Gender and Learning in Science and Engineering

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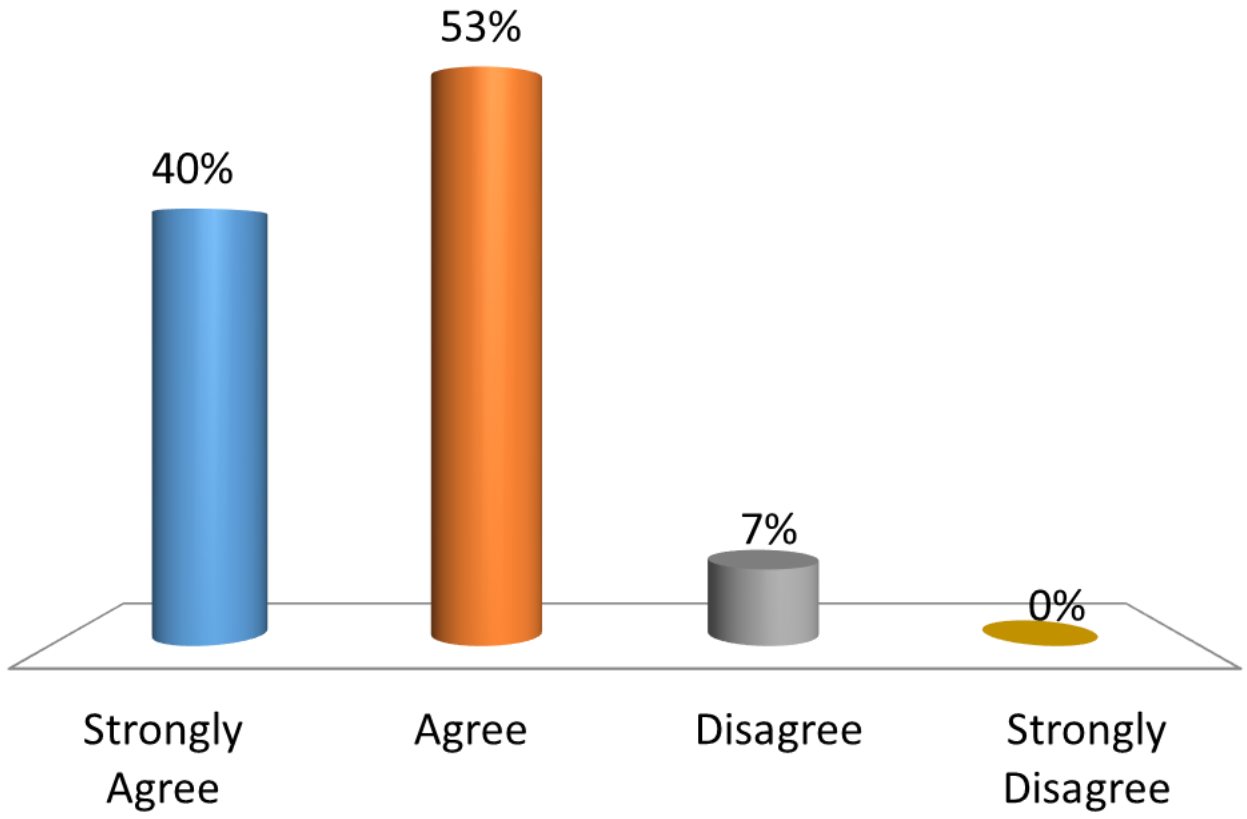
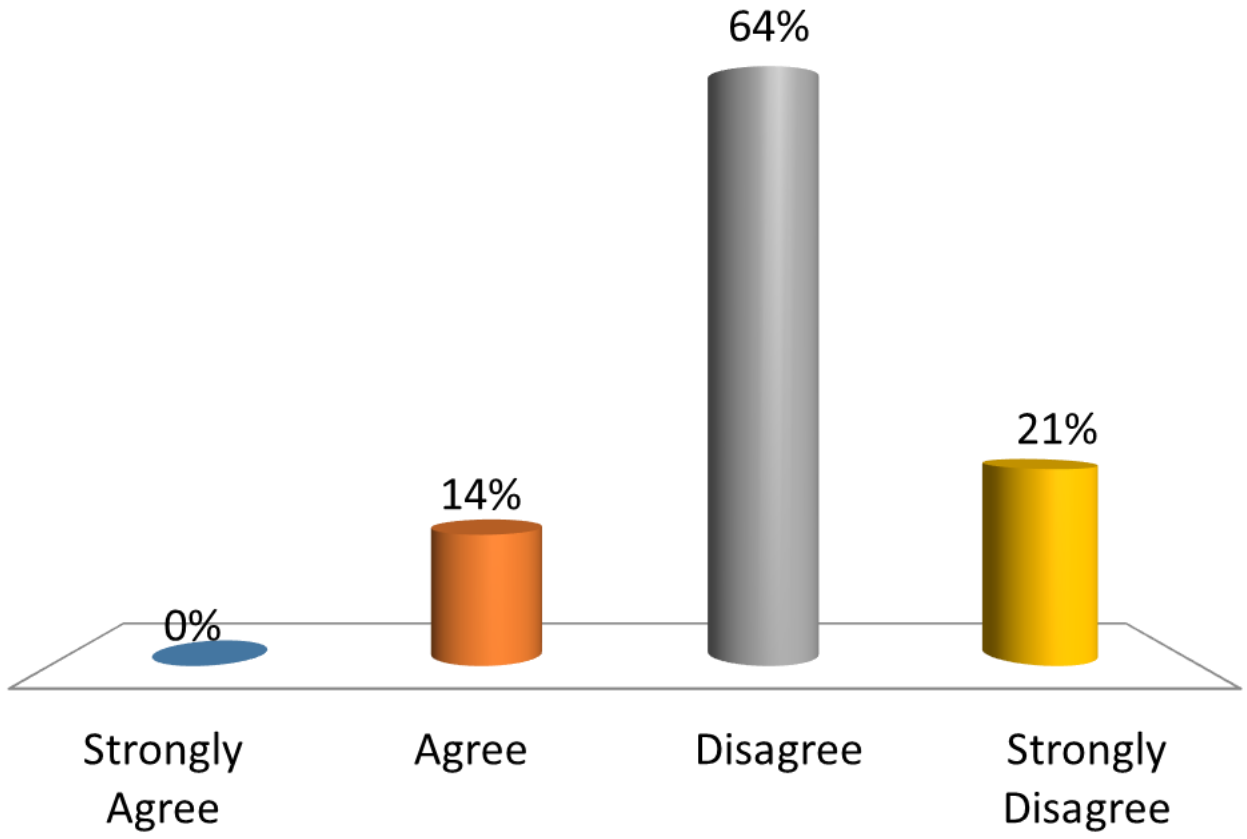
A question for women only: “Men explain to me things I know more about than they do”

