes are included in the school enrollment.

Students in the graduating classes of 1965 through 1969 who had been administered the Lorge-Thorndike Intelligence Test, Level 4, Verbal Battery, in their seventh grade constituted the population used in this study. Table I in the Appendix shows the frequency of I. Q. scores derived from this testing of 240 girls and 263 boys.

Those members of the classes of 1965 and 1966 who had also taken the Lorge-Thorndike Intelligence Test, Level 5, Verbal and Non-verbal Batteries, in the eleventh grade; the Differential Aptitude Tests in the eighth grade; and the Iowa Tests of Educational Development in the ninth and eleventh grades were then used as the group from which to select the matched sample for the second and third phases of this study.

Matching was done using the seventh grade Lorge-Thorndike Test, Verbal Battery. Fifty-four pairs were chosen so that the I. Q.'s would not differ by more than two I. Q. points. Thirty-six pairs were perfectly matched while the remaining eighteen pairs differ by only one I. Q. point.

The standard error of measurement in I. Q. points for this form of the Lorge-Thorndike averages 4.6 so that the two point difference which was selected as a criterion and the actual one point difference of these pairs would be negligible.[41] These pairs are listed in Table II of the Appendix.

Testing Instruments

A. The Lorge-Thorndike Intelligence Test

The Lorge-Thorndike Intelligence Tests are administered at Hermantown High School under the Minnesota Statewide Testing Program as they are in many area schools so that comparisons with other schools could readily be made. These tests have been found to be highly correlated with other widely used instruments so that previously mentioned studies could be compared. The verbal battery at the seventh grade level has a correlation of .83 with the California Tests of Mental Maturity and of .85 with the Otis; at the eleventh grade level these correlations are .83 and .84, respectively. The correlations of the non-verbal battery with the California Tests of Mental Maturity at the seventh grade level are .73 and .66 and at the eleventh grade level they are .74 and .70.[42] This would indicate that results using other tests would probably be

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[41] Irving Lorge and Robert L. Thorndike, Technical Manual. Boston: Houghton Mifflin Co., 1957, p. 9. Table 2 shows a t-value of zero for the Lorge-Thorndike Test, level 4, given in grade seven; this indicates the matching was accurate, there is no difference between the means."

[42] Ibid., p. 13.

relatively similar. Tests in the Lorge-Thorndike batteries are measures of abstract intelligence expressed in verbal, pictorial, diagrammatic, and numerical symbols.[43] School achievement is also expressed in these symbols making these tests suitable criteria for evaluating classroom ability. The standard errors of measurement of this test for the non-verbal battery, seventh grade level is 7.1 I. Q. points; at the eleventh grade level it is 6.1 points; for the verbal battery seventh grade level it is 4.6 I. Q. points; and at the eleventh grade level 5.1 points.[44]

Predictive validity of the Lorge-Thorndike battery shown in one ninth grade study indicated a correlation of .672 between Level 4 administered in the fall of the year and achievement measured through grade averages the following spring.[45]

Two methods of determining the reliability of the Lorge-Thorndike Tests were used with the following results:

Level	Grade	Battery	Alt-form[46]	Odd-even[47]
4	7	Verbal	.865	.929
5	11	Verbal	.858	.882
5	11	Non-verbal	.846	.905

The reliability and validity of the Lorge-Thorndike Tests seem adequate for use in this study.

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[43] Ibid.

[44] Ibid., p. 9.

[45] Ibid., p. 15.

[46] Ibid., p. 7.

[47] Ibid., p. 8.

B. The Differential Aptitude Tests

The use of a comprehensive test battery goes along with Guilford's idea that intelligence must be broken into various components:

> . . .each intellectual component or factor is a unique ability that is needed to do well in a certain class of tasks or tests. As a general principle we find that certain individuals do well in the tests of a certain class, but they may do poorly in the tests of another class.[48]

Varied aspects are covered by the Differential Aptitude Tests, thus giving a broader field of comparison between the sexes. Sex differences in some abilities were found here, indicated by the review of literature. Sex differences have already been indicated by the authors and publishers of this test; therefore, percentile ranks are figured independently for boys and girls using national norms. Developers of the tests have found there are sex differences between different aspects of the test, and the authors feel some of these differences are sizeable and of considerable importance in vocational planning. Separate norms are given in order that the counselors' work may be of greater significance.[49] In this study raw scores were used so that actual performance of the sexes on the various tests within the battery could be compared.

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[48] J. P. Guilford, "Three Faces of Intellect," The Adolescent--A Book of Readings, Jerome M. Seidman, editor. New York: Holt, Rinehart, and Winston, Inc., 1960, pp. 199-200.

[49] George K. Bennett, Harold G. Seashore, and Alexander G. Wesman, Manual for the Differential Aptitude Test, Third Ed. New York: The Psychological Corporation, 1959, p. 21.

Tests included in this battery are verbal ability, numerical ability, abstract reasoning, space reasoning, mechanical ability, clerical speed and accuracy, and the ver-num (verbal-numerical) total--a raw score total of the first two tests considered to be an indication of general classroom ability. The following standard errors of measurement have been computed for the eighth grade; these are given in raw score points:

Test	Boys	Girls[50]
Verbal Reasoning	2.7	2.9
Numerical Ability	2.8	2.8
Abstract Reasoning	3.5	3.4
Space Relations	6.9	7.3
Mechanical Reasoning	5.0	5.4
Clerical Speed and Accuracy	4.2	3.3

The Differential Aptitude Tests have been correlated with various parts of the Iowa Tests of Educational Development to show the relationship between this aptitude battery and an achievement battery. Rather high correlations for girls are shown in all but the clerical speed and accuracy test. The correlations for boys are somewhat lower.[51]

C. The Iowa Tests of Educational Development

The first two testing instruments used estimated the abilities of the students; however, an achievement test must also be used for these students in order to see what the student has already learned in a particular field or fields. In judging achievement one must consider the factors of

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[50] *Ibid.*, p. 67.

