

3. Referat : Geschlechterdifferenzen
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About the Book and Editor

Feminist inquiry has affected the nature of research in all the social and natural sciences over the past decade, but much contemporary writing on feminist methods simply offers a critique of traditional methods. This book, one of the first to offer a practical guide to conducting research informed by feminist methods, is based on the premise that abstract discussion of methodological issues is most meaningful and instructive in conjunction with examples of actual research.

A comprehensive and far-reaching introduction defines feminist research and explains how it differs from traditional methodology in the social and natural sciences. In a beautifully clear style, Dr. Nielsen guides the reader through a number of philosophy of science, history of science, and sociology of knowledge issues that are fundamental to understanding the nature of scientific method in its traditional sense and the role of feminist scholarship in the larger intellectual movement that is transforming and redefining scientific methodology. Part One presents the best of feminist commentary on both feminist and traditional methods. Part Two consists of readings that illustrate particular feminist methods, including oral history, linguistic analysis, feminist anthropology informed by feminist literary criticism, and reinterpretation and reanalysis of empirical data from a feminist perspective. Substantive issues addressed in the readings include women's suffrage in the United States, women as shamans, sex differences in suicide rates, sex differences in cognitive abilities, gender dominance through conversation, gender and public policy, and public-private sphere dichotomies.

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Feminist Research Methods

Exemplary Readings in the Social Sciences

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 41. Hunt (n. 36 above), p. 229.
 42. Marks and Abernathy (n. 29 above), p. 15; John L. McIntosh and John F. Santos, "Changing Patterns in Methods of Suicide by Race and Sex," *Suicide and Life-threatening Behavior* 12 (Winter 1982): 221-33.
 43. Hendin (n. 22 above), pp. 148-49.
 44. *Ibid.*, p. 145.
 45. Marks and Abernathy (n. 29 above), p. 15.
 46. Grethe Paerregaard, "Suicide in Denmark: A Statistical Review for the Past 150 Years," *Suicide and Life-threatening Behavior* 10 (Fall 1980): 150-57. See also *World Health Statistics Report* (Geneva: United Nations, 1968), 21:6; Kramer et al. (n. 8 above), p. 220.
 47. Hendin (n. 22 above), p. 145; Maurice Taylor and Jerry Wicks, "The Choice of Weapons: A Study of Suicide by Sex, Race, and Religion," *Suicide and Life-threatening Behavior* 10 (Fall 1980): 142-49; Paul Friedland, "Suicide among Police: A Study of 93 Suicides among New York City Policemen, 1934-1940," in *Essays in Self-Destruction*, ed. Edwin Shneidman (New York: Science House, 1967), pp. 414-49.
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How Large Are Cognitive Gender Differences? A Meta-Analysis Using ω^2 and d

JANET SHIBLEY HYDE

Behavioral scientists have tried for more than fifty years to document sex differences at the psychological level (for example, differences in personality attributes and cognitive abilities). Close analysis of the data used to support the general hypothesis of the existence of sex differences shows that there are few, if any, real differences at this level. Even aggression, traditionally considered male, or "masculine," behavior is not as exclusive to men as researchers and the public once thought it was. Yet researchers continue to try not only to document sex differences but to explain them. This some rather elaborate theories have been devised to explain a phenomenon that is nonexistent. Sociobiologists have carried this practice to an extreme, by stressing comparisons of males and females across species and ignoring those features of humans that differentiate them from other species—consciousness, a sense of self, and a sense of humor. Hyde's chapter is important because it challenges this tradition on its own terms—that is, she uses the style, format, and methodology of traditional science to show that sex differences in certain cognitive abilities are so small they are meaningless. ("Small" here means that a comparison of both women and men with respect to the ability in question shows almost similar distributions. See Hyde's Figures 1 and 2.)

