Olga Eizner Favreau

research on Sex Differences in Behavior:

some reinterpretations

In recent years there has been a trend in the social sciences in general, and in psychology in particular, to revive biological determinist theories of human behavior. This trend has been most evident in relation to race and sex differences. Because of their controversial nature, these views have not remained confined within the scientific community, but have gained fairly wide circulation in the popular media. Their contribution to the debate on racial and sexual discrimination has not always been limited to justifying current discriminatory practices; some authors¹ have gone so far as to recommend new forms of discrimination. The purpose of this paper is to examine some of the kinds of data on which biological determinist views of sex differences have been based and to see whether the data justify the interpretations.

biological determinism, women and academe

An incident which occurred at McGill University in 1971 is an appropriate illustration of the topic. It provides both a succinct statement of a typical biological determinist view and is also an example of how such a view was used in an attempt to influence a decision in a situation involving discrimination. In 1971, a McGill University Senate committee that had been charged with investigating sex discrimination at the University issued its report. One of the findings was that, holding rank and years of service constant, women faculty members earned, on the average, \$1000 a year less than their male colleagues. Accordingly, among the recommendations made by the committee was one that all women's salaries be raised by \$1000. A global remedy of this kind is vulnerable to attack on many grounds and I do not intend to evaluate the recommendation itself. What is relevant in the present context is that D. O. Hebb, who is one of the most eminent psychologists of this century and who was at the time

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the Chancellor of the university, issued a statement criticizing the committee's report. The statement was circulated to all members of the Senate at the meeting at which the report was to be discussed. The statement read as follows:

A good case is spoiled by supporting it with bad arguments. There is discrimination in the University but it is not general, and the idea of raising all women's salaries by \$1000 a year is absurd. Also, it does not prove discrimination to show that women are promoted more slowly despite being equally well trained. Are they equally productive in research? Until that is shown, there is no case. The record shows that a small proportion of women are outstandingly good and must be recognized, but that women on the average are much less productive of significant original research. On the average, they are bound to get less promotion in a University that values research.

It is not that women are less intelligent. The evidence is that they are more intelligent, at least during growth to age 15, but they have a different pattern of intellectual abilities. Girls are better at *all* language tasks and in visual memory, boys better at arithmetic by age 9 and better at tasks involving spatial relations. From an early age boys are not only more active physically and more aggressive, but also less willing to follow, and in these respects they show a picture that is general in all mammalian species. None of this can be attributed to differences in the way boys and girls are brought up. Some of the behavioral differences traditionally explained in this way appear quite clearly in captive chimpanzees, where the explanation does not apply. Male-female differences are not merely anatomical.

The inborn male aggressiveness is a factor in research, and so obviously is the greater aptitude for mathematical thinking, and a greater interest in abstract problems. Given two new Ph.D.s, male and female, equally promising as teachers: which is more likely to add to the University's reputation by doing and publishing significant research? The man is, on the record, and so he is more valuable to the University on the average. In a 20-year period, 1949-1968, we gave the Ph.D. to 41 women and 87 men. At a rough estimate, nearly twice as high a proportion of the men have made themselves widely known.

So the hard question the Committee must ask, if it wants to prove its case, is this: Have women with equal research achievement been retarded in promotion? It would be difficult to get the data needed to answer the question, but until then the proof is missing. I am sure that women are discriminated against in some quarters, and something should be done about it; but this report does not help. If anything it weakens the women's case instead of strengthening it. It is out of touch with academic and psychological reality.