A. Strongly Agree
B. Agree
C. Disagree
D. Strongly Disagree



A question for men only: “Women explain to me things I know more about than they do”

A. Strongly Agree
B. Agree
C. Disagree
D. Strongly Disagree



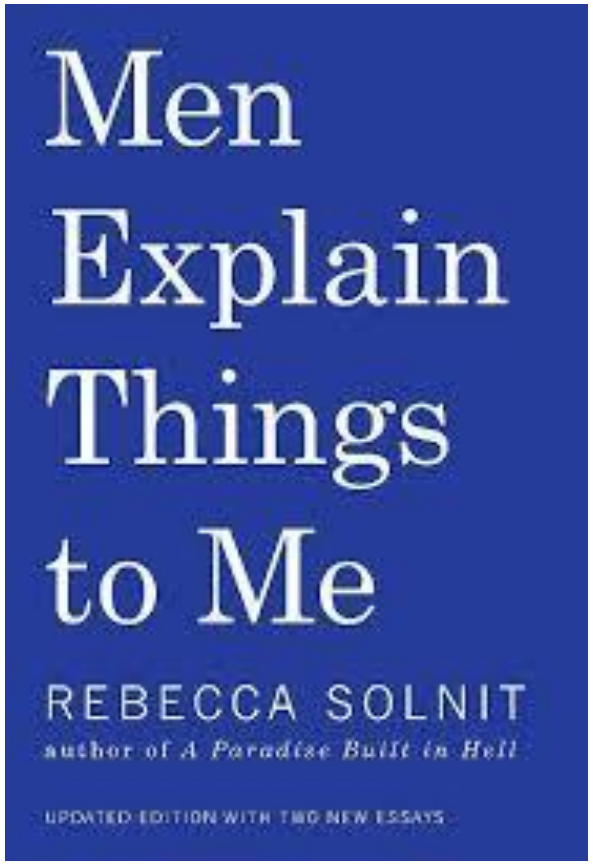
Mansplaining mansplained…

- "…occurs when a man talks condescendingly to someone (especially a woman) about something he has incomplete knowledge of, with the mistaken assumption that he knows more about it than the person he's talking to does"