[51] *Ibid.*, pp. 56-57.

motivation and effort that will affect the progress of individuals in the sample. Many believe that girls are more highly motivated in the classroom and will therefore show better achievement on standardized tests.

Tests which have correlated favorably with the Lorge-Thorndike Intelligence Tests have also correlated well with the Iowa Tests of Educational Development, the achievement battery used in this study. At the ninth grade level the Iowa Tests of Educational Development and the California Tests of Mental Maturity have a correlation of .593 and at the eleventh grade level a correlation of .781. The correlation between the Iowa Tests of Educational Development and the Otis for grade nine is .799.[52]

The Iowa Tests as originally constructed yielded a reliability coefficient of .91 and this standard has been maintained in the later forms which were used in testing for this study.[53]

Reliability coefficients are available for the various versions using the split halves technique as well as a comparison between different versions of the test. In the derivation of the standard scores the standard error of measurement averages 1.5.[54]

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[52]Science Research Associates, ITED the Iowa Tests of Educational Development, Manual for the School Administrator. Chicago: Science Research Associates, Inc., 1963, p. 22.

[53]*Ibid.*, p. 23.

[54]*Ibid.*, p. 25.

Data concerning the scores of individuals used in this study were obtained from the permanent record cards in the school's files. Over 50% of the tests were administered by this writer.

Hypotheses

Using these samples which have been described and the testing instruments listed the following hypotheses were considered:

1. there is no significant sex difference in general verbal intelligence between boys and girls taken from the same environment;

2. within a select matched sample taken from the above population no significant sex differences in general intelligence or in general achievement will be found; and

3. within this same matched sample no significant sex differences occur in particular aptitudes and achievements.

CHAPTER IV.

RESULTS OF THE STATISTICAL ANALYSIS

Hypothesis 1

The first hypothesis the writer proposed was:

> there is no significant sex difference in general verbal intelligence between boys and girls taken from the same environment.

TABLE 1.

t-VALUE FOR LORGE-THORNDIKE INTELLIGENCE TESTS
I. Q. SCORES, VERBAL BATTERY
GRADE 7, TOTAL POPULATION

	Mean Score		t-value	df	Sign.
	Girls	Boys			
Verbal, Grade 7	109.48	108.66	.034	200	N.S.

Using Fisher's table[55] we find the null hypothesis must be accepted. No significant sex difference occurs in the performance aspect of mental abilities of girls and boys tested at the seventh grade level with the Lorge-Thorndike Intelligence Test, verbal battery.

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[55] Benton J. Underwood, et. al., Elementary Statistics. New York: Appleton-Century-Crofts, Inc., 1954, p. 230.

Hypothesis 2

The second hypothesis to be tested was:

> within a select matched sample taken from the above population no significant sex differences in general intelligence or in general achievement will be found.

Fifty-four matched pairs were used to determine if there were significant differences between girls and boys for the following tests:

General Intelligence

Lorge-Thorndike, Verbal Battery, Level 4, Grade 7
Lorge-Thorndike, Verbal Battery, Level 5, Grade 11
Lorge-Thorndike, Non-verbal Battery, Level 5, Grade 11
Differential Aptitude Tests, Ver-num Total, Grade 8

General Achievement

Iowa Tests of Educational Development, Composite 1-8, Grade 9
Iowa Tests of Educational Development, Composite 1-8, Grade 11

Because the groups were matched the data was computed by use of an appropriate "t" test; the direct-difference method as described by Underwood was used.[56] Significance levels were determined by use of Fisher's table. According to this table the t-value for 53 degrees of freedom of this study will necessitate the use of 50 degrees of freedom. The value of t at the 5% level of significance is 2.01 and at the 1% level it is 2.68.[57] A positive t-value will indicate girls have the

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[56] Ibid., p. 167.

[57] Fisher and Yates. Statistical Tables for Biological, Agricultural and Medical Research. Edinburgh: Oliver and Boyd, Ltd., 1953, Table III.

advantage while a negative t-value indicates the difference favors the boys.

All of the t-values in Table 2 support the null hypothesis and we may assume that in this matched sample there is no significant sex difference in the verbal as well as the non-verbal aspects of the Lorge-Thorndike Intelligence Tests. Table 3 also supports the null hypothesis; there is no significant sex difference in general intelligence as measured by the Ver-num (verbal-numerical) totals of the Differential Aptitude Tests. Table 4 indicates there is no significant sex difference in general achievement as measured by the composite scores of the Iowa Tests of Educational Development at both the ninth and eleventh grade levels. Therefore, the null hypothesis is accepted--no significant sex differences in general intelligence or in general achievement were found.

Hypothesis 3

The third hypothesis of this study was:

> within this same matched sample no significant sex differences occur in particular aptitudes and achievements.

This hypothesis can be divided into two parts--that of particular aptitudes and that of achievement in special areas.

Concerning ourselves first with particular aptitudes we will examine the results of the six tests in the Differential Aptitude Tests,

TABLE 2.

t-VALUES FOR LORGE-THORNDIKE INTELLIGENCE TESTS
I. Q. SCORES, GENERAL INTELLIGENCE
54 MATCHED PAIRS

	Mean Score		t-value	df	Sign.
	Girls	Boys			
Verbal, Grade 11	108.89	108.70	.115	50	N.S.
Non-verbal, Grade 11	112.09	115.28	-1.848	50	N.S.

TABLE 3.

t-VALUES FOR DIFFERENTIAL APTITUDE TEST
RAW SCORES, GENERAL INTELLIGENCE
54 MATCHED PAIRS

	Mean Score		t-value	df	Sign.
	Girls	Boys			
Ver-num total, Gr. 11	34.41	32.37	1.329	50	N.S.

TABLE 4.

t-VALUES FOR IOWA TESTS OF EDUCATIONAL DEVELOPMENT
STANDARD SCORES, GENERAL ACHIEVEMENT
COMPOSITE-TESTS 1-8, 54 MATCHED PAIRS

	Mean Score		t-value	df	Sign.
	Girls	Boys			
Grade 9	13.50	13.26	.485	50	N.S.
Grade 11	17.24	17.41	-.301	50	N.S.