To summarize Hebb's view, lower average salaries for academic women are justified because women are less productive of original research. This lower productivity is seen as a second-order effect of more basic innate biological differences between the sexes ("None of this can be attributed to the way boys and girls are brought up.") Specifically, although women are more intelligent and excel at language tasks, boys are better at arithmetic and at tasks involving spatial relations. Furthermore, boys are more active and aggressive and "less willing to follow" and this difference, too, must be innate because a similar pattern of sex differences is found in other mammals. Similar views have been expressed by other authors.²

There has been a great deal of research on sex differences in many different kinds of behavior. These include such diverse topics as role modeling, dependency, conformity, anxiety, manual skills, verbal abilities, and other cognitive abilities. Some of these can more readilv be attributed to cultural influences than others. In this paper I shall deal with some of the kinds of behavior for which sex differences have been reported and which, it has been argued (by Hebb and others) are biologically fixed. Thus I shall not deal directly with publication rate, since there are many socio-cultural factors as well as specific pressures within the University community which provide impediments to women that men do not have to contend with.³ The work of Goldberg⁴ shows that the evaluation of articles is not free of sexual bias. Thus differential publication rates by men and women could be caused by purely cultural factors, or they could be the secondary consequences of more basic underlying biological factors. This paper examines the question of whether there is behavioral evidence that such biological sex differences exist and, if so, whether there is any reason to believe that they can influence publication rate or performance in other occupations. The specific topics that will be dealt with are mathematical abilities, spatial abilities, verbal abilities, manual dexterity and aggression.

Before going on to review work on specific sex differences, we should examine a few general issues that are related to this kind of research. Research on sex differences is liable to be contaminated by two irreconcilable problems. The first is that many researchers who use both males and females in investigations of various kinds of behavior are likely to include tests for sex differences among the statistical analyses that they perform on their data. Because of the nature of statistics, statistically significant sex differences will occur in 5% of the comparisons purely by chance (i.e. sex differences can be found in the sample that was studied even though they do not occur in the population from which the sample was drawn). The index of *Psychological Abstracts* for 1972 lists 750 published studies in which sex differences were investigated in humans. If these studies represent all the research that was done on the topic, then, by chance, 37 should have reported statistically significant sex differences.

It is furthermore important to note that journal editorial policies generally favor the publication of reports in which at least some of the results are statistically significant. This is because, due to the vagaries of statistical reasoning, it is not valid to infer that the absence of a statistically significant difference implies that no real difference exists.⁵ Consequently, studies which find no sex differences

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when that is the major variable being investigated are unlikely to enter the literature. It can be seen, then, that statistical hazards taken together with editorial practices introduce a bias which favors the reporting of sex differences which may not actually exist while at the same time tending to suppress information concerning the absence of sex differences.

One way of avoiding the hazard of accepting randomly occurring sex differences as "real" would be to search the literature for consistent results, that is, those that are obtained repeatedly in many different experiments. But here we come upon the second problem. When a given result is reported with any regularity, researchers may come to expect to continue finding it. They are then more likely to obtain the same results in their own work because of subtle, probably unconscious manipulations of the experimental conditions. The existence of this kind of experimenter bias has been amply demonstrated by Rosenthal.⁶

an examination of the research

In spite of possible experimenter effects, the only way we can reasonably estimate which kinds of sex differences occur with any regularity is by examining a large body of research and then determining how much consistency there is in the results of repeated investigations of similar kinds of behavior.

A classified bibliography of research on sex differences in sixteen general behavior categories that was compiled by Oetzel is an invaluable aid for this kind of analysis. The following discussions relies heavily on Oetzel's bibliography.⁷

MATHEMATICAL ABILITIES

Tests of mathematical abilities are of interest for a number of reasons. Hebb claimed that boys are better at arithmetic by age nine. Broverman *et al.*^{*} make a finer distinction. They claim that girls and women are better at relatively simple mathematical tasks, like computation, whereas boys excel in mathematical reasoning. (The views of Broverman *et al.* will be examined in greater detail below). Deciding on whether a discrepancy in mathematical abilities, if it exists, is sexdetermined is a kind of chicken-and-egg problem. If boys are better at mathematical reasoning due to cultural prejudice, where did the prejudice originate? Could it be that boys really are better?

Consider, first, computation, on which girls are allegedly better. In Oetzel's bibliography, twenty studies on counting and computation are cited. Girls were found to excel in six, boys in one, and there were no statistically significant differences in the remaining thirteen. Thus although there is a tendency for girls to be better, the data hardly provide solid support for the contention of Broverman *et al.* that girls in general excel at simple computational tasks to an extent that would justify relegating women to bookkeeping rather than accounting, mathematics, and research.

