Gender Differences in Human Cognition

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Counterpoints
COGNITION, MEMORY, & LANGUAGE

GENDER DIFFERENCES IN HUMAN COGNITION

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Preface

This contribution to the Counterpoints series is concerned with the issue of whether women and men differ in terms of their intellectual abilities. Women are sometimes said to outperform men in verbal ability, and men are sometimes said to outperform women in mathematical and spatial ability. Are these assertions true? If so, where should one look for the origins of these differences? In the biological makeup of women and men? In influences during childhood? Or in cultural stereotypes? Yet, if these assertions are not true, why do people continue to make them?

In Chapter 1, I set the scene by providing a brief review of the historical development of research into differences between women and men insofar as it is relevant to contemporary discussions regarding actual or potential differences in intellectual abilities. I then describe the various issues that are involved in conducting and evaluating research on differences between men and women, as well as the broad range of theoretical explanations of the findings obtained in such research.

In Chapter 2, Janet Shibley Hyde and Nita McKinley introduce the techniques of meta-analysis, which have been used to integrate the results of studies on the existence and magnitude of differences in the cognitive performance of men and women. Hyde and McKinley review research on verbal, mathematical, spatial, and scientific abilities, and they examine findings from the Study of Mathematically Precocious Youth. They also describe results that suggest that gender differences have been growing smaller over recent decades.

In Chapter 3, Paula Caplan and Jeremy Caplan maintain that much research on gender differences in cognition has been poorly conceived and executed, and that its findings have been quite irresponsibly interpreted in order to keep women "in their place." They suggest that profound conceptual and methodological problems undermine the validity of research on gender differences in mathematical, spatial, and verbal abilities, and they raise the more basic question of why the search for gender differences in cognition has been, and continues to be, so intense.

In Chapter 4, Mary Crawford and Roger Chaffin illustrate some of the negative consequences of a focus on *differences.* As an alternative, they locate the subject of differences between men and women within a framework that regards gender as a social system that organizes relations of power and status. By referring to research on mathematical and spatial abilities, they use this framework to demonstrate how situational and contextual variables can give rise to systematic gender-related effects on cognitive performance.

Finally, in Chapter 5, I integrate the main conclusions from the various contributors into a single statement regarding the nature and origins of gender differences in human cognition.

The idea for this volume was originally proposed by the series editor, Marc Marschark, and the Executive Editor at Oxford University Press, Joan Bossert. In editing the volume, I have been most grateful for their kind support, for the cooperation and input of the other contributors, and for technical assistance from Mark Mower and his colleagues in the Department of Human Sciences at Brunel University.

Brunel University *J. T. E. R.*
June 1996

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CHAPTER 1

Introduction to the Study of Gender Differences in Cognition

John T. E. Richardson

Men and women have probably been alleged to differ from each other in every area of psychological functioning at some time or another. This book is concerned with the specific hypothesis that women and men differ in terms of their cognitive abilities and, by implication, in terms of the underlying cognitive representations and processes. In his *Dictionary of Psychology,* Drever (1952) explained that "cognition" was "a general term covering all the various modes of knowing—perceiving, imagining, conceiving, judging, reasoning" (p. 42). However, the psychological research exploring gender differences has focused on particular domains of cognitive functioning: mathematical, spatial, and verbal abilities. It is typically claimed that men outperform women in mathematical and spatial abilities, and that women outperform men in verbal abilities. Accordingly, these specific aspects of human cognition are the ones that receive the most attention in this volume.

In this chapter, I briefly review the historical development of research into differences between women and men as it relates to contemporary discussions concerning actual or potential differences in cognition. I then consider methodological issues that are involved in research on differences between men and women and the broad variety of theoretical accounts that tend to be put forward in order to explain the findings obtained in such research. I illustrate some of these issues by discussing the research findings obtained in the case of one particular measure of spatial ability, the Rod and Frame Test. Finally, I summarize the main points to be presented in each of

the substantive contributions to this volume and trace the evolving thread of argument that runs through the book as a whole.

HISTORICAL BACKGROUND

The origins of contemporary research on differences between women and men lie in traditional concerns either to support or to refute assumptions and expectations about the appropriate social roles for men and women (see Mosedale, 1978; Shields, 1975). When conventional explanations based upon religious doctrine ceased to command general assent in the early 19th century, scientists and other thinkers began to look for differences that could account for men's supposedly greater intellect, because this, in turn, was assumed to explain the subordinate social position of women and their consequent confinement to the roles of wife and mother.

Because the seat of the intellect was believed to be situated in the brain, researchers focused upon differences between the brains of men and women. The discipline of phrenology was based on the assumption that the structure of the brain would be manifest in the structure of the cranium; consequently, the expected differences in women's and men's brains should be evident in studying the cranium. Phrenologists believed that they had found such differences: The frontal lobe was less developed in women than in men; women's brains were more developed for nurturing traits, but men's were more developed for aggressiveness and constructiveness; and the brain tissue itself was softer in the female brain, they claimed (Walker, 1850).

