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JOHN F. DASHIELL, *Editor*

Sex Differences in Dispersion at the High School and College Levels

By

JESSE B. RHINEHART

The University of Illinois

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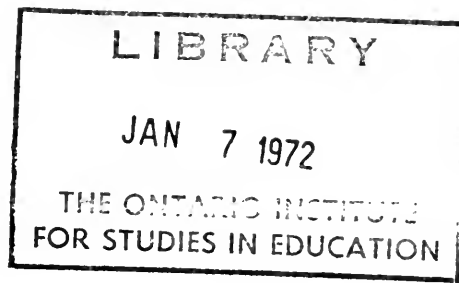
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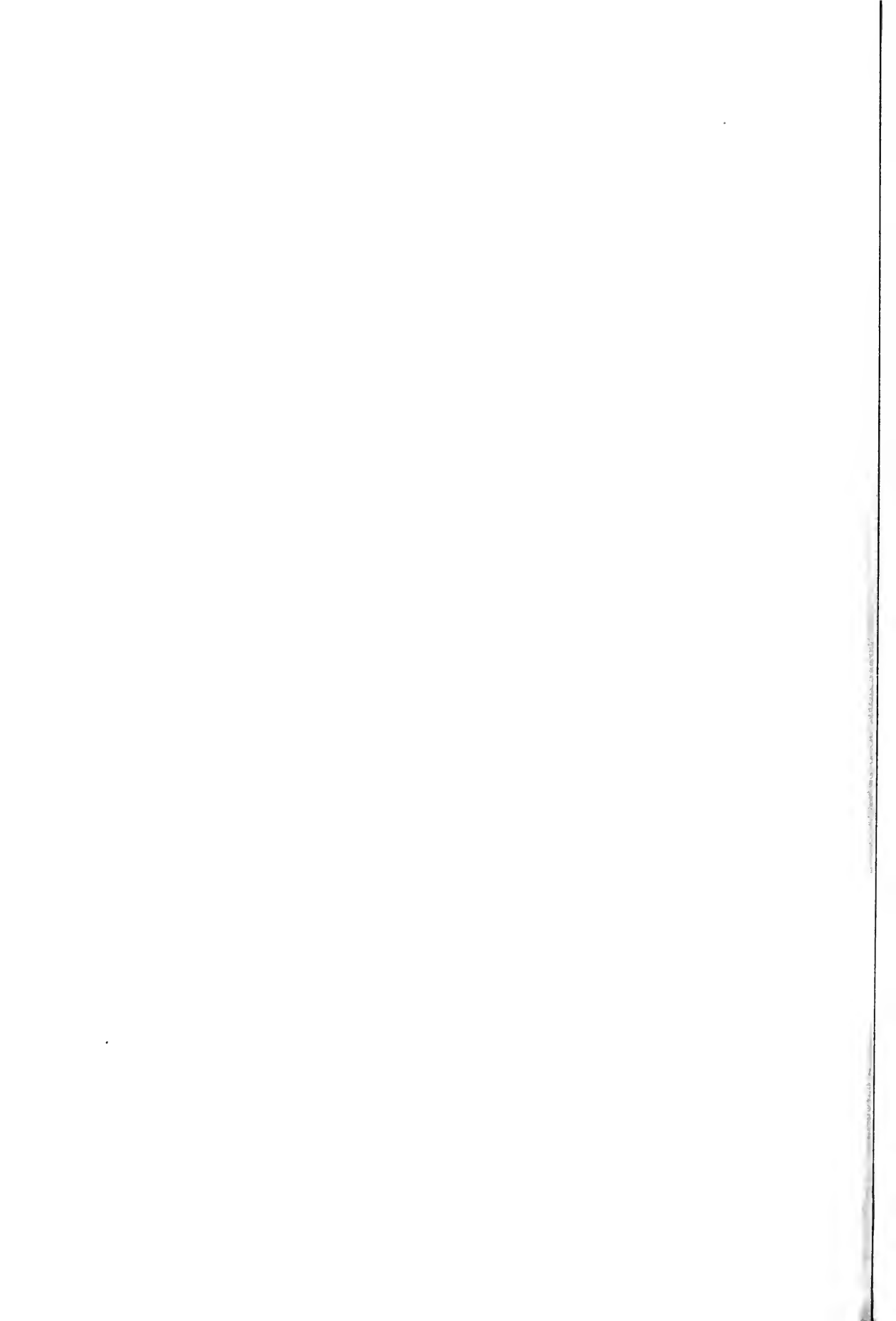
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SEX DIFFERENCES IN DISPERSION AT THE HIGH SCHOOL AND COLLEGE LEVELS

By JESSE B. RHINEHART

THE PROBLEM

ARE MALES or females the more variable? Are both sexes equal in terms of their tendency to cluster about the mean?

The first question is concerned with *absolute variability*, *i.e.*, the extent to which the sexes are represented at the extremes of a distribution of scores. For some four or five decades writers in the psychological literature have concerned themselves with this problem. From a pragmatic standpoint the answer to the question is of interest in attempting to explain the greater achievement of the male sex in art, science, literature, and world affairs. In other words, have more men attained the status of genius by virtue of their tendency to be absolutely more variable, *i.e.*, by reason of the fact that they have been and are better equipped biologically to attain greater eminence than women?

The second question posited in the first paragraph above is related to the problem of *relative variability* and is of concern, in the main, to those individuals interested in determining the contribution of females to biological evolution.

The present paper will not be concerned with attempting to determine *why* men have attained greater eminence, nor will it be concerned with attempting to

determine which of the two sexes has made the greater contribution to either the biological or social evolutionary process.

To minds uncluttered with academic impedimenta it *seems* obvious that woman has been restricted educationally, socially, and finally, biologically, by the nature of her role in the reproduction process; that opportunity for measurable achievement has been unequal for the two sexes; and that the contributions made by the two sexes have not been in spheres making possible equality of recognition. The question of possible sex differences in motivation to achievement and the question of possible differences in glandular make-up, as well as differences in opportunity, would need to be considered *adequately* before we are ready to determine to the satisfaction of the scientist, the *why* of the greater male achievement. In the present research the writer is not concerned with these or other possible practical implications of differences in sex variability, but rather will be concerned with attempting to determine sex differences in dispersion, *i.e. variational tendencies as observed in some 34 comparisons made at the high school and college levels.*

HISTORICAL BACKGROUND

PRIOR to Darwin's (4) enunciation of the theory of evolution, investigators had found sometimes the one and sometimes the other sex the more variable. Prior to this time variability had been regarded as a mark of inferiority. Subsequently, however, variability came to be regarded as an indication of superiority, since it was felt that variability constituted the mechanism upon which natural selection operated to elevate man to his present position on the phylogenetic scale.

Havelock Ellis (5, 6) was probably the first writer in the psychological literature to take cognizance of the assumed greater male variability reported in the biological literature. Using this as a starting point, he reviewed material pointing to the greater conservatism of women in dress, in customs, and to their greater mediocrity when judged on the basis of achievement in world affairs. He thus verbalized greater "psychic" variability for the male, stressing the fact that he regarded women as the more stable, conservative, true to type representatives of the human species. He was concerned with the greater frequency of genius (defined in terms of eminence) as a *manifestation* of greater male variability. Both social and biological evolution were, he felt, a function of the greater variability of the male sex.

Pearson (29), the first writer to regard variability as a quantitative concept, presented an array of data on physical measurement, his analysis of which he considered to be a refutation of the conclusions reached by Ellis. He pointed out further, that it is the bulk of variation, the degree of concentration about the mean which is important from the standpoint of the evolutionary process

and suggested the coefficient of variation as a means of determining relative variability.

In 1906 Thorndike concluded that ". . . though girls in general rank as high or higher in high school and college, they less often lead the class; thus, there are more eminent intellects among men and twice as many idiots." (39, p. 96)

Wells (40), Hollingworth and Montague (15), Hollingworth (16, 17, 18, 19), Farrell (7), Mulhall (28), Terman (36, 37), Keyes (21), Frasier (9, 10), Pressey (30), Starch (32), Whitnire (41), Henman and Livingston (14), Thompson (38), Tanaka (35), Pyle (31), Thorndike (39), Stewart (33), Commins (3), Meltzer and Bailor (27), Young (44), Winsor (42), and Witty (43) published the main studies purporting to evaluate sex differences in dispersion prior to 1936.

The publication of E. A. Lincoln (24) in 1927 has not been included in the enumeration above, since because of its exhaustiveness and sound statistical analysis, it seems to merit special mention. Lincoln, in his volume *Sex Differences in School Children*, studied differences in sex variability in physical measurements, in physiological maturity, in anatomic development, in dentition, in mental development, in arithmetic, reading, handwriting, spelling, and history. He concludes:

It appears, then, that neither sex can be called more variable than the other on the basis of data at present available. The facts gathered in this chapter do not, of course, answer the question as to whether men are more variable than women, since this study has concerned itself only with boys and girls during the school period. The inference may be made, however, that if men are more variable, their greater variability is, in large part, at least, the result of environmental conditions rather than of a definite inherent

tendency. Another possibility, of course, for which there appears to be some evidence, especially in the data concerning variation in physical traits, is that variability is a function of maturity. It seems fairly clear, at any rate, that the maturity factor is at times chiefly responsible for the differences which appear. (24, p. 164)

In 1936 McNemar and Terman (26) published perhaps the most exhaustive study up to that time on sex differences in variation tendencies. The reader is referred to this source for a more comprehensive pre-1936 bibliography than has been included in the present report.

In the McNemar and Terman study anthropometric, psychological, and educational data on investigations numbering, for the most part, no less than 100 subjects, are analyzed. In some instances the number of subjects runs well into the thousands. Among the secondary data employed by these writers are those of Boas, Elderton, Habakkuk, Wissler, Hollingworth and Montague, Pearson, Pintner, Thorndike, Whitmire, Pressey, Conrad and Jones, Burt, Snoddy and Hyde, Pyle, Council of Education, and many others.

In general the data have been analyzed statistically in terms of standard deviations. The authors conclude that, at some age, with some kinds of data, they find greater female variability, and at other ages, with other kinds of data, they find either the reverse, or no significant differences at all. In the area of special abilities equally non-definitive results were obtained. However, with respect to the evidence presented by standardized intelligence batteries, the authors say they find a rather significant trend:

Of 33 comparisons based on age groupings, 29 show greater male variation. The mean of the ratios of differences to their standard

errors is 1.47, which differs from zero by 8.4 times its standard error, and the median value of 1.18 is 5.4 times its standard error. These data being consistent from battery to battery and for the several age levels, would seem to be rather conclusive in favor of greater male variations in intelligence as defined by these tests. (26, p. 57)

The authors conclude that the difference in variability is equivalent to about one point on the IQ scale and that this would mean, in general about nine boys to six girls would score above 140 or below 60 IQ, and that twice as many boys as girls would exceed 160 or fall below 40.

The above conclusions are drawn from data based upon pre-adult samples. The authors point out, too, that the inconsistent results found for other psychological tests given at school ages do not preclude the possibility of a greater variability for either sex at the adult level.

Since this 1936 publication of McNemar and Terman, studies purporting to measure sex differences in dispersion have not been so numerous. An attempt has been made here to take brief cognizance of the several noteworthy studies which have appeared during the past decade.

In 1937 Jordan (20), published the results of a study, the data of which consisted of an examination involving questions on reading, literature, English usage, history, science, and mathematics. Some 11,000 girls and 8,000 boys, all high school seniors served as subjects in the study. The results indicated that boys were slightly ahead on the test as a whole and that they surpassed girls in their scores on mathematics, science, and history. The girls surpassed the boys on English usage. In reading and literature scarcely any sex differences were ob-

served. Comparisons on the basis of the means and standard deviations of the two groups indicated little difference in *total scores* between the two groups. For the boys a standard deviation of 21.05 and a mean of 82.90 was obtained whereas for the girls a standard deviation of 20.15 and a mean of 81.65 was secured.

Further comparisons indicated:

Only 20 percent of the boys reach or exceed the median girl in scores in English usage. Twice as many girls as boys make the highest scores. In science only 32 percent of the girls reach or exceed the median boy. Boys, on this test, score twice as many A's as girls and about half as many of the lowest scores. In math about 35 percent of the girls reach or exceed the median boy. Boys make about 50 percent more A's and B's and about half as many E's as girls do. In American history boys score about 40 percent more A's and B's and about 40 percent fewer E's than girls do. (20, p. 260)

Stroud and Lindquist (34) in 1942 conducted a study of Iowa school children. They found that in grades 3 to 8 girls consistently performed better than boys on tests of reading comprehension, vocabulary, work study skill, and basic language skills, while boys were superior only on a test of basic arithmetic skills. In the high schools, however, the general superiority favored the boys. Girls attained higher scores on algebra and reading comprehension only, while the boys evidenced superiority on tests of geometry, general science, biology, physics, history, government, contemporary affairs, economics, and Latin.

In 1943 Canady (2) made an analysis of the A. C. E. test scores of 637 Negro

men and 669 Negro women. An analysis of sex differences of gross scores indicated male superiority on the numerical parts of the test and female superiority on the verbal parts of the test. It was concluded that the results do not support a theory of greater male variability.