To fully understand and appreciate this article, it is helpful to have some basic training in statistics. But those who do not should keep in mind the meaning of the term statistical significance. It does not necessarily mean that the difference between two groups (in this case, males and females) is a large one nor does it mean the difference is substantive. Even though evidence of statistical significance sometimes determines whether a study will be published, the determination of statistical significance depends to a great extent on the size of the sample: The larger the sample, the more likely a small or even minuscule difference between two groups will appear statistically significant. Further, the size, or magnitude, of a sex difference—that is, how much variation on a given attribute in a given population is due to sex (what Hyde calls effect size)—is an altogether different and separate statistical question than that of whether there is any difference at all. Hyde refers to the latter question as “hypothesis-testing.” The point is that because of the nature of the methodology employed, sex differences in cognitive abilities (and in other individual attributes) have been greatly exaggerated—some might even say constructed—by the research process itself.

This note and Hyde's chapter refer to sex differences at the individual level, not to those at the social-structural, or interactional, level. There are sex differences in social patterns like the gender gap in earnings, sex segregation in occupations, and even some sex differences reported in this book—for example, Fishman's analysis of intimate conversation. These seem to be real differences in the sense that (1) their magnitude is greater than that for psychological differences of the kind Hyde is discussing and (2) they are partly explained by reference to ideological factors such as a culture's perceived differences about women and men. The discrepancy between evidence for sex differences at the individual level and those at the interactional and social levels itself needs to be explained.

Maccoby and Jacklin (1974) reviewed the enormous literature on psychological gender differences. In particular, they concluded that three cognitive gender differences were “well-established”: Girls have greater verbal ability than boys, and boys have better visual-spatial ability and better mathematical ability than girls.

Sherman (1978) re-reviewed the evidence on cognitive gender differences and pointed out that even for these supposedly well-established differences, the magnitude of the gender difference was very small. For example, Maccoby and Jacklin (1974, Table 3.4) computed the magnitude of gender differences

in verbal ability for a subset of studies providing sufficient data. Typically, the magnitude of the differences was only about .25 standard deviations. Sherman (1978, p. 43) noted that the proportion of variance (ω^2) accounted for by gender differences in verbal ability for the 1955 standardization of the WAIS (Matarazzo, 1972) was less than .01.

Meta-analysis is a technique for analyzing a body of research on a particular topic by statistical analysis of the analyses of the individual studies (Glass, 1976). It is becoming increasingly popular as a technique for evaluating a given area of research (for examples, see Hall, 1978; Kulik, Kulik, & Cohen, 1979; Smith, 1980; Smith & Glass, 1977). Typically, these studies use the measure

$$d = \frac{M_1 - M_2}{SD}$$

as a measure of the magnitude of differences between two groups, that is, as a measure of effect size.

The purpose of the present article is to reanalyze the studies on cognitive gender differences considered to be well-established by Maccoby and Jacklin (1974) and to determine the magnitude of these gender differences. Two measures of effect size were used: ω^2 (Hays, 1963) and d . Such an analysis is particularly important because the term “well-established” is often taken to mean “large.” Maccoby and Jacklin's review has had a widespread influence, and their conclusions are cited in many introductory-level psychology texts. Thus, large numbers of people may have the impression that there are large gender differences in cognitive abilities. This, in turn, may affect practices such as vocational counseling. For example, a girl might be discouraged from a career in mathematics or science because of the “well-established” and “large” superiority of males in quantitative ability (despite repeated caveats in many texts about the great overlap in male and female distributions). Thus, it seems important to determine whether these “well-established” differences are in fact “large.”

This study can be viewed as one example of a larger issue in psychological research: criticism of the hypothesis-testing approach and a suggested alternative, estimating the magnitude of effects. Cognitive gender differences are good examples because they are widely believed to be well-established, yet the size of the gender difference has rarely been estimated.

METHOD

Selection of the Data Set

The studies analyzed here are those listed in the Maccoby and Jacklin (1974) review. Thus, the studies reviewed on verbal ability are those listed in Tables 3.3. and 3.4 in Maccoby and Jacklin's book. The studies of quantitative ability are those in Maccoby and Jacklin's Table 3.5. The studies of visual-spatial ability are from Maccoby and Jacklin's Table 3.7. And, finally,

the studies of field articulation (visual-analytic spatial ability) are from Maccoby and Jacklin's Table 3.8. These studies were chosen because they are precisely the studies that have led to the conclusion that these cognitive gender differences are "well-established."