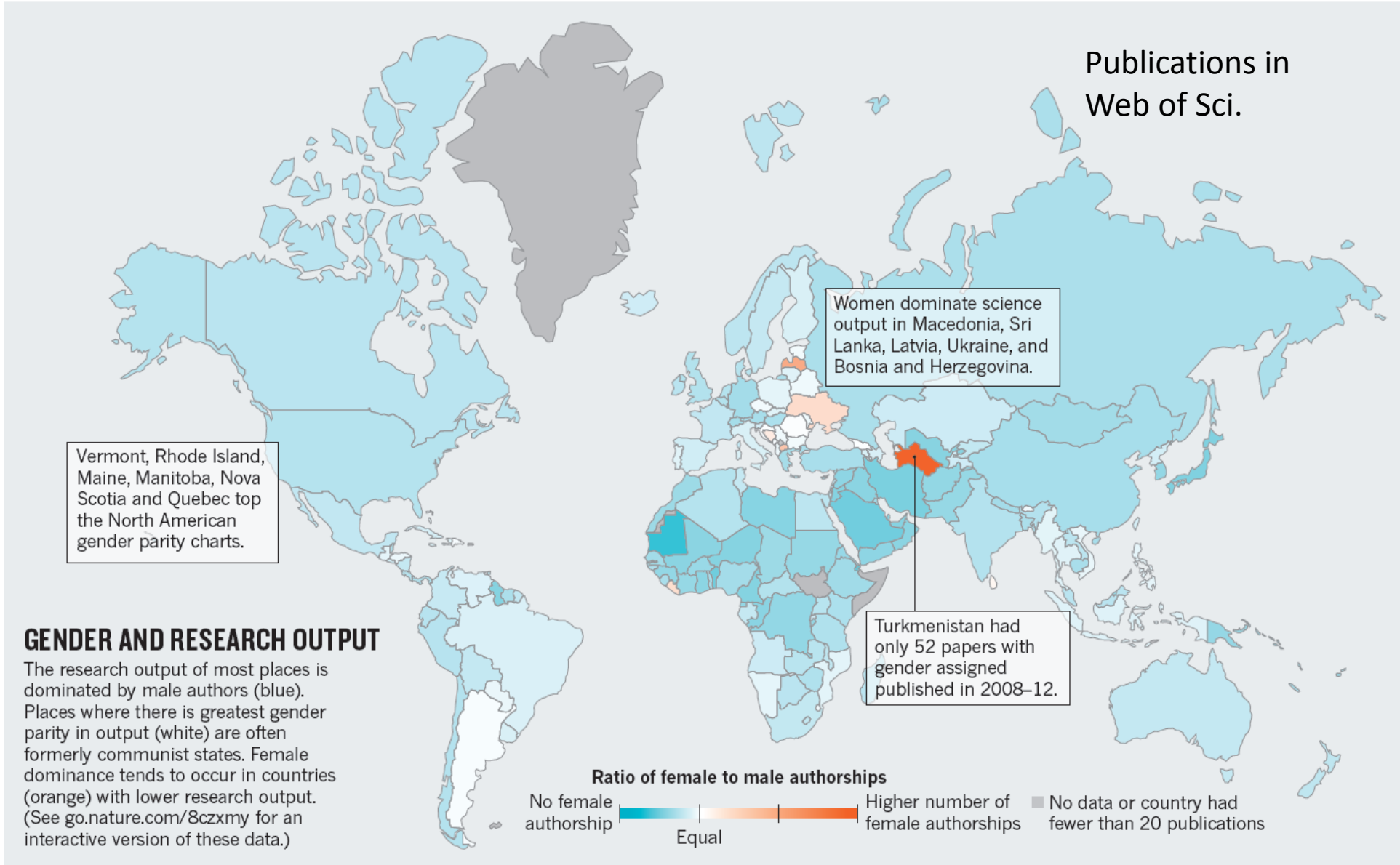
  Merriman-Webster, Words we're watching

- "Stating accurate, verifiable facts. Especially when these facts are inconvenient to the feminist worldview, or contradict feminist talking points…."