Gray (13) in 1944 studied differences in variability in school achievement and intelligence. Achievement was measured by the Unit Scales of Attainment; intelligence was measured on the basis of the Kuhlman-Anderson test. It was concluded that sex differences in variability were negligible.

In 1945 Fraser (8) published a report in which he observed that boys showed more variability in IQ than girls, although the mean IQ of both groups was found to be approximately the same. That is to say, he found that the sexes were approximately the same with respect to *relative variability* but they differed as to absolute variability. From his data Fraser estimated the number of boys per 100 girls at the various IQ ranges presented. He went further, deciding that his findings suggested certain "practical implications."

It would seem that, except for Fraser's findings, the more recent and the more exhaustive studies have been in more or less agreement in their conclusions which have been, in effect that:

(1) demonstrated, measurable sex differences are, for the most part, negligible

(2) found differences in sex dispersion or variability seems to be either a function of the age levels studied and/or the types of measurement employed.

PRESENT STUDY

IN THIS study secondary data have been employed from two sources:

The Carnegie Foundation for the Advancement of Teaching in cooperation with the Joint Commission of the Association of Pennsylvania College Presidents and the State Department of Public Instruction conducted an extensive testing program in a number of Pennsylvania high schools and in 49 Pennsylvania colleges (22). It was from this source that a large portion of the material constituting the data for this research was obtained. Numerous sources were obtained on (1) high school seniors, (2) 1928 college seniors, (3) 1930 college sophomores, and (4) 1932 college seniors.

Intelligence test scores, physical and physiological measurements of the freshmen enrolled at the University of Pittsburgh over a ten-year period (from 1924-

25 to 1934-35), supplied the second source of data utilized here.

From these two sources it was possible to make 39 different comparisons on groups numbering from 1,047 to 12,383 each of males and females at the college level, except for five instances in which the comparisons made were based on high school seniors.

Since the number of test scores available for female students exceeded the number of test scores available for the male students of the groups studied here, the larger number was reduced to equal the smaller on the basis of the percentage of frequencies appearing in each class interval of the larger distribution. An equal number of test scores, then, was analyzed on each measurement for each sex.

RESULTS

1. SEX VARIABILITY IN HIGH SCHOOL SENIORS OF THE PENNSYLVANIA STUDY

INTELLIGENCE test scores as well as the scores on the American history, French, algebra, and English tests of the high school seniors participating in the Pennsylvania Study served as the basis of comparison for the high school males and females. The English test scores used here are composite scores based on several sub-tests. The number of participating seniors is indicated in Table 1.

TABLE 1
Number of participating high school seniors in the Pennsylvania study

Tests	No. of Males	No. of Females	Total
American History	11,520	11,520	23,040
Intelligence	12,383	12,383	24,766
French	2,933	2,933	5,866
Algebra	8,699	8,699	17,398
Total English	12,284	12,284	23,568

Table 2 lists the range of scores on the various tests. It will be noted that the range of scores of the male students exceeds that of the female students on the American history, intelligence, and English tests by five, two and 20 intervals, respectively. The range of scores for the female students is the greater by 10 intervals on the French test. On the algebra test the ranges are equal for the two sexes.

TABLE 2
Range of test scores of high school seniors in the Pennsylvania study

Tests	Lowest Scores		Highest Scores		Range	
	Males	Females	Males	Females	Males	Females
American History	2.5	7.5	202.5	202.5	200.0	195.0
Intelligence	8.0	10.0	76.0	67.0	68.0	66.0
French	5.0	5.0	265.0	275.0	260.0	270.0
Algebra	2.0	2.0	66.0	66.0	64.0	64.0
Total English	5.0	25.0	295.0	295.0	290.0	270.0

Table 3 lists the standard deviations and coefficients of variation of the high school seniors on these five tests. The absolute variability as measured by the standard deviations is slightly greater on all tests in the case of the male students. The relative variability is greater for the female high school seniors on the American history, intelligence, and algebra tests.

In Table 4, it will be observed that in every instance the significance of the difference between the coefficients of variation is either equal to or greater than four, this being the minimum number insuring complete reliability.

D.
(11, p. 136) When the _____'s of P.E. (diff.)

standard deviations are examined, it will be noted that in the case of the algebra scores only is complete reliability insured. The reliability of the difference between the standard deviations on the intelligence test is .67 which means that there are only 67 chances in 100 that the difference is a true one. (11, p. 135) There are 98 chances in 100 that the differences between the standard deviations on the American history, French, and English tests, respectively, are significant.

It would seem, then, that the results of these five tests are such as to indicate a slightly greater absolute male variabil-

TABLE 3
Comparison of females to males on basis of standard deviation and coefficient of variation

Tests	Number of Males and Females in Groups	Standard Deviation			Coefficient of Variation		
		Males	Females	Ratio	Males	Females	Ratio
American History	11,520	25.65	25.15	1.020	35.80	40.40	.886
Intelligence	12,383	10.34	10.30	1.004	20.87	22.19	.941
French	2,993	47.70	46.80	1.019	41.64	36.90	1.128
Algebra	8,699	11.76	10.20	1.153	64.79	77.80	.833
Total English	12,284	35.20	34.70	1.014	26.22	25.22	1.040

ity. The comparisons on the basis of relative variability are such as to indicate that the performance of the male high school seniors on three of the five tests suggests greater conformity to type.

1. The questions, instead of requiring written answers, will be of a sort to test memory, judgment, and reasoning ability through simple recognition. . . .

2. Instead of dealing solely with subjects that you may have studied in college, the

TABLE 4
Differences and significance of differences between standard deviations and coefficients of variation

Tests	Standard Deviations		Coefficients of Variation	
	Difference	D. P.E. (diff.)	Difference	D. P.E. (diff.)
American History	.50—.16	3.13	4.60—.27	17.04
Intelligence	.04—.06	.67	1.32—.33	4.00
French	.90—.59	1.53	4.74—.50	8.46
Algebra	1.56—.08	19.50	13.01—.61	21.32
Total English	.50—.21	.238	1.00—.17	5.88

2. SEX VARIABILITY IN THE 1928 COLLEGE SENIORS OF THE PENNSYLVANIA STUDY

In 1928, a 12-hour general examination was administered to seniors in 49 Pennsylvania colleges. The purpose and nature of the examination are defined by W. S. Learned:

The purpose underlying the proposed test is to learn what the bachelor's degree, representing an eight-year high school and college education in Pennsylvania, amounts to in terms (1) of clear, available, important ideas; and (2) of ability to discriminate exactly among ideas and to use them accurately in thinking.

test aims to present, in a balance fashion, the main fields of organized knowledge and to let you 'register' as far as you can wherever you are informed. . . .

3. In each field the questions will range from very easy ones that many high school students could answer to very difficult ones that your college teachers could probably not answer unless they were expert in that particular subject. . . . (23, p. 3)

In Table 5 the number of participating 1928 college seniors is listed for the achievement test of the Pennsylvania Study.

In Table 6 the range of scores may be noted for a rough estimate of the vari-

TABLE 5

Test scores available for college seniors on 1928 college achievement test of the Pennsylvania study

Tests	Males	Females	Total
Language, Literature and Fine Arts	1,410	1,410	2,820
Natural Science	1,410	1,410	2,820
Total Social Studies	1,407	1,407	2,814
Total Score	1,411	1,411	2,822

ability of the two groups.

It will be observed that in language, literature, and fine arts and in total score, the males have a greater range. The females have a greater range in natural science. On the material classified

studies. The men students show greater relative variability on all the tests except natural science. The significance of the differences between the standard deviations and coefficients of variation is shown in Table 8.

All the differences in absolute variability are significant except on the language, literature, and fine arts test. It will be recalled that this was the only instance in which the standard deviations suggested greater female variability. According to the $\frac{D}{P.E. (diff.)}$, there

are 81 chances in 100 that the difference is a true one. (11, p. 135) In the case

TABLE 6
Range of test scores of 1928 college seniors in the Pennsylvania study

Tests	Lowest Scores		Highest Scores		Range	
	Males	Females	Males	Females	Males	Females
Language, Literature and Fine Arts	10	10	670	610	660	600
Natural Science	5	5	275	315	270	310
Total Social Studies	30	60	670	700	640	640
Total Score	125	175	1,575	1,425	1,450	1,250

as total social studies, there is no difference in range.

The figures in Table 7 suggest greater absolute male variability in natural science, total score, and total social

of relative variability, the differences shown on the language, literature, and fine arts test, and on the natural science test are significant. There are 99 chances in 100 (11, p. 135) that the difference in

TABLE 7
Comparison of females and males on basis of standard deviations and coefficients of variation

Tests	Number of Males and Females in Groups	Standard Deviation			Coefficient of Variation		
		Males	Females	Ratio	Males	Females	Ratio
Language, Literature and Fine Arts	1,410	85.00	87.00	.977	56.97	44.93	1.294
Natural Science	1,410	44.20	32.80	1.348	50.57	55.62	.909
Total Social Studies	1,411	95.60	81.00	1.180	37.91	36.86	1.029
Total Score	1,407	103.50	172.50	1.122	33.20	30.98	1.072

TABLE 8
Differences and significance of differences between standard deviations and coefficients of variation of college seniors of 1929 group

Tests	Standard Deviations		Coefficients of Variation	
	Difference	D.	Difference	D.
		P.E. (diff.)		P.E. (diff.)
Language, Literature and Fine Arts	2.00	1.31	12.04	11.35
Natural Science	11.40	16.31	5.05	4.21
Total Social Studies	14.60	9.14	1.05	1.38
Total Score	21.00	6.38	2.22	3.52

the coefficients of variation on total score is significant. There are 83 chances in 100 (11, p. 135) that the difference in relative variability on total social studies is a true difference.

Both in absolute and relative variability on three of the four test groups included in this particular section of the Pennsylvania Study, the test performances indicated greater male variability.

3. SEX VARIABILITY IN THE 1930 COLLEGE SOPHOMORES OF THE PENNSYLVANIA STUDY

The data used in this section are the data secured in May, 1930, in the general examination given in 45 Pennsylvania colleges to students completing their sophomore year. The nature of the examination is described by Dr. Learned:

... a part (1,220) of the questions was of a comprehensive nature, ranging from very simple to very difficult, over the following fields: general science, 290 questions; foreign literature, 330; fine arts, 250; and general history and social studies, 310. The knowledge required for success in this section of the test would nowhere appear as organized college courses. The questions were prepared, however, by experienced university teachers with the avowed purpose of testing such knowledge as one would expect to find increasing from year to year as a result of reading and study both within and without

the limits of formal courses. . . . (23, p. 7)

The remainder of the examination is described as comprising 1,500 questions exclusive of the intelligence test. These 1,500 questions were distributed over fields that are the subjects of formal study in college. Dr. Learned writes:

English with 450 questions, and mathematics with 220, together with the general culture section already described, were required of all students. In addition, each took his choice of one of four languages, about 325 questions each; one of four social sciences, about 200 questions each; and one of five natural sciences, about 300 questions each. It was the object of each of these self-chosen special fields to push the student to the limit of his knowledge, and each test was intended to outrange college achievement. (23, p. 8)

The score termed "general culture total" here is a composite score derived from the general science, foreign literature, fine arts, and history and social studies tests. The score designated here as "English total" is a composite score taken from the spelling, grammar, punctuation, vocabulary, and literature tests.

For this 1930 college group, men and women sophomores contributed 1,017 test scores each, or a total of 2,094 test scores for the analysis made here.

Table 9
Range of test scores of 1930 sophomores
in the Pennsylvania study

Tests	Lowest Scores		Highest Scores		Range	
	Males	Females	Males	Females	Males	Females
	Number— 1,047	Number— 1,047				
Total Common Subjects	100.0	170.0	1,200	990.0	1,100	820
Total General Culture	25.0	55.0	755	605.0	730	550
Otis Intelligence	25.0	23.0	75	75.0	50	52
Fine Arts	1.0	1.0	43	33.0	42	32
Literary Acquaintance	3.0	1.0	20	31.0	26	30
General Science	1.0	2.0	53	42.0	52	40
History and Social Studies	1.0	1.5	51	49.5	50	48
Mathematics	1.0	1.0	43	37.0	42	36
Foreign Literature	1.0	1.0	39	33.0	38	32
Vocabulary	2.5	12.0	97	97.0	94.5	85
Total English	20.0	60.0	350	370.0	330	310

Table 9 lists the range of test scores for the 1930 sophomore group. The range for the men students is greater in every comparison except in intelligence and fine arts.

Table 10 partially agrees with the rough estimate given in Table 9. The ratios of the standard deviations indicate greater absolute male variability in all but two of the 11 comparisons. However, according to Table 10, it is on the literary acquaintance and history and

social studies tests that the women students demonstrated greater absolute variability. The women students also demonstrated greater relative variability on four of the tests: intelligence, general science, history and social studies, and mathematics.

The significance of these differences can be seen in Table 11.