Two restrictions were placed on the studies from those tables analyzed here. First, studies based on non-U.S. samples were omitted. It was seen as a reasonable goal simply to determine the size of gender differences in the United States. It seems quite possible that owing to differences in factors such as socialization practices or school curricula, gender differences present in one culture may not be present in another. Thus, inclusion of non-U.S. samples might only have clouded the picture. Second, a restriction of studies was made according to the age of subjects in the studies, based on the developmental nature of Maccoby and Jacklin's conclusions. In particular, they concluded that gender differences in verbal ability did not emerge until subjects were about 11 years of age. Thus, in an assessment of the magnitude of the established gender difference, it would be inappropriate to include studies based on subjects younger than 11 years of age. Hence, in Maccoby and Jacklin's Table 3.3, the study by Achenbach (1969) with 11-year-olds and all studies following it in the table are included. Similarly, Maccoby and Jacklin concluded that the gender difference in quantitative ability does not emerge until children are 12 to 13 years of age. Accordingly, the study by Hilton and Berglund (Note 1) including 10-, 12-, 14-, and 16-year-olds and all succeeding studies in Table 3.5 were included in the present review. Maccoby and Jacklin concluded that the gender difference in spatial ability was found consistently in adolescence and adulthood but not in childhood. Accordingly, the study by Nash (1973) with 11- and 14-year-olds and all succeeding studies in Table 3.7 were included in the analysis of visual-spatial ability here, and the study by Nash (1973) and all succeeding studies in Table 3.8 were included in the analysis of field articulation here.

Within the analysis of research on a particular cognitive ability, each study cited represents independent data. In cases in which longitudinal developmental data were presented, data from only one age-group are presented here. Only three studies were in this category, and in two of the three, the statistics were nearly identical at the different ages. In cases of cross-sectional developmental data, results from all appropriate ages were included. In addition, some studies included several different measures of the construct in question (e.g., verbal ability). In such cases, only one measure was included in the analysis in order to preserve the independence of the items in the data set. Only four studies were in this category, and one of them showed identical results for two measures. Of the remaining three studies, the measure showing intermediate results was reported.

It should be noted, however, that some studies are included in the analysis of two or more different abilities. For example, the study of Droege (1967) provided data on verbal ability, quantitative ability, and visual-spatial ability and thus is included in those three separate analyses.

Statistical Analyses

A number of measures of effect size are available (e.g., Craig, Eison, & Metzke, 1976; Fleiss, 1969; Friedman, 1968; Hays, 1963; Tresemer, 1975). For each study, an attempt was made to compute two statistical measures of the magnitude of the gender difference. The first was ω^2 (Hays, 1963), which measures the proportion of the total variance in the population that is accounted for by gender differences. This measure is advocated by Fleiss (1969); see also Craig et al., 1976 for estimating the magnitude of effects. Its meaning is similar to the r^2 (proportion of variance accounted for) statistic in correlation and regression. Just as r^2 gives the proportion of variance in the criterion (Y) explained by the predictor (X), so ω^2 gives the proportion of variance in the entire distribution of scores that can be accounted for by gender differences (the remaining variance being due to within-gender variation and error of measurement). In the commonest cases, in which a t value or group means and standard deviations were presented, ω^2 was calculated using the following formula:

$$\omega^2 = \frac{t^2 - 1}{t^2 + n_1 + n_2 - 1}.$$

In the case of a two-factor design, the following formula was used:

$$\omega^2 = \frac{SS \text{ gender} - (c - 1) MS \text{ error}}{MS \text{ error} + SS \text{ total}},$$

where c = the number of levels of the gender factor, that is, $c = 2$ (Hays, 1963, p. 407). In the case of $t < 1$ or $F < 1$, ω^2 was set equal to 0. The statistic d is defined as the ratio of the difference between group means to the standard deviation of a group (the standard deviations of the two groups are assumed to be equal). It has been recommended for use in meta-analyses (e.g., Glass, 1976). In the present study, the standard deviation was defined as the average of the standard deviation for males and the standard deviation for females. Since the statistic assumes the standard deviations to be equal, the best estimate of that standard deviation is the average of the standard deviations of the two samples, male and female. Thus,

$$d = \frac{M_1 - M_2}{SD}.$$

The sign of d was set to be positive if the study yielded findings in the direction of the "well-established" difference and to be negative if the finds were in the opposite direction. For purposes of interpretation, Cohen (1969) considers a d of .20 small, a value of .50 medium, and a value of .80 large.