Consider, next, the twenty-one studies on mathematical reasoning that are listed in Oetzel's bibliography. In these, males were superior in eleven, females in one, and no statistically significant differences were reported in the remaining nine. Thus, although not overwhelmingly, the results tend to favor males. Is it possible to conclude that girls are simply not suited for mathematical reasoning?

Let us examine the results in one of the papers in which boys were found to be better than girls. This is a study by Schiller that has been cited by Anastasi.⁹ The mean score for boys was 40.39 and for girls it was 35.81. The difference was statistically significant at the 1% level of confidence. Yet, when one examines the distributions of the scores it is evident that there is a great deal of overlapping. In fact, the highest girls' scores were as high as the highest boys' scores and the worst boys achieved scores as low as the worst girls did. The source of the statistically significant difference is that, across the entire range of scores, there was a tendency for boys to achieve more higher scores than did girls. But, as Anastasi pointed out, 28% of the girls reached or exceeded the median of the boys' scores.

Overlapping distributions of this kind are typical of research on sex differences (as they are of research on racial differences). As Anastasi has pointed out, a more meaningful account of the data would be to report the results in terms of the percent of members of one group whose scores are higher than the median score of the other group. Current usage is, however, still to report these kinds of differences in a form such as "Males are better than females at. . . ." Such statements are understood by those who are unfamiliar with statistics to mean that all males are better than all females at whatever task is in question. Yet it is obvious that the fact that extensive overlapping occurs makes it impossible to infer on the basis of sex whether any individual has an aptitude for mathematical reasoning. The existence of such overlapping distributions also makes it obvious that biological sex is not a major contributor to individual differences, although the question of whether some subtle biological factors exert a minor effect is not resolved.

Let us examine some sources of cultural effects on mathematical reasoning. Tests of computation are relatively content free in a cultural sense; that is, they require only the manipulation of numbers. Mathematical reasoning tests, on the other hand, by their very nature, must refer to specific situations. These are often situations of the kind that boys have been encouraged to be interested in such as the speeds of cars, trains and planes. Therefore, if girls tend to achieve lower scores on these tests, it may be because they are not as interested in the problem as boys are, or as familiar with the elements of the problem. A study by Milton¹⁰ showed that the problem-solving scores of women undergraduates were improved when the content of problems was more closely related to traditional female sex-roles (such as quantities of batter for baking). Similarly, the scores of men tended to decrease when they worked on women's sex-role appropriate problems. Overall, however, the men's scores did remain slightly higher than the women's.

There is evidence that other cultural factors can affect women's performance on problem solving. Maccoby¹¹ cited a study by Carey in which it was found that the performance of a group of college women on problem solving was improved following discussions which emphasized the social acceptability of problem solving. The performance of men did not improve following similar discussions.

Milton¹³ has shown that scores on problem solving are influenced by a personality factor — the degree of identification with male or female sex roles. Both men and women who identify with the male sex role are better at problem solving. Thus it can be seen that both specific situational as well as general personality factors can affect performance on problem solving tasks. These, viewed with the overlap in scores, make it appear even less likely that invariant biological factors contribute significantly to performance on such tasks.

Oetzel lists eight studies in a category that is labelled "Abstract Reasoning." This is an ability that would seem to be related to mathematical reasoning, especially with respect to the kinds of research situations in which it would be useful. In three of the eight studies girls and women performed better than boys and men, males were better in two, and there were no statistically significant sex differences in three. These results are inconsistent with those obtained in tests of mathematical reasoning and cast some doubt on the validity of using the results of the latter to draw conclusions about how well suited women are for doing research.

SPATIAL ABILITIES

Under the rubric spatial abilities is included a large variety of tasks such as the manipulation of objects in space as well as tests of spatial orientation. As Hebb claimed, male superiority of performance on these tasks is reported frequently. Of the eighteen studies on spatial abilities that were listed in Oetzel's bibliography, boys were better in twelve, girls in none, and there were no statistically significant differences in six. Similarly in field dependence, a related constellation of spatial abilities, in the thirteen studies listed by Oetzel, boys and men were better in eleven, girls in one, and no difference was reported in one.

