Why are girls severely under-represented among top scorers on challenging math tests?

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Researchers are still working on this question, but we do know the following:

Girls and boys have similar math scores in Kindergarten, but girls begin to lose ground during elementary school. However, differences in confidence are larger than differences in actual math test scores, and overall gender differences in math test scores are small (typically .1 to .3 standard deviations or less, or roughly a few months of schooling). (See Lubienski, Robinson, Crane and Ganley's 2013 article in the Journal for Research in Mathematics Education for more information)

Girls do very well in school math – they get good grades and perform as well as boys on standardized tests that mirror the school curriculum, as well as tests that have few challenging problems. This is why some state tests show no gender disparities.

However, gaps at the very top of the achievement distribution are larger, especially on tests that do not simply reflect the school curriculum. For example, among 125,000 students who took the American Mathematics Competition test, boys outnumbered girls 6 to 1 among the top 1% of scorers, and 12 to 1 among the top .1%. It's worth noting that 43% of the test takers were female, and the highest-scoring girls came from a relatively small set of schools. This suggests that girls in other schools are interested but are not scoring as well as they could be. (For more information, see Ellison & Swanson's 2010 article in the Journal of Economic Perspectives.)

Gaps in high school mathematics course taking and even undergraduate mathematics majors have drastically narrowed over the past decades. Still, the percentage of women in lucrative math-intensive fields (e.g., engineering, computer science) remains around 20% and this disparity contributes to serious wage gaps between men and women.

As to the question of why these disparities persist, there are several factors at play.

Work by Sian Beilock and colleagues reveals that the math anxiety of (predominately female) elementary teachers have a detrimental affect on the girls in their classrooms.

My research with Joe Robinson-Cimpian and others has revealed that teachers under-rate the abilities of girls when compared with equally performing and behaving boys, and diminished teacher expectations of girls in math may have a detrimental affect.

Work by Jacque Eccles and colleagues has shown that males and females, on average, hold different occupational values, with females' more likely to want to work with people. These differences in values may affect which subjects high school students prioritize.

Girls are relatively strong in other subjects, such as reading, and so with more options available, they may be less likely to pursue high-level math.

Some believe spatial skills may play a role. However, there is ample evidence that spatial skills can be taught, and so gender differences in spatial skills should not be viewed as fixed or inevitable.

My current research is examining another possibility — the "good girl" hypothesis" — for why we see the gap particularly among high scorers. That is, girls are more often conditioned to follow rules and obey authority. In math class, this can mean that girls do well in following teacher-given rules, but they may be less likely to develop the bold problem solving skills needed to solve non-routine problems, including those on the American Mathematics Competition test, and some items on the SAT.

This work is continuing, but frankly, I have found that research on gender and math is a bit of a "hard sell" compared to other types of research, since girls do very well in school generally, and disparities by race and SES tend to be much larger than by gender. Yet, I see the gendered patterns in math performance as both an intriguing puzzle to be solved, as well as an issue with serious repercussions for both the quality of our workforce and the women who are over-represented in low-paying careers.

For a brief, accessible summary of research on gender gaps in math see

http://www.nctm.org/Publications/Teaching-Children-Mathematics/Blog/Current-Research-on-Gender-Differences-in-Math/

For a discussion of what teachers and others can do about it, see
http://www.nctm.org/Publications/Teaching-Children-Mathematics/Blog/What-Can-We-Do-about-Gender-Differences-in-Math_/