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Reviews

Gender Differences in Mathematics: an Integrative Psychological Approach. Edited by Ann M. Gallagher and James C. Kaufman. Pp 351. Cambridge: Cambridge University Press. 2005. £17.99 (pbk). ISBN 0 521 53344 9 (pbk).

Lawrence Summers, president of Harvard University, ignited a powder keg when he suggested – as an invited provocateur – that the difference in the number of men and women in high-level research positions in mathematics and the sciences might be related to inherent differences between the sexes, among other factors. Although the outrage expressed by many members of the academic community was, in my opinion, overblown, the attendant controversy has had the beneficial affect of focusing attention on an area of research that is of both scientific and practical importance. Gallagher and Kaufman's edited collection of 15 chapters provides a timely overview of much of the state of knowledge of our understanding of sex differences in mathematics classrooms, on standardised achievement and ability measures, and in career choices, although there are important gaps in this coverage; for instance, a chapter by Lubinski and Benbow on their long-term study of mathematically gifted people would have added an important dimension (e.g., Lubinski *et al.*, in press).

In any case, Chipman opens the volume with a personal retrospective on her experiences as a researcher in this area, and provides a good review of historical trends in the pattern of sex differences in advanced course taking in mathematics and undergraduate degrees earned in mathematics. Over the past 40 years, the advantage of men in these areas has virtually disappeared but, at the same time, a gap has remained in other areas. The advantage of men on standardised achievement and ability tests, especially at the high end of performance, has not changed substantially in the past 30 to 40 years (see chapter by Halpern), and the sex difference in the proportion of earned doctorates in mathematics and related fields (e.g., physics) not changed much in the past 10 years (women earn about 15 per cent of 25 per cent of these degrees in the United States; Hill and Johnson, 2004). Much of the remainder of her discussion and the focus of many of the other chapters are on examining evidence related to social, cognitive, or biological factors, or some combination, that might contribute to the sex differences for these outcomes. Many of the authors acknowledge multiple influences and a few (e.g., Halpern *et al.*, Byrnes, Nuttal *et al.*) focus on interactions among these factors, but the majority tend to emphasise potential social (e.g., Chipman, Caplan and Caplan, Cohen and Ibarra, Davies and Spencer, Ben-Zeev *et al.*) or cognitive/biological (e.g., Nuttal *et al.*, Royer and Garofoli) influences.

With respect to social factors, an historical focus on blatant discrimination against women and fewer educational opportunities for women (Sells, 1980) has shifted to sex differences in interests (e.g., people versus non-living mechanical objects), the stereotype that maths is a 'male domain', stereotype threat, mathematics anxiety, and self efficacy. The presentations range from poorly supported ideological arguments (Caplan and Caplan) to serious scientific study of the correlates and potential causes of the above noted sex differences (e.g., Davies and Spencer, Jacobs *et al.*). Of these potential correlates or causes there is now substantial

support for the view that girls and women have a stronger interest, on average, for study in fields that involve dealing with people (e.g., medicine) or living things (e.g., biology), whereas boys and men have a stronger interest, on average, for study in fields that involve dealing with abstractions (e.g., mathematics) or non-living things (e.g., engineering). This sex difference, in turn, influences course-taking in college and later career choices.

The chapters by Davies and Spencer and Ben-Zeev *et al.* *focus* on stereotype threat; specifically, the stereotype that girls and women are not as skilled in mathematics as boys and men results in a concern that poor performance on mathematical tests will confirm this negative stereotype. The concern, in theory, results in increased worry and anxiety during test taking and thus lower performance. To date, the theory is supported in lab settings, but only with high-ability samples of women who are heavily invested in mathematics. The model developed by Eccles and her colleagues and described in the chapter by Jacobs *et al.* is the most nuanced and sophisticated of the social theories. They provide some evidence that parental beliefs and attitudes can contribute to sex differences in interest in mathematics. As the authors note, however, it is not clear whether these relations emerge because parents are reacting to the different interests of girls and boys, or whether parents are contributing to these sex differences.

Halpern *et al.*, Royer and Garofoli, and Nuttal *et al.* conclude that the advantage of boys and men in certain spatial domains, such as the ability to visual shapes and motion in three dimensions, contributes to the male advantage on certain types of mathematical problems and on high stakes tests such as the Mathematics section of the Scholastic Achievement Test. This is not the whole story – Royer and Garofoli provide evidence that a male advantage in speed of accessing basic facts from long-term memory is also involved – but the evidence for the importance of spatial abilities for some forms of mathematical problem solving is strong. These authors and others (e.g., Byrnes) propose that the male advantage in spatial abilities is related at least in part to biological factors (e.g., pattern of early brain lateralisation), a conclusion that is disputed in several other chapters (e.g., Caplan and Caplan).

It is almost certain that the advantage of boys and men on some standardised mathematics tests and in the pursuit of mathematics and related fields as a career is due to many factors. The best supported of these are the sex differences in interests (e.g., in careers involving people) and in spatial abilities, but the question of the origin of these differences remains debated. In all, *Gender Differences in Mathematics* provides timely and useful coverage of what we currently know about these differences and an interesting historical snapshot of the various arguments and debates regarding these differences.

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