Study examines why some STEM fields have fewer women than others

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Women's relative lack of participation in science, technology, engineering and math is well documented, but why women are more represented in some STEM areas than others is less clear.

A new University of Washington study is among the first to address that question by comparing gender disparities across STEM fields. Published Oct. 12 in the journal *Psychological Bulletin*, the paper identifies three main factors driving the disparity—and the most powerful one, the researchers conclude, is a "masculine culture" that makes many women feel like they don't belong.

"There is widespread knowledge that women are underrepresented in STEM, but people tend to lump STEM fields together," said lead author Sapna Cheryan, a UW associate professor of psychology. "This is one of the first attempts to really dig down into why women are more underrepresented in some STEM fields than others."

Women now earn about 37 percent of undergraduate STEM degrees in the United States, but their representation varies widely across those fields. Women receive more than 40 percent of undergraduate degrees in math, for example, but just 18 percent of degrees in computer science.

The UW study focused on six of the largest science and engineering fields with the most undergraduate degrees: biology, chemistry and math, which have the highest proportions of female participation, and computer science, engineering and physics, which have bigger gender

gaps.

The researchers analyzed more than 1,200 papers about women's underrepresentation in STEM, and from those identified 10 factors that impact gender differences in students' interest and participation in STEM. Then they winnowed the list down to the three factors most likely to explain gendered patterns in the six STEM fields—a lack of pre-college experience, gender gaps in belief about one's abilities, and a masculine culture that discourages women from participating.

The paper identifies three main aspects of that masculine culture: stereotypes of the fields that are incompatible with how many women perceive themselves, negative stereotypes about women's abilities and a dearth of role models. Those factors decrease women's interest in a field by signaling that they do not belong there, the researchers write.

A lack of pre-college experience is also a factor, the paper finds. The gender gap in STEM interest is smaller among high school seniors at schools with stronger math and science offerings, the researchers note. But courses in computer science, engineering and physics are less likely to be offered and required in U.S. high schools than courses in biology, chemistry and mathematics—leaving students with little information about what those fields are like and who might be suited for them.

"Students are basing their educational decisions in large part on their perceptions of a field," Cheryan said. "And not having early experience with what a field is really like makes it more likely that they will rely on their stereotypes about that field and who is good at it."

A lack of experience does not itself cause women's underrepresentation in STEM, the researchers write. Women are attracted to many fields that students are typically not exposed to before college, such as nursing and social work, the researchers note. But when a lack of early experience is

accompanied by a masculine culture, the gender proportion skews male. Early learning opportunities in STEM, Cheryan said, will only attract girls if they convey that girls belong in those fields as much as boys do.

"If we're not providing students with a welcoming culture, these efforts are not likely to succeed," she said.

Belief in one's abilities was a common theme in previous studies and may help explain current gender gaps, but Cheryan said inconsistent findings made it a less compelling factor. For example, she said, girls tend to report less confidence in their math abilities than boys, but the field of math is still relatively gender-balanced.

Similarly, Cheryan said, gender discrimination in hiring and other opportunities was not able to explain current patterns of variability. The researchers expected to find less discrimination in the fields with higher female representation, she said, but discovered that it differed little across the six areas.

The researchers embarked on the study focusing primarily on women's choices, Cheryan said, but quickly realized that explaining women's underrepresentation required also looking at men's choices. The proportion of women receiving computer science degrees, for example, has declined steadily since the mid-1980s, due more to an influx of men to the field than a drop in women's participation. Cultural historians attribute the shift to the advent of the personal computer and an accompanying stereotype of the nerdy male computer genius.

"When we drilled down into the numbers, we realized that if we just looked at women, that wouldn't tell the whole story," Cheryan said. "Underrepresentation is shaped just as much by what men are doing as by what women are doing."

The researchers conclude that a more inclusive culture across STEM fields is the most effective way to boost female participation. That can be achieved, Cheryan said, by developing "subcultures" that make girls feel they belong, whether that involves changing classroom décor to create a more welcoming environment or counteracting negative stereotypes about women's abilities by making it clear that everyone has the potential to succeed.

"Cultural change is never easy, but there are lots of examples of it being done successfully, and it translates into changing who's in a particular field," she said.

More information: Sapna Cheryan et al. Why Are Some STEM Fields More Gender Balanced Than Others?, *Psychological Bulletin* (2016). DOI: 10.1037/bul0000052

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