In cases in which the original reference provided insufficient information to compute either of these statistics (e.g., if only a significance level was reported), a letter was sent to the author at the address provided in the

original paper or to a more recent address if provided by the APA Directory. The letter requested means and standard deviations for males and females and standard deviations for males and females and the t or F statistics. It was necessary to write such letters for 18 of the 53 different studies analyzed here. Thus, 34% of the studies provided insufficient information for a standard meta-analysis. Only seven responses to letters were received, and only two of these were able to provide the information requested. The remaining studies are listed as having no available ω^2 and d values in the tables.

RESULTS

Verbal Ability

The results for the 27 studies of verbal ability are shown in Table 1. As can be seen in that table, for those studies for which it was possible to compute ω^2 and d , both values tended to be low. The median value of ω^2 for verbal ability was .01; that is, gender differences accounted for only about 1% of the variance in verbal ability. The median value of d was .24. That is, the means for males and females were about one fourth of a standard deviation apart.

Quantitative Ability

The results from the 16 studies of quantitative ability are shown in Table 2. Once again, the values of ω^2 and d tended to be low. The median value of ω^2 was .01 for quantitative ability. The median value of d was .43.

Visual-Spatial Ability

The results from the 10 studies of visual-spatial ability are shown in Table 3. Three of those studies provided data for different samples at two different age groups. Hence, Table 3 can be considered to show 13 sets of data. The median value of ω^2 was .043. The median value of d was .45.

Field Articulation (Visual-Analytic Spatial Ability)

The results from the 20 studies of field articulation (typically measured by the Rod-and-Frame Test) are shown in Table 4. Two of the studies provided data for three separate age-group samples each, so that the number of data sets can be considered to be 24. The median value of ω^2 was .025. The median value of d was .51.

DISCUSSION

Magnitude of Gender Differences

The main conclusion that can be reached from this analysis is that the gender differences in verbal ability, quantitative ability, visual-spatial ability,

TABLE 1
Studies of Gender Differences in Verbal Ability

Study	Age	N	Difference	ω^2	d	Kind of Sample
Achenbach (1969)	11	159	None	NA	NA	5th and 6th graders
Cicirelli (1967)	11	641	None	NA	NA	6th graders, suburban, middle-class, white
Weinberg & Rabinowitz (1970)	12-19	48	None	NA	NA	Hospital patients
Flanagan (Note 2)	14, 17	1,545	Females	NA	NA	Project TALENT data
Walberg (1969)	16-17	2,074	Females	.02	.33	High school physics students
Backman (1972)	17	2,925	Females	.33	1.40	Project TALENT sample
American College Testing Program (1976-1977)	18	45,222	Females	.02	.26	College freshmen
Rosenberg & Sutton-Smith (1966)	18-20	600	None	NA	NA	College sophomores
Bieri et al. (1958)	18-21	76	None	0	.19	Radcliffe women and Harvard men
DeFazio (1973)	18-21	44	None	0	NA	Selected for extreme scores on Hidden Figures Test
Feather (1968)	18-21	60	None	NA	NA	College students selected for extreme internal-external scores
Feather (1969)	18-21	165	None	NA	NA	College students
Koen (1969)	18-21	72	None	NA	NA	Harvard summer school
Laughlin (1969)	18-21	528	None	0	.03	College students
Marks (1968)	18	760	None	NA	NA	Penn State freshmen
Mendelsohn & Griswold (1966)	18-21	223	None	0	.16	College (Berkeley)
Mendelsohn & Griswold (1967)	18-21	181	None	0	NA	Berkeley undergraduates
Sarason & Minard (1962)	18-21	96	None	NA	NA	College
Very (1967)	18-21	355	Females	.04	.41	Penn State students
Rosenberg & Sutton-Smith (1964)	19	377	Females	.02 ^a	NA	College students
Rosenberg & Sutton-Smith (1969)	19	1,013	Females	.04	NA	College students
Sutton-Smith et al. (1968)	19	1,055	None	NA	NA	College students
Bayley & Oden (1955)	29	1,102	Males	.01	.25	Gifted adults and their spouses
Blum, Fosshage, & Jarvik (1972)	84	54	Females	.06	.58	Longitudinal development sample
Gates (1961)	13	1,657	Females	.01	.22	Schoolchildren
Droege (1967)	18	6,167	Females	.01	.22	Representative sample of high school students
Matarazzo (1972) ^b	16-64	1,700	Females	.003	.12	WAIS 1955 standardization sample