As in the case of mathematical abilities, there is much overlapping of scores obtained by males and females in tests of spatial abilities. For example in one of Witkin's¹³ standardizations of the Embedded Figures Test (a test of field dependence), the best women's scores are in the same range as the best men's scores. There is a tendency for a few women to have scores that are worse than the worst men's scores. But even if it is true that a few women perform worse than most men, the statement that men perform better than women is misleading, as it does not take into account the highest women's scores.

It is difficult to see, a priori, why men, on the average, tend to have superior scores on tests of spatial ability. Are there any kinds of systematic sex specific experiential differences that contribute to these differences? Some studies have shown that performance on these tasks can be affected by certain kinds of prior experience. For example Witkin et al.¹⁴ reported that boys who had been encouraged to be independent performed better on the Embedded Figures Test than boys who had been allowed to be dependent. Since, in our culture, girls are generally permitted less independence than boys, it is not surprising to find that girls' performance tends to be worse. As far as specific experience is concerned, Chance and Goldstein¹⁵ showed that with practice on the EFT girls improved to a point where their performance did not differ from a group of boys who had been given the same amount of practice. Harris (in press) also cites a number of instances in which training on spatial tasks improved women's scores.

In the foregoing discussion of mathematical and spatial abilities, I have made two points: first, that when males and females are tested for these abilities there is much overlap in their scores; and second, that certain kinds of sex-related and other experiential differences can affect performance on tasks that involve mathematical and spatial abilities. Neither of these facts proves that sex-related biological factors play no role in these behaviors (it is logically impossible to prove that). However, the overlap in performance implies that whether or not these differences are partly biologically determined is irrelevant to decisions about how to treat people.

A monograph by Garai and Scheinfeld is a deplorable example of prescriptive suggestions based on this research. Even though they acknowledge that all reported sex differences are based on group averages, they nevertheless go on to prescribe different kinds of instruction in mathematics for boys and girls because of the alleged basic differences in their modes of thinking — girls as a group being said to be less able to think spatially. This different instruction, they

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piously hope, may make girls as proficient at mathematics as boys. I will not here deal with the dangers of the "separate but equal" aspect of this argument. I would simply like to suggest that efforts of this kind would be wasted on the many girls who are better than average and on the many boys who are worse than average. Instead of using sex as a criterion for the application of different pedagogical methods, it might be more productive to assess the needs of individual children and teach accordingly.

VERBAL ABILITIES

The constellation of behaviors included under the label "verbal activities" includes such diverse topics as the ages at which the first word and sentence are spoken, articulation, spelling, grammar, and reading. In most of these activities girls are, on the average, better than boys. In the 103 studies related to various aspects of verbal ability that are listed by Oetzel, girls and women were superior in sixty-two, boys and men in fourteen, and no significant differences were reported in the remaining twenty-seven.

In the case of verbal abilities, the same points can be made about overlap in scores and subtle experiential differences that are true of mathematical and spatial abilities. For example, there seems to be some evidence that mothers have a tendency to talk more to infant daughters than to sons. This could explain the earlier ages for the utterance of first word and first sentences. Thus there are no solid grounds for attributing female superiority to biological factors that are unique to females.

Regardless of the causes of the sex differences in mathematical, spatial, and verbal abilities, it is the case that males do tend to have higher average performance scores on the first two, while women tend to excel at the latter.

It is interesting to compare the way in which these different ability patterns are interpreted. Although Hebb acknowledged female superiority at verbal abilities, he argued that male superiority in mathematical and spatial tasks provides an advantage in research productivity. There is no obvious justification for this *post hoc* reasoning — one could just as cogently argue that superior verbal abilities are advantageous for doing research. For example, since publication rate is the ultimate visible product of research, one could claim that women should be likely to publish more because of their greater facility in many aspects of verbal behavior. We simply do not know enough about what kinds of cognitive abilities contribute to publication rate and we do know that many socio-cultural factors can exert an effect. What is clear from Hebb's explanation of differential publication rates, is that even when women are found to excel in a given area, the evidence is not interpreted in their favor.

