EDUCATION

Stanford Center on Poverty and Inequality

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How do male and female students fare in the U.S. educational system? One common narrative holds that boys perform better in math and science, while girls outperform boys in reading and language arts. A second narrative focuses on college success, noting that, at least in recent years, female students attend and graduate college at higher rates but remain underrepresented in science, technology, engineering, and mathematics (STEM) and earn fewer degrees in these fields. To what extent are these narratives true, how have they changed over time, and what do they mean for gender equality in education?

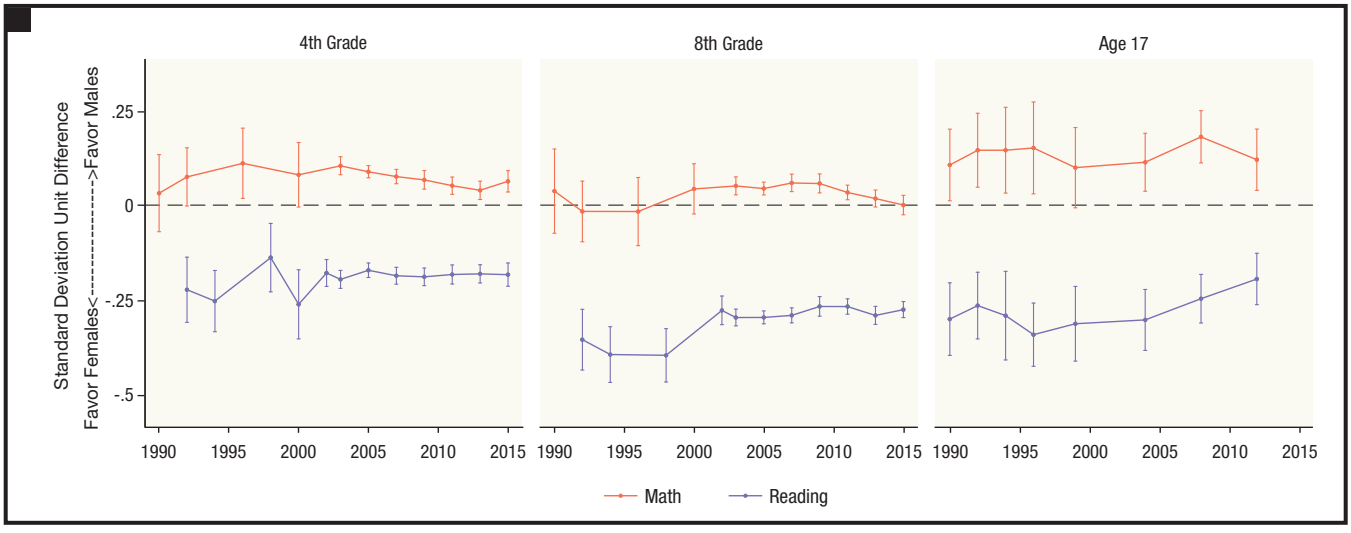
Gender Gaps in Academic Performance

The National Assessment of Educational Progress (NAEP) provides comparable information on the average math and reading skills of U.S. fourth- and eighth-grade students over the past two decades.[1] Figure 1 shows the male-female test score gaps from 1990 through 2015 on the fourth and eighth grade NAEP Main Assessments and on the age 17 NAEP Long-Term Trend (LTT) Assess-

KEY FINDINGS

- Despite common beliefs to the contrary, male students do not consistently outperform female students in mathematics. On average, males have a negligible lead in math in fourth grade, but that lead essentially disappears by eighth grade. This pattern shifts in high school. By age 17, there is a meaningful male advantage in math, approximately one-third of a grade level in 2012.
- In reading, female students consistently outperform male students from fourth grade through high school. In 2015, the male-female test score gap in fourth-grade reading was about half of a grade level, and in eighth grade it was even larger, at four-fifths of a grade level. At age 17, reading gaps persist at just over half a grade level.
- Although women attend college and graduate from college at higher rates than men, women are underrepresented in STEM majors and earn fewer STEM degrees.

FIGURE 1. Gender Gaps in Test Scores by Subject and Grade, 1990–2015



Source: National Assessment of Educational Progress.

ments.[2] Positive gaps indicate that male students are doing better than female students; negative gaps indicate the opposite.

These data show that the first narrative is, in part, true: In reading, female students clearly and consistently outperform male students from fourth grade through high school. In 2015, the male-female test score gap in fourth grade reading was 0.18 standard deviation units, or about half of a grade level; and in eighth grade, it was even larger, at four-fifths of a grade level. At age 17, the reading gap persists; it was just over half a grade level in 2012 (the most recent year of LTT).[3] Moreover, this female advantage in reading has remained relatively consistent since the 1990s.