Note: NA = not available (could not be computed from original paper, and author did not respond to request for further information or could not supply it). WAIS = Wechsler Adult Intelligence Scale.

^aPercentage of variance accounted for was computed as $\phi^2 = r^2/N$.

^bThis study is not included in Maccoby and Jacklin's (1974) review; it is an additional large-scale study noted by Sherman (1978), included here because it is a major standardization study.

TABLE 2
Studies of Gender Differences in Quantitative Ability

Study	Age	N	Difference	ω^2	d	Kind of Sample
Hilton & Berglund (Note 1)	16	539	Males	NA	NA	College-bound students
Cicirelli (1967)	11	641	None	NA	NA	6th graders, suburban, white
Keating & Stanley (1972)	12-13	396	Males	NA	NA	Junior high students exceptionally gifted in math
Droege (1967)	18	6,167	Males	<.01	.06	High school students
Flanagan (Note 2)	14, 17	4,545	Males	NA	NA	Project TALENT data
Walberg (1969)	16-17	1,050	Males	.01	.43	High school physics students
Backman (1972)	17	2,925	Males	.17	.89	Project TALENT sample—high school students
American College Testing Program (1976-1977)	18	45,222	Males	.03	.35	College freshmen
Rosenberg & Sutton-Smith (1964)	19	377	None	.007 ^a	NA	College students
Rosenberg & Sutton-Smith (1969)	19	1,013	Males	.005	NA	College students
Sutton-Smith et al. (1968)	19	1,055	None	NA	NA	College students
Rosenberg & Sutton-Smith (1966)	19	600	Males	NA	NA	College students
Bieri et al. (1958)	18-21	76	Males	.11	.72	Radcliffe women, Harvard men
Jacobsen et al. (1970)	18-21	136	None	.01	.27	College students
Sarason & Minard (1962)	18-21	96	None	NA	NA	College students
Very (1967)	18-21	355	Males	.06	.59	College students

Note: NA = not available.

and field articulation reported by Maccoby and Jacklin (1974) are all small. Gender differences appear to account for no more than 1%-5% of the population variance. The difference in means is only about one fourth to one half of a standard deviation (see Figures 1 and 2). Generally, it seems that gender differences in verbal ability are smaller and gender differences in spatial ability are larger, but even in the latter case, gender differences account for less than 5% of the population variance.

Practical Implications

What are the practical implications of the finding that these cognitive gender differences, although statistically reliable and replicable, are small? Two areas of practical concern are discussed below: vocational counseling

TABLE 3
Studies of Gender Differences in Visual-Spatial Ability

Study	Age	N	Difference	ω^2	d	Kind of Sample
Nash (1975)	11-12	105	None	0	.04	6th and 9th graders, New York public schools
Stafford (1961)	14-15	102	Males	.04	.48	High school students
Droege (1967)	14-17	128	Males	.07	.60	High school students
Flanagan et al. (Note 2)	18	6,167	Males	.04	.41	High school seniors
Backman (1972)	14, 17	4,545	Males	NA	NA	Project TALENT data
Backman (1972)	17	2,925	Males	.14	.83	Project TALENT sample—high school students
Brisset & Nowicki (1973)	18-21	80	None	0	—	College students
Kidd & Cheryminis (1965)	18-21	100	Males	.045	NA	College students
Very (1967)	18-21	355	Males	.06	.52	College students
Davies (1965)	20-29	90	Males	.57	NA	Adult volunteers
Sherman (1978) ^a	30-39	90	Males	.13	NA	NA
	15	1,233	NA	.01	.25	High school math students
	16			.03	.37	

Note: NA = not available.