That the differences between the standard deviations on the history and social studies test is a true one is sub-

TABLE 10
Comparison of females to males on basis of standard
deviations and coefficients of variation

Tests	Standard Deviations			Coefficients of Variation		
	Males	Females	Ratio	Males	Females	Ratio
	Number— 1,047	Number— 1,047				
Total Common Subjects	166.00	143.00	1.16	28.44	26.99	1.05
Total General Culture	102.00	86.30	1.18	34.46	33.35	1.03
Otis Intelligence	9.84	9.66	1.01	17.25	17.48	.90
Fine Arts	4.66	4.37	1.07	42.56	36.71	1.16
Literary Acquaintance	4.60	4.72	.97	32.44	31.66	1.03
General Science	6.14	5.25	1.17	28.48	35.59	.80
History and Social Studies	4.00	7.32	.55	48.75	51.40	.95
Mathematics	9.02	6.18	1.46	49.00	53.46	.92
Foreign Literature	5.52	5.12	1.08	45.06	43.32	1.06
Vocabulary	18.20	18.00	1.01	32.80	32.49	1.01
Total English	55.50	54.30	1.02	27.95	25.11	1.11

stantiated by the $\frac{D.}{P.E. (diff.)}$ of 27.21.

There are 80 chances in 100 (11, p. 135) that the greater absolute female variability demonstrated on the literary acquaintance test is significant. There are 72 and 76 chances in 100 (11, p. 135) that the differences in absolute variabil-

English tests, there are only 61 and 62 chances in 100 that the differences are significant.

The men sophomore college students more frequently demonstrated greater absolute variability on these 11 comparisons than did the women students. However, the women students more fre-

TABLE 11
Differences and significance of differences between standard deviations and coefficients of variation

Tests	Standard Deviations		Coefficients of Variations	
	Differences	D.	Differences	D.
		P.E. (Diff.)		P.E. (Diff.)
Total Common Subjects	23.00—3.25	7.12	1.45— .62	2.34
Total General Culture	15.70—1.97	7.97	1.11— .72	1.54
Otis Intelligence	.18— .20	.88	.23— .37	.62
Fine Arts	.29— .09	3.09	5.85— .68	8.60
Literary Acquaintance	.12— .10	1.24	.78— .73	1.07
General Science	.89— .12	7.75	7.11— .70	10.16
History and Social Studies	3.32— .12	27.21	2.65—1.27	2.09
Mathematics	2.84— .16	17.64	4.37—1.32	3.31
Foreign Literature	.40— .12	3.27	2.64—1.10	2.40
Vocabulary	.20— .38	.53	.31— .75	.41
Total English	1.20—1.14	1.05	2.84—5.91	.48

ity on the intelligence and total English tests are significant and only 63 chances in 100 that the difference indicating greater absolute male variability on the vocabulary test is a true one.

There are 66, 91 and 99 chances in 100 that the differences indicating greater relative female variability on the intelligence, history and social studies, and mathematics tests, respectively, are true differences, while the $\frac{D.}{P.E. (diff.)}$ of

the general science test indicates definitely a significant difference. As for the greater relative male variability on the total general culture and literary acquaintance tests, there are 85 and 76 chances in 100 that the differences are true ones. On the vocabulary and total

quently demonstrated greater relative variability. In neither absolute nor relative variability were either men students or women students more variable in every comparison.

4. SEX VARIABILITY IN THE 1932 COLLEGE SENIORS OF THE PENNSYLVANIA STUDY

The sophomore students tested in 1930 were tested again as seniors in 1932 on the same battery of tests used two years previously. Here again, 1,047 test scores were utilized for each group, male and female.

Table 12 gives a rough estimate of the variability of the two sexes on the basis of the range of scores. It will be noted that in four of the tests the men students

TABLE 12
Range of test scores of 1932 college seniors
in the Pennsylvania study

Tests	Lowest Scores		Highest Scores		Range	
	Males	Females	Males	Females	Males	Females
	Number	Number				
	1,047	1,047				
Otis Intelligence	21	20	75	75	54	46
Foreign Literature	1	1	47	41	40	40
History and Social Studies	1	1	57	07	54	46
Fine Arts	1	1	39	37	38	36
General Science	4	4	52	40	48	36
Mathematics	1	1	43	41	42	40
Vocabulary	12	12	97	97	85	85
Total Common Subjects	100	170	1,350	1,210	1,160	1,040
Total English	45	75	375	385	330	310
Total General Culture	70	75	790	775	720	700
Literary Acquaintance	1	3	31	33	30	30

have the low scores, on six tests the lowest scores are the same for the two sexes, and in only one instance did the women students make the low scores. In seven cases the males have the high scores, in two cases the highest scores are the same for the two sexes, and in two cases the women students have the high scores. In nine of the comparisons the men have the greater range, and in two comparisons the ranges are the same.

According to Table 13, on this battery of tests the performance of the women students showed greater absolute varia-

bility on the foreign literature, general culture, and literary acquaintance tests. They showed relative variability on the history and social studies, general science, mathematics, common subjects, and general culture scores.

The significance of the differences indicated in Table 13 is shown in Table 14. The difference between the standard deviations on the total general culture scores indicated greater absolute female

variability. The $\frac{D.}{P.E. (diff.)}$ of the differ-

TABLE 13
Comparison of females to males on basis of standard
deviations and coefficients of variation

Tests	Standard Deviations			Coefficients of Variation		
	Males	Females	Ratio	Males	Females	Ratio
Otis Intelligence	9.30	8.88	1.047	15.21	14.88	1.02
Foreign Literature	6.68	6.76	.99	46.13	43.10	1.07
History and Social Studies	8.94	8.54	1.05	43.78	46.09	.95
Fine Arts	5.38	5.06	1.06	42.30	34.92	1.21
General Science	8.28	5.78	1.43	33.93	35.14	.97
Mathematics	9.38	7.22	1.30	49.95	61.29	.82
Vocabulary	17.85	17.60	1.01	28.80	28.24	1.02
Total Common Subjects	182.60	173.40	1.05	27.75	28.10	.99
Total English	61.50	56.70	1.09	28.21	23.50	1.20
Total General Culture	57.20	108.20	.53	16.35	34.28	.48
Literary Acquaintance	5.00	5.34	.94	32.34	31.23	1.04

ence suggests that this difference is reliable. There are 98 chances in 100 (11, p. 135) that the difference between the standard deviations on the literary acquaintance test is a true one. However, there are only 65 chances in 100 (11, p. 135) that the greater absolute male variability demonstrated on the vocabulary test is significant.

The greater relative female variability indicated by the total general culture

The concluding remark made concerning the performance of the college sophomores may be aptly repeated here in the case of the college seniors. The men senior college students more frequently demonstrated greater absolute variability on these 11 comparisons than did the women students. However, the women students more frequently demonstrated greater relative variability. In neither absolute nor relative variability

TABLE 14
Significance of the differences between the standard deviations and coefficients of variation of the 1932 seniors of the Pennsylvania study

Tests	Standard Deviations		Coefficients of Variation	
	Difference	D. P.E. (Diff.)	Difference	D. P.E. (Diff.)
Otis Intelligence	.42— .19	2.21	.33— .32	1.03
Foreign Literature	.08— .14	.57	3.03— 1.04	2.01
History and Social Studies	.40— .18	2.22	2.31— 1.04	2.22
Fine Arts	.32— .11	2.91	7.38— .02	8.02
General Science	2.50— .11	22.72	1.21— .80	1.51
Mathematics	2.16— .17	12.71	11.34— 1.40	7.71
Vocabulary	.25— .37	.68	.50— .04	.88
Total Common Subjects	9.20— 3.71	2.48	.35— .02	.50
Total English	4.80— 1.23	3.90	4.71— .57	8.20
Total General Culture	51.00— 1.80	28.33	17.93— .01	20.30
Literary Acquaintance	.34— .11	3.09	1.11— .72	1.54

scores and the mathematics test seems to be partially substantiated by the

D.

—'s of 29.99 and 7.61. There are P.E. (diff.)

93, 84, and 64 chances in 100 (11, p. 135) that the difference between the relative measures of variability on the history and social studies, general science, and common subjects tests are true differences. On the intelligence, vocabulary, and literary acquaintance tests on which greater relative male variability was indicated there are respectively 75, 72 and 85 chances in 100 (11, p. 135) that the differences between the appropriate coefficients of variation are significant.

were either men students or women students the more variable in every comparison.

5. SEX VARIABILITY IN UNIVERSITY OF PITTSBURGH FRESHMEN (1924-1931)

The data presented in this section were obtained from the records of freshmen at the University of Pittsburgh from the school year 1924-25 up to and including the first semester of the school year of 1934-35. Since in each class there are usually only one-third as many women as there are men at the University, a random sampling of the scores and measurements of the men was made for each item of comparison by selecting

TABLE 15
Number of cases used for each of the eight items of
comparison of University of Pittsburgh freshmen

Measurements	Number of Scores Used		
	Total	Males	Females
A.C.E. Intelligence	2,860	1,430	1,430
Thorndike Intelligence	4,460	2,230	2,230
Weight	7,230	3,615	3,615
Systolic Blood Pressure	4,020	2,010	2,010
Diastolic Blood Pressure	4,020	2,010	2,010
Pulse (Before Exercise)	6,950	3,475	3,475
Pulse (After Exercise)	6,540	3,270	3,270
Height	7,088	3,544	3,544

every third score. Many times the records for individual students were incomplete with respect to the items selected for consideration here. For that reason the same number of cases is not reported for every item. Table 15 lists the number of cases used here for each of the measurements.

In Table 16 note that the range of scores on the A. C. E. (American Council on Education) Intelligence Test is the same for the two sexes. Note also that the range is 10 points greater on the Thorndike for the females.

According to Table 17, the men and women students show approximately equal absolute variability on the A. C. E. The men show greater relative variability on this same test. The men students are absolutely and relatively more variable than the women students when the two groups are compared on the

Thorndike. It may be that the material included in the Thorndike is the type of material on which males have had more of both incidental and formal practice than have females.

According to Table 18, the difference between the standard deviations of the Thorndike Intelligence Test is significant, but there are only 55 chances in 100 (11, p. 135) that the difference between the standard deviations of the A. C. E. for the two groups is a true difference.

The difference between the measures of relative variability is significant in the case of the A. C. E. Intelligence Test. There are 93 chances in 100 (11, p. 135) that the difference between the coefficients of variation on the Thorndike Intelligence Test is a significant one.

A comparison of physical and physiological measurements of the University

TABLE 16
Range of scores of University of Pittsburgh
freshmen on intelligence tests

Tests	Number of Males and Females	Lowest Scores		Highest Scores		Range	
		Males	Females	Males	Females	Males	Females
A.C.E. Intelligence	1,430	2.5	2.5	100.0	100.0	97.5	97.5
Thorndike Intelligence	2,230	12.5	7.5	112.5	117.5	100.0	110.0

TABLE 17
Comparison of intelligence test scores of university freshmen on basis of standard deviations and coefficients of variation

Tests	Number of Males and Females in Each Group	Standard Deviations			Coefficients of Variation		
		Males	Females	Ratio	Males	Females	Ratio
A.C.E. Intelligence	1,430	28.15	28.05	1.00	57.59	51.31	1.11
Thorndike Intelligence	2,230	17.30	15.52	1.12	26.91	25.04	1.08

TABLE 18
Significance of difference between measures of absolute and relative variability

Tests	Standard Deviations		Coefficients of Variation	
	Difference	D.	Difference	D.
		P.E. (diff.)		P.E. (diff.)
A.C.E. Intelligence	.10—.50	.20	6.28—1.23	5.11
Thorndike Intelligence	1.78—.24	7.42	1.87—.84	2.23

freshman group on the basis of absolute range is given in Table 19. On the basis of range of measurements, in three instances the men are more variable, and in three instances the women are more variable.

Table 20 affords a comparison of the men and women students of this group on the basis of absolute and relative variability. The women students show greater absolute variability on both

systolic and diastolic blood pressure and greater relative variability on the same measures as well as on weight.

The significance of these differences is indicated in Table 21.

The $\frac{D.}{P.E. (diff.)}$'s of the standard deviations indicate that all of the differences between the measures of absolute variability are significant with the exception of systolic and diastolic blood

TABLE 19
Comparison of University of Pittsburgh freshmen on physiological and physical measurements on the basis of range

Measurements	Number of Males and Females in Each Group	Range		Difference Range	
		Males	Females	Males	Females
Systolic Blood Pressure	2,010	84	112	—	28
Diastolic Blood Pressure	2,010	80	90	—	10
Pulse (Before Exercise)	3,475	112	108	4	—
Pulse (After Exercise)	3,270	144	112	32	—
Height	3,544	26	22	4	—
Weight	3,615	190	215	—	25

TABLE 20
Comparison of men and women students on physical
and physiological measurements

Measurements	Standard Deviations			Coefficients of variation		
	Males	Females	Ratio	Males	Females	Ratio
Systolic Blood Pressure	10.74	10.89	.99	8.33	9.85	.85
Diastolic Blood Pressure	8.50	9.12	.94	11.39	13.08	.87
Pulse (Before Exercise)	13.90	12.30	1.14	16.74	13.99	1.20
Pulse (After Exercise)	10.00	16.25	1.17	17.58	13.74	1.28
Height	2.79	2.47	1.13	4.07	3.89	1.05
Weight	10.70	18.25	1.68	14.00	15.22	.93

pressure. There are 73 chances in 100 and more than 99 chances in 100 (11, p. 135) that the differences between the standard deviations on systolic and diastolic blood pressure, respectively, are true.

As for the reliability of the differences in relative variability, there are 99 chances in 100 that the difference between the coefficients of variation on height is significant. The remainder of the differences between the coefficients of variation of the two sexes on these physical and physiological measurements are significant.

