

# Tool could help uncover bias against female faculty in STEM fields

December 12 2012

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A new Northwestern University study of professors in STEM fields at top research universities across the country shows that bias against women is ingrained in the workforce, despite a societal desire to believe workplace equality exists.

The quantitative study of the complete publication records of more than 4,200 professors in seven STEM fields (science, technology, engineering and mathematics) confirms that, for some disciplines, female faculty do publish fewer papers than male faculty but not for lack of talent or effort.

The researchers found the "productivity gap" varied depending on the discipline. In fields that require more resources, women publish less. This indicates the gap may exist because academic departments historically have not invested resources equally in female faculty from the start of their careers. Men are getting greater resources.

"If a woman starts her career at a lower point, it is impossible to catch up," said Luís Amaral, a professor of chemical and [biological engineering](#) in the McCormick School of Engineering and Applied Science. "Women in academia are perceived as less productive, but this may be explained to a great extent by the fact that women are given fewer resources to succeed."

Amaral said he believes the results represent what is happening to all underrepresented groups in science and engineering, such as African-

Americans and Hispanics, and possibly in workplaces outside academia, such as business, politics and the [legal profession](#).

Amaral and Teresa K. Woodruff led the study, which will be published today (Dec. 12) by the journal [PLOS ONE](#). The findings have significant, field-specific policy implications for achieving diversity at the faculty level within the STEM disciplines.

"We are losing the potential of women—in science and engineering and many other fields – because of this biased difference," said Woodruff, the Thomas J. Watkins Memorial Professor of Obstetrics and Gynecology at the Feinberg School of Medicine. "I expect it would cost very little to bridge the gap and take bias out of the system. Our goal is to understand the productivity gap so we can intervene, change the culture and create new policy."

Xiaohan Zeng, a graduate student in Amaral's lab and a co-first author of the paper, spent nearly three years amassing information on 437,787 publications authored by 4,292 professors in seven STEM fields—chemical engineering, chemistry, ecology, industrial engineering, material science, molecular biology and psychology.

The research team built a database that sorted faculty by field. A wide variety of considerations needed to be factored in, such as the increase in publication rate over the last 40 years and the fact that senior faculty publish at a higher rate than junior faculty. The researchers only studied independent academic researchers—those who had survived the STEM pipeline and went on to become professors with their own labs.

"These data enabled us to characterize the career-long scientific production of a sizable sample of faculty from seven disciplines, and to measure statistically significant differences that would have otherwise remained hidden," the authors wrote.

The researchers found that for a discipline such as industrial engineering, where research resource requirements are low, the gap essentially is absent. Male and female faculty published papers at similar rates. But for a discipline such as molecular biology, where resource requirements are very high, the gap is quite wide, with male faculty publishing at significantly higher rates than their female colleagues.

"We need rigorous mechanisms to help us not be unfair in the workplace," Amaral said. "We need facts to start studying these biases and get changes in the culture. You can't just trust people to say they don't have bias. We all do have unconscious bias."

The researchers used publicly available data in their study, but their methods can easily be used more broadly, including in the private sector, to investigate the effects of potential biases.

In the study, the research team also found that in disciplines where pursuing an academic position incurs greater career risk, such as in ecology, female faculty tend to have a greater fraction of higher impact publications than males. The greater the risk of career choice, the greater the impact gap, with women having more impactful papers.

This suggests female faculty in higher-risk careers publish papers of higher quality than their male colleagues.

"Women are self-selecting—they are not allowed to be as risky when choosing an academic career," Woodruff said. "You have to be really, really good to be a female in ecology. We are losing talented women in the STEM fields because they are choosing to go elsewhere."

**More information:** The title of the PLOS ONE paper is "The Possible Role of Resource Requirements and Academic Career-Choice Risk on Gender Differences in Publication Rate and Impact."

[dx.plos.org/10.1371/journal.pone.0051332](https://doi.org/10.1371/journal.pone.0051332)

Provided by Northwestern University

Citation: Tool could help uncover bias against female faculty in STEM fields (2012, December 12) retrieved 26 April 2024 from <https://phys.org/news/2012-12-tool-uncover-bias-female-faculty.html>

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