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Ceci, Stephen J. & Williams, Wendy M. (2010). *The Mathematics of Sex: How Biology and Society Conspire to Limit Talented Women and Girls*. Oxford University Press, USA.

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Reviewed by Susan Holloway
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Almost twenty years ago I graduated at the top of my class from a mechanical engineering program and proceeded to work in the field before leaving for what I thought would be a temporary hiatus as I raised two children. For several years I met regularly with a set of female friends with similar credentials to talk and to drink beer. Okay, mostly to drink beer. I've kept track of many of those women, and the unfolding of their lives has fueled my own small study of the same topic that I find in this book. In fact, my experience and observations are almost exactly mirrored by what these authors say about why so few women enter math intensive fields, and why so many women leave once they get there.

In their book, *The Mathematics of Sex*, authors Stephen Ceci and Wendy Williams employ formidable depth of research to answer for themselves, and for all of us, why

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there are so few women in math related professions. The authors hail from Cornell University where their life work is to investigate the formation of intelligence.

Ceci and Williams use *The Mathematics of Sex* to dissect and analyze hundreds of studies for us. It would seem that they have considered every possible correlating variable in their quest to understand the persistent and troubling trend of bright women leaving math related professions. While the sheer mass of studies from which they gleaned their understanding adds credibility to the authority with which they state their thesis, I began to wonder why these authors did not create a more accessible book for a topic of more or less general interest. That is, while a discussion of androgen control of finger ridge counts may imply a thorough investigation, it is irrelevant minutia to most readers.

Perhaps the authors' intense and sometimes obscure focus on data can be partially explained by a request that was repeated throughout the book. Over and over, Ceci and Williams ask for adherence to the rules of engagement for scholarly debate. Please, they implore, do not roll out words like sexism and hegemony because you do not agree with these findings. Please produce your own data and submit to the rigor of peer reviewed journals. Evidently, Ceci and Williams have found themselves in the crosshairs of polemical debate surrounding their work, and they do not appreciate being crucified for reporting trends that are clearly upheld by the data.

So the emphasis on a dispassionate view of the research findings belies a passionate topic, one which not only influences the lives of many women, but which also dictates the form and the direction of science in the United States. Math related careers, identified with the acronym STEM (Science, Technology, Engineering, and Mathematics), are one of the last bastions of career super-dominance by males. Not only are women in STEM disciplines underrepresented within the numbers of recent graduates, but women leave STEM careers at greater rates than other careers so that the field of those practicing as professionals within these disciplines is extraordinarily male dominated.

The authors examine evidence from more than 400 studies originating in the physical sciences, economics, and

Stephen J. Ceci holds a lifetime endowed chair in developmental psychology at Cornell University, where he studies the development of intelligence, memory, and sex differences. Dr. Ceci has served on the White House Task Force on Children and Families, the National Academy of Science Board of Cognitive, Sensory and Behavioral Sciences, and the National Science Foundation Advisory Board.

Wendy M. Williams is a Professor in the Department of Human Development at Cornell University, where she studies the development, assessment, training, and societal implications of intelligence in its many forms. She has authored or edited thirteen books and dozens of articles, including the 2007 volume *Why Aren't More Women in Science?*

education in order to form their thesis which is presented in three main arguments. First, Ceci and Williams inspect data about the social and cultural barriers that exist for women in STEM fields to make a statement about the environmental influences on this gender disparity. The biological portion of the argument relates research about women's innate mathematics abilities when compared to men. The third perspective questions whether women might simply be less interested in math related fields, and investigates the possible reasons for this.

The authors commence a pattern of setting out the data and evaluating it, but then challenging everything they've previously shown us or challenging the statistical significance of the initial research. While the effect of this tactic may fit the complexity of the data, the effect on a reader is sometimes confusion. At the end of a conflicting set of presentations, I found myself referring to concluding remarks in order to confirm the authors' final stance.