We may say that on the physical and physiological measurements reported here, it seems that neither the men students nor the women students are exclusively more variable either absolutely or relatively.

6. SUMMARY AND FURTHER ANALYSES OF DIFFERENCES IN ABSOLUTE AND RELATIVE VARIABILITY FOR MALE AND FEMALE STUDENTS OF THE PENNSYLVANIA STUDY AND 1924-1934 UNIVERSITY OF PITTSBURGH FRESHMEN

Inspection of Table 21 shows:

Greater *absolute* male variability was indicated on all five tests in the high school group. Only on the algebra test, however, was a significant difference found between the standard deviations for the two sexes.

In the high school group greater *relative* variability for the girls appeared on three of the five tests. The critical ratios of the differences show that all three differences are significant. The conclusion is indicated, then, that the scores of the females of the high school group clustered about the mean to a

TABLE 21
Significance of differences in variability
indicated in Table 20

Measurements	Standard Deviations		Coefficients of Variation	
	Difference	D. P.E. (diff.)	Difference	D. P.E. (diff.)
Systolic Blood Pressure	.15—.16	.92	1.13—.14	10.86
Diastolic Blood Pressure	.53—.13	3.98	1.52—.10	8.80
Pulse (Before Exercise)	1.60—.15	11.19	1.60—.18	15.28
Pulse (After Exercise)	2.75—.21	13.22	2.75—.19	20.21
Height	.32—.03	10.67	3.84—.05	3.60
Weight	1.54—.21	7.23	.18—.17	6.65

greater extent than did the scores for the high school males on (a) the American history, (b) the intelligence and (c) the algebra tests.

In the college groups greater *absolute* male variability is indicated on 26 of the 34 comparisons made, the females showing greater *absolute* variability on only eight of the 34 comparisons.

Expressed in terms of the percentage of significant differences, in 41 percent of the comparisons greater *absolute* variability for the males seems apparent. The test items and groups involving these significant differences for greater *absolute* variability are as follows:

- (a) the 1928 college seniors for the natural science test
- (b) the 1930 college sophomores for the fine arts test
- (c) the 1932 college seniors for the history and social studies test
- (d) the 1932 college seniors for the total English test
- (e) the University of Pittsburgh freshmen for the A. C. E. Intelligence Test
- (f) the University of Pittsburgh freshmen for the pulse rates both before and after exercise.

Significantly greater *absolute* variability for the females is indicated for the following test items and groups:

- (a) the 1928 college seniors on the language, literature, and fine arts test
- (b) the 1932 college seniors on the total general culture test
- (c) the University of Pittsburgh freshmen for systolic and diastolic blood pressure.

On the measurements shown in Table 22 college males showed greater *relative* variability in 21 of the 34 comparisons made. Seven or 33 $\frac{1}{3}$ per cent of these differences seem to be significant. Significantly greater *relative* variability for the males, then, is indicated for:

- (a) the 1928 college seniors on the language, literature, and fine arts test
- (b) the 1930 college seniors on the fine arts test
- (c) the 1932 college seniors on the history and social studies test
- (d) the 1932 college seniors on the total English Test
- (e) the University of Pittsburgh on the A. C. E. Intelligence test
- (f) the University of Pittsburgh freshmen on measures of pulse rate before and after exercise.

For the females significantly greater *relative* variability seems indicated for the following groups and test items:

- (a) 1928 college seniors on the natural science test
- (b) 1930 college sophomores for the general science test
- (c) 1932 college seniors for the mathematics test
- (d) 1932 college seniors for the total general culture test
- (e) University of Pittsburgh freshmen for systolic and diastolic blood pressure.

7. COMPARISON OF MALE AND FEMALE HIGH SCHOOL SENIORS OF THE PENNSYLVANIA STUDY ON THE BASIS OF MEASURES OF CENTRAL TENDENCY, SKEWNESS, UPPER AND LOWER QUANTILES, AND HIGHEST AND LOWEST 10 PER CENTS OF THE DISTRIBUTIONS

The 1928 high school seniors of the Pennsylvania Study are compared in Table 23 on the basis of two measures of central tendency. On both comparisons the central tendencies of the female students exceed that of the males on the French and total English tests. The central tendencies of the male students are greater on the other three comparisons. Both central tendencies of male students are considerably higher than those of the females on the algebra test.

The significance of the differences between the means of the two groups is

TABLE 22

Summary of comparisons of males and females at the senior high school and college levels on basis of absolute and relative variability

Tests	Total Males and Females	Standard Deviation			Coefficient of Variation			Critical Ratio of Standard Deviations	Critical Ratio of Coefficients of Variation
		Males	Females	Ratio	Males	Females	Ratio		
High School									
American History	23,040	25.65	25.15	1.02	35.80	40.40	.89	3.13	17.04
Intelligence	24,766	10.34	10.30	1.00	20.87	22.19	.94	.67	4.00
French	5,866	47.70	46.80	1.02	41.64	36.90	1.13	1.53	8.46
Algebra	17,398	11.76	10.20	1.15	64.79	77.80	.83	19.50	21.32
Total English	24,568	35.20	34.70	1.01	26.22	25.22	1.04	2.38	5.88
1928 College Seniors									
Language, Literature, and Fine Arts	2,820	85.00	87.00	.98	56.97	44.06	1.29	1.31	11.35
Natural Science	2,820	44.20	32.80	1.35	50.57	55.62	.91	16.31	4.21
Total Social Studies	2,814	193.50	172.50	1.12	33.20	30.98	1.07	6.38	3.52
Total Score	2,822	95.60	81.00	1.18	37.91	36.86	1.03	9.14	1.38
1930 College Sophomores									
Total Common Subjects	2,094	166.00	143.00	1.16	28.44	26.99	1.05	7.12	2.34
Total General Culture	2,094	102.00	86.30	1.18	34.46	33.35	1.03	7.97	1.54
Otis Intelligence	2,094	9.84	9.66	1.01	17.25	17.48	.99	.88	.62
Fine Arts	2,094	4.66	4.37	1.07	42.56	36.71	1.16	3.09	8.60
Literary Acquaintance	2,094	4.60	4.72	.97	32.44	31.66	1.03	1.24	1.07
General Science	2,094	6.14	5.25	1.17	28.48	35.59	.80	7.75	10.16
History and Social Studies	2,094	4.00	7.32	.55	48.75	51.40	.95	27.21	2.09
Mathematics	2,094	9.02	6.18	1.46	49.09	53.46	.92	17.64	3.31
Foreign Literature	2,094	5.52	5.12	1.08	45.96	43.32	1.06	3.27	2.40
Vocabulary	2,094	18.20	18.00	1.01	32.80	32.49	1.01	.53	.41
Total English	2,094	55.50	54.30	1.02	27.95	25.11	1.11	1.05	.48
1932 College Seniors									
Otis Intelligence	2,094	9.30	8.88	1.05	15.21	14.88	1.02	2.21	1.03
Foreign Literature	2,094	6.68	6.76	.99	46.13	43.10	1.07	.57	2.91
History and Social Studies	2,094	8.94	8.54	1.05	43.78	46.09	.95	2.22	2.22
Fine Arts	2,094	5.38	5.06	1.06	42.30	34.92	1.21	2.91	8.02
General Science	2,094	8.28	5.78	1.43	33.93	35.14	.97	22.72	1.51
Mathematics	2,094	9.38	7.22	1.30	49.95	61.29	.82	12.71	7.61
Vocabulary	2,094	17.85	17.60	1.01	28.80	28.24	1.02	.68	.88
Common Subjects	2,094	182.60	173.40	1.05	27.75	28.10	.99	2.48	.56
Total English	2,094	61.50	56.70	1.09	28.21	23.50	1.20	3.90	8.26
Total General Culture	2,094	57.20	108.20	.53	16.35	34.28	.48	28.33	29.39
Literary Acquaintance	2,094	5.00	5.34	.94	32.34	31.23	1.04	3.09	1.54
University of Pittsburgh Freshmen									
A.C.E. Intelligence	2,860	28.15	28.05	1.00	57.59	51.31	1.11	.20	5.11
Thorndike Intelligence	4,460	17.30	15.52	1.12	26.91	25.04	1.08	7.42	2.23
Systolic Blood Pressure	4,020	10.74	10.89	.99	8.33	9.85	.85	.92	10.86
Diastolic Blood Pressure	4,020	8.59	9.12	.94	11.39	13.08	.87	3.98	8.80
Pulse (Before Exercise)	6,540	13.99	12.30	1.14	16.74	13.99	1.20	11.19	15.28
Pulse (After Exercise)	6,540	19.00	16.25	1.17	17.58	13.74	1.28	13.22	20.21
Height	7,088	2.79	2.47	1.13	4.07	3.89	1.05	10.67	3.60
Weight	7,230	19.79	18.25	1.08	14.09	15.22	.93	7.23	6.65

TABLE 23

Comparison of male and female high school seniors of the Pennsylvania study

Tests	Means			Medians		
	Males	Females	Ratio	Males	Females	Ratio
American History	71.65—.16	62.25—.16	1.15	71.41	58.31	1.24
Intelligence	49.45—.06	46.41—.06	1.07	49.47	46.23	1.07
French	114.53—.59	126.84—.58	.90	112.00	126.15	.89
Algebra	18.15—.09	13.11—.07	1.38	16.06	10.48	1.53
Total English	134.24—.21	137.59—.21	.98	131.30	133.75	.98

shown in Table 24. On all the comparisons the differences are significant according to the $\frac{D}{P.E. (diff.)}$'s.

The skewness of the distributions is

TABLE 24
Significance of differences between means of male and female high school students of Pennsylvania study

Tests	Means	
	Difference	$\frac{D}{P.E. (diff.)}$
American History	9.40—.23	40.87
Intelligence	3.04—.06	33.78
French	12.31—.83	14.83
Algebra	5.04—.11	45.88
Total English	3.35—.30	11.16

shown in Table 25. Positive skewness, it will be recalled, means that the scores are massed at the low end of the scale. Negative skewness means, of course, that the scores are massed at the high end of the scale. With this in mind, note in Table 25 that the positive skewness of four of the distributions of the female students exceeds that of the male students. That is, on four of the five comparisons the test scores of the female students show a greater tendency to be massed at the lower end of the scale. On the intelligence test the distribution of the scores of the male students shows

negative skewness, whereas that of the females indicates positive skewness.

The scores above which and below which the upper and lower 25 per cent of the groups scored are shown in Table 26. The lowest 25 per cent of the female students excelled the lowest 25 per cent of the male students on the French and English scores. Likewise, the highest 25 per cent of the female students excelled the highest 25 per cent of the male students on the same two tests. On three of the comparisons the male students exceeded the female students on both the upper and lower quartiles. However, the ratios of the upper quartiles indicated that, although the highest 25 per cent of the male students exceeds the highest 25 per cent of the female students on the algebra test, the difference between the upper quartiles for the two sexes on the algebra test is less than the difference between the lower quartiles on the same test. The same remark holds for the American history test, and to a lesser degree, for the intelligence test.

A comparison similar to the previous one is made in Table 27. In this case the highest and lowest 10 per cents of the distributions serve as the comparative basis.

An inspection of the ratios indicates that the differences noted between the highest and lowest 25 per cents of the

TABLE 25
Skewness of distributions of test scores of high school seniors of Pennsylvania study

Tests	Skewness		Greater Positive Skewness		Greater Negative Skewness	
	Males	Females	Males	Females	Males	Females
American History	-.028	-.470				
Intelligence	-.006	-.052				
French	-.103	-.044				
Algebra	-.533	-.774				
Total English	-.251	-.332				

TABLE 26
Comparison of male and female high school students
on the basis of upper and lower quartiles

Tests	Lower Quartiles (Q ₁)			Upper Quartiles (Q ₃)		
	Males	Females	Ratio	Males	Females	Ratio
American History	50.45	45.30	1.25	88.05	74.20	1.19
Intelligence	42.38	39.23	1.08	50.67	53.41	1.06
French	78.56	02.00	.85	147.41	159.94	.92
Algebra	8.74	5.18	1.60	25.05	18.98	1.35
Total English	110.14	113.85	.96	155.25	156.86	.99

TABLE 27
Highest and lowest 10 per cents of distribution of test scores
of male and female high school seniors

Tests	Lowest 10 Per Cent			Highest 10 Per Cent		
	Males	Females	Ratio	Males	Females	Ratio
American History	44.49	35.42	1.26	107.06	92.21	1.16
Intelligence	36.19	33.36	1.08	63.17	60.09	1.05
French	52.50	64.72	.81	178.45	187.86	.95
Algebra	4.63	.00	4.63	35.04	28.26	1.24
Total English	92.56	97.67	.95	179.23	181.30	.99

distributions of test scores for the two sexes are likewise to be found between the highest and lowest 10 per cents. However, a greater drop in the ratio between the algebra scores of the highest 10 per cents is apparent.

8. COMPARISON OF MALE AND FEMALE 1928 COLLEGE SENIORS OF THE PENNSYLVANIA STUDY ON THE BASIS OF MEASURES OF CENTRAL TENDENCY, SKEWNESS,

UPPER AND LOWER QUARTILES, AND HIGHEST AND LOWEST 10 PER CENTS OF THE DISTRIBUTIONS

In Table 28 the men and women students of the 1928 college seniors of the Pennsylvania Study are compared on the basis of two measures of central tendency, the median and the mean.