^aThis study was not included in Maccoby and Jacklin's (1974) review.

and explanation of observed gender differences in participation in certain occupations.

As noted in the introduction, there may be a temptation to use the findings of "well-established" gender differences in vocational counseling. The present analysis shows that gender is a poor predictor of one's performance on ability tests in any of these areas. Thus, presumably, gender would also be a poor predictor of performance on jobs requiring these abilities. Because the gender differences are small, one might question the wisdom of mentioning such differences in introductory psychology or child development texts that will be read by students who will eventually become teachers and guidance counselors and who may be prone to make the error of applying the findings of gender differences in their own counseling. At the very least, it would be important to stress how small the differences are and how unwise it would be to apply them in counseling a given individual.

The findings of gender differences in cognition have also been used in an explanatory way, in particular to account for gender segregation in some occupations. For example, only about 1% of engineers in the United States are women (Bird, 1968). Assuming that engineering requires a high level of spatial ability, can the gender difference in spatial ability account for the relative absence of women in this profession? The above finding of such a small gender difference would appear to argue that the answer is no. However, the question has now shifted from a discussion of overall mean differences in the population to differences at the upper end of the distribution. And

TABLE 4
Studies of Gender Differences in Field Articulation

Study	Age	N	Difference	ω^2	d	Kind of Sample
Nash (1975)	14	102	Males	NA	NA	9th graders, New York public schools
Weinberg & Rabinowitz (1970)	12-19	48	None	NA	NA	Hospital patients
Fiebert (1967)	12	30	None	.02	.49	Deaf subjects
	15	30	None	0	.30	
	18	30	Males	.06	.67	
Silverman et al. (1973)	18-22	30	Males	NA	NA	College students
Gross (1959)	18-25	140	Males	.22	1.16	College students
Stuart et al. (1965)	18-21	64	None	0	NA	College students and some noncollege high school graduates
Gruen (1955)	19-35	60	Males	.11	.77	Trained dancers
Schwartz & Karp (1967)	17	46	Males	.09	.85	Paid volunteers
	30-39	40	Males	.09	.71	
	58-80	34	None	.03	.51	
Bieri (1960)	18-21	60	None	NA	NA	College students
Bieri et al. (1958)	18-21	76	Males	NA	NA	Radcliffe women and Harvard men
Bogo et al. (1970)	18-21	97	Males	.12	.78	College students
Goldstein & Chance (1965)	18-21	26	None	0	NA	College students
Morf et al. (1971)	18-24	78	Males	.025	.40	College students
Morf & Howitt (1970)	18-27	44	None	0	.27	College students
Oltman (1968)	18-21	163	None	0	.17	College students
Sarason & Minard (1962)	18-21	96	Males	NA	NA	College students
Vaught (1965)	18-21	180	Males	.04	NA	College students
Willoughby (1967)	18-21	76	None	0	.18	College students
Gerace & Caldwell (1971)	25	40	Males	.08	NA	Adult volunteers
Blum et al. (1972)	64	43	None	.02	-.46	Aging twins (females scored higher)

Note: NA = not available.

relatively small mean differences can generate rather large differences at the tails of distributions, as the following sample calculation will show. Assume, conservatively, that the gender difference in spatial ability is .40 SD. Using z scores, the mean score for males will be .20 and the mean for females will be -.20. Assume also that being a successful engineer requires spatial ability at least at the 95th percentile for the population. A continuation of the z-score computation shows that about 7.35% of males will be above this cutoff, whereas only 3.22% of females will be. This amounts to about a 2:1