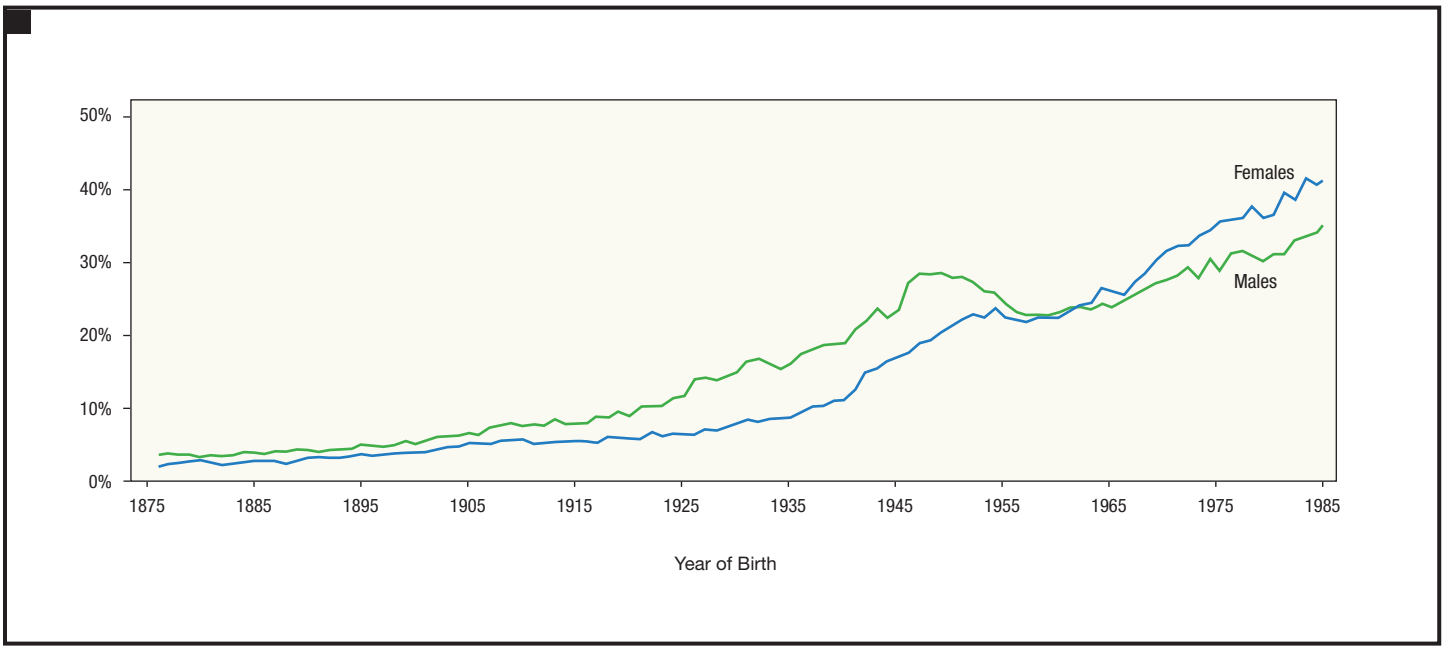
On the other hand, male students do not consistently outperform female students in mathematics, despite commonly held beliefs to the contrary. On average, males have a negligible lead in math in fourth grade; and in eighth grade, male and female students perform nearly equally on the NAEP math assessments.[4] However, this pattern shifts in high school. By age 17, there is a meaningful male advantage in math—approximately one-third of a grade level, in 2012. As with reading, these small male-favoring gaps have stayed largely the same since the 1990s.[5]

Interestingly, in both math and reading, the trends across grades suggest that female students gain ground, relative to males, through eighth grade—widening the reading gap and completely closing the math gap. However, this pattern is reversed after eighth grade—the math gap starts to favor male students and the reading gap no longer grows, as it does from fourth to eighth grade, in favor of female students.

Gender Gaps in College Enrollment and Graduation

There have been significant changes in the gender composition of students attending and graduating from college. Figure 2 shows the trend in college graduation rates of U.S.-born male and female adults. For cohorts born prior to the mid-1950s, men graduated at rates up to 9 percentage points higher than women. However, the graduation rates among males born between 1950 and 1960 dropped off steeply following the Vietnam War, to the point where the rates were nearly equal among male and female adults born in 1960. As a result of changing expectations for women regarding work and marriage, combined with the relatively higher rates of behavioral problems among male students (e.g., suspensions or arrests), female students surpassed male students in college attendance and graduation,[6] leading to a 5-percentage-point gap favoring females among adults today.