From the comparisons in Table 28, it is evident that only on the language,

TABLE 28
Comparison of men and women students of the 1928 college seniors
on two measures of central tendency

Tests	Medians			Means		
	Males	Females	Ratio	Males	Females	Ratio
Language, Literature, and Fine Arts	139.74	187.82	.74	149.19	107.58	.76
Natural Science	80.53	52.57	1.53	87.40	58.97	1.48
Total Score	560.80	536.30	1.05	582.75	556.85	1.05
Total Social Studies	243.56	207.62	1.17	252.18	219.74	1.15

literature, and fine arts tests were the measures of central tendency greater for the women students. The ratios of the natural science scores suggest that the men students exceeded the women students considerably so far as the central tendencies of the two groups are concerned.

In Table 29 the significance of the differences between the means is shown. It will be observed that in every instance

TABLE 29
Significance of the difference between the means of the 1928 college seniors of the Pennsylvania study

Tests	Difference Between Means	D.
		P.E. (Diff.)
Language, Literature, and Fine Arts	48.39—2.10	22.10
Natural Science	28.43— .99	28.72
Total Social Studies	32.44—2.26	14.35
Total Score	25.90—4.66	5.56

the critical ratio indicates that the difference is significant.

The skewness of the distributions is shown in Table 30. All four distributions are positively skewed, and in every case the positive skewness is greater in the distributions of the women students.

TABLE 30
Skewness of distributions of test scores of 1928 college seniors of Pennsylvania study

Tests	Skewness		Greater Positive Skewness		Greater Negative Skewness	
	Males	Females	Males	Females	Males	Females
Language, Literature, and Fine Arts	-.334	-.337				
Natural Science	-.466	-.585				
Total Social Studies	-.271	-.449				
Total Score	-.340	-.357				

The ratios in Table 31 show that the lowest 25 per cent of the women students excelled the lowest 25 per cent of the men students on the language, literature, and fine arts tests and on the total score. However, the highest 25 per cent of the men students excelled the highest 25 per cent of the women students on all the comparisons except the language, literature, and fine arts tests. The superiority of the upper quartile of the men students over the upper quartile of the women students is particularly marked on the natural science test.

In Table 32 it is evident that the same differences noted between the upper and lower quartiles of the men and women students are also found between the highest and lowest 10 per cents of the two groups.

9. COMPARISON OF MALE AND FEMALE COLLEGE SOPHOMORES OF THE PENNSYLVANIA STUDY ON THE BASIS OF MEASURES OF CENTRAL TENDENCY, SKEWNESS, UPPER AND LOWER QUANTILES, AND THE HIGHEST AND LOWEST 10 PER CENTS OF THE DISTRIBUTIONS

In Table 33, the 1930 college sophomores of the Pennsylvania Study are compared on the basis of the median scores of the men and women students.

TABLE 31
Comparison of men and women college seniors on
basis of upper and lower quartiles

Tests	Lower Quartiles (Q ₁)			Upper Quartiles (Q ₃)		
	Males	Females	Ratio	Males	Females	Ratio
Language, Literature, and Fine Arts	80.12	133.60	.60	197.66	253.14	.78
Natural Science	54.59	37.14	1.47	112.41	73.48	1.53
Total Social Studies	180.70	62.18	1.11	312.78	269.36	1.16
Total Score	406.90	432.05	.94	693.90	659.95	1.05

TABLE 32
Comparison of men and women college seniors of 1928 group
on basis of highest and lowest 10 per cents

Tests	Lowest 10 Per Cent			Highest 10 Per Cent		
	Males	Females	Ratio	Males	Females	Ratio
Language, Literature, and Fine Arts	60.86	91.88	.66	264.72	313.68	.84
Natural Science	36.70	24.89	1.47	148.21	98.45	1.51
Total Social Studies	138.58	125.00	1.11	379.62	326.50	1.16
Total Score	351.95	354.50	.99	842.25	792.00	1.06

TABLE 33
Median scores of the 1930 sophomores of the Pennsylvania study

Tests	Medians		
	Males	Females	Ratio
Total Common Subjects	576.52	516.40	1.12
Total General Culture	284.90	250.11	1.14
Otis Intelligence	58.07	56.90	1.02
Fine Arts	10.72	11.59	.92
Literary Acquaintance	14.03	14.73	.95
General Science	21.04	14.41	1.46
History and Social Studies	15.15	13.27	1.14
Mathematics	17.35	10.34	1.68
Foreign Literature	11.52	11.39	1.01
Vocabulary	54.76	55.29	.99
Total English	195.79	215.47	.91

An examination of the ratios indicates that the median score of the men exceeds that of the women in seven of the 11 comparisons. The difference is particularly marked on the general science and mathematics tests.

In Table 34 the means of the men and women students on these 11 tests offer a more reliable measure of the central tendencies of the two groups. On the fine arts, literary acquaintance, and the total English tests, the mean scores of

TABLE 34
Mean scores of the 1930 sophomores of the Pennsylvania study

Tests	Means		
	Males	Females	Ratio
Total Common Subjects	583.66—3.46	529.10—2.98	1.10
Total General Culture	295.97—2.13	258.77—1.80	1.14
Otis Intelligence	57.04— .21	56.27— .20	1.01
Fine Arts	10.95— .10	11.96— .00	.92
Literary Acquaintance	14.18— .10	14.91— .10	.95
General Science	21.56— .13	14.75— .11	1.46
History and Social Studies	16.41— .08	14.24— .15	1.15
Mathematics	18.58— .19	11.56— .13	1.61
Foreign Literature	12.01— .12	11.82— .11	1.02
Vocabulary	55.48— .38	55.40— .38	1.00
Total English	198.54—1.16	216.26—1.13	.92

the women students exceed those of the men. There is practically no difference on the vocabulary test.

The significance of the differences indicated in Table 34 is shown in Table 35. The differences between the means are significant on all the tests except on the total general culture, Otis Intelli-

100 (11, p. 135) that these differences are true ones.

In Table 36 it will be noted that only in the case of the Otis Intelligence Test is there evidence of negative skewness. That is, only in the case of the intelligence test is there a tendency for the scores to be massed at the upper end of

TABLE 35
Significance of the differences between the means of the 1930 college sophomores of the Pennsylvania study

Tests	Means	
	Difference	D. P.E. (diff.)
Total Common Subjects	54.56—4.57	11.04
Total General Culture	37.20—2.85	1.31
Otis Intelligence	.77— .29	2.06
Fine Arts	1.01— .13	7.77
Literary Acquaintance	.73— .14	5.21
General Science	6.81— .17	40.00
History and Social Studies	2.17— .17	12.76
Mathematics	7.02— .23	30.52
Foreign Literature	.19— .16	1.19
Vocabulary	.08— .55	1.45
Total English	17.72— 1.02	10.94

gence, foreign literature, and vocabulary tests. The $\frac{D.}{P.E. (diff.)}$'s of the differences

on these tests indicate that there are, respectively, 81, 96, 79, and 84 chances in

the scale. On six of the 10 remaining tests, the men students show greater positive skewness. In other words, on six of the 10 tests, the scores of the men students show a greater tendency to be massed at the lower end of the scale.

TABLE 36
Skewness of test score distributions of the 1930 college
sophomores of the Pennsylvania study

Tests	Skewness		Greater Positive Skewness		Greater Negative Skewness	
	Males	Females	Males	Females	Males	Females
Total Common Subjects	-.120	-.206				
Total General Culture	-.326	-.301	—			
Otis Intelligence	-.314	-.106			—	
Fine Arts	-.148	-.254				
Literary Acquaintance	-.098	-.114				
General Science	-.254	-.194	—			
History and Social Studies	-.954	-.398	—			
Mathematics	-.409	-.592		—		
Foreign Literature	-.266	-.252	—			
Vocabulary	-.110	-.018	—			
Total English	-.140	-.044	—			

In Table 37 the test scores of the two sexes may be compared on the basis of the upper and lower quartiles. The ratios indicate that on the fine arts, literary acquaintance, and total English tests, the lower quartile was higher for the girls. On the vocabulary and foreign literature tests there was very little difference. On the Otis Intelligence Test there was no difference according to the ratio. However, the lower quartiles of the men students exceed those of the women students considerably on the general science and mathematics tests.

Practically the same general remarks

made concerning the lower quartiles of the two sexes on these tests can be repeated for the upper quartiles. The upper quartile of the men students, however, exceeds that of the women students on the intelligence test.

In Table 38 the two groups are further compared on the basis of the scores made by the lowest and highest 10 per cents on the same battery of tests.

We find that the lowest 10 per cent of the women students scored higher than the men students on the fine arts, literary acquaintance, foreign literature, and total English tests but scored the same

TABLE 37
Upper and lower quartiles of test scores of the 1930 college
sophomores of the Pennsylvania study

Tests	Lower Quartiles (Q ₁)			Upper Quartiles (Q ₃)		
	Males	Females	Ratio	Males	Females	Ratio
Total Common Subjects	466.28	430.46	1.08	686.97	620.63	1.11
Total General Culture	229.25	198.66	1.15	353.94	308.64	1.15
Otis Intelligence	49.85	49.06	1.00	64.98	63.55	1.02
Fine Arts	7.76	8.85	.88	13.69	14.78	.93
Literary Acquaintance	11.00	11.58	.95	17.11	17.06	.95
General Science	16.17	11.07	1.46	26.75	17.93	1.49
History and Social Studies	10.81	9.00	1.09	20.79	19.64	1.06
Mathematics	11.57	7.09	1.63	25.07	14.87	1.69
Foreign Literature	8.31	8.15	1.02	15.20	14.79	1.03
Vocabulary	42.11	41.51	1.01	69.32	66.80	1.01
Total English	159.63	179.08	.89	235.80	253.22	.93

TABLE 38
Upper and lower 10 per cents of test scores of the 1930
college sophomores of the Pennsylvania study

Tests	Lower 10 Per Cents			Upper 10 Per Cents		
	Males	Females	Ratio	Males	Females	Ratio
Total Common Subjects	375.80	357.20	1.05	806.40	722.40	1.12
Total General Culture	173.50	156.30	1.11	425.40	370.00	1.15
Otis Intelligence	44.08	43.04	1.02	60.36	68.90	1.01
Fine Arts	5.24	6.62	.79	16.74	17.64	.95
Literary Acquaintance	8.38	8.86	.95	20.22	21.22	.95
General Science	12.22	8.36	1.46	31.50	21.66	1.45
History and Social Studies	7.52	6.72	1.12	27.12	25.26	1.07
Mathematics	7.46	4.70	1.59	32.00	20.00	1.60
Foreign Literature	5.08	5.62	.90	16.18	18.56	1.03
Vocabulary	31.70	31.70	1.00	80.75	80.40	1.00
Total English	128.30	144.80	.89	274.20	290.00	.95

as the men students on the vocabulary test.

As for the highest 10 per cent of the women students, we find them excelling the highest 10 per cent of the men students on the same tests on which they excelled in the previous comparison. Again we note that the men students excel considerably on the general science and mathematics tests.

10. COMPARISON OF 1932 MALE AND FEMALE COLLEGE SENIORS OF THE PENNSYLVANIA STUDY ON THE BASIS OF MEASURES OF CENTRAL TENDENCY, SKEWNESS, UPPER AND LOWER QUAR-

TILES, AND THE HIGHEST AND LOWEST 10 PER CENTS OF THE DISTRIBUTIONS

The difference in central tendencies observed between the 1930 college sophomore men and women in Tables 33 and 34 are also evident when the ratios of the central tendencies of the 1932 senior men and women are examined in Table 39. That is to say, the central tendencies of the senior women exceed those of the senior men on the fine arts, vocabulary, English, and literary acquaintance tests. In addition to the tests just enumerated, the senior women also exceed the senior men on the foreign literature test in

TABLE 39
Mean and median scores of the 1932 college seniors
of the Pennsylvania study

Tests	Medians			Means		
	Males	Females	Ratio	Males	Females	Ratio
Otis Intelligence	62.64	60.64	1.04	61.13	59.69	1.02
Foreign Literature	13.63	15.03	.91	14.44	15.66	.92
History and Social Studies	19.18	17.61	1.09	20.42	18.53	1.10
Fine Arts	12.17	14.12	.86	12.72	14.40	.88
General Science	23.84	15.96	1.49	24.40	16.45	1.48
Mathematics	17.52	8.77	2.00	18.78	11.78	1.59
Vocabulary	61.77	63.09	.98	61.98	62.32	.99
Total Common Subjects	653.42	606.98	1.08	658.00	617.02	1.07
Total English	217.85	243.63	.89	217.00	241.27	.90
Total General Culture	338.40	308.03	1.10	340.76	315.60	1.11
Literary Acquaintance	15.36	16.95	.91	15.46	17.10	.90

central tendency. The marked superiority shown by the men sophomores on the general science and mathematics tests was exhibited also by the senior men. The ratio of the means of the two sexes of the senior group on the mathematics test, however, is considerably greater than the ratio of the means of the men and women sophomores on the same test. It would seem that so far as the averages of the groups are concerned, the senior men excelled the senior women on the

The significance of the differences between the means of the senior men and women of this group is shown in Table 40. It will be observed that there is a significant difference between the means of the two sexes on 10 of the 11 comparisons. There are 67 chances in 100 (11, p. 135) that the difference between the means on the vocabulary test is a significant one.