As more sophisticated techniques were developed for investigating the brain, phrenology fell into disuse, but the search for gender differences favoring men persisted. It was frequently assumed that the female brain was smaller than the male brain, supposedly reflecting inferior reasoning ability. Traditionally, the size of the brain was estimated at autopsy by weighing the excised brain or by measuring the volume of the cranium. In living subjects, the volume of the brain can be estimated indirectly from external measurements of the skull. Today, the volume of the brain can be estimated from X-ray photographs or from magnetic resonance images.

By the mid 1800s, considerable evidence had accumulated that the male brain was indeed both larger and heavier in absolute terms than the female brain. It was usually assumed that the "missing five ounces of the female brain" accounted both for women's alleged intellectual inferiority and for their restricted social position (see Mosedale, 1978). Nevertheless, the use of the absolute size of the brain as an index of intellectual ability was problematic, because it entailed that animals with larger brains were more

intelligent than humans were. The hypothesis that the male brain was larger than the female brain was consequently revised to refer to a gender difference in the size of the brain relative to the size of the body.

In fact, the evidence suggested that the weight of the brain relative to the weight of the body was actually greater in women than in men. This led to the development of other measures that might once again confirm the presumed intellectual superiority of men, including comparisons with body height or the weight of the thigh bone (Haller & Haller, 1974, pp. 50–51). It was argued that the surface area of the brain relative to the surface area of the body was greater in men than in women, and more specifically that the cortex of the female brain contained fewer convolutions than its male counterpart. However, one critic pointed out that, on this basis, men ought to be inferior to "certain animals which are regarded as stupid and dull, such as sheep" (see Mosedale, 1978, p. 47).

More recently, adjusting or scaling physiological measurements by the use of simple ratios has been criticized on the grounds that it assumes that the relevant measurement varies *isometrically* with body size: in this case, that absolute brain size is just a direct proportion of body size, so that relative brain size is constant for each sex. Packard and Boardman (1988) showed that these adjustments could give rise to misleading conclusions if the variable in question varied *allometrically* with body size (i.e., if it was not a direct linear function of body size). Jerison (1982) noted that the function that provided the best fit to the relation between brain size and body size, both within the human species and across different species, was a negatively accelerating curve and not a straight line. This implies that relative brain size varies inversely with absolute body size, a point that was demonstrated empirically by Ankney (1992).

During the 19th century, some writers postulated that the average weight of the brain was greater for men than for women of the same height (see Haller & Haller, 1974, p. 51). This seems to have been demonstrated first by Gould (1981, p. 106), but Ankney (1992) confirmed that, for any given body size, the average size of the brain was larger in males than in females. Although some have tried to link this finding to putative gender differences in intelligence (e.g., Lynn, 1994), the difference between men and women in the overall size of their brains does not seem to correspond to any difference in the number of cortical neurons (Haug, 1987). Indeed, Ankney recognized that the difference in brain size might be determined by variables that had little to do with cognitive functioning, such as muscularity or metabolic rate.

The logic of this kind of argument can indeed be reversed. This was first noted by Mosedale (1978), who reported the observation by one 19th-century writer that "the male brain can not fall below 37 ounces without

involving idiocy; while the female may fall to 32 ounces without such a result." As Mosedale pointed out, this "seems to imply that the feminine brain surpasses the masculine in 'productive capacity' per ounce of brain tissue, if males require more brain matter to be normal" (p. 32). Since women achieve similar test performance to men across a wide range of abilities despite having smaller brains, Ankney (1992) noted that women's brains might actually be regarded as more efficient than those of men, in that men apparently require more brain tissue to achieve the same level of ability at processing information. This interpretation is consistent with the finding that men and women possess the same number of cortical neurons in spite of the difference in their overall brain size or, in other words, that women have a higher density of neurons than men have (see Haug, 1987; Witelson, Glezer, & Kigar, 1995).

Other researchers examined specific areas of the brain in attempts to prove the alleged superiority of men. Until the end of the 19th century, it was believed that men had more developed frontal lobes but that women had more developed parietal lobes. Some scientists then proposed that the parietal lobes, not the frontal lobes, were the seat of the intellect, and evidence was soon forthcoming to show that in fact it was men who had more developed parietal lobes, but that women had more developed frontal lobes (Mosedale, 1978). More recently, researchers have continued to look for evidence that men and women differ in terms of the anatomical structure of their brains. However, they have tended to move away from making general statements concerning the gross anatomy of the brain to putting forward specific hypotheses about circumscribed neural structures.

