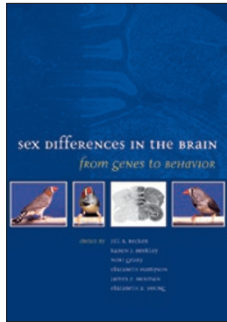


## Fraternizing with gender differences



### **Sex Differences in the Brain: from Genes to Behavior**

**Edited by Jill B Becker, Karen J Berkley,  
Nori Geary, Elizabeth Hampson,  
James P Herman & Elizabeth Young**

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**Reviewed by Alfredo Durazzo &  
S Marc Breedlove**

As America wrestles with whether it's ready for a woman president, amid sex scandals populated exclusively by male politicians, the issue of how and why men and women come to behave differently continues to color our headlines. As usual, scientists have something to say about these issues, and, as usual, no one outside of science seems to care much about what that might be. This compendium of reviews from leaders in the field of sexual differentiation of behavior brings together an authoritative and timely perspective on how sex differences in behavior evolved in animals, how those sex differences in behavior unfold during development in nonhuman animals and the extent to which these findings apply to our own species.

In general, the book does a good job of tackling complex issues such as genetic versus gonadal sexual differentiation, presenting some of the most recent and relevant findings on this topic, such as *de novo* estrogen synthesis in the zebra finch brain and defeminization of female mice lacking the aromatase enzyme. The authors manage to address the complexity of the subject while still maintaining a style of writing that both graduate and undergraduate students can find engaging. Also addressed is the evolutionary question of why the sexes sometimes strive to be the same. The book gives a solid, comprehensive review of steroid receptor molecular biology, which may be lacking in textbooks.

Sex differences in the brain are also becoming increasingly relevant to neuropsychiatric disorders, as the book describes. For example, the authors underline the clinical relevance of neurological sex differences in the etiology of anxiety disorders and the potential for treatment (for example, estrogen alleviates anxiety symptoms in postmenopausal women). Furthermore, emerging studies (such as one by Kimchi, Xu and Dulac that was published last year in *Nature*) continue to challenge the accepted dogma in this field, making it important for students to be aware of this dynamic and continually evolving subject and develop a broader perspective of how gonadal hormones function in tandem with other neurotransmitters to exert their effects.

*Sex Differences in the Brain: from Genes to Behavior* addresses these issues, for example, by mentioning that vomeronasal organ ablation in naive male rats severely impairs sexual performance, although it causes minimal impairments in sexually experienced males, emphasizing the importance of learning and memory in sexual behavior.

As with most edited volumes, some ideas are left dangling in one chapter without ever being taken up again for resolution later. For example, an early, well-organized chapter on strategies and methods for research discusses the possibility that sex chromosomes may act directly on the brain, without a hormonally mediated link, to direct sexual differentiation. In discussing humans with androgen insensitivity syndrome (AIS), this chapter points out that if such direct sex chromosome effects occur in people, one would expect women with AIS, who have a fully masculine XY genotype but a feminine exterior, to show some evidence of masculinization of behavior. This sets up the question nicely, but according to the index and our reading, women with AIS never come up again later in this chapter or in the several subsequent chapters regarding sex differences in human behavior. A reader might think that this question has never been answered, but in fact the behavior of women with AIS has been studied and found to be quite feminine, suggesting that sex chromosomes have little or no direct nonhormonally mediated effect on sexual differentiation of human behavior.

Likewise, many chapters talk about the role of aromatization of testosterone to estrogens to masculinize the brains of rodents, but no chapter mentions how AIS women (and several other findings in humans) indicate little or no role for aromatization for masculinization of human behavior. Quite the contrary, the fully feminine behavior of AIS women indicates that if any hormone receptor mediates masculinization of the human brain, it is the androgen receptor rather than the estrogen receptor. Even in rodents, there is growing evidence that androgen receptors are as active in masculinizing the brain as the estrogen receptor, which represents one of the few new ideas omitted from the book. The text does not address neuroanatomical sex differences in great depth, but this is understandable, given the more reductionist approach the field has taken in recent years. Another burgeoning topic that could have been more thoroughly addressed is the cellular and molecular mechanisms underlying brain sexual differentiation.

The chapters are thoughtfully organized, and the introduction and conclusion sections effectively pique the reader's interest. A comprehensive scope, with capable and active researchers as authors, is a strength of the volume. Several chapters bringing together scientists with separate research approaches as coauthors to produce new perspectives are another bonus of this book. This is an ideal volume for advanced undergraduates, either to supplement a textbook in behavioral endocrinology or as a separate seminar following such a course. Graduate seminars would also benefit from the book's broad scope. As comedian Robert Orben said, "Nobody will ever win the battle of the sexes; there's just too much fraternizing with the enemy." However, we can at least attempt to understand the playing field. ■

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