In Table 41 the skewness of the distributions of test scores may be seen. On

TABLE 40
Significance of difference between the means of the senior men and women of the 1932 group of the Pennsylvania study

Tests	Means	
	Difference	D. P.E. (diff.)
Otis Intelligence	1.44— .27	5.33
Foreign Literature	1.22— .20	6.10
History and Social Studies	1.89— .26	7.27
Fine Arts	1.77— .16	11.06
General Science	7.95— .21	37.85
Mathematics	7.00— .25	28.00
Vocabulary	.34— .52	.65
Total Common Subjects	40.98—5.26	7.70
Total English	23.28—1.74	13.38
Total General Culture	34.16—2.55	13.40
Literary Acquaintance	1.64— .16	10.25

mathematics tests more than the sophomore men excelled the sophomore women. Undoubtedly, at least part of this difference between the mean scores of the men and women students is to be attributed to the fact that women taking the liberal arts course in college take fewer courses in mathematics than do men. The same is true of the science. Hence, since all students were required to take all parts of the comprehensive examination, those omitting from their schedules courses in certain fields would necessarily be penalized on parts of the examination relating to those omitted fields.

the vocabulary and English tests the scores of the women students are massed at the high end of the scale. On the Otis Intelligence Test, the distributions of both men and women students are negatively skewed. However, the scores of the men students are skewed negatively to a greater degree than are the scores of the women students. On the eight remaining comparisons, in four instances the scores of the women show greater positive skewness, and in four instances the scores of the men students show greater positive skewness.

The senior men and women students of the 1932 group of the Pennsylvania

TABLE 41
Skewness of test scores of the 1932 college seniors
of the Pennsylvania study

Tests	Skewness		Greater Positive Skewness		Greater Negative Skewness	
	Males	Females	Males	Females	Males	Females
Otis Intelligence	-.487	-.247	—	—	—	—
Foreign Literature	-.364	-.280	—	—	—	—
History and Social Studies	-.416	-.323	—	—	—	—
Fine Arts	-.307	-.210	—	—	—	—
General Science	-.203	-.254	—	—	—	—
Mathematics	-.397	-1.251	—	—	—	—
Vocabulary	-.035	-.131	—	—	—	—
Total Common Subjects	-.075	-.174	—	—	—	—
Total English	-.007	-.125	—	—	—	—
Total General Culture	-.596	-.210	—	—	—	—
Literary Acquaintance	-.060	-.084	—	—	—	—

Study are compared in Table 42 on the basis of the upper and lower quartiles. On both the upper and lower quartiles we find practically the same differences observed in Table 37 in the case of the college sophomores. In other words, we find the senior women excelling the senior men on the fine arts, English, and literary acquaintance tests and equalling them on the vocabulary test. However, in this instance, the senior women also excel the senior men on the foreign literature test. As in the sophomore group we find the ratios indicating that the

upper and lower quartiles of the men on the intelligence test exceed those of the women to a slight degree. We also find the senior men exceeding considerably on the general science and mathematics. Again it might be well to recall here that at least part of this difference may be attributed to the fact that fewer women include mathematics and science courses in their schedules. It is also to be noted that the differences shown between the sexes on the verbal tests are probably due to some degree to the fact that more women are apt to be enrolled in those

TABLE 42
Comparison of the 1932 senior men and senior women of the Pennsylvania
study on the basis of upper and lower quartiles

Tests	Lower Quartiles (Q_1)			Upper Quartiles (Q_3)		
	Males	Females	Ratio	Males	Females	Ratio
Otis Intelligence	55.24	54.11	1.02	68.30	66.54	1.03
Foreign Literature	9.97	10.90	.91	17.50	19.77	.80
History and Social Studies	14.04	12.11	1.16	25.44	23.55	1.08
Fine Arts	9.03	10.72	.84	15.94	17.75	.90
General Science	18.17	12.47	1.46	30.28	19.76	1.53
Mathematics	10.18	6.79	1.50	25.61	14.61	1.75
Vocabulary	49.43	49.21	1.00	76.12	75.23	1.01
Total Common Subjects	521.36	492.76	1.06	776.10	710.06	1.08
Total English	177.41	203.60	.87	257.76	280.34	.92
Total General Culture	267.22	237.74	1.12	410.04	277.86	1.51
Literary Acquaintance	12.29	13.60	.90	18.57	20.38	.91

courses more predominantly verbal in nature.

In Table 43 the highest and lowest 10 per cents of the two sexes are the basis of comparison. It will be observed that the same differences noted in Table 42 when the upper and lower quartiles served as bases of comparison are like-

A. C. E. (American Council on Education) and Thorndike Intelligence Tests are shown in Table 44. Note that on the A. C. E. the central tendencies for the females are higher in both instances. The reverse is found to be true on the Thorndike Intelligence Test.

In Table 45 the difference between

TABLE 43
Comparison of senior men and women on the basis of
the highest and lowest 10 per cents

Tests	Lowest 10 Per Cent			Highest 10 Per Cent		
	Males	Females	Ratio	Males	Females	Ratio
Otis Intelligence	48.34	47.20	1.02	71.96	70.74	1.02
Foreign Literature	7.06	7.36	.96	22.94	24.65	.93
History and Social Studies	10.00	8.41	1.19	32.80	29.82	1.10
Fine Arts	6.27	7.76	.81	19.70	21.83	.90
General Science	13.82	9.48	1.46	36.59	23.98	1.52
Mathematics	7.08	4.49	1.58	32.75	22.21	1.47
Vocabulary	38.00	38.72	.98	86.04	85.75	1.00
Total Common Subjects	428.22	404.84	1.06	897.16	850.00	1.06
Total English	143.14	164.66	.87	294.62	314.65	.94
Total General Culture	212.10	185.21	1.15	501.68	459.34	1.09
Literary Acquaintance	8.91	10.28	.87	21.90	24.21	.90

wise to be found when the highest and lowest 10 per cents of the distributions serve as the bases of comparison.

11. COMPARISON OF (1924-1934) MALE AND FEMALE UNIVERSITY FRESHMEN ON THE BASIS OF MEASURES OF CENTRAL TENDENCY, SKEWNESS, UPPER AND LOWER QUARTILES, AND THE LOWEST AND HIGHEST 10 PER CENTS OF DISTRIBUTIONS

The central tendencies of the scores of University of Pittsburgh freshmen on the

the means and the significance of the differences may be observed. In both comparisons the differences shown are significant differences.

The skewness of the distributions of the scores of the male and female students on the A. C. E. and Thorndike tests is shown in Table 46.

The scores of the female students on the A. C. E., it will be noted, are massed at the high end of the scale, while the scores of the males are massed at the low

TABLE 44
Central tendencies of scores of University of Pittsburgh
freshmen on A.C.E. and Thorndike Intelligence Tests

Tests	Medians			Means		
	Males	Females	Ratio	Males	Females	Ratio
A.C.E.	47.04	56.91	.83	48.88	54.68	.89
Thorndike	64.55	63.74	1.01	64.30	61.96	1.04

TABLE 45
Significance of differences between means of University of Pittsburgh freshmen on A.C.E. and Thorndike tests

Tests	Means		Difference	D. P.E. (diff.)
	Males	Females		
A.C.E.	48.88	54.68	5.80 - .71	8.17
Thorndike	64.30	61.96	2.34 - .33	71.09

end. On the Thorndike the measures of skewness shown in Table 46 indicate a normal distribution for the females and negative skewness for the males. The females, it would seem, excel on the A. C. E., whereas the males excel on the

TABLE 46

Skewness of scores of University of Pittsburgh freshmen on A.C.E. and Thorndike Intelligence Tests

Tests	Skewness	
	Males	Females
A.C.E.	-.196	-.240
Thorndike	-.045	.000

Thorndike. However, the females seem to excel the males on the A. C. E. a little more than the males excel the females on the Thorndike.

In Table 47 the two groups are compared on the basis of the upper and lower quartiles on the same two tests. Again we find the females excelling on the A. C. E. while the males excel on the Thorndike. Again we find that the fe-

males seem to excel the males more on both the upper and lower quartiles on the A. C. E. than the males exceed the females on the upper and lower quartiles of the scores on the Thorndike.

Table 48 affords still another comparison. The same general differences observable between the upper and lower quartiles of the scores of the two sexes on the A. C. E. and Thorndike tests are found when the groups are compared on the basis of the highest and lowest 10 per cents. However, in the latter comparison it will be noted that the lowest 10 per cent of the females is slightly higher than the lowest 10 per cent of the males. In other words, when the males and females are compared on the basis of the highest and lowest 10 per cents, the females excel in three of the four comparisons.

In general, it would seem that if there are any differences in superiority between the two groups when compared on these two intelligence tests, these differences favor the females rather than the males.

TABLE 47
Comparison of University of Pittsburgh freshmen on basis of upper and lower quartiles on A.C.E. and Thorndike tests

Tests	Lower Quartiles (Q ₁)			Upper Quartiles (Q ₃)		
	Males	Females	Ratio	Males	Females	Ratio
A.C.E.	24.87	32.61	.76	72.45	79.20	.91
Thorndike	52.88	51.05	1.04	70.45	72.45	1.06

TABLE 48

Comparison of University of Pittsburgh freshmen on basis of highest and lowest 10 per cents on A.C.E. and Thorndike Intelligence Tests

Tests	Lowest 10 Per Cent			Highest 10 Per Cent		
	Males	Females	Ratio	Males	Females	Ratio
A.C.E.	10.60	13.74	.77	89.11	92.44	.96
Thorndike	40.90	41.80	.98	86.92	82.16	1.06

12. A STATISTICAL RECAPITULATION OF THE FINDINGS DETAILED UNDER SECTIONS 7, 8, 9, 10, AND 11 IS GIVEN IN TABLE 49

In Section 11 the comparisons of the University of Pittsburgh Freshmen on the basis of physical and physiological measurements was omitted. Otherwise, the data utilized here in Sections 7, 8, 9, 10, and 11 were identical with those

utilized in the comparisons made in Sections 1, 2, 3, 4, 5, and 6 of this report.

When the various comparisons made on the basis of central tendencies are examined in Table 49, the following observations seem to be indicated:

- (a) The two measures of central tendency used here, that is, the mean and the median, are in close agree-

TABLE 49

Summary of sex differences other than variability at the fourth-year high school and college levels

Tests	Total Males and Females	Medians			Means			Critical Ratio of Means	Skewness	
		Males	Females	Ratio	Males	Females	Ratio		Males	Females
High School										
American History	23,040	71.41	58.31	1.24	71.65	62.25	1.24	40.87	-.028	-.470
Intelligence	24,766	49.47	46.23	1.07	49.45	46.41	1.07	33.78	-.006	-.052
French	5,866	112.90	126.15	.89	114.53	126.84	.89	14.83	-.103	-.044
Algebra	17,398	16.06	10.48	1.53	18.15	13.11	1.53	45.88	-.533	-.774
Total English	24,568	131.30	133.75	.98	134.24	137.59	.98	11.16	-.251	-.332
1928 College Seniors										
Language, Literature, and Fine Arts	2,820	139.74	187.82	.74	149.19	197.58	.76	22.10	-.334	-.337
Natural Science	2,820	80.53	52.57	1.53	87.40	58.97	1.48	28.72	-.466	-.585
Total Social Studies	2,814	560.80	536.30	1.05	582.75	556.85	1.05	5.56	-.340	-.357
Total Score	2,822	243.56	207.62	1.17	252.74	219.74	1.15	14.35	-.271	-.449
1930 College Sophomores										
Total Common Subjects	2,094	576.52	516.40	1.12	583.66	529.10	1.10	11.94	-.129	-.266
Total General Culture	2,094	284.90	250.11	1.14	295.97	258.77	1.14	1.31	-.326	-.301
Otis Intelligence	2,094	58.07	56.90	1.02	57.04	56.27	1.01	2.66	-.314	-.196
Fine Arts	2,094	10.72	11.59	.92	10.95	11.96	.92	7.77	-.148	-.254
Literary Acquaintance	2,094	14.03	14.73	.95	14.18	14.91	.95	5.21	-.098	-.114
General Science	2,094	21.04	14.41	1.46	21.56	14.75	1.46	40.06	-.254	-.194
History and Social Studies	2,094	15.15	13.27	1.14	16.41	14.24	1.15	12.76	-.954	-.398
Mathematics	2,094	17.35	10.34	1.68	18.58	11.56	1.61	30.52	-.409	-.592
Foreign Literature	2,094	11.52	11.39	1.01	12.01	11.82	1.02	1.19	-.266	-.252
Vocabulary	2,094	54.76	55.29	.99	55.48	55.40	1.00	1.45	-.119	-.018
Total English	2,094	195.79	215.47	.91	198.26	216.26	.92	10.94	-.149	-.044
1932 College Seniors										
Otis Intelligence	2,094	62.64	60.64	1.04	61.13	59.69	1.02	5.33	-.487	-.247
Foreign Literature	2,094	13.63	15.03	.91	14.44	15.66	.92	6.10	-.280	-.280
History and Social Studies	2,094	19.18	17.61	1.09	20.42	18.53	1.10	7.27	-.323	-.323
Fine Arts	2,094	12.17	14.12	.86	12.72	14.49	.88	11.06	-.219	-.219
General Science	2,094	23.84	15.96	1.49	24.40	16.45	1.48	37.85	-.254	-.254
Mathematics	2,094	17.52	8.77	2.00	18.78	11.78	1.59	28.00	-1.251	-1.251
Vocabulary	2,094	61.77	63.09	.98	61.98	62.32	.99	.65	-.131	-.131
Common Subjects	2,094	653.42	606.98	1.08	658.00	617.02	1.07	7.79	-.174	-.174
Total English	2,094	217.85	243.63	.89	217.99	241.27	.90	13.38	-.125	-.125
Total General Culture	2,094	338.40	308.03	1.10	349.76	315.60	1.11	13.40	-.210	-.210
Literary Acquaintance	2,094	15.36	16.95	.91	15.46	17.10	.90	10.25	-.084	-.084
University of Pittsburgh Freshmen										
A.C.E. Intelligence	2,860	47.04	56.91	.83	48.88	54.68	.89	8.17	-.196	-.240
Thorndike Intelligence	4,460	64.55	63.74	1.01	64.30	61.96	1.04	71.09	-.045	-.000

ment. The single outstanding exception is the difference between the mean and the median of the 1932 college seniors on the mathematics test. However, although there is a considerable difference in this case, in both instances the central tendency of the male students exceeds appreciably that of the females; that is, the measures are in agreement with respect to the direction in which the difference lies. Comparisons summarized here with respect to the mean, then, are likely to be equally apt when the median serves as the basis of comparison.