  Urban dictionary, top definition

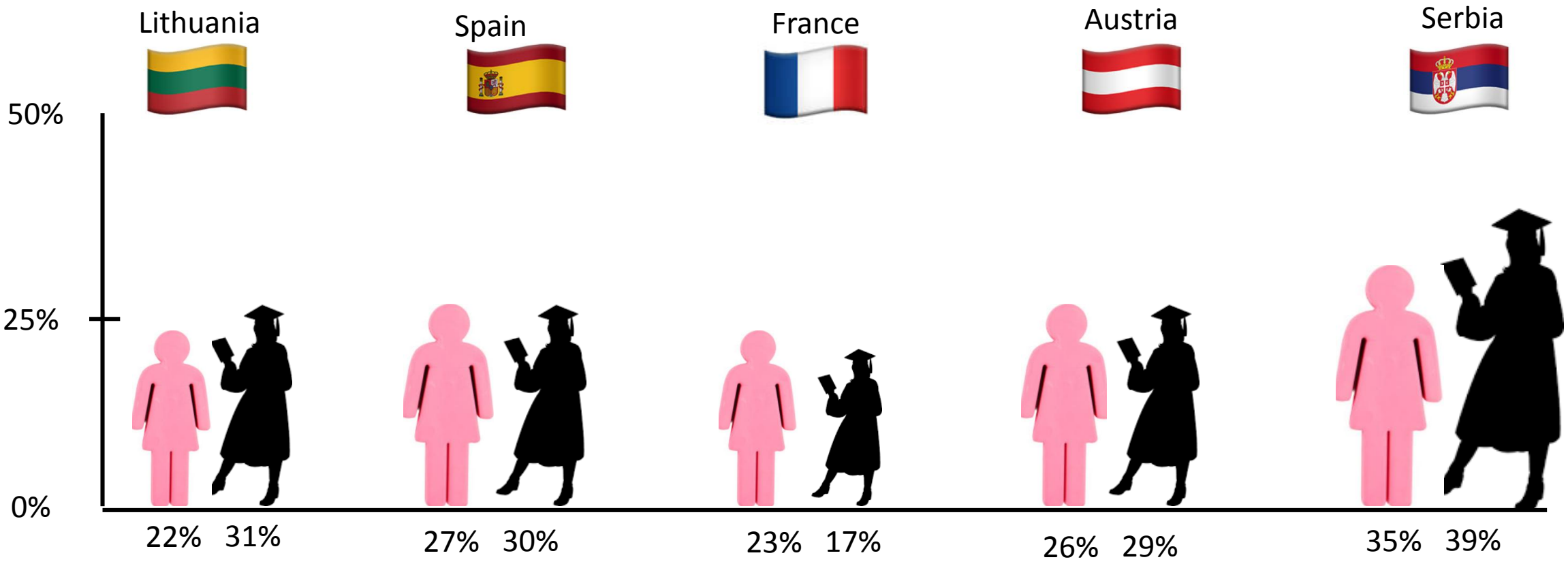


Starting points

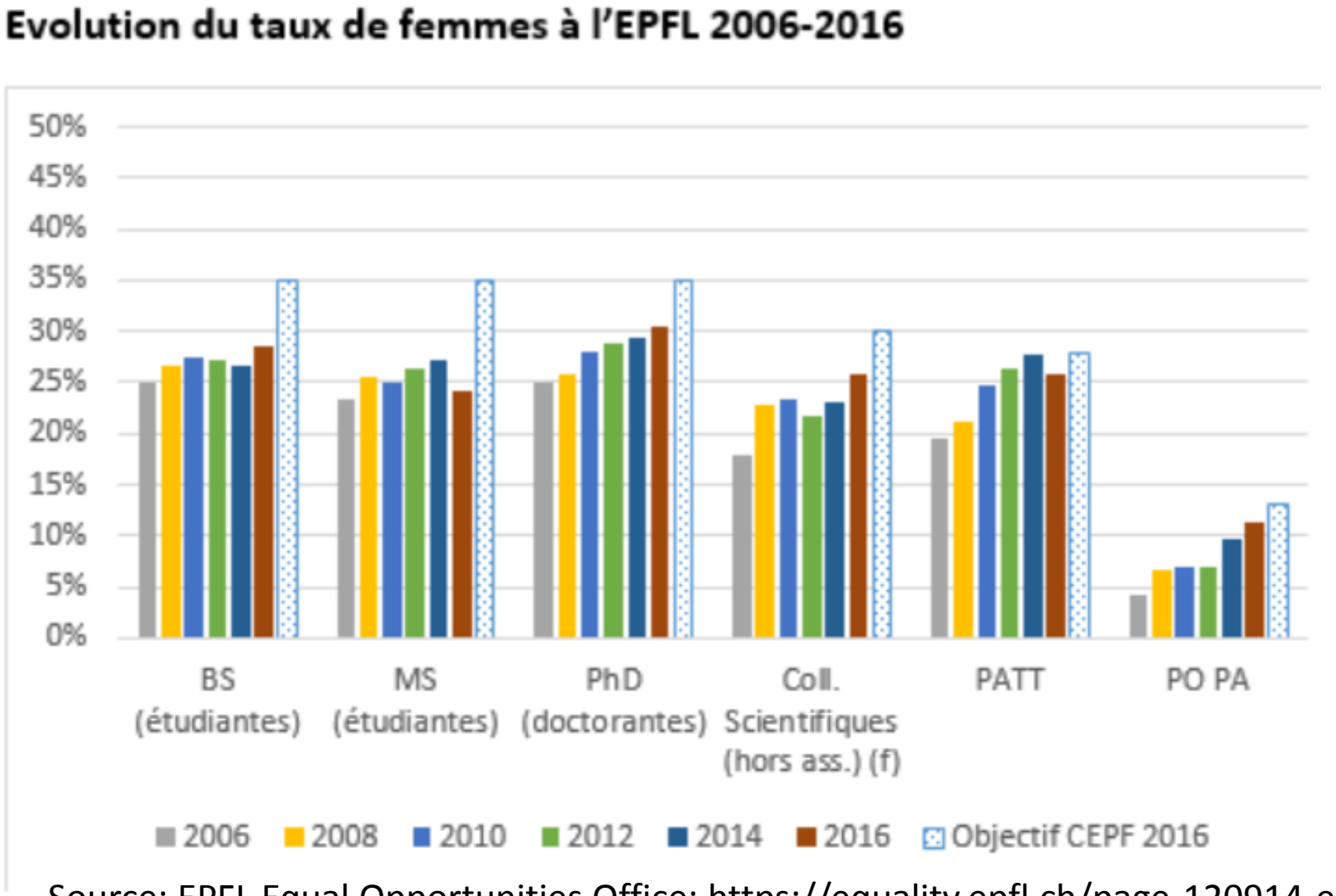

Publications in Web of Sci.
Women dominate science output in Macedonia, Sri Lanka, Latvia, Ukraine, and Bosnia and Herzegovina.
Vermont, Rhode Island, Maine, Manitoba, Nova Scotia and Quebec top the North American gender parity charts.
Turkmenistan had only 52 papers with gender assigned published in 2008–12.
GENDER AND RESEARCH OUTPUT
The research output of most places is dominated by male authors (blue). Places where there is greatest gender parity in output (white) are often formerly communist states. Female dominance tends to occur in countries (orange) with lower research output. (See go.nature.com/8czxmy for an interactive version of these data.)
Ratio of female to male authorships
No female authorship
Equal
Higher number of female authorships
No data or country had fewer than 20 publications

Women as engineering students and graduates

Source: Barnard , Hassan , Bagilhole & Dainty (2012)



…and at EPFL



- IC: 13% at Ba
- STI: 14% at Ba
- SB: 28% at Ba
- ENAC: 41% at Ba
- SV: 50% at Ba

Source: EPFL Equal Opportunities Office: https://equality.epfl.ch/page-120914-en.html

Explicit and Implicit Bias

Explicit Bias against engineering students

- UK Study: (Bernard et al. 2012)
  - Students told “women don’t belong in engineering”

- German study: (Marsden et al. 2016)
  - 16% of the female students vs. 3% of the males said, that they have been discriminated against based on their gender
  - 21% of females have witnessed discrimination towards others based on their gender compared to only 8% of males

Mary graduated from university 12 years ago with a master's degree in English literature. She wrote her dissertation on the representation of female domestic servants in 19 century American novels.