Table 5. Girls show an advantage in verbal reasoning but it is not significant. Although boys may have slight advantages in abstract and space reasonings, they are not significant.

However, the last two tests in this battery support the theory that certain aptitudes will show significant differences. The t-value for mechanical ability is sufficiently high to show a significant difference at the 1% level in favor of the boys. Clerical speed and accuracy results show almost as great an advantage for the girls as mechanical ability does for the boys. In this test the girls out-perform the boys at the 1% level of significance. Scores for the Differential Aptitude Tests can be found in Table III of the Appendix.

Significant differences do occur in particular aptitudes. The null hypothesis is rejected.

Turning then to achievement in special areas as tested by the Iowa Tests of Educational Development (see Table 6) we find that boys at the ninth grade level excel the girls in social studies background, but not significantly. However, there is a significant difference favoring the boys shown at the 1% level in Background in Natural Sciences and at the 5% level in Quantitative Thinking.

Girls on the other hand show an advantage in all aspects concerned with the language arts and reading. These differences are not significant in General Vocabulary or in Reading of Social Studies and

TABLE 5.

t-VALUES FOR APTITUDES FOR SPECIAL AREAS AS TESTED WITH DIFFERENTIAL APTITUDE TEST, RAW SCORES GRADE 8, 54 PAIRS MATCHED ACCORDING TO I. Q.

Test	Mean Score		t-value	df	Sign.
	Girls	Boys			
Verbal Reasoning	17.54	15.61	1.986	50	N.S.
Numerical Reasoning	16.89	16.80	.079	50	N.S.
Abstract Reasoning	26.37	28.26	-1.165	50	N.S.
Space Reasoning	37.94	40.15	- .596	50	N.S.
Mechanical Ability	23.31	34.54	-4.802	50	.01
Clerical Speed and Accuracy	49.85	44.56	3.235	50	.01

TABLE 6.

t-VALUES FOR SCHOLASTIC ACHIEVEMENT IN SPECIAL AREAS
AS TESTED WITH THE IOWA TESTS OF EDUCATIONAL
DEVELOPMENT, STANDARD SCORES
GRADE 9, 54 PAIRS
MATCHED ACCORDING TO I. Q.

Test	Mean Score		t-value	df	Sign.
	Girls	Boys			
Background in Social Studies	13.13	14.06	-1.508	50	N.S.
Background in Natural Sciences	13.43	15.52	-3.064	50	.01
Correctness of Expression	15.33	12.72	4.440	50	.01
Quantitative Thinking	12.41	13.94	-2.420	50	.05
Reading in Social Studies	12.17	11.65	.639	50	N.S.
Reading in Natural Sciences	12.50	12.35	.184	50	N.S.
Reading Literature	13.04	11.22	2.597	50	.05
General Vocabulary	13.48	12.83	1.159	50	N.S.
Use of Sources of Information	13.78	11.89	2.482	50	.05

Reading of Natural Sciences. Significant differences occur at the 5% level in Reading Literature and Use of Sources of Information while the girls show a decided superiority (1% level of significance) in achievement in Correctness of Expression as tested by the Iowa Tests of Educational Development in grade 9. Scores for these tests are found in Table IV of the Appendix.

Using this same battery of tests in its senior high school form we find (Table 7) that boys now excel, but not significantly, in the Reading of Natural Sciences. They now excel at the 5% level of significance in Background of Social Studies, and at the 1% level of significance in Background of Natural Sciences and Quantitative Thinking. Boys had already shown superiority over girls to some extent in these areas at the ninth grade level.

Girls still excel in language arts and reading but now at the 5% level of significance in general vocabulary and at the 1% level of significance in Correctness of Expression. They still excel in Reading of Social Studies and Reading of Literature and in Uses of Sources of Information but not significantly. Scores may be found in Table V of the Appendix.

The second part of the third hypothesis is rejected as there are significant differences in the achievement between the sexes as tested by the Iowa Tests of Educational Development.

Not only do these differences occur, but their ratios of significance as tested by the Iowa Tests change during a period of two years. Table 8

TABLE 7.

T-VALUES FOR SCHOLASTIC ACHIEVEMENT IN SPECIAL AREAS
AS TESTED WITH THE IOWA TESTS OF EDUCATIONAL
DEVELOPMENT, STANDARD SCORES
GRADE 11, 54 PAIRS
MATCHED ACCORDING TO I. Q.

Test	Mean Score		t-value	df	Sign.
	Girls	Boys			
Background in Social Studies	16.21	17.56	-2.113	50	.05
Background in Natural Sciences	16.72	18.89	-3.273	50	.01
Correctness of Expression	18.52	15.56	5.810	50	.01
Quantitative Thinking	15.04	18.00	-3.262	50	.01
Reading in Social Studies	16.80	15.81	1.181	50	N.S.
Reading in Natural Sciences	15.65	15.96	- .455	50	N.S.
Reading Literature	15.69	14.56	1.552	50	N.S.
General Vocabulary	17.70	16.54	2.219	50	.05
Use of Sources of Information	16.63	15.15	.562	50	N.S.

TABLE 8.

COMPARISON OF t-VALUES FOR SCHOLASTIC ACHIEVEMENT
IN SPECIAL AREAS AS TESTED WITH
THE IOWA TESTS OF EDUCATIONAL DEVELOPMENT
GRADES 9 and 11

Test	t-Values		Significance	
	Grade 9	Grade 11	Grade 9	Grade 11
Background in Social Studies	-1.508	-2.113	N.S.	.05
Background in Natural Sciences	-3.064	-3.273	.01	.01
Correctness of Expression	4.440	5.810	.01	.01
Quantitative Thinking	-2.420	-3.262	.05	.01
Reading in Social Studies	.639	1.181	N.S.	N.S.
Reading in Natural Sciences	.184	-.455	N.S.	N.S.
Reading Literature	2.597	1.552	.05	N.S.
General Vocabulary	1.159	2.219	N.S.	.05
Use of Sources of Information	2.482	.562	.05	N.S.

will show that in only four areas was no change of significance indicated--Background of Natural Sciences, Correctness of Expression, Reading of Social Studies, and Reading of Natural Sciences. In three areas the level of significance was refined or significant differences appeared in the eleventh grade--Background of Social Studies, Quantitative Thinking, and General Vocabulary. Only two areas showed a change from a 5% level of significance to no significant difference--Reading Literature and Use of Sources of Information.