(b) A further examination of the

means shows that in 12 of the 33 comparisons the average for the female students exceeds the average for the male students. In 16 instances the average for the male students of this group exceeds the average for the female students. In five instances the averages for the sexes are practically equal. An examination of the critical ratios shows that all but five of the differences noted above are significant differences. In one of the 16 instances in which the means of the males exceed the means of the females, in one of the 12 instances in which the means of the females exceed those of the males, and in

TABLE 49 (Continued)

Lower Quartiles			Upper Quartiles			Lowest 10 Per Cent			Highest 10 Per Cent		
Males	Females	Ratio	Males	Females	Ratio	Males	Females	Ratio	Males	Females	Ratio
56.45	45.30	1.25	88.65	74.20	1.19	44.49	35.42	1.26	107.06	92.21	1.16
42.38	39.23	1.08	56.67	53.41	1.06	36.19	33.36	1.08	63.17	60.09	1.05
78.56	92.90	.85	147.41	159.94	.92	52.50	64.72	.81	178.45	187.86	.95
8.74	5.18	1.69	25.65	18.98	1.35	4.63	0.00	4.63	35.04	28.26	1.24
110.14	113.85	.96	155.25	156.86	.99	92.56	97.67	.95	179.23	181.30	.99
80.12	133.60	.60	197.66	253.14	.78	60.86	91.88	.66	264.72	313.68	.84
54.59	37.14	1.47	112.41	73.48	1.53	36.70	24.89	1.47	148.21	98.45	1.51
406.90	432.05	.94	693.90	659.95	1.05	351.95	354.50	.99	842.25	792.60	1.06
180.70	62.18	1.11	312.78	269.36	1.16	138.58	125.00	1.11	279.62	526.50	1.16
466.28	430.46	1.08	686.97	620.63	1.11	375.80	357.20	1.05	806.40	722.40	1.12
229.25	198.66	1.15	353.94	308.64	1.15	173.50	156.30	1.11	425.40	370.00	1.15
49.85	49.96	1.00	64.98	63.55	1.02	44.08	43.04	1.02	69.36	68.90	1.01
7.76	8.85	.88	13.69	14.78	.93	5.24	6.62	.79	16.74	17.64	.95
11.00	11.58	.95	17.11	17.96	.95	6.38	8.86	.95	20.22	21.22	.95
16.17	11.07	1.46	26.75	17.93	1.49	12.22	8.36	1.46	31.50	21.66	1.45
10.81	9.90	1.09	20.79	19.64	1.06	7.52	6.72	1.12	27.12	25.26	1.07
11.57	7.09	1.63	25.07	14.87	1.69	7.46	4.70	1.59	32.00	20.00	1.60
8.31	8.15	1.02	15.20	14.79	1.03	5.08	5.62	.90	19.18	18.56	1.03
42.11	41.51	1.01	69.32	68.80	1.01	31.70	31.70	1.00	80.75	80.40	1.00
159.63	179.08	.89	235.80	253.22	.93	128.30	144.80	.89	274.20	290.00	.95
55.24	54.11	1.02	68.39	66.54	1.03	48.34	47.26	1.02	71.96	70.74	1.02
9.97	10.90	.91	17.56	19.77	.89	7.06	7.36	.96	22.94	24.65	.93
14.04	12.11	1.16	25.44	23.55	1.08	10.00	8.41	1.19	32.80	29.82	1.10
9.03	10.72	.84	15.91	17.75	.90	6.27	7.76	.81	19.70	21.83	.90
18.17	12.47	1.46	30.28	19.76	1.53	13.82	9.48	1.46	36.59	23.98	1.52
10.18	6.79	1.50	25.61	14.61	1.75	7.08	4.49	1.58	32.75	22.21	1.47
49.43	49.21	1.00	76.12	75.23	1.01	38.00	38.72	.98	86.04	85.75	1.00
521.36	492.76	1.06	776.10	719.06	1.08	428.22	404.84	1.06	897.16	850.00	1.06
177.41	203.60	.87	257.76	280.34	.92	143.14	164.66	.87	294.62	314.65	.94
267.22	237.74	1.12	419.04	277.86	1.51	212.10	185.21	1.15	501.68	459.34	1.09
12.29	13.60	.90	18.57	20.38	.91	8.91	10.28	.87	21.90	24.21	.90
24.87	32.61	.76	72.45	79.20	.91	10.60	13.74	.77	89.11	92.14	.96
52.88	51.05	1.04	76.45	72.45	1.06	40.90	41.80	.98	86.92	82.16	1.06

three of the five instances in which the means for the sexes seem to be about equal, the differences indicated were not significant.

- (c) Five comparisons of the sexes on the basis of intelligence tests were made. In two instances the mean scores of the males exceeded the mean scores of the females. In one instance the mean score of the females exceeded that of the males. In two instances there was practically no difference between the mean scores for the two sexes. On the A. C. E. Intelligence Test the mean for the females exceeds that of the males by 11 per cent. On no comparison did the mean of the males exceed that of the females to such an extent. The critical ratios indicate that the differences are significant with the exception of one of the two instances in which the means of the sexes were practically equal.
- (d) On all three of the science tests, the males excelled the females to the extent of from 46 to 48 per cent.
- (e) On all three of the mathematics tests, the means of the males very appreciably excelled those of the females. All the differences were significant.
- (f) Those tests predominantly verbal in nature were grouped for comparison. The literary acquaintance, the foreign literature, the language, literature and fine arts, the vocabulary, the fine arts, the French and English tests were included in this group. In no instance did the mean scores of the males exceed the mean scores of the females. In 10 cases the mean scores of the females exceeded

those of the males, all the differences being significant. In three cases the means for the two sexes were found to be practically equal; none of these differences were found to be significant. On both of the vocabulary tests the ratios of the means indicate practically no difference between the sexes, the ratios being .99 and 1.00.

- (g) Four comparisons were afforded on history and social studies tests. In three instances the means of the male students exceed those for the females, all of the differences being significant ones. On the fourth comparison there was not much difference between the means for the sexes.

The various comparisons made in Table 49 on the basis of skewness seem to indicate:

- (a) On only four of the items did the scores of the male students show negative skewness; that is, in four instances the scores were massed at the high end of the scale. In every case it is on the intelligence tests that this negative skewness is to be found.
- (b) In five instances the distributions of the female students exhibited negative skewness, and in one instance (on the Thorndike Intelligence Test) the scores showed a normal distribution. On three of the intelligence tests, on one vocabulary test, and on one total English test was the negative skewness of the female students to be found.

The various comparisons shown in Table 49 comparing the sexes on the basis of the lower quartiles and the lowest 10 per cents suggest:

- (a) These groups are all in fairly close

agreement with two exceptions. On the foreign literature test of the 1930 sophomores, the lowest 25 per cent of the males slightly exceeds the lowest 25 per cent of the females, whereas the lowest 10 per cent of the females slightly exceeds the lowest 10 per cent of the males. On the algebra test at the high school level, the ratio of the lowest 10 per cent of the males to females is approximately three times the ratio of the lower 25 per cent of the males to females. However, in general, conclusions drawn with respect to the ratios of the lowest 10 per cent of the males to females likewise hold true in comparing the sexes on the basis of the lowest quartiles.

- (b) Comparing the sexes on the basis of the ratios of the lowest 10 per cent of the distributions, then, we find that in 15 instances the males excel the females, in 12 instances the females excel the males, and in six instances the ratios indicate that the scores for the two groups are practically equal.
- (c) The ratios of the scores for the lowest 10 per cent of the distributions of the intelligence tests show that in one instance the males excel the females, in one case the females excel the males, and in three of the comparisons the scores are practically the same.
- (d) On the mathematics and science tests the lowest 10 per cent of the males excelled the lowest 10 per cent of the females. Likewise the males are found to excel on the history and social studies tests except in the case of the 1928 college seniors.
- (e) The lowest 10 per cent of the fe-

male students excelled the lowest 10 per cent of the male students on those tests predominantly verbal in nature.

Comparisons of the sexes on the basis of the upper quartiles and the highest 10 per cents is indicated in Table 49.

- (a) These statistical measures are in close agreement in 28 of the 33 items of comparison. There are several instances, however, in which there is a noticeable drop in the ratios of the upper 10 per cent as compared with the ratios of the upper 25 per cent. This is found to be true on the high school algebra test, the 1930 sophomore mathematics test, and on the total general culture test of the 1932 college senior group. In each of the cases just named the males excelled the females when compared on the basis of the upper quartiles much more than when the sexes were compared on the basis of the highest 10 per cent.
- (b) When the sexes are compared on the basis of the highest 10 per cent, in 17 instances the males excelled the females, in 10 instances the females excelled the males, and in six instances the sexes were practically equal. When the sexes are compared on the basis of the upper quartiles, in 17 instances the males excel the females, in 11 instances the females excel the males, and in five instances there is practically no difference.
- (c) In general, the males were outstandingly superior on the mathematics and science tests when compared with the females on the basis of the upper quartiles and the highest 10 per cent.
- (d) Using the same statistical meas-

ures as the basis of comparison, the females excelled the males in practically every instance on the more verbal tests. However, the female students did not excel the male students on the verbal tests to the same extent that the males excelled the females on the science and mathematics tests.

- (c) When the upper quartiles and the highest 10 per cent of the scores of the males and females on the intelligence tests are compared, in two instances the males slightly excel the females, in one instance the females slightly excel the males, and in two instances there is little difference between the sexes.

SUMMARY AND CONCLUSIONS

FOR THE populations studied and with the measurements employed in the present report, certain statistically reliable sex differences were found:

- (1) The *high school males* were found to be more *absolutely* variable in the algebra test.
- (2) The *high school females* gave evidence of greater *relative* variability on the American history, intelligence, and algebra tests.
- (3) Greater *absolute* variability for *college males* was indicated for 1928 seniors on the natural science test; 1930 sophomores on the fine arts test; 1932 seniors on the history and social studies and total English tests; 1924-1934 University of Pittsburgh freshmen on the A. C. E. Intelligence Test and on pulse rate both before and after exercise.
- (4) Greater *absolute* variability for *college females* was indicated for the 1928 seniors on the language, literature, and fine arts test; 1932 seniors on the total general culture test; 1924-1934 University of Pittsburgh freshmen for systolic and diastolic blood pressure.
- (5) Greater *relative* variability for *college males* was found for 1928 seniors on the language, literature, and fine arts test; 1930 seniors on the fine arts test; 1932 seniors on the history and social studies test and on the total English test; 1924-1934 University of Pittsburgh freshmen on the A. C. E. Intelligence Test and on pulse rate before and after exercise.
- (6) Greater *relative* variability for *college females* seemed indicated for 1928 seniors on the natural science test; 1930 sophomores on the general science test; 1932 college seniors for the mathematics and total general culture tests; 1924-1934 University of Pittsburgh freshmen for systolic and diastolic blood pressure.
- (7) When the scores of the high school and college females were compared on the basis of the measures of central tendency, skewness, upper and lower quartiles, and upper and lower 10 per cents the following observations seemed to be indicated:
 - (a) When the number of items on which one or the other sex excels is considered, neither seemed to be superior.
 - (b) When the *kind* of items on which one or the other sex excels is considered, males seemed to excel particularly on the mathematics and science tests, whereas females seemed to excel on more purely verbal tests such as literary acquaintance, fine arts, etc.

The data utilized herein were obtained from two sources. The first and main source constituted test scores obtained by the Carnegie Foundation for the Advancement in Teaching in cooperation with the Joint Commission of the Association of Pennsylvania College Presidents and the State Department of Public Instruction in an extensive testing program conducted in a number of Pennsylvania high schools and in 49 Pennsylvania colleges. The second source of data obtained from intelligence test scores as well as physical and physiological measurements of the freshmen enrolled at the University of Pittsburgh

from the 1924-25 academic year to the 1934-35 academic year. From these sources 39 different items of comparison were made possible on groups numbering from 1,047 to 12,383 *each* of males and females. Only five of the items of comparison were at the high school level, the remaining 34 being at the college level.