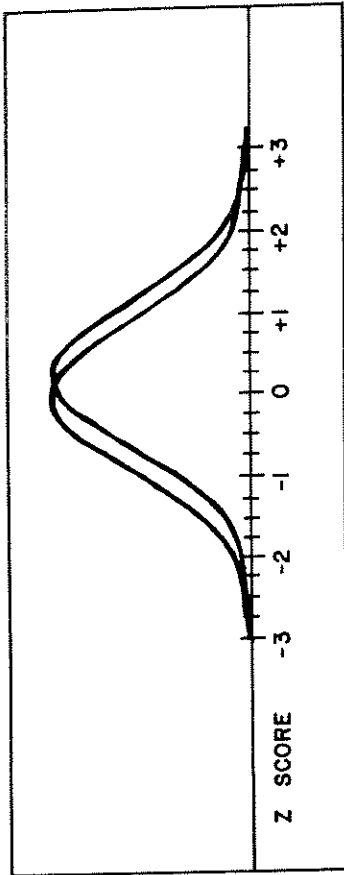


FIGURE 1 Two normal distributions with means .25 SD apart, that is, with a d of .25. This is approximately the magnitude of the gender difference in verbal ability.

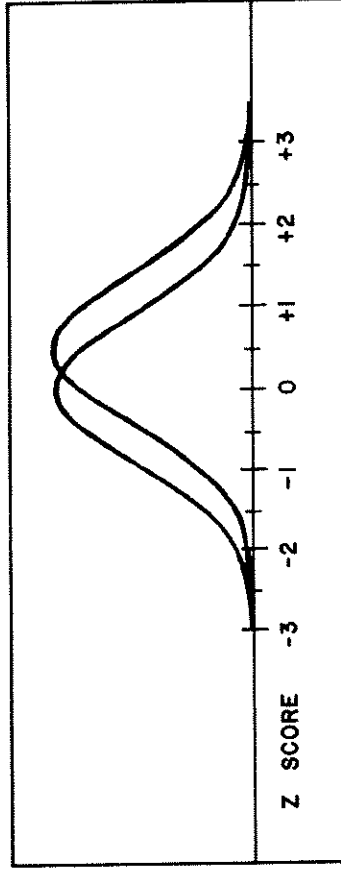


FIGURE 2 Two normal distributions with means .50 SD apart, that is, with a d of .50. This is approximately the magnitude of the gender differences in quantitative ability, visual-spatial ability, and field articulation.

ratio of males to females with sufficient ability for the profession. This could, therefore, generate a rather large difference although certainly not as large as the existing one.

The disparity would become even larger if one considered some occupational feat, such as winning a Nobel prize or a Pulitzer prize, that would require even higher levels of the ability. For example, suppose that spatial ability at the 99.5th percentile is now required. The same z-score calculations indicate that .85563% of males and .27375% of females would be above that cutoff, for an approximate 3:1 ratio of males to females. Once again, though, this is not nearly a large enough difference to account for the small proportions of women winning Nobel prizes. (The same computations could be used, recognizing the female superiority in verbal ability, to account for gender differences in the winning of Pulitzer prizes; once again, the gender difference in abilities would not, by itself, account for the observed difference.)

In sum, even small average gender difference in abilities can generate rather large differences in proportions of males and females above some high cutoff point that might be required for outstanding performance of some occupation. Nonetheless, the known differences in abilities are still too small to explain the observed occupational differences.

Sampling

In evaluating the existence and magnitude of cognitive gender differences, one important methodological issue deserves further discussion: sampling. It seems reasonable to define a cognitive gender difference as existing at a particular age if it is found to exist in a random sample of males and females of that age from a given culture (in this case, the United States). This definition is in contrast to that of Sherman (1978), who argued that gender differences are best studied on samples matched for prior relevant experience. For example, she has studied visual-spatial ability and quantitative ability in males and females who had taken the same high school math courses. The problem with this approach is that it may involve different percentages of the male and female populations and different cutoff points in their distributions. Essentially it confuses research on the existence of a gender difference with research on the cause of it. It would seem important first to establish the existence of a gender difference in random samples of the population, and then, if it exists, proceed to analyze its causes, whether biological or cultural or both.