A particularly striking example of cultural bias in the interpretation of differential sexual abilities can be found in a paper by Broverman et al.¹⁶ These authors propose a biological interpretation of sex differences in cognitive abilities. Because of alleged differential activating effects of estrogens and androgens on the central nervous system, "females surpass males on simple, overlearned, perceptual-motor tasks; males excel on more complex [emphasis mine] tasks requiring an inhibition of immediate responses to obvious stimulus attributes in favor of responses to less obvious stimulus attributes."17 How, then, can these authors account for female superiority in verbal behavior in a way that is consistent with their theory? Quite simply by defining verbal behavior as a non-complex task. Thus, they state that the behaviors in which females are superior have, among others, the following attributes: they are "based mainly upon past experience or learning as opposed to problem solving of novel or difficult tasks. Thus . . . talking, reading, etc. are based upon extensive previous experience. As a result of extensive prior practice, the behaviors appear to involve minimal mediation by higher cognitive processes" [emphasis mine].¹⁸

Thus language, considered by many to be the most distinctive accomplishment of the human brain, is relegated to the status of a lesser cognitive achievement in order to support a theory that females are better at simple tasks and males at more complex tasks. The argument can be turned about. If one were determined to be a biological determinist, one could use the same evidence to claim that females solve the language problem at an earlier age. Garai and Scheinfeld¹⁹ also minimize the importance of women's superiority in language. They attribute it to an earlier maturation of the motor vocal apparatus, thereby dismissing it as a mechanical artifact, with no necessary relation to intellectual development.

MANUAL DEXTERITY

Manual dexterity will be considered briefly because it is one ability in which it is believed, by some authors, that women excel. Thus Anastasi,²⁰ Broverman *et al.*,²¹ and Garai and Scheinfeld²² all claim that women tend to have greater manual dexterity than men. Actually, the literature on this is mixed. Oetzel's bibliography lists eight studies on manual skills. Boys were superior in four, girls in three, and there was no difference in one.

What is relevant in the present context is that there is a *belief* that women possess greater manual dexterity than men. The interesting question that follows is how this belief is applied. A quote from Garai and Scheinfeld is instructive: The previously reported greater tactile sensitivity of females which is already apparent at birth may contribute to their greater manual dexterity and in early life direct them toward activities which require manual skills, such as sewing, knitting, embroidery, dental laboratory work, and microscope research in biology and biochemistry.²³

The authors justify or explain the participation of women in relatively low status activities. What is notable is the absence of any suggestion that because of their alleged greater manual dexterity women should be favored in such specialties as surgery and dentistry. Yet these same authors did recommend different mathematical education for boys and girls. Thus, the *status quo* is defended (or not challenged) when changing it in accordence with sex differences might lead to discriminatory practices against men. But when men are not at a disadvantage, as in mathematics, the authors are prepared to recommend discriminatory action.

In another context Garai and Scheinfeld²⁴ deplore the "feminization" of the elementary school classroom due to the prevalence of women teachers. They express concern for the welfare of little boys who are deprived of male models to identify with. While this may be a legitimate concern, the bias of this point of view becomes obvious when one realizes that it is not matched by an equal concern about the "masculinization" of the university, where women students may suffer from the absence of appropriate female role models.

In general, our review of the interpretation of the results of research on sex differences shows that men are in a position which can be characterized as "Heads I win, tails you lose." That is, men are favored in various ways for superior performance on mathematical and spatial tasks. However, the fact that women are superior at other kinds of tasks has not elicited reciprocal suggestions that women be given priority in high prestige occupations which involve verbal abilities and manual dexterity. The importance of women's superiority is either trivialized, or used to support arguments that they continue to be employed in relatively menial jobs.