In summary of the analysis we can say that the first two hypotheses were supported by the data collected for the total population in the first and for the matched pairs in the second thus no significant sex difference occurs in general intelligence and achievement. The third hypothesis is rejected as the data showed significant sex differences do occur in two aptitudes as measured by the Differential Aptitude Tests and in various areas of achievement as measured by the Iowa Tests of Educational Development.

CHAPTER V.

INTERPRETATION OF THE STATISTICAL ANALYSIS

Interpretation of the Data

Perhaps the most significant feature of this study is that its longitudinal nature indicates that in the short period of four years changes did occur. By examining the eight tables of the previous chapter it can be noted that nearly all the changes which occurred were to the advantage of the boys--even though some of these changes were very minor.

Bayley, in the Berkeley Growth Study, has found that the intellectual growth spurt occurs between about ten and twelve years of age or before the adolescent spurt of physical growth in boys.[58] Through results of this present study it would seem that this intellectual growth of boys occurs a little later and that it more nearly parallels their physical growth pattern. A number of sources cited in Chapter II (pages 7 and 8) support this theory.

Basing judgement upon the mechanical ability test of the Differential Aptitude Test and the science and mathematical tests of the Iowa Tests of Educational Development it would seem that much more can be expected from boys in the engineering-scientific research fields than can be expected from girls.

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[58] Nancy Bayley, "A New Look at the Curve of Intelligence," The Adolescent--A Book of Readings, Jerome M. Seidman, editor. New York: Holt, Rinehart and Winston, Inc., 1960, p. 187.

Let us examine some possible reasons for this superiority in one of these fields--mechanical ability. Is this a result or a cause of our culture? Are boys better able to answer the questions in this test because they have tinkered with motors, etc., as a natural interest of an American youth of this era, or do they do better because they have this inborn ability? If girls in our society were interested in mechanics and had worked on model cars, taken clocks apart, helped fix Mother's appliances, helped repair the family car in anticipation of driving, would they, too, rank higher in this test? These questions cannot be answered and the fact remains that test-wise the boys have displayed a continuous and decided advantage in this area.

Chapter II indicated some reasons why girls seem to be superior in verbal areas. This superiority was maintained in this testing in the areas of general vocabulary and correctness of expression. The boys seemed to advance more during this period of time in the fields of reading.

The clerical speed and accuracy test of the Differential Aptitude Test showed a distinct advantage for girls. This test, which consists of a practice and then the test proper, does not as it might suggest include items of a stenographic nature. The test which consists of rapidly choosing a given number from a group of numbers might indicate the girls are more able to do routine work. Because the test emphasizes speed rather than accuracy some good academic students are too cautious and score low.[59]

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[59]Bennett, op. cit., p. 8.

Boys in this study followed the pattern of early studies indicating an excelling in mechanical abilities, quantitative thinking, background in natural sciences, and background in social studies. Can this be considered reason for adult male success in mechanics, engineering, medicine, politics, etc.?

In turn the girls supported earlier findings in that they excelled in correctness of expression, reading of literature, and vocabulary. Clerical speed and accuracy abilities also showed a significant difference. Perhaps, this mastery of language is why our secretarial field seems to be dominated by women--women who correct the boss's errors in his dictation, handle social correspondence for him, and many times do a public relations service as receptionist. Industry looks for women to work on their assembly lines; can this be a result of their superiority in clerical speed and accuracy?

Table 8 tends to support statements from Bayley, Olson, and Wozencraft that boys seem to achieve later than girls. The longitudinal study shows that the change in general intelligence as tested by the Lorge-Thorndike verbal battery moved slightly toward the girls' favor while general achievement as tested by the Iowa Tests of Educational Development moved toward the boys during this period of time from ninth to the eleventh grade. It would be natural then to expect, as did occur, that achievement in special areas also became more favorable to the boys.

What influence would more extensive research along this line have in school placement? Would a follow-up study of those members of the sample group who continued their academic work in college or went on to trade school show greater changes in t-values? Would boys continue to advance? The value of the longitudinal study might then be far reaching in our educational system, supporting theories that boys are not ready for school as early as girls are.

Limitations of the Study

Certain limitations influence the findings of this study and might raise some questions:

1. What results would occur with the use of other testing instruments?

Even though the testing instruments used in this analysis have been favorably correlated with other well known instruments, a difference might occur because of the testing sophistication the sample had for these particular types of tests.

2. What results would have been achieved if a group with a different environmental and cultural background had been used?

Were the students handicapped because they come from a less "sophisticated" environment rather than from a wealthier, larger school district? The reader should be aware of the fact that these students are afforded most of the cultural advantages of a city school. Perhaps the boys in this environment are more apt to have had mechanical experience very early in life because of the transportation problem of living in a rural-suburban area; this could influence certain scores in this testing. Studies from similar groups of students in the Duluth public and parochial schools and in other area schools would bring considerably more information on the subject of this study.

> 3. Why did the Lorge-Thorndike show so much higher a mean I. Q. for the non-verbal battery than for the verbal battery for both sexes (Table 2), but especially for the boys?

Does this go back to the type of environment that these students come from or might this show up in other groups as well?

> 4. What might have resulted if the pairs had been matched with a non-verbal battery rather than a verbal battery?

This might have changed the significance of the difference in several fields; particularly in the mechanical ability test and in other non-verbally oriented tests.

> 5. Would differences have occurred in the results if matching would have been done at an earlier grade level, perhaps fourth or fifth?

Could sex role identity have occurred by the seventh grade to such an extent that the scores were already influenced by preferences in special fields of abilities and achievement? Perhaps this identity would not be as well defined in the earlier grade and would have made the matching more accurate, considering native ability as a basis.