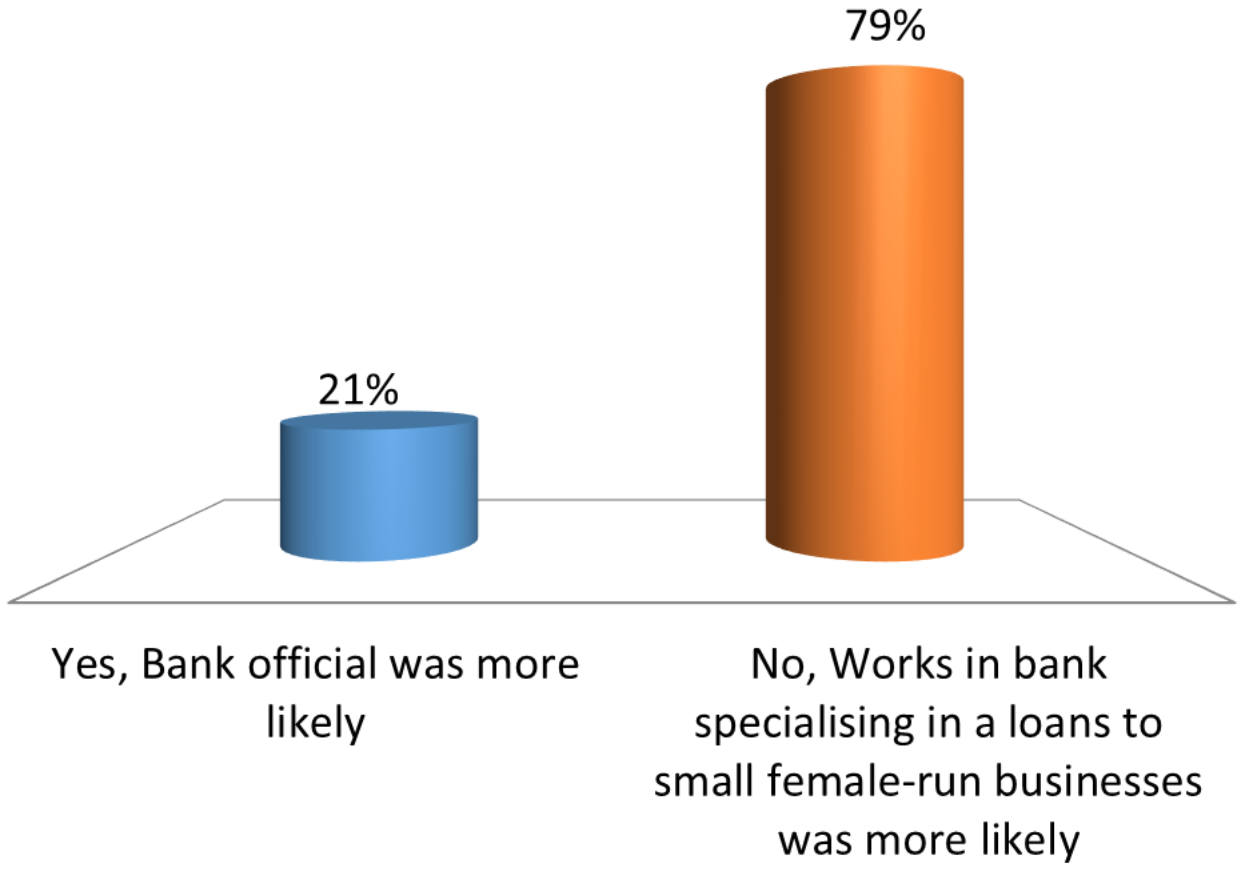
Rank in order from most likely (1) to least likely (5) what you think her job is now:

- Manages a chain of 4 child care crèches
- Bank official
- Owns a small bookshop
- Works in bank specialising in a loans to small female-run businesses
- Is a librarian in the library of a research institute

Think once more about your answer…

In the question about Mary's job did you rate "Bank official" as being **more** likely than "Works in bank specialising in a loans to small female-run businesses"

A. Yes, Bank official was more likely
B. No, Works in bank specialising in a loans to small female-run businesses was more likely



Testing Unconscious Bias

- Implicit Attitudes Tests
  - e.g. Male=Science; Female = Literature
- Tested through reaction speed
- https://implicit.harvard.edu/implicit/takeatest.html

