

Lack of ability does not explain women's decisions to opt out of math-intensive science careers

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Women don't choose careers in math-intensive fields, such as computer science, physics, technology, engineering, chemistry, and higher mathematics, because they want the flexibility to raise children, or because they prefer other fields of science that are less math-intensive--not because they lack mathematical ability, according to a new study.

The study, an integrative analysis of 35 years of research on sex differences in math, offers explanations for why women are underrepresented in math-intensive science careers. The findings appear in the March issue of *Psychological Bulletin*, published by the American Psychological Association.

Researchers from Cornell University reviewed more than 400 articles and book chapters to reconcile conflicting evidence on why math-proficient women are underrepresented in math-intensive fields such as engineering, why they choose less math-intensive fields (such as biology, medicine, dentistry and veterinary medicine), and why when they do choose math-intensive careers, they are more likely to drop out as they advance.

"Career preferences and lifestyle needs largely dictate why women aren't choosing physics or engineering as their profession," said lead author Stephen J. Ceci, PhD. Women with advanced math abilities choose non-

math fields more often than men with advanced math abilities. They also drop out of scientific fields--especially math and physical science--at higher rates than do men, particularly as they advance, said Ceci.

"A major reason explaining why women are underrepresented not only in math-intensive fields but also in senior leadership positions in most fields is that many women choose to have children, and the timing of childrearing coincides with the most demanding periods of their career, such as trying to get tenure or working exorbitant hours to get promoted," Ceci said.

Further, if women enter these fields, they are more likely to drop out before they advance very far due to the need for greater flexibility and the demands of parenting and caregiving, said co-author Wendy M. Williams, PhD. "These are choices that all women, but almost no men, are forced to make."

Women today compose approximately 50 percent of medical school classes; however, despite these gains, women who enter academic medicine are less likely than men to be promoted or serve in leadership posts, the authors said. As of 2005, only 15 percent of full professors and 11 percent of department chairs were women. Non-math fields are also affected: for example, only 19 percent of the tenure track faculty in the top 20 philosophy departments are women.

"Hormonal, brain and other biological sex differences did not emerge as primary factors explaining why women were underrepresented in science careers," said co-author Susan Barnett, PhD. And the authors found studies on social and cultural effects to be inconsistent and inconclusive.

Much of the evidence on discrimination was dated or anecdotal, the authors said, and the effects were not strong enough to explain women's current low numbers in math-intensive fields. "Even though institutional

barriers and discrimination exist, these influences still cannot explain why women are not entering or staying in STEM careers," said Ceci. "The evidence did not show that removal of these barriers would equalize the sexes in these fields, especially given that women's career preferences and lifestyle choices tilt them towards other careers such as medicine and biology over mathematics, computer science, physics, and engineering."

Men did outscore women on spatial ability tests, a measure that predicts later mathematics achievement but, said the authors, this still doesn't account for the low numbers of women in the STEM fields. Moreover, studies showing that men's scoring in the top 1 to 0.1 percent on the SAT-M and GRE-Q exams more frequently than women cannot account for the low numbers of women in math-intensive careers.

The evidence shows that if math ability were solely a function of sex, there would be roughly double the number of women in math-intensive careers compared to what exists now, assuming a 2:1 male-female ratio at the top 1 percent in math ability, Ceci said. "Women would comprise 33 percent of the professorships in math-intensive fields if it was based solely on being in the top 1 percent of math ability, but they currently comprise less than 10 percent."

Several large surveys examined in the analysis found that lifestyle choice had the largest influence on career preferences. In a survey of 2,000 33-year-old academic professionals in science careers who were in the top 1 percent of their high school math classes, the men devoted more time to their current job and said they would devote even more time in their dream job compared to the women, suggesting that this could lead to more productivity and promotions.

Another survey of almost 5,000 tenure-track faculty at nine California universities revealed that family issues affected women's success and

satisfaction more than it affected men's. And a National Science Foundation survey of doctoral recipients in scientific and engineering fields found that women with children under 18 worked and published less than the men.

Science, technology, engineering and math are not the only professions affected by women's career choices, said the authors. Several studies showed that while women are well-represented in less math-intensive fields, such as medicine, law, biology, psychology, dentistry, and veterinary science, they are still underrepresented in the top positions of these fields. They are either not on tenure track, drop off tenure track or opt for part-time positions until their children get older, the researchers found.

"It appears that the family-career trade-offs constitute a major factor in the dearth of women in fields such as engineering, physics, computer science and in higher-level positions in non math-related fields," said Ceci. "Women who are good in math seem to have more career options. Those who are highly competent in math are more likely than men to have high verbal competence, too, thus opening up the option of going into the humanities or law, which may offer more flexibility in their career tracks."

There are ways to remedy the situation, the authors said. They suggest that universities, other institutions and companies create options for women with math talents who want to pursue math-intensive careers. These could include deferred start-up of tenure-track positions and part-time work that segues to full-time tenure-track work for women who are raising children, and courtesy appointments for women unable to work full-time but who would benefit from use of university resources (e-mail, library resources, grant support) to continue their research from home.

More information: Article: "Women's Underrepresentation in Science: Sociocultural and Biological Considerations," Stephen J. Ceci, PhD, Wendy M. Williams, PhD, and Susan M. Barnett, PhD, Cornell University; *Psychological Bulletin*, Vol. 135, No. 2.
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