Implications for Further Study

The limitations of the present study suggest the possibility of further study with three factors in particular that might be changed.

A study of strictly urban children or of small town students might give two entirely different sets of results than did this rural-suburban population. Because of the close association of the Hermantown Schools and the Duluth Public Schools it might be most interesting to see the results of a similar study in the Duluth system.

The second factor which might deserve consideration in the future would be the beginning of such a study on a lower grade level. Difficulties occur here in the population used because it is a rather fluid population and the number in the sample would have been considerably smaller. A larger system might give more opportunity to start such a study on the fourth grade level, carrying through the senior high school.

Use of different testing instruments might possibly influence the results of such a study. A study in which the matching was done using different criteria might produce different results.

It appears that most studies of sex differences in intelligence have been very limited in scope, either subject matter-wise or time-wise. Broader, longer range studies might be more valuable than those already made.

The statistical analysis made in this study has confirmed the first two hypotheses which this writer proposed. The indications that there is no significant sex differences in general ability or in general achievement might then indicate that boys should be as successful in school as are the girls. Both sexes should be equally qualified to go on to college and the professions, choosing here the special areas where they excel.

In connection with the rejection of the third hypothesis, it is interesting to note that for every special area that shows significant difference at either the 1% or 5% level for the girls there is also one for the boys. Thus with this balance of differences it is not surprising that the null hypothesis is accepted for general abilities and general achievement. Two authors have indicated that they believe the test constructors manipulate the items in general intelligence tests so that no sex difference is evidenced. Scheinfeld feels the items that girls do well in are balanced by items answered correctly by boys.[60] Anastasi feels items that show a difference may be deliberately eliminated when the test is constructed.[61] If this is true than there can be little value in the use of standardized test materials in a study of this kind.

> No intelligence test exists which can accurately measure the relative mental capacities of the two sexes. No such tests probably ever will be devised.

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[60]Scheinfeld, loc. cit.

[61]Anne Anastasi, Psychological Testing. New York: Macmillan Co., 1954, pp. 169-170.

> And that being so, no one can say now, or will ever be able to say, whether the sexes are equal or unequal in intelligence, or whether either is superior to the other.[62]

Perhaps Scheinfeld is right. Yet the differences we have thus far found through those tests that are available can be important to both teachers and parents. Will additional work with boys in language arts and reading help them to be even more successful than they now are? Will encouraging girls to engage in some of the less feminine activities lead them into more of the technical fields?

The most important consideration of all has not yet been mentioned here--we must never lose sight of the individual when we are considering any of these results. It is doubtful that any one of the matched pairs would follow the exact trend of the means. Caution in the use of this or any study is of prime importance so that the individual being considered will not suffer from being one of the mass.

These warnings and those of Powell who feels too much emphasis may be placed on sex differences without careful consideration[63] should cause educators, parents, and others interested in working with young people to be extremely cautious when considering these sex differences

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[62]Scheinfeld, loc. cit.

[63]Powell, O'Connor, Parsley, loc. cit.

in their associations with youth. Hasty decisions based on sex differences may lose for society a woman who might have evolved a cure for cancer or a man who might be able to fire the next generation with a love for Shakespeare.

CHAPTER VI

SUMMARY

A longitudinal study to determine whether sex differences occur in abilities and/or achievement was undertaken. Use was made of a group of high school students who had taken part in a standardized testing program because the results over a five-year period were readily available.

Three null hypotheses were advanced: (1) there is no significant difference between the general abilities of boys and the general abilities of girls, (2) there is no significant difference between the general achievement of boys and the general achievement of girls, and (3) there are no significant differences between boys and girls in particular abilities and achievements.

Through the use of the results of Lorge-Thorndike Intelligence Tests administered in grades 7 and 11, the Differential Aptitude Tests administered in grade 8, and the Iowa Tests of Educational Development administered in grades 9 and 11, fifty-four matched pairs were compared through use of an appropriate t-test. The results indicated that the first two null hypotheses were supported--there are no significant differences in general intelligence or in general achievement--but the third null hypothesis was rejected--differences between boys' and girls' particular abilities and achievements do occur.

The longitudinal aspect of the study indicated that the levels of superiority in achievement of one sex or the other did change. With only one exception these changes showed the boys advanced more in their achievement than did the girls.

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APPENDIX

TABLE I.

FREQUENCY OF I. Q. SCORES OF TOTAL POPULATION

Test: Lorge-Thorndike, Level 4, Verbal, Grade 7 Testing, Classes '65-'69

X	f	Y	f	X	f	Y	f
142	1	146	1	94	5	97	3
140	1	144	1	93	3	96	8
139	2	141	1	92	1	95	8
138	1	137	1	91	3	94	5
134	1	134	2	90	2	93	5
133	2	132	3	89	3	92	4
131	3	131	1	88	2	91	5
130	1	130	1	87	2	90	3
128	5	129	2	86	2	89	2
125	4	128	3	84	1	88	4
124	3	127	4	82	1	87	2
123	2	126	3	81	1	83	1
122	7	125	3	80	1	81	1
121	7	124	1				
120	2	123	5				
119	3	122	4				
118	9	121	2				
117	10	120	5				
116	6	119	12				
115	9	118	5				
114	5	117	4				
113	10	116	6				
112	13	115	7				
111	4	114	2				
110	8	113	7				
109	11	112	7				
108	11	111	12				
107	8	110	10				
106	5	109	8				
105	12	108	10				
104	8	107	8				
103	7	106	13				
102	6	105	7				
101	3	104	11				
100	4	103	6				
99	3	102	4				
98	5	101	7				
97	5	100	4				
96	2	99	8				
95	4	98	1				

N	240	253
M_X	109.4792	
M_Y	108.6562	
t	.034	
X	Girls' scores	
Y	Boys' scores	

TABLE II.

