## Study reveals patterns in STEM grades of girls versus boys

September 252018


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A new study, led by UNSW Sydney Ph.D. student Rose O'Dea, has explored patterns in academic grades of 1.6 million students, showing that girls and boys perform very similarly in STEM—including at the top
of the class.

The analysis, published today in prestigious journal Nature
Communications, casts doubt on the view that there are fewer women in STEM-related jobs because they aren't as capable in those subjects as men-a notion that has been supported by the concept that gender differences in variability lead to gender gaps in associated fields.

In their meta-analysis, the UNSW researchers compared gender differences in variation of academic grades from over 1.6 million students aged six through to university from all over the world, across 268 different schools and classrooms.
"We combined data from hundreds of studies, and used a method developed by my supervisor to comprehensively test for greater male variability in academic performance," lead author Rose O'Dea says.

A classroom with more variable grades indicates a bigger gap between high and low performing students, and greater male variability could result in boys outnumbering girls at the top and bottom of the class.
"Greater male variability is an old idea that people have used to claim that there will always be more male geniuses-and fools-in society," O'Dea says.

The team found that on average, girls' grades were higher than boys', and girls' grades were less variable than boys'.
"We already knew that girls routinely outperform boys at school, and we also expected female grades to be less variable than those of males, so that wasn't surprising. In fact, our study suggests that these two factors haven't changed in 80 years," O'Dea says.
"However, what was most surprising was that both of these gender differences were far larger in non-STEM subjects, like English. In STEM subjects girls and boys received surprisingly similar grades, in both average and variability."

In other words, the researchers demonstrated that academic STEM achievements of boys and girls are very similar-in fact, the analysis suggests that the top $10 \%$ of a class contained equal numbers of girls and boys.

O'Dea says that there are multiple reasons that these figures don't translate into equivalent participation in STEM jobs later in life.
"Even if men and women have equal abilities, STEM isn't an equal playing field for women-and so women often go down paths with less male competition."For example, we found that the ability overlap between girls and boys is much greater in STEM, and smaller in nonSTEM subjects, meaning that there are fewer boys competing with girls in non-STEM subjects.
"So say you're a girl in a class and you're a straight A student. In your math class, you're surrounded by top-achieving boys, and then in English there's fewer boys that you're competing with, so it can look like nonSTEM is an easier option or a safer path."

Stereotypical societal beliefs about what fields girls are seen to be successful in also play a role."Girls are susceptible to conforming to stereotypes in the traditionally male-dominated fields of STEM. Girls who try to succeed in these fields are often hindered by backlash effects," O'Dea says.
"For example, the stereotype that girls aren't good at maths actually makes it harder for girls to be good at maths, both because of the way we
perceive ourselves and the way other people perceive us. We all have subconscious biases, and there's a strange phenomenon called stereotype threat, where being reminded of the stereotype connected to your identity can make it harder to defy that stereotype."

O'Dea says that there's no simple fix to work on the underrepresentation of women in STEM.
"Science and academia have a lot of structural issues that will take time to fix. However, there's a lot we can do to encourage girls to perform better at maths-for example, girls tend to do better when they're taught by a woman with a strong maths background, so they can see they can do maths, too."

Professor Emma Johnston, Dean of Science at UNSW, says a lot needs to be done to encourage girls to choose a STEM path."This powerful, evidence-based research has revealed that girls and boys are equally good at STEM subjects. Differential participation in STEM training and STEM careers must therefore be explained by other factors.
"Australia really needs more women to enter, stay, and succeed in STEM areas. We absolutely need to change the structural barriers to gender equality in science, but we must also change the strong negative stereotypes and unconscious biases as well. We must give our girls and women more successful science role models-something grand to aspire to.
"We all need to actively work to close this gap-for example, UNSW's Women in Maths and Science Champions Program is a unique opportunity to support women who are completing their Ph.D. in UNSW Science. The program focuses on strengthening the cohort's communication and leadership skills to support their professional careers and their lifelong role of advocacy to inspire women to pursue a career
in maths and science.
"The author of this landmark study is a great example-Rose is an incredible role model and her leadership in traditionally male-dominated fields like science and the AFL is inspiring to many girls," Professor Johnston concludes.

> More information: R. E. O'Dea et al, Gender differences in individual variation in academic grades fail to fit expected patterns for STEM, Nature Communications (2018). DOI: 10.1038/s41467-018-06292-0

## Provided by University of New South Wales

Citation: Study reveals patterns in STEM grades of girls versus boys (2018, September 25) retrieved 10 April 2024 from
https://phys.org/news/2018-09-reveals-patterns-stem-grades-girls.html

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