FIGURE 2. Trends in College Graduation Rates at Age 30



Source: Goldin and Katz, 2008, Figure 7.1, with supplemental data for 1976–1985 birth cohorts provided by Katz (personal communication, 2017).

Although women are graduating from college at higher rates, the other half of this narrative is also true: Women remain underrepresented in STEM majors and earn fewer STEM degrees. For example, in 2016 only 35 percent of STEM bachelor's degrees were awarded to women.[7] Within STEM fields, there are subfields where women comprise an even lower percentage of the students (e.g., computer science at 22%).[8]

What Causes These Patterns?

Multidisciplinary research has investigated how different biological,[9] psychological, and social factors work together to constrain male and female students' educational opportunities. This research highlights two critical contributors: societal beliefs about gender roles and behavioral differences between male and female students. There are pervasive stereotypes in the United States that "boys are better at math/science" and "girls are better at reading/language." The translation of these beliefs into differential expectations for male and female children by parents[10] or teachers[11] has meaningful consequences for students' performance in school and placement into advanced or remedial courses, in particular for female students in mathematics. These beliefs also shape students' interests or educational identities,[12] which can dissuade them from continuing in fields that do not "match" with their gender.[13] Simultaneously, there is evidence that male students have higher rates of school disciplinary action, recorded behavioral problems, and placement into special education throughout their school careers, which provides female students an overall advantage in school.[14,15]

The gender disparities in K–12 achievement and post-secondary education reflect the tension between these two factors. The overall female advantage from fourth through eighth grades and in college graduation appears to result, in part, from their behavioral advantage. The widening of the math gaps between eighth grade and age 17, along with the underrepresentation of women in STEM fields in college, indicate that stereotypes and differential expectations for boys and girls in math have a meaningful impact in high school that continues into college. These disparities have large potential consequences for men and women in the labor market: If men remain less likely to have a college degree, they will earn lower wages in less-skilled jobs; if women remain less likely to have STEM degrees, they will continue to have more limited access to some high-skill, lucrative fields.

Reducing gender inequality in education has direct benefits for both males and females, but it is unclear that school-based measures, such as providing support for female students in STEM or developing interventions to reduce behavioral problems for male students, will be sufficient. The evidence suggests that to truly achieve gender equality in education, our society's long-standing beliefs about gender roles and identities must change.

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NOTES

1. There are two different NAEP assessments: Main and Long-Term Trend NAEP. We use Main NAEP assessments for fourth and eighth grade because they provide larger sample sizes and more frequent assessments in elementary and middle school than the Long-Term Trend NAEP; we use Long-Term Trend NAEP at age 17 because the 12th-grade Main NAEP assessments have been administered less frequently in the last two decades. All NAEP assessment data can be accessed at https://nces.ed.gov/nationsreportcard/naepdata/.

2. We calculate the male-female gap as: $(\mu_{male}-\mu_{female})/ sd_{all}$; the standard errors of the gaps are computed as $\sqrt{(se(\mu_{male})^2+se(\mu_{female})^2)}/ sd_{all}$. The error bars shown indicate 95 percent confidence intervals.

3. Studies using the Early Childhood Longitudinal Study kindergarten cohort (ECLS-K) show that this female advantage in ELA exists even as early as kindergarten. See, for example, Robinson, Joseph Paul, and Sarah Theule Lubienski. 2011. "The Development of Gender Achievement Gaps in Mathematics and Reading During Elementary and Middle School: Examining Direct Cognitive Assessments and Teacher Ratings." *American Educational Research Journal* 48(2), 268–302. https://doi.org/10.3102/0002831210372249.

4. There is evidence, however, that although average differences in achievement during elementary and middle school are small, female students are underrepresented among the highest-achieving math students. Penner, Andrew M., and Marcel Paret. 2008. "Gender Differences in Mathematics Achievement: Exploring the Early Grades and the Extremes." *Social Science Research* 37(1), 239–253. https://doi.org/10.1016/j.ssresearch.2007.06.012; Robinson and Lubienski, 2011.

5. In fact, NAEP-LTT data show that these patterns have been largely unchanged since the 1970s. National Center for Education Statistics. 2013. "The Nation's Report Card: Trends in Academic Progress 2012." NCES 2013-456. https://nces.ed.gov/nationsreportcard/subject/publications/main2012/pdf/2013456.pdf.

6. Goldin, Claudia, and Lawrence F. Katz. 2008. *The Race Between Education and Technology*. Cambridge, MA: Belknap Press for Harvard University Press; Goldin, Claudia, Lawrence F. Katz, and Ilyana Kuziemko. 2006. "The Homecoming of American College Women: The Reversal of the College Gender Gap." *Journal of Economic Perspectives* 20(4), 133–156. https://doi.org/10.1257/jep.20.4.133.

7. Data from the 2016 Digest of Education Statistics Table 318.45. Retrieved from https://nces.ed.gov/programs/digest/d16/tables/dt16_318.45.asp.

8. Data from the 2016 Digest of Education Statistics Tables 322.50 and 322.40. Retrieved from https://nces.ed.gov/programs/digest/d16/tables/dt16_322.50.asp and https://nces.ed.gov/programs/digest/d16/tables/dt16_322.40.asp.

9. There is little support for hypotheses that there are "innate" differences between males and females that drive the male-favoring academic gender achievement gaps in math. Research actually shows that men and women are similar along most cognitive and psychological dimensions. Hyde, Janet Shibley. 2005. "The Gender Similarities Hypothesis." *American Psychologist* 60(6), 581–592. https://doi.org/10.1037/0003-066X.60.6.581; Spelke, Elizabeth S. 2005. "Sex Differences in Intrinsic Aptitude for Mathematics and Science?: A Critical Review." *American Psychologist* 60(9), 950–958. https://doi.org/10.1037/0003-066X.60.9.950.

10. Eccles, Jacquelynne S., Janis E. Jacobs, and Rena D. Harold. 1990. "Gender-Role Stereotypes, Expectancy Effects, and Parents' Role in the Socialization of Gender Differences." *Journal of Social Issues* 46(2), 183–201. https://doi.org/10.1111/j.1540-4560.1990.tb01929.x; Tomasetto, Carlo, Francesca Romana Alparone, and Mara Cadinu. 2011. "Girls' Math Performance Under Stereotype Threat: The Moderating Role of Mothers' Gender Stereotypes." *Developmental Psychology* 47(4), 943–949. https://doi.org/10.1037/a0024047.

11. Robinson and Lubienski, 2011; Upadyaya, Katya, and Jacquelynne Eccles. 2015. "Do Teachers' Perceptions of Children's Math and Reading Related Ability and Effort Predict Children's Self-Concept of Ability in Math and Reading?" *Educational Psychology* 35(1), 110–127. https://doi.org/10.1080/01443410.2014.915927.

12. Cech, Erin. 2015. "Engineers and Engineeresses? Self-Conceptions and the Development of Gendered Professional Identities." *Sociological Perspectives* 58(1), 56–77. https://doi.org/10.1177/0731121414556543; Cech, Erin A. 2013. "The Self-Expressive Edge of Occupational Sex Segregation." *American Journal of Sociology* 119(3), 747–789. https://doi.org/10.1086/673969; Cech, Erin, Brian Rubineau, Susan Silbey, and Caroll Seron. 2011. "Professional Role Confidence and Gendered Persistence in Engineering." *American Sociological Review* 76(5), 641–666. https://doi.org/10.1177/0003122411420815.

13. Cheryan, Sapna, Sianna A. Ziegler, Amanda K. Montoya, and Lily Jiang. 2017. "Why Are Some Stem Fields More Gender Balanced Than Others?" *Psychological Bulletin* 143(1), 1–35. https://doi.org/10.1037/bul0000052.

14. DiPrete, Thomas A., and Jennifer L. Jennings. 2012. "Social and Behavioral Skills and the Gender Gap in Early Educational Achievement." *Social Science Research* 41(1), 1–15. https://doi.org/10.1016/j.ssresearch.2011.09.001; Goldin and Katz, 2008; Hibel, Jacob, George Farkas, and Paul L. Morgan. 2010. "Who Is Placed into Special Education?" *Sociology of Education* 83(4), 312–332. https://doi.org/10.1177/0038040710383518; Jacob, Brian A. 2002. "Where the Boys Aren't: Non-Cognitive Skills, Returns to School and the Gender Gap in Higher Education." *Economics of Education Review* 21(6), 589–598. https://doi.org/10.1016/S0272-7757(01)00051-6; Robinson and Lubienski, 2011.

15. Note that these behavioral differences may also result from stereotypes that "girls are well-behaved and quiet" and "boys are active and loud," and children's socialization into those roles.