One structure of interest is the corpus callosum, the band of fibers that transfers information between the cerebral hemispheres (cf. Gould, 1981, pp. 77–81). In one study, it was claimed that the posterior portion of the corpus callosum was larger and more bulbous in women than in men (de Lacoste-Utamsing & Holloway, 1982), in spite of the fact that women's brains as a whole tend to be smaller than those of men. However, another study based upon a larger sample of cases found no evidence for such a pattern; indeed, in those individuals who had not been consistently right handed, the posterior portion of the corpus callosum tended to be larger in males than in females, even when differences in the total weight of the brain had been taken into account (Witelson, 1985; see also Bleier, 1988).

Recently, other researchers have adopted a different strategy in light of more general developments in understanding the physiology and organization of the brain. They have proposed that women and men differ in the anatomical localization of particular psychological functions in the brain, especially with regard to the lateralization of those functions between the

two cerebral hemispheres (see Tavris, 1992). For instance, it has been claimed that women are less likely than men to exhibit asymmetries favoring structures within the left hemisphere that are thought to be involved in language function (Kulynych, Vladar, Jones, & Weinberger, 1994). Speculations of this kind constitute one type of explanation for apparent differences in the cognitive performance of men and women, and I examine them in more detail later in this chapter. Before doing so, however, I need to discuss several methodological and definitional issues that arise in this kind of research.

RESEARCH ISSUES

First, it is very important to clarify the distinction between *sex differences* and *gender differences.* "Sex" marks an essentially biological distinction between women and men that may be based upon their anatomical, physiological, or chromosomal properties. "Gender" marks a sociocultural distinction between men and women on the basis of the traits and behavior that are conventionally regarded as characteristic of and appropriate to the two groups of people. Feminist theorists and others have classically argued that gender is a social construction that is linked by society to each sex in a wholly arbitrary way and learned quite independently of the underlying biological information (see Humm, 1989, pp. 84, 203; Tresemer, 1975; Unger, 1979). In most psychological research (but not all), it is appropriate to talk of "gender differences" rather than "sex differences," because the participants are categorized on the basis of their outward appearance and behavior, not on the basis of biological characteristics. This is reflected in the title that we have chosen for this volume.

The idea that "gender" is constructed, created, and acquired through social interactions is often contrasted uncritically with the notion that "sex" is given, innate, and based upon objective biological reality. For instance, in introducing a recent volume concerned with the psychology of gender (Beall & Sternberg, 1993), Sternberg (1993) asserted that "everyone agrees that sex is biologically determined" (p. 2), and, indeed, all the contributors to that volume appear to concur with this idea without exception. Recently, however, radical feminist theorists have pointed out that the biological notion of sex is itself socially constructed: More precisely, it is constituted in those cultural practices according to which specific biological characteristics or markers are taken to "underlie" the assumed dichotomy between male and female.

This can be illustrated by the fate of those children born in Western societies who do not fit neatly into one of the two available categories. Children

with congenital adrenal hyperplasia, for example, receive surgery and hormonal treatment in order to reconcile their external appearance and sexual functioning with their gonadal structures and chromosomal status. On the other hand, children with Turner's syndrome are invariably labeled as "female" on the basis of their genital anatomy, even though they are in other respects essentially neuter. Either way, society chooses to alter the children in question rather than to expand the available categories. Nevertheless, other societies may construe the distinction between "male" and "female" in quite different ways (see, e.g., Porter Poole, 1981).

Although borderline examples arise in both cases, "sex" and "gender" relate to distinctions that are constructed as rigorous dichotomies. In contrast, most actual or alleged differences between females and males in their physical characteristics and their behavior constitute overlapping distributions on a continuous dimension rather than any strict dimorphism (see Morgan, 1980; Nyborg, 1983). Height and weight are obvious examples of this. Moreover, to talk of a "difference" tends to stress the contrast between these two groups at the expense of the within-group variation. A number of authors have noted that, in the case of psychological variables, gender differences often do not occur at all and that, when they do occur, their magnitude (in other words, the degree of separation between the two distributions) is often very small relative to the overall variation (see Anderson, 1987; Caplan, MacPherson, & Tobin, 1985; Hyde, 1981; Jacklin, 1981; Plomin & Foch, 1981; see also Chapter 2, this volume).

Some researchers have noted that even modest gender differences in ability could have major practical consequences (Eagly, 1995; Rosenthal & Rubin, 1982), especially if the effects are cumulative across individuals, or if people are being sampled from one end of a distribution, as in selection for education, training, or employment (Burnett, 1986; Johnson & Meade, 1987). However, such comments in themselves already assume that there are differences between women and men in terms of their underlying cognitive abilities and not simply in terms of observable behavior. To predicate social policies and action upon such assumptions runs the risk of reinforcing and perpetuating differential patterns of behavior in men and women, when these may in fact originate not in differences in ability but in social or cultural influences (see Chapter 3, this volume).

Sex and gender are also classification variables that are determined in advance of a research project rather than treatment variables that are under experimental control. In other words, in making comparisons between men and women, it is not possible to assign the participants at random to two different groups or conditions. It follows that the findings will be purely correlational in nature, and that any differences may well be due to the

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