With this definition of sampling in mind, brief descriptions of the samples involved in the gender differences studies can be found in Tables 1, 2, 3, and 4. Some of the deviations from ideal sampling are striking. For example, the study of verbal ability by Bieri, Bradburn, and Galinsky (1958) used as subjects Radcliffe female and Harvard male undergraduates. These subjects have surely already been selected for high levels of verbal ability, and the finding of no significant gender difference in the study is not at all surprising. Other obvious examples of problematic sampling occur in a study of verbal ability using Harvard summer school students (Koen, 1966), in another study of verbal ability using Berkeley undergraduates (Mendelsohn & Griswold, 1967), and in another study of verbal ability using high school physics students (Walberg, 1969). Finally, the study of quantitative ability by Keating and Stanley (1972) used junior high students who were exceptionally gifted in math and who initially were self-selected; doubtless, girls are less likely to self-select for high ability, particularly in a gender-inappropriate area such as math. Thus, many talented girls were probably lost from the sample. In defense of these studies, none was designed with the goal of normatively assessing the existence and magnitude of gender differences. Nonetheless, they have counted in the major tallies.

Indeed, the tough-minded might argue that all studies of college students are rendered irrelevant because the subjects have already had some prior selection on the basis of their cognitive abilities. If this rule is followed, few studies are left on the basis of which one can assess cognitive gender differences.

The more general point is that if one is to assess the existence and magnitude of cognitive gender differences, careful attention must be paid to sampling, and this has not been done in prior research or reviews.

A second point about sampling also needs to be raised. Some of the best studies from the point of view of random sampling are those that involve representative sampling of all high school students or all students in a given district. Such studies often involve enormous sample sizes. For example, the study by Droege (1967), which included measures of verbal ability, quantitative ability, and spatial ability, had a sample size of 6,167. Such a sample size increases the chance of finding a highly reliable gender difference that is very small and accounts for very little variance. Such sample sizes seldom appear in research in other meta-analyses (e.g., Hall, 1978; Smith, 1980). It seems that research on cognitive gender differences is particularly prone to the problems of enormous samples because cognitive gender differences can so easily be studied in large-scale research, such as standardization of tests. Thus, research on cognitive gender differences seems particularly prone to having large sample sizes that produce reliable but tiny differences.

Finally, the present findings may help to explain the lack of replicability in this area. If the true difference in population means for males and females is small, then one would expect that in repeated samplings, many would find no significant gender differences. This is precisely what one sees in Maccoby and Jacklin's tables. Further, the present findings explain why theories designed to explain the differences (e.g., brain lateralization theories) have met with little success and produce such conflicting data (Sherman, 1978). A small phenomenon will produce conflicting data in repeated sampling.

Recommendations

One problem that occurred in the process of doing the present analyses was the relatively high proportion of studies that provided insufficient information for ω^2 and d to be calculated. To facilitate more systematic assessment of gender differences, some journals have adopted the policy of requiring authors to report results of analyses of gender differences. However, if such analyses are to be complete, the magnitude of the differences also needs to be assessed. Based on the poor yield in response to letters requesting complete information for the present study, it seems important that such data be included in the original paper. Thus, a recommendation that emerges from this study is that journals encourage authors either to report ω^2 and/or d values along with their analyses of gender differences or to report sufficient information (means and standard deviations for males and females and/or t and F statistics) so that ω^2 and d can be calculated. Such policies would seem to be important in order to avoid the assumption that gender differences that are well-established are also large, an assumption that the present review has shown to be false.

A more radical recommendation is also suggested by the present study. The results indicate that it is possible to have a moderately reliable psychological

phenomenon (e.g., one that appears in 50% or more of published studies on the topic) that is nonetheless small. How many other areas of psychological research and theory are based on small effects that are assumed to be large and reliable because the size of the effect has never been evaluated? The radical recommendation, then, is that journals require reports of effect size such as ω^2 or d with all reports of significant results. Of course, a small effect might still be an important one. But at least the reader would have the option of deciding whether a significant effect was large enough to merit further attention, either in teaching or in research.

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