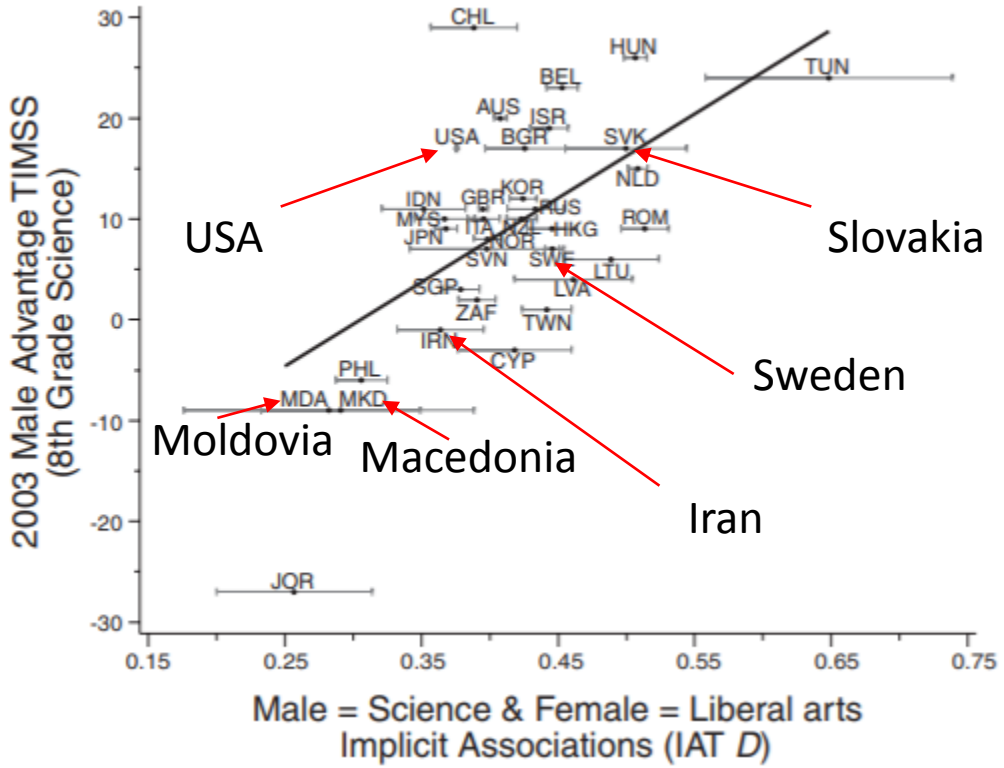


Fig. 1. The relationship between implicit gender–science stereotyping and national sex differences in science performance for 2003 TIMSS data.

Horizontal error bars represent the standard error of the mean for implicit stereotype data.

Brian A. Nosek et al. (2009) National differences in gender–science stereotypes predict national sex differences in science and math achievement PNAS

So what happens in practice?

Teacher feedback to students

- Gender differences in academic ratings
  - Moss-Racusin et al (2012)
  - Good (not excellent) application materials of student applying for a lab manager position
  - Same application, randomly described as John or Jennifer
  - Reviewed by 127 biology, chemistry and physics professors
  - Rated:
    - Competence
    - Hireability
    - Suggested salary
    - How much mentoring would they offer

Results…

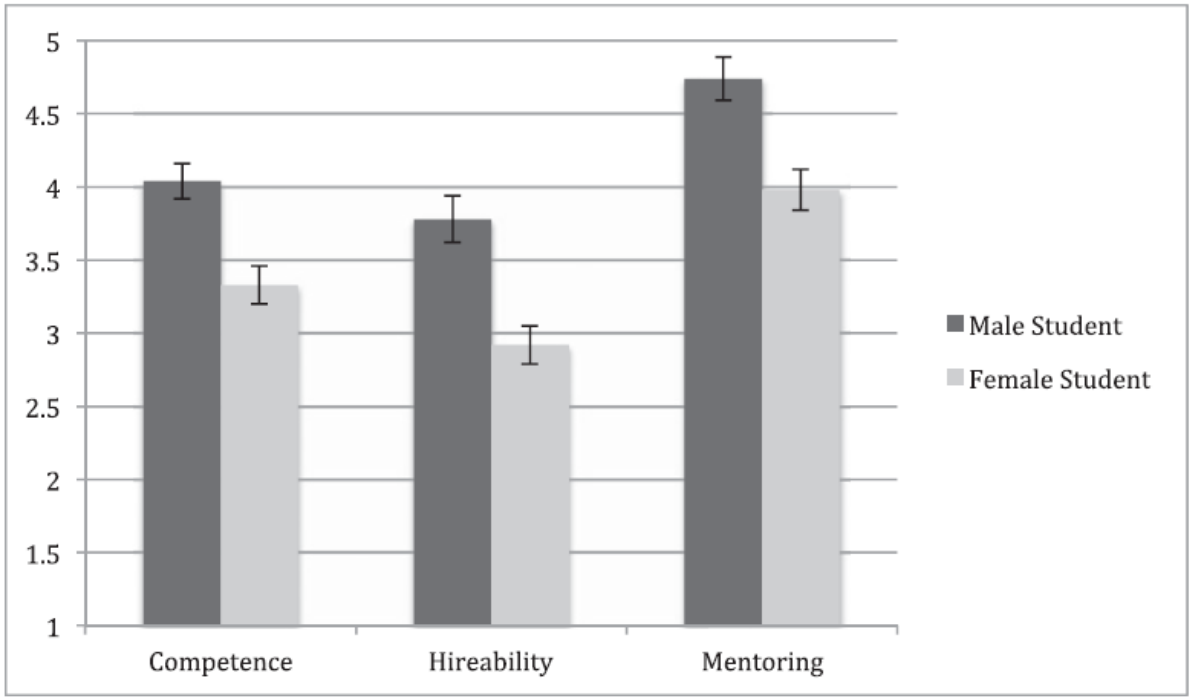


Fig. 1. Competence, hireability, and mentoring by student gender condition (collapsed across faculty gender). All student gender differences are significant ($P < 0.001$). Scales range from 1 to 7, with higher numbers reflecting a greater extent of each variable. Error bars represent SEs. $n_{\text{male student condition}} = 63$, $n_{\text{female student condition}} = 64$.

