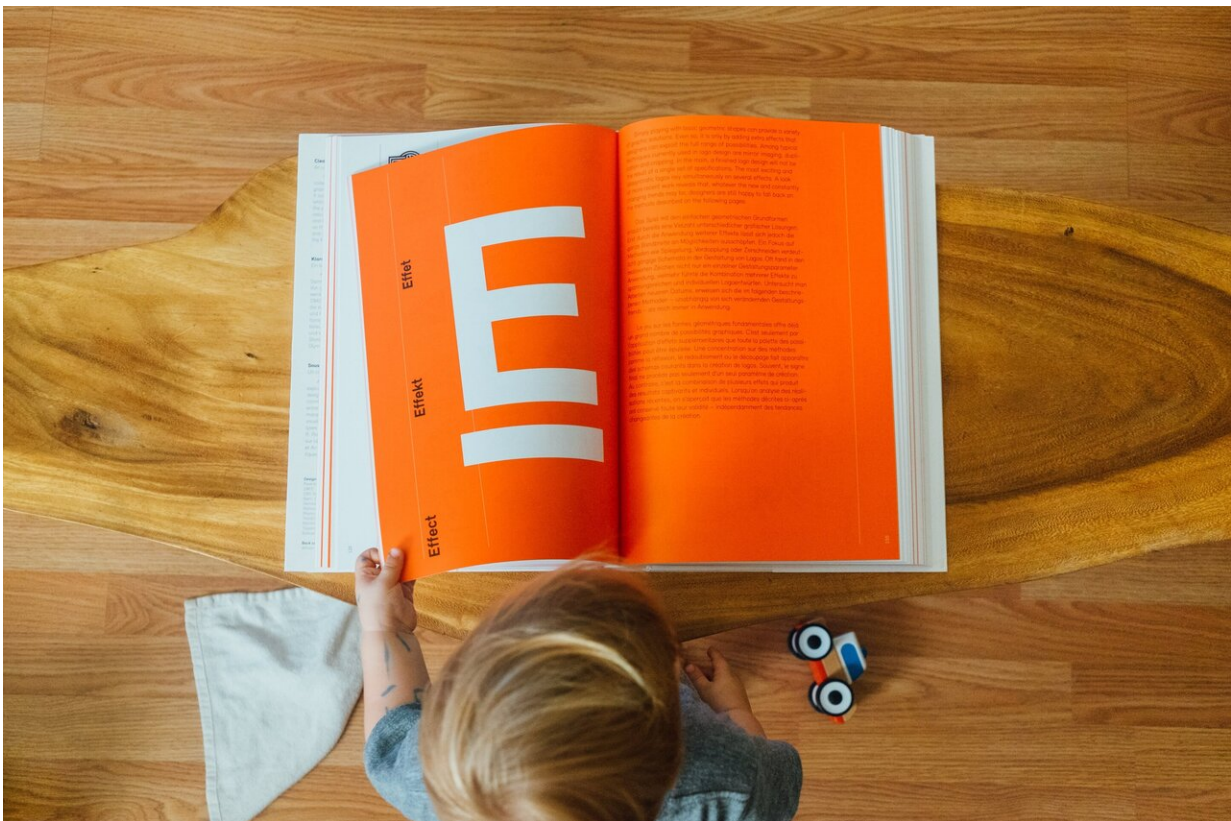# Language may undermine women in science and tech

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Despite decades of positive messaging to encourage women and girls to pursue education tracks and careers in STEM, women continue to fall far below their male counterparts in these fields. A new study at

Carnegie Mellon University examined 25 languages to explore the gender stereotypes in language that undermine efforts to support equality across STEM career paths. The results are available in the August 3rd issue of *Nature Human Behavior*.

Molly Lewis, special faculty at CMU and her research partner, Gary Lupyan, associate professor at University of Wisconsin-Madison, set out to examine the effect of language on career stereotypes by gender. They found that implicit gender associations are strongly predicted by the language we speak. Their work suggests that linguistic associations may be causally related to people's implicit judgment of what women can accomplish.

"Young children have strong gender stereotypes as do older adults, and the question is where do these biases come from," said Lewis, first author on the study. No one has looked at implicit language—simple language that co-occurs over a large body of text—that could give information about stereotypical norms in our culture across different languages."

In general, the team examined how words co-occur with women compared to men. For example, how often is 'woman' associated with 'home,' 'children' and 'family,' where as 'man' was associated with 'work,' 'career' and 'business.'

"What's not obvious is that a lot of information that is contained in language, including information about cultural stereotypes, [occurs not as] direct statements but in large-scale statistical relationships between words," said Lupyan, senior author on the study. "Even without encountering direct statements, it is possible to learn that there is stereotype embedded in the language of women being better at some things and men at others."

They found that languages with a stronger embedded gender association are more clearly associated with career stereotypes. They also found that a positive relationship between gender-marked occupation terms and the strength of these gender stereotypes.

Previous work has shown that children begin to ingrain gender stereotypes in their culture by the age of two. The team examined statistics regarding gender associations embedded in 25 languages and related the results to an international dataset of gender bias (Implicit Association Test).

Surprisingly, they found that the median age of the country influences the study results. Countries with a larger older population have a stronger bias in career-gender associations.

"The consequences of these results are pretty profound," said Lewis. "The results suggest that if you speak a language that is really biased then you are more likely to have a gender stereotype that associates men with career and women with family."

She suggests children's books be written and designed to not have gender-biased statistics. These results also have implications for algorithmic fairness research aimed at eliminating gender bias in computer algorithms.

"Our study shows that language statistics predict people's implicit biases—languages with greater gender biases tend to have speakers with greater gender biases," Lupyan said. "The results are correlational, but that the relationship persists under various controls [and] does suggest a causal influence."

Lewis notes that the Implicit Association Test used in this study has been criticized for low reliability and limited external validity. She stresses

that additional work using longitudinal analyses and experimental designs is necessary to explore language statistics and implicit associations with gender stereotypes.

More information: Lewis, M., Lupyan, G. Gender stereotypes are reflected in the distributional structure of 25 languages. *Nat Hum Behav* (2020). doi.org/10.1038/s41562-020-0918-6

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