For example, in one set of findings having to do with biological differences between men and women, a discussion ensues about differences in cognition and perception that appear with hormonal influence. Statistical evidence supports the fact that mathematical abilities could be affected by sex differences, but the authors demure and point to a contradictory study. The first statistically supported point of view is that males consistently outperform females on exams which are designed to test high level cognitive mathematics related skills such as the SAT-M (Scholastic Achievement Test – Mathematics). After presenting a cogent set of data, the authors refer to a second set of data that shows that women consistently outperform men in college level mathematics. So which is it? Does the SAT-M fail to predict college level mathematics ability, or does the SAT-M measure some mathematics ability that is not evaluated in college? As with most of the studies considered here, the complexity of this research disallows simplistic statements.

The discussion about environmental correlations for women in STEM careers was also lengthy, but it was curiously limited in breadth, and in fact, is the basis for my central criticism about the book. When examining environment, the authors seem only to consider the

conundrum that women find themselves in within a tenure system. Having worked on both private sector and government research contracts, I recognize that many of the issues that Ceci and Williams detail are common to both tenure systems and private sector settings, but the authors fail to talk about any examples except those in academia. They fail to acknowledge the practicing women engineers who are sizing ductwork for hospitals, creating shut-down procedures for nuclear plants, designing satellites, or otherwise engaged in high level math careers that are not part of the university tenure system. The voices and conditions of these women are not even considered, and I would hazard to guess that prejudices in the private sector are stronger and hiring patterns more traditional than university systems which receive more public scrutiny.

Even so, statistics about career advancement would seem transferable between STEM occupations, and it is within this realm that we find irrefutable patterns that work against women. In familial decisions, for example, high ability women tend to partner with high ability men, and this means that two careers tend to overwhelm the household's temporal resources. In their quest for advancement, men are rewarded for their marital condition, seeming more stable, while women gain no professional status. The presence of children widens the career advancement gap, as women persist in taking on more of the familial responsibilities and are therefore put at a disadvantage in competitive positions. The result is that women must ultimately make a choice between focusing on their family and achieving success in their careers. Why does this choice create such a disparity for women in the STEM careers when it does not appear so evident for other careers? Ceci and Williams think that it is because information within the STEM fields becomes obsolete more quickly and therefore creates larger penalties for women taking time off for child rearing. It is because women, unlike men, are pressured to choose between their personal lives and their STEM related professional lives.

And how do the findings of Ceci and Williams relate to my cadre of female engineer friends? I must say rather accurately. Out of about 15 women who were practicing engineers or computer programmers, only four are still in a

STEM career today. We had begun to meet, mostly childless, in our twenties, but as we aged and had children, one by one, we left our math-intensive fields. Of the four remaining in engineering, three women had significant assistance with child care from their nearby families.

I recommend that a wide variety of folks take the time to read and consider the message contained in this book. In particular, policy makers and large employers who have the authority to make employment more family friendly and therefore more survivable for women. On-site daycare and flex-time for both men and women are options that are proven to offer relief to families, but that are still unavailable in many employment venues. Educators should read this book and ought to think of how to increase the number of women entering math intensive fields so that attrition doesn't devastate women's numbers quite so profoundly. Finally, women who are interested in mathematics as a profession should read this to have a more clear understanding of the trends and how they might either overcome or accommodate the inherent challenges in their fields.

About the Reviewer

Susan Holloway has a BS in Engineering (University of Tennessee), a BA in Education (University of Arizona), and a Master of Arts in Education (in Bilingual/Bicultural Education from the University of Colorado). She worked several years on exotic materials and alternative energy in the aerospace industry and has taught school in Arizona, Colorado, Tennessee, and Mexico. Ms. Holloway currently teaches at the New America School in Lakewood, Colorado where she is a secondary math instructor with a specialty and endorsement in English as a Second Language (ESL) students. She is a doctoral candidate at the University of Colorado in Educational Leadership. Ms. Holloway has published her writings in *The Colorado Mathematics Teacher*, and has also shared her ideas via conference proceedings and presentations at CoTESOL (Colorado Affiliate of Teachers of English to Speakers of Other Languages) and CCTM (Colorado Council of Teachers of Mathematics).

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