A battle of the sexes?

Scoring of Male and Female Faculty of Applications

	"Male" Student		"Female" student	
	Male Faculty	Female faculty	Male Faculty	Female faculty
Competence	4.01	4.1	3.33	3.32
Hireability	3.74	3.92	2.96	2.84
Mentoring	4.74	4.73	4.00	3.91
Salary	30, 520	29,333	27,111	25,000

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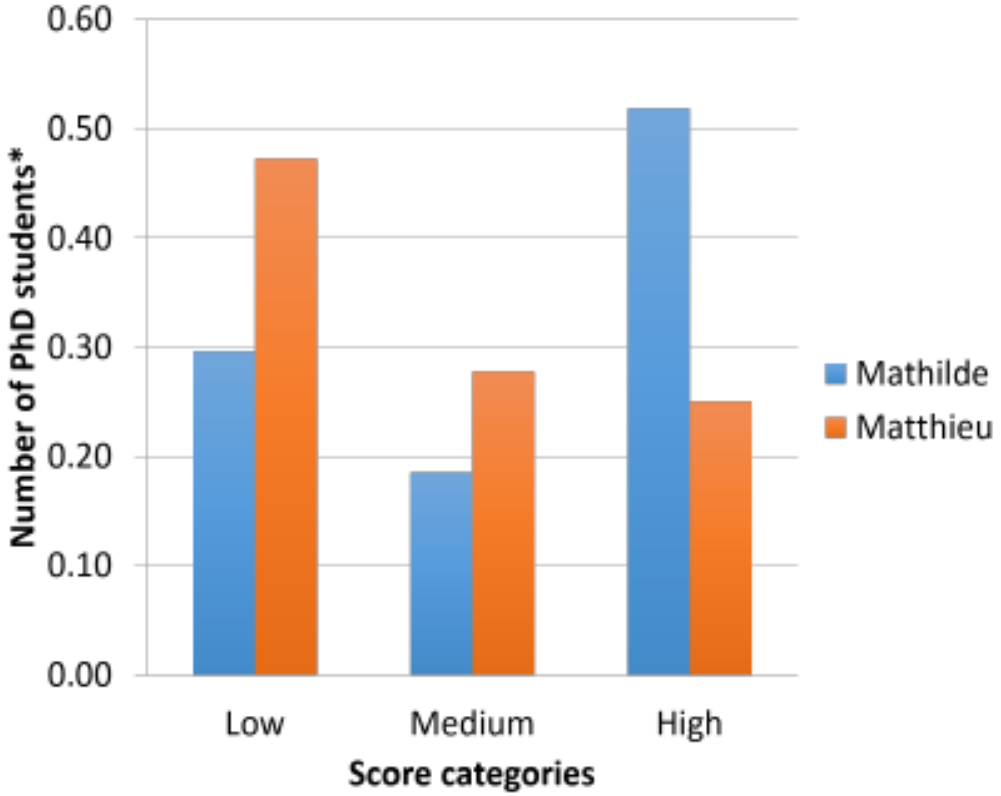
Competence judgements

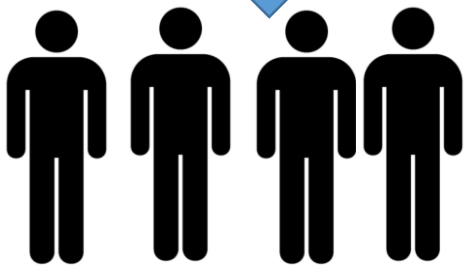
- “Because students depend on feedback… faculty assessments of student competence [are] likely to contribute to students’ self-efficacy and goal setting” (Moss-Racusin et al. 2012)

- “John”/”Jennifer” study with STI doctoral assistants (n=63):
  - No difference in competence, hireability, mentoring scores
  - How would you rate his/her suitability for a career in Research and Development
    - Bias in favour of women
    - Not significant (p=0.09)