It is recognized that the *selectivity of groups at these higher educational levels is a factor which definitely limits the extent to which generalizations can be evolved from this study. It should be noted further that, in addition to this factor, there exists the further limiting factor of differential selectivity for the sexes.* Initially, more test scores were available for college males than for college females, necessitating adjustments in the number of test scores on females utilized for each comparison. This means that, at the time these various measurements were made (1928-1935), more men than women were enrolled in the colleges included in the Pennsylvania Study and in the University of Pittsburgh.

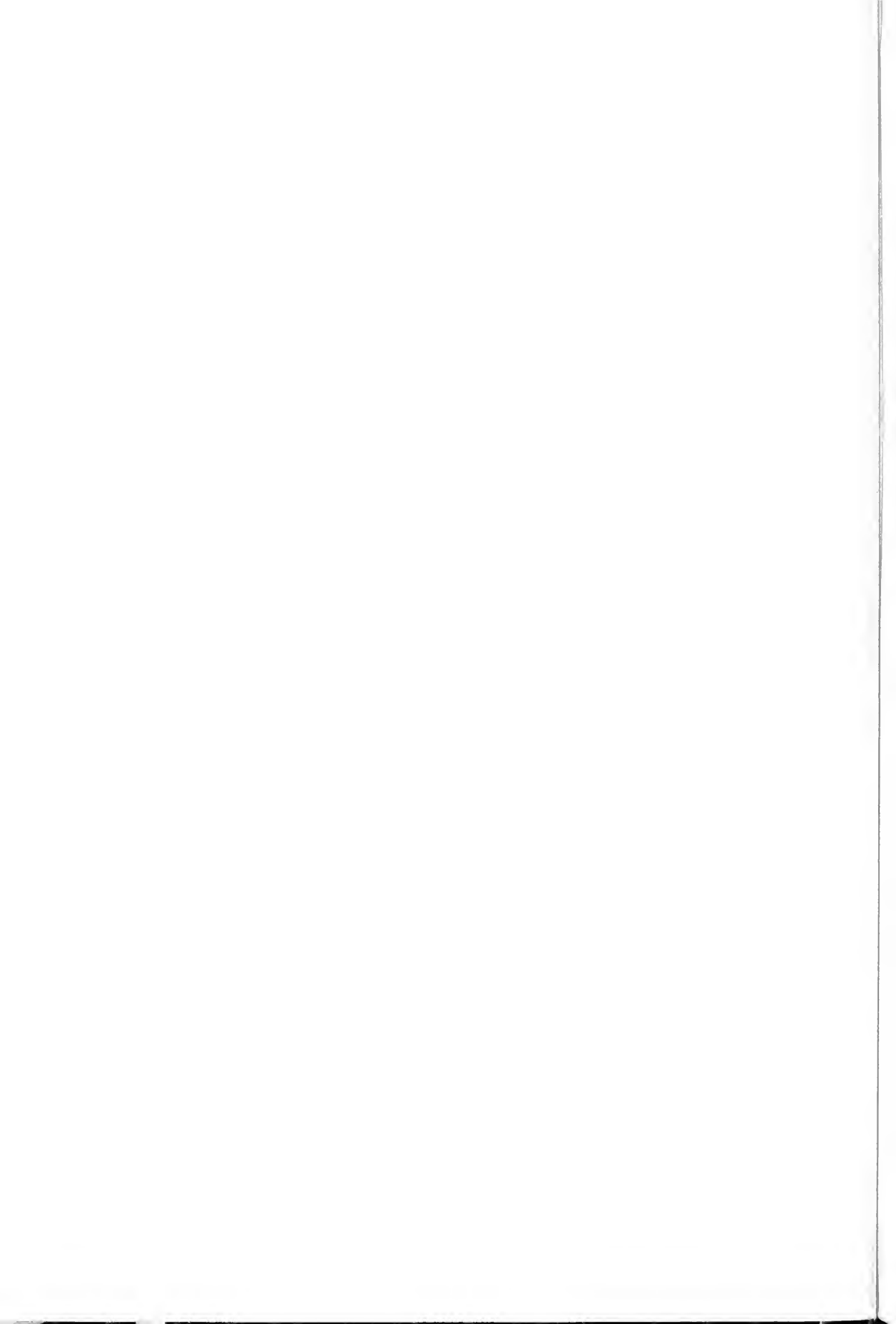
The *why* of this differential selectivity is merely speculative. It could possibly, but not probably, have been due to the fact that more males showed intellectual promise and hence were encouraged to go to college for this reason. Secondly, it could have been that the outcome of attaching greater importance to the *need*

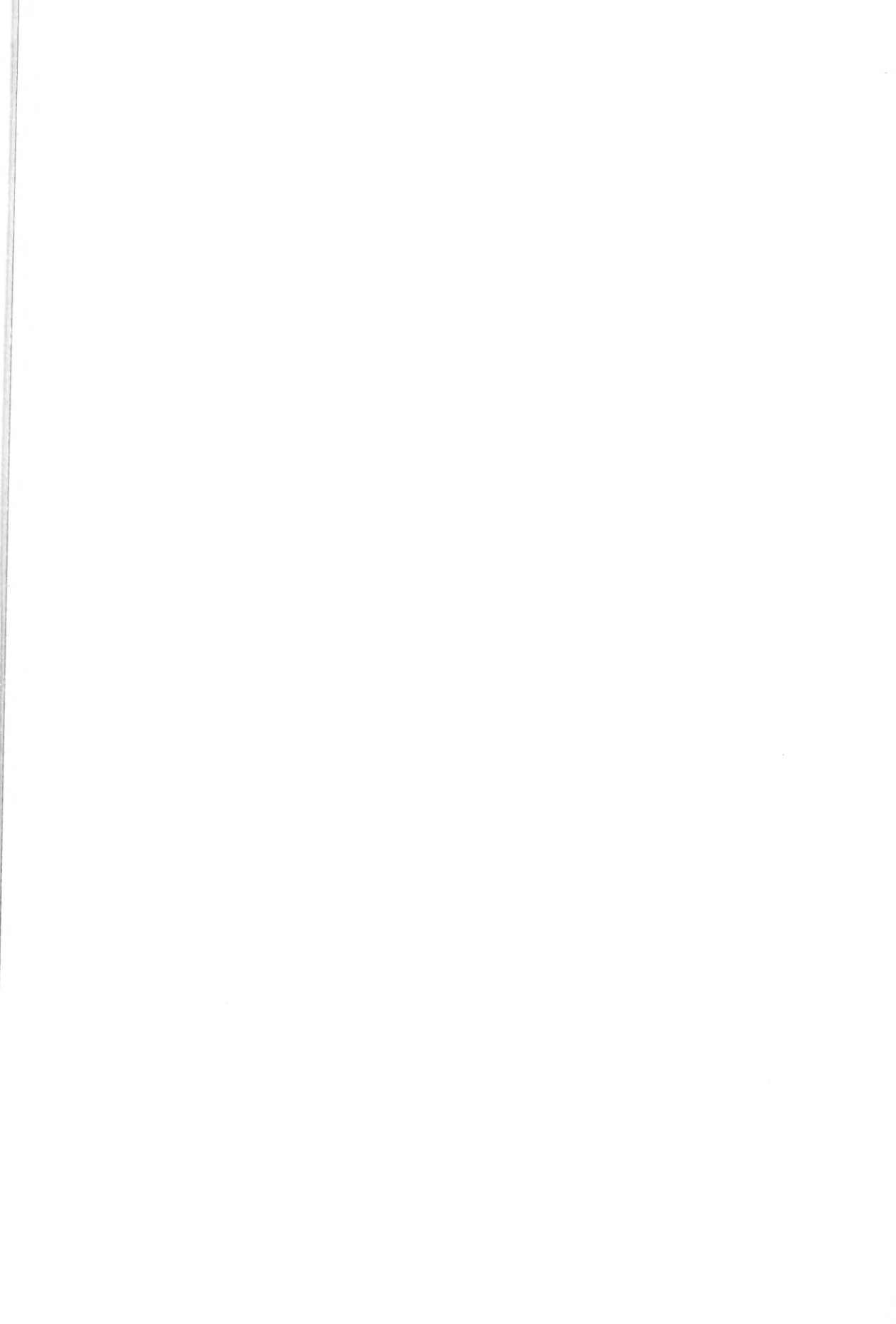
for a college degree on the part of men. Again, it could have been one outcome of the shunting of women into specialized types of occupations such as stenography, teaching, and nursing. Women training for these and similar vocations and professions would either (a) conclude their formal academic training at the high school level or (b) be enrolled in business colleges, in teacher training institutions such as the state normal or teachers' colleges, or in hospital training programs.

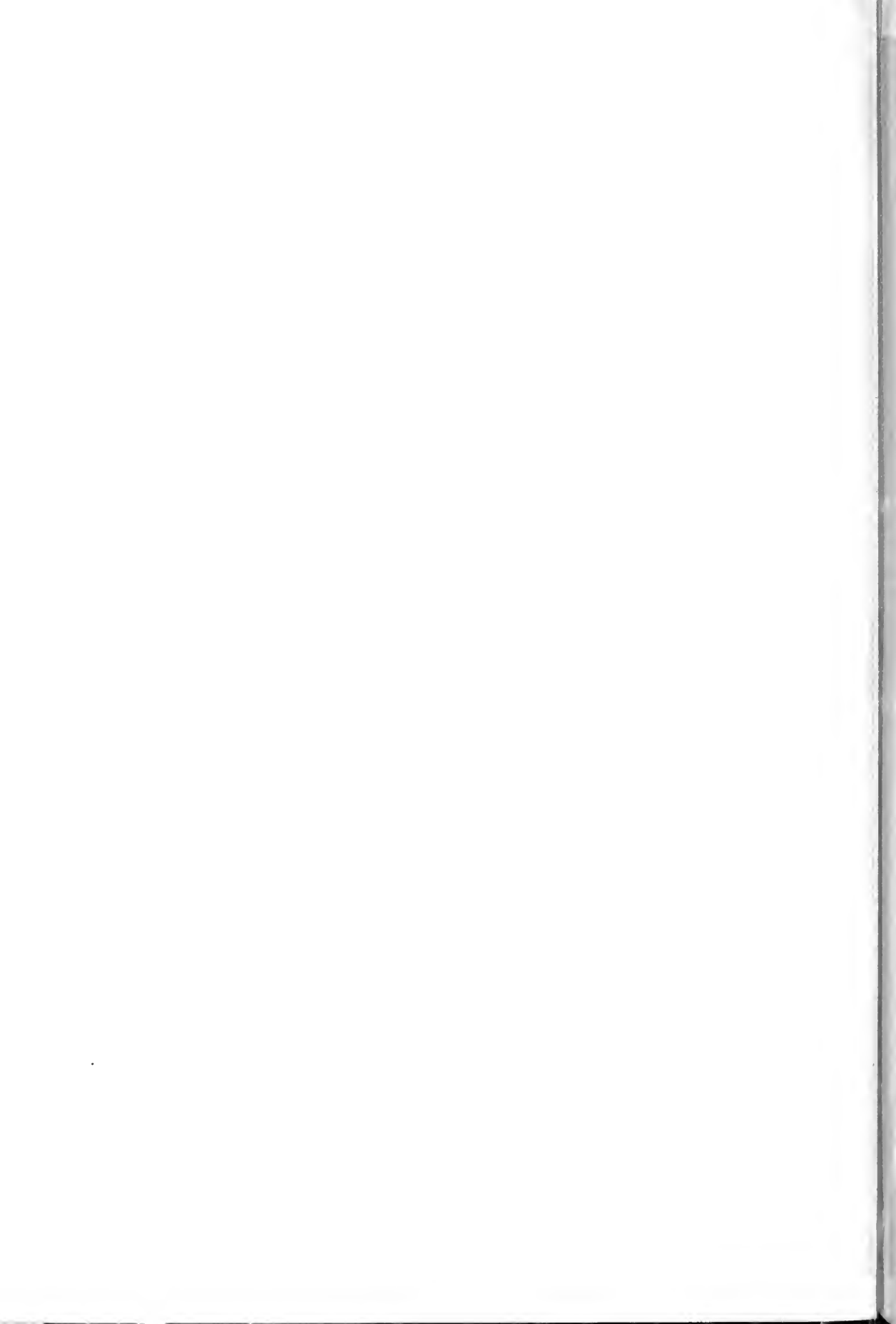
Recognition of the conditions and limitations suggested above, however, does not obviate the conclusion that neither the males nor the females studied herein at the high school and college levels could be considered exclusively the more variable, either absolutely or relatively. When greater variability for either sex seemed to have been demonstrated, it would seem that the statistical findings could be attributed perhaps to the area measured or the instruments of measurement employed. These non-definitive results with respect to differences between the sexes suggest that perhaps differences in life performances should be construed in terms of observable environmental differences in the training of the two sexes unless sex differences as shown in test results can be more definitively demonstrated than seemed possible in the present study.

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