I. Q. SCORES FOR MATCHED SAMPLE
LORGE-THORNDIKE TESTS

Verbal Battery Level 4 Grade 7				Verbal Battery Level 5 Grade 11				Non-Verbal Battery Level 5 Grade 11			
X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
130	130	100	99	125	132	106	72	112	114	107	100
128	128	100	101	134	123	110	109	123	117	107	106
128	127	99	99	114	123	98	98	111	134	97	111
124	124	99	99	122	121	107	108	127	131	112	114
124	125	98	97	122	132	96	110	103	128	89	111
121	121	97	97	110	125	115	100	132	120	125	107
120	120	95	95	122	119	103	112	105	134	101	109
119	119	94	94	123	105	105	97	112	114	96	99
118	119	94	94	124	113	86	105	119	110	85	126
118	119	93	93	120	109	83	99	124	120	97	96
117	117	93	93	114	115	104	99	125	138	113	122
117	116	89	88	108	111	98	92	109	122	118	105
115	115	89	90	107	117	99	83	122	126	99	100
113	113	88	88	115	109	84	104	116	125	90	126
113	113	86	86	105	120	94	90	130	122	92	105
113	113	82	83	107	125	89	91	117	110	118	94
112	112			109	124			131	140		
112	113			122	107			134	118		
112	111			118	110			87	144		
111	111			111	110			107	116		
110	110			120	119			122	121		
110	110			117	122			101	127		
110	111			114	111			125	112		
109	109			103	123			110	124		
108	108			112	107			117	123		
108	107			114	114			128	109		
107	107			110	112			119	124		
107	107			105	107			118	116		
107	107			111	105			116	118		
106	106			104	117			109	117		
105	105			100	108			107	116		
105	104			110	98			122	103		
105	104			113	96			116	101		
105	106			104	116			115	111		
105	105			103	107			106	117		
104	104			118	103			130	99		
104	104			119	91			97	126		
101	101			94	95			103	101		

X Girls' scores Y Boys' scores

TABLE III.

RAW SCORES FOR MATCHED SAMPLE
DIFFERENTIAL APTITUDE TESTS
GRADE 8

Verbal Reas.		Num. Ability		Abst. Reas.		Space Reas.		Mech. Ability		Clerical Speed & Accuracy		Verb+Num Total	
X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
26	28	21	15	28	30	49	52	23	59	63	48	47	43
32	14	17	25	41	27	59	24	26	27	64	45	49	37
22	26	19	17	34	28	52	60	29	39	44	40	41	43
25	26	28	32	39	35	26	63	35	43	54	36	53	58
14	33	16	35	24	35	49	72	29	62	56	41	30	68
25	18	28	24	38	38	56	77	39	46	59	45	53	42
20	17	17	20	26	28	32	57	18	38	53	48	37	37
21	15	23	21	21	26	37	46	31	28	3	54	44	36
29	15	19	19	43	25	64	15	38	35	56	48	48	34
16	12	18	26	36	34	44	35	43	19	38	48	34	38
24	21	25	13	34	34	36	27	38	32	58	50	49	34
23	19	19	18	31	32	40	47	35	14	75	51	42	37
19	22	21	17	28	33	59	18	32	42	43	40	40	39
25	15	19	18	30	31	47	24	18	36	59	43	44	33
23	20	20	24	39	35	34	47	22	32	57	43	43	44
18	18	23	13	37	30	57	44	32	50	49	48	41	31
24	18	28	18	27	39	65	75	21	45	69	49	52	36
27	12	21	19	43	19	50	27	19	46	45	30	48	31
27	20	13	22	13	39	52	28	2	61	57	53	40	42
16	11	20	15	31	31	34	49	32	28	57	50	36	26
19	20	14	18	39	29	55	61	27	44	33	40	33	38
20	14	14	20	22	38	24	42	23	30	52	43	34	34
15	18	16	15	38	39	28	28	26	43	52	50	31	33
13	25	15	18	22	36	19	44	23	25	52	47	28	43
17	20	25	23	32	35	57	14	25	39	55	52	42	43
19	14	16	17	26	36	46	45	32	38	59	44	35	31
20	16	22	14	26	28	29	58	26	23	61	45	42	30
13	15	14	24	28	26	39	47	30	36	40	60	27	39
24	16	20	21	32	31	22	56	34	37	33	44	44	37
12	16	25	23	23	33	24	65	30	17	57	56	37	39
15	16	19	19	23	41	39	79	13	46	48	49	34	35
18	13	8	8	35	26	55	6	29	22	50	42	26	21
20	7	19	12	30	5	48	9	22	6	57	51	39	19
12	17	18	21	36	32	39	68	25	51	48	47	30	38
17	9	13	15	19	19	52	26	10	35	51	40	30	24
19	18	20	15	35	24	74	6	33	4	55	41	39	33

TABLE III. (continued)

Verbal Reas. X	Verbal Reas. Y	Num. Ability X	Num. Ability Y	Abst. Reas. X	Abst. Reas. Y	Space Reas. X	Space Reas. Y	Mech. Ability X	Mech. Ability Y	Clerical Speed & Accuracy X	Clerical Speed & Accuracy Y	Ver-Num Total X	Ver-Num Total Y
12	21	10	18	7	25	31	68	22	50	50	39	22	39
6	18	18	17	22	26	43	32	11	22	39	42	24	35
25	8	11	5	25	22	47	16	33	31	40	38	36	13
23	16	23	20	33	30	47	48	15	43	46	41	46	36
14	11	13	9	20	29	19	36	11	44	62	54	27	20
11	8	12	17	28	22	32	11	16	27	41	50	23	25
15	14	4	8	17	10	13	25	4	27	53	40	19	22
16	15	25	9	32	18	55	50	36	38	49	44	41	24
10	15	12	17	15	27	10	40	25	47	37	37	22	32
10	8	13	0	9	23	15	11	11	26	39	49	23	8
7	16	4	10	1	32	0	50	8	41	53	51	11	26
7	9	4	11	0	18	15	0	14	10	51	38	11	20
15	15	13	28	12	41	33	81	20	39	41	40	28	43
14	6	13	15	23	19	44	55	37	36	46	42	27	21
7	8	11	10	32	22	17	35	2	30	41	44	18	18
8	10	8	11	17	30	16	35	15	15	56	32	16	21
9	6	20	6	12	20	7	17	1	40	43	27	29	12
9	5	4	2	10	5	13	17	8	21	43	37	13	7

X Girls' scores
Y Boys' scores

TABLE IV.