AGGRESSION

The view that aggressive behavior is more frequent in males than in females in derived from several sources. As Hebb claimed, there is evidence that in many mammalian species the males tend to be more aggressive than the females. Injections of the male hormone, testosterone, leads to increased levels of aggressive behavior. The evidence from human behavior is also that aggression is more common in males. In the fifty-seven studies on various forms of aggressive behavior that were listed by Oetzel, males were found to be more aggressive in forty-four, females in four, and there were no differences in the remaining nine. An examination of the extent to which biological and experiential factors underlie aggressive behavior is beyond the scope of this paper. The discussion will be confined to a consideration of what relation, if any, there may be between aggressive behavior and research productivity.

To select aggression as a factor in research output would appear to be an example of inappropriate post hoc reasoning. There is no obvious reason to believe that men will be more prolific scientists than women because males tend to be more aggressive than females. Actually, the small amount of evidence that can be brought to bear on this question suggests that the opposite may be true. Maccoby²⁵ cites a number of studies in which it was found that, for boys, passivity and absence of aggressive behavior tend to be positively related to high intellectual performance. Intelligent girls, on the other hand, are often more active and impulsive when compared with less intelligent girls. If these results, which were obtained with children, can be generalized to the academic community, then it may well be that selective factors have created a situation in which women in academe are more aggressive than their male colleagues. This would necessitate reversing Hebb's hypothesis about the relation between aggression and research productivity. The most important point, though, is that linking various measures of aggression and general activity in animals and children to research productivity requires an inadmissibly large inferential leap.

Attitudes towards aggressive behavior illustrate once again the double-bind that women are in with regard to the interpretation of the results of research on sex differences. In the abstract, many people would agree that aggression is generally an undesirable form of behavior. However, in the context of the greater incidence of aggression in men, psychologists are quick to point out that a natural tendency to be aggressive provides men with a justifiable advantage. This is a particularly deplorable aspect of the "biology is destiny" form of reasoning. That is, a kind of behavior which in itself may be undesirable is valued simply because it occurs (in men). A more constructive approach might be to ask whether aggressive behavior has any intrinsic social value. It should be noted that many different kinds of behavior are labeled "aggressive" and that they are not all necessarily caused by the same set of underlying factors.²⁶ One could then investigate means of decreasing the incidence of undesirable forms of aggressive behavior and of promoting the incidence of more desirable forms.27

summary and conclusions

Our limited review of research on sex differences has shown that there are some kinds of abilities and behavior which are more typical of men and others which are relatively more typical of women. It was pointed out that there is generally sufficient overlap in the distributions of scores of both sexes that it is not possible to predict the performance of an individual on the basis of sex. Furthermore, it is clear that socio-cultural factors can influence the occurrence of these behaviors. Nevertheless, it is still logically possible, although not proven, that sex-specific biological factors play some part in causing differences in behavior. What is evident is that, if there are any biologically determined sex differences, their role is minimal and they are irrelevant to making decisions about individuals in relation to educational or occupational opportunities.

Another important point should be made. To argue against any and all forms of biological determinism is futile. The biological constitution of an organism clearly limits its capabilities. Amoebae cannot do arithmetic. Similarly the potential of human beings is restricted by whatever biological factors underlie intellectual performance. To take the argument one step further, it is not unlikely that, among human beings, there are individual differences in potential. It is not inconceivable that for some types of activity some component of these individual differences may be related to sex. However, it is evident that, whatever this component may be (if it exists), it is so minimal that other variables unrelated to sex are much more important in determining the ultimate performance. The lesson to be drawn from this is that it is self-defeating for those of us who argue against sex discrimination to deny that there are any biological differences. It is possible that a truly determined researcher using sophisticated experimental techniques can demonstrate that some components of behavioral differences are sex linked. If one's case against discrimination is based on the assumption that no differences exist, then one such finding logically destroys the whole case. It is much more realistic to argue that since so many non-biological factors are involved in causing sex differences in cognitive abilities and other aspects of behavior, whatever differences are due to fixed biological factors cannot be used to justify discrimination against women or against men.

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