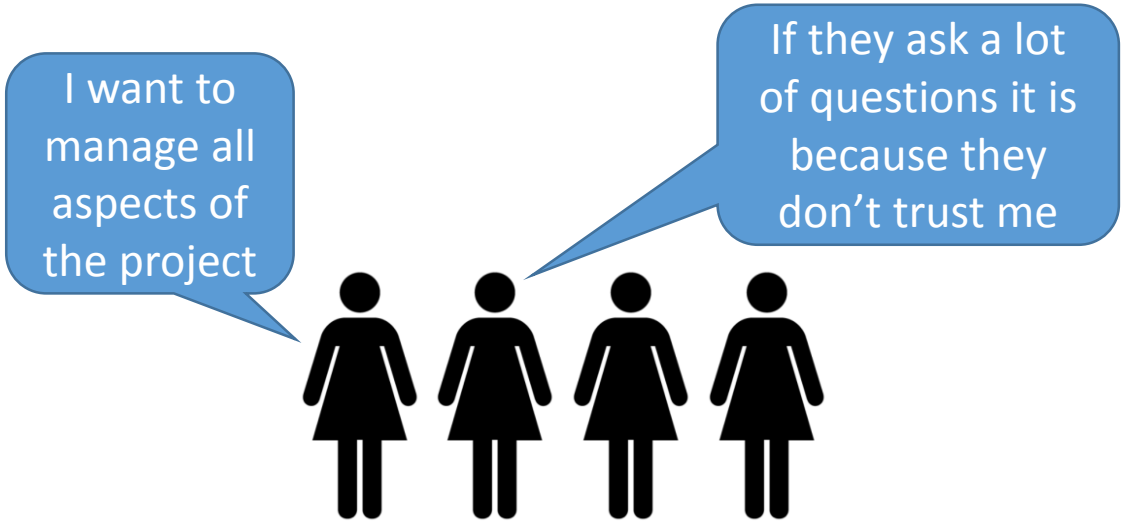


Prisca Moranda, Mira Puthettua, Chenyue Xua, Yanfei Zhao (2016) Doctoral Assistants Do Not Show Gender Bias Favoring Male Students *HPL Project Report*

Compared to



Prisca Aeby, Roger Fong, Mila Vukmirovic (2016)
Does gender under- and over-representation in engineering students' group work make a difference?



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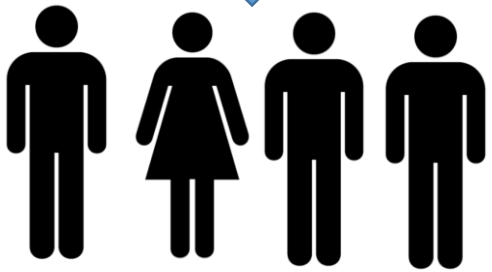

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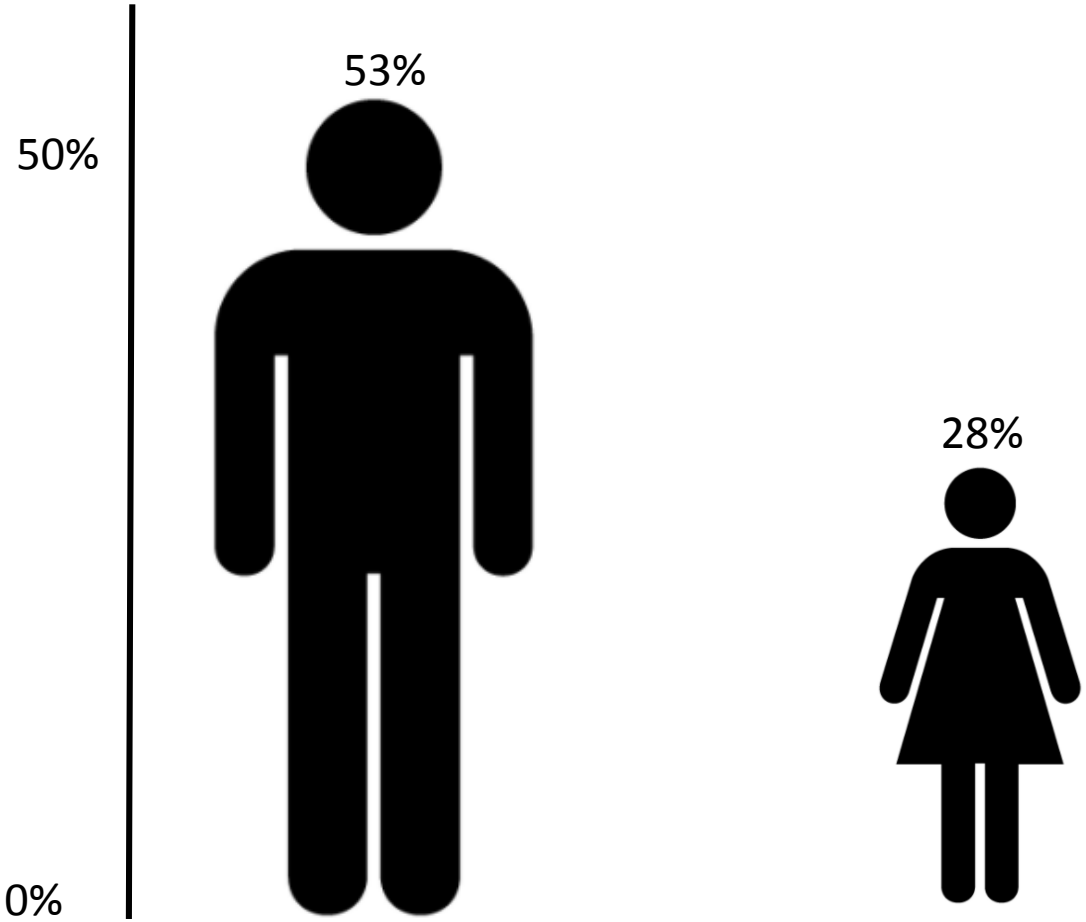