STANDARD SCORES FOR MATCHED SAMPLE
IOWA TESTS OF EDUCATIONAL DEVELOPMENT
GRADE 9

Background Soc. Studies		Background Nat. Science		Correctness of Expression		Quantitative Thinking		Reading Soc. Studies	
X	Y	X	Y	X	Y	X	Y	X	Y
19	18	18	22	21	15	18	13	22	15
22	26	22	17	20	15	18	23	24	19
19	19	19	20	22	16	10	15	15	17
23	15	17	21	22	17	17	17	18	10
21	17	17	23	18	22	13	24	16	17
16	20	16	21	16	16	17	18	10	22
19	18	18	19	20	17	13	19	17	17
11	15	18	19	17	14	14	7	17	5
17	16	17	18	17	10	17	14	16	14
14	19	15	18	17	16	11	21	11	20
9	15	16	16	22	18	17	18	14	12
18	17	18	14	15	17	17	13	15	14
14	14	16	19	15	12	14	15	15	13
23	18	15	24	15	15	16	20	19	16
14	19	16	16	14	15	14	19	15	7
11	17	12	21	15	14	12	17	14	13
16	16	14	21	17	16	16	23	14	15
16	7	20	13	15	12	18	13	16	1
19	15	17	23	20	14	9	16	20	16
17	13	20	15	14	17	19	18	14	17
14	14	20	18	17	16	14	14	17	8
14	24	17	18	16	14	10	21	18	18
6	14	11	16	18	12	10	12	5	17
8	20	6	21	17	17	11	18	6	17
14	15	11	13	13	11	14	17	8	11
11	15	17	19	19	15	17	14	9	17
13	9	13	13	17	13	16	10	11	8
10	12	7	5	12	7	12	7	11	2
12	14	8	12	19	13	13	13	9	13
8	17	10	17	20	8	15	16	7	9
11	13	15	16	12	14	12	17	10	13
7	7	8	11	17	9	12	9	7	8
12	14	18	8	17	13	15	11	13	14
14	18	7	18	13	12	6	12	7	20
16	9	8	16	14	10	12	11	9	12
20	21	15	13	15	9	18	12	17	14
12	11	14	16	11	14	11	16	7	10

TABLE IV. (continued)

Reading Nat. Science		Reading Literature		General Vocabulary		Composite 1-8		Use of Sources of Information	
X	Y	X	Y	X	Y	X	Y	X	Y
20	19	21	19	20	22	21	19	20	16
22	18	26	19	22	18	23	20	25	15
17	19	17	16	20	17	18	18	18	15
19	15	21	13	18	18	20	16	17	17
13	19	20	16	18	19	18	21	17	22
17	16	13	21	18	17	16	20	14	15
14	16	16	17	17	17	18	18	17	14
12	14	16	14	15	13	16	13	15	10
22	17	17	17	16	16	18	16	16	12
8	22	10	16	15	16	13	19	13	15
13	13	15	10	10	15	15	15	18	16
18	11	13	18	16	12	17	15	17	20
10	13	11	10	11	16	14	14	10	13
20	21	14	21	18	17	18	20	17	17
13	15	18	15	10	18	15	16	13	18
13	21	15	16	11	13	13	17	15	15
14	15	15	17	16	15	16	18	23	9
17	8	11	6	15	12	17	9	20	6
16	21	16	17	19	11	18	17	19	15
18	11	16	15	17	16	18	16	21	12
13	8	16	4	17	16	17	13	13	18
13	13	19	14	21	15	17	18	20	13
16	12	12	10	15	12	12	14	15	11
9	20	8	19	10	18	9	20	9	15
15	13	17	8	12	10	13	13	11	12
13	13	15	9	15	9	15	14	16	12
17	15	12	8	11	14	14	12	13	6
9	9	13	10	13	8	12	7	11	10
8	6	12	7	14	14	12	12	11	11
6	12	6	12	9	15	10	14	15	14
10	13	12	13	14	13	12	14	14	11
8	12	9	6	14	3	10	7	12	9
14	11	19	5	19	11	17	11	13	9
5	18	9	13	11	14	9	16	9	14
13	15	13	14	11	12	12	13	14	9
15	6	16	11	12	15	17	13	18	6
9	15	10	12	10	10	11	13	11	11

TABLE IV. (continued)

Background Soc. Studies		Background Nat. Science		Correctness of Expression		Quantitative Thinking		Reading Soc. Studies	
X	Y	X	Y	X	Y	X	Y	X	Y
16	15	14	11	15	13	10	12	12	11
7	5	6	10	14	12	11	7	6	11
16	11	14	9	17	7	16	13	11	8
12	12	10	9	10	5	10	9	8	8
13	12	10	14	13	13	9	16	11	10
9	11	14	5	4	5	1	9	11	7
15	12	19	16	20	13	7	8	15	8
14	14	8	19	14	10	7	12	11	8
11	6	7	5	13	5	11	10	11	7
6	12	9	14	8	13	8	10	13	5
2	10	9	13	9	11	6	9	7	6
13	11	8	16	13	14	13	17	13	9
7	12	14	15	17	10	12	8	7	12
14	13	10	11	15	5	11	8	12	7
3	5	9	12	4	17	7	13	6	3
7	8	11	16	14	9	5	9	1	8
4	9	7	13	9	10	8	10	9	10

TABLE IV. (continued)

Reading Nat. Science		Reading Literature		General Vocabulary		Composite 1-8		Use of Sources of Information	
X	Y	X	Y	X	Y	X	Y	X	Y
13	15	10	7	11	13	13	12	12	11
12	5	14	6	12	8	10	7	8	9
13	2	12	9	13	11	14	8	21	5
12	8	5	1	10	11	10	7	10	8
12	10	9	11	12	5	11	12	12	15
6	6	8	2	11	7	7	5	12	6
7	10	19	6	15	6	15	10	18	7
12	6	11	12	13	16	12	12	10	11
10	10	4	1	9	11	9	5	10	6
8	7	7	8	7	10	8	10	6	13
8	10	9	7	3	8	5	9	5	9
15	3	11	12	14	12	13	12	11	13
12	7	7	6	13	11	11	10	11	15
13	6	14	8	10	8	13	8	9	6
10	3	8	1	9	11	6	7	2	6
2	11	8	6	8	11	6	10	9	2
1	13	9	15	8	7	5	11	8	17

X Girls' scores
Y Boys' scores

TABLE V.

STANDARD SCORES FOR MATCHED SAMPLE
IOWA TESTS OF EDUCATIONAL DEVELOPMENT
GRADE 11

Background Soc. Studies		Background Nat. Science		Correctness of Expression		Quantitative Thinking		Reading Soc. Studies	
X	Y	X	Y	X	Y	X	Y	X	Y
21	23	19	24	24	18	19	20	21	18
24	26	24	24	24	18	31	22	28	27
20	22	21	24	24	21	17	19	23	24
22	21	23	25	23	24	24	31	25	13
22	22	21	25	22	24	9	31	23	15
18	27	20	24	20	17	22	26	17	21
23	22	22	24	20	21	10	21	23	25
16	20	23	18	19	17	18	20	17	21
21	20	21	21	23	16	23	15	22	18
17	22	17	24	19	18	13	27	20	26
16	19	18	21	24	18	15	24	18	19
18	18	22	23	23	21	17	20	18	15
15	20	13	19	17	17	17	18	16	13
22	23	22	24	24	16	18	25	25	20
20	18	17	21	15	19	20	19	15	22
15	19	16	22	16	17	12	17	21	17
21	21	18	24	25	15	13	26	15	22
22	14	25	17	22	16	22	19	22	8
20	21	18	24	24	17	21	20	24	21
25	18	24	22	23	21	21	15	13	14
17	20	22	21	21	18	19	15	17	12
18	22	20	24	19	16	19	26	19	19
13	15	16	19	17	16	14	17	17	17
11	22	14	23	18	15	10	23	10	24
18	18	16	20	22	15	14	20	22	12
15	22	21	21	23	20	14	17	18	12
16	18	16	20	18	19	17	20	12	13
9	10	15	9	15	11	14	13	17	10
14	14	18	13	20	17	18	19	10	10
12	19	16	20	21	14	19	20	14	14
18	19	13	22	20	15	13	20	14	18
17	11	16	19	15	13	14	6	18	15
19	21	20	13	21	14	22	11	22	10
9	20	12	23	15	14	15	21	17	14
12	20	13	18	17	14	9	14	11	16
20	20	16	17	23	12	24	18	19	19
17	15	17	17	16	14	13	20	11	10

TABLE V. (continued)

Reading Nat. Science		Reading Literature		General Vocabulary		Composite 1-8		Use of Sources of Information	
X	Y	X	Y	X	Y	X	Y	X	Y
22	18	22	24	25	28	23	23	20	18
27	23	27	20	27	24	30	25	24	21
22	21	20	20	23	23	23	23	18	18
25	19	24	17	24	19	25	22	25	23
18	19	21	17	23	19	21	23	22	19
16	23	16	22	21	24	20	25	18	21
19	22	22	20	28	22	22	24	18	21
15	20	19	21	21	17	19	20	18	12
26	19	21	20	22	21	24	20	23	17
14	25	15	18	17	18	17	24	18	16
20	19	15	17	20	18	19	20	21	22
19	17	17	18	21	19	20	20	21	23
16	22	15	15	16	19	16	19	17	13
17	23	20	20	20	24	22	23	23	25
19	20	14	15	17	18	18	20	15	21
18	19	18	19	18	20	18	20	12	21
17	23	16	24	19	19	19	23	26	20
21	10	21	6	17	12	23	13	21	13
19	22	24	17	25	20	23	21	23	20
19	13	21	6	19	21	22	17	27	11
26	15	19	17	20	18	21	18	25	18
20	21	21	12	25	17	21	21	23	19
15	20	14	14	17	17	16	18	18	14
17	23	8	19	16	18	13	22	13	21
18	14	20	18	21	15	20	17	19	8
21	15	17	13	19	18	19	18	25	19
14	16	15	13	14	16	16	18	19	19
12	6	12	9	17	7	14	9	14	8
15	18	16	16	20	17	17	16	19	15
18	18	13	11	17	18	17	18	10	19
16	16	11	17	16	16	16	19	6	16
16	10	13	5	17	12	16	10	19	14
16	12	17	13	18	18	20	14	19	13
8	18	14	16	14	20	13	19	14	19
12	15	14	17	17	17	14	17	20	12
15	14	18	19	18	15	20	18	23	20
13	13	10	14	15	12	14	15	12	18

TABLE V. (continued)

Background Soc. Studies		Background Nat. Science		Correctness of Expression		Quantitative Thinking		Reading Soc. Studies	
X	Y	X	Y	X	Y	X	Y	X	Y
17	21	12	12	17	15	11	14	19	16
19	6	15	13	18	13	9	8	6	11
18	15	17	17	17	13	22	14	19	9
11	15	10	17	12	10	10	17	9	13
17	18	17	16	14	16	14	21	15	7
7	9	15	4	9	12	6	6	9	15
18	9	20	18	18	10	22	18	24	16
13	18	17	19	15	14	9	14	17	15
16	11	12	16	14	13	13	15	17	13
8	14	4	18	12	11	6	14	11	12
10	16	6	10	12	11	2	15	14	14
12	16	15	19	17	17	11	25	12	17
18	14	20	23	16	9	14	13	18	15
14	16	14	17	17	10	12	10	24	11
6	11	7	15	11	20	6	14	9	16
10	7	7	15	16	8	11	9	6	13
9	10	10	12	13	10	4	10	14	17