High-stakes exams can put female students at a disadvantage

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Research has long shown that women who enter college intending to pursue a career in science abandon that path more frequently than their male peers, with many citing poor grades and large gateway classes as

reasons for their declining interest. To what extent do these women fall behind because of the way science is taught and tested?

A new study of students in introductory biology courses finds that women overall performed worse than men on high-stakes exams but better on other types of assessments, such as lab work and written assignments. The study also shows that the anxiety of taking an exam has a more significant impact on women's grades than it does for men.

"It was striking," said Shima Salehi, a doctoral student at Stanford Graduate School of Education and one of the study's two lead authors. "We found that these types of exams disadvantage women because of the stronger effect that test anxiety has on women's performance."

The study, co-led by Cissy Ballen and co-authored by Sehoya Cotner from the University of Minnesota, was published Oct. 19 in *PLOS ONE*.

The researchers collected data on 1,562 students in 10 large introductory biology course sections during fall 2016. (A majority of these students were women, typical for introductory biology classes.) They analyzed exam scores as well as students' performance on non-exam assessments like lab activities, discussion sections, written assignments and low-stakes quizzes.

On average, the researchers found, female students underperformed compared to males on biology course exams. They did better than males, however, on the non-exam assessments – a finding the study's authors said underscores the likelihood that high-pressure testing does not adequately capture a student's understanding.

"Other studies have shown that students' performance on high-stakes exams is not a good predictor for whether they're acquiring the skills that STEM professionals need," Salehi said. "And if psychological barriers

prevent women from performing optimally on exams, it may be time to reconsider exams as a primary method for evaluating students' knowledge."

Impact of anxiety and interest

To better understand what might be affecting exam performance, the researchers focused on two factors: test anxiety and a lack of interest in the subject matter of the course. They surveyed a subset of the subject pool (286 students from three of the introductory sections) before final exams about their anxiety and their interest in the course content.

In the survey, students were asked to rate on a scale of 1 to 7 how well certain statements applied to them. Statements about anxiety, for example, included "I am so nervous during a test that I cannot remember facts that I have learned" and "When I take a test, I think about how poorly I am doing." Statements to assess students' interest included "I think that what I am learning in this course is useful for me to know" and "I think I will be able to use what I learn in this course in later studies."

The effect differed markedly between genders, the researchers found. Among males, neither self-reported test anxiety nor interest in the course correlated with final exam scores. But for female students – who, on average, reported higher anxiety and higher interest – final exam grades correlated with both factors. As the women's interest in the material increased, so did their exam scores, whereas greater test anxiety diminished their exam performance.

These findings, the researchers said, point to two possible tactics to help minimize the gender gap in test scores. First, past studies have found that replacing a few high-stakes exams with more frequent low-stakes testing – and using other types of assessments to lessen the significance of exams – can reduce the impact of test anxiety. Second, research

indicates that more explicitly connecting the course material to students' lives can make it more relevant and interesting to them, "and by nurturing their interest in science," said Salehi, "we can create a buffer to shield women from the negative effects of test anxiety."

Adopting strategies for mitigating test anxiety and choosing materials and methods that enhance students' interest in science would make the science, technology, engineering and mathematics pathway more accessible for all students, Salehi said. "We want to figure out what kind of instructional methods will ensure that everyone can navigate successfully through these courses and have a wider range of career options."

More information: Cissy J. Ballen et al. Exams disadvantage women in introductory biology, *PLOS ONE* (2017). DOI: 10.1371/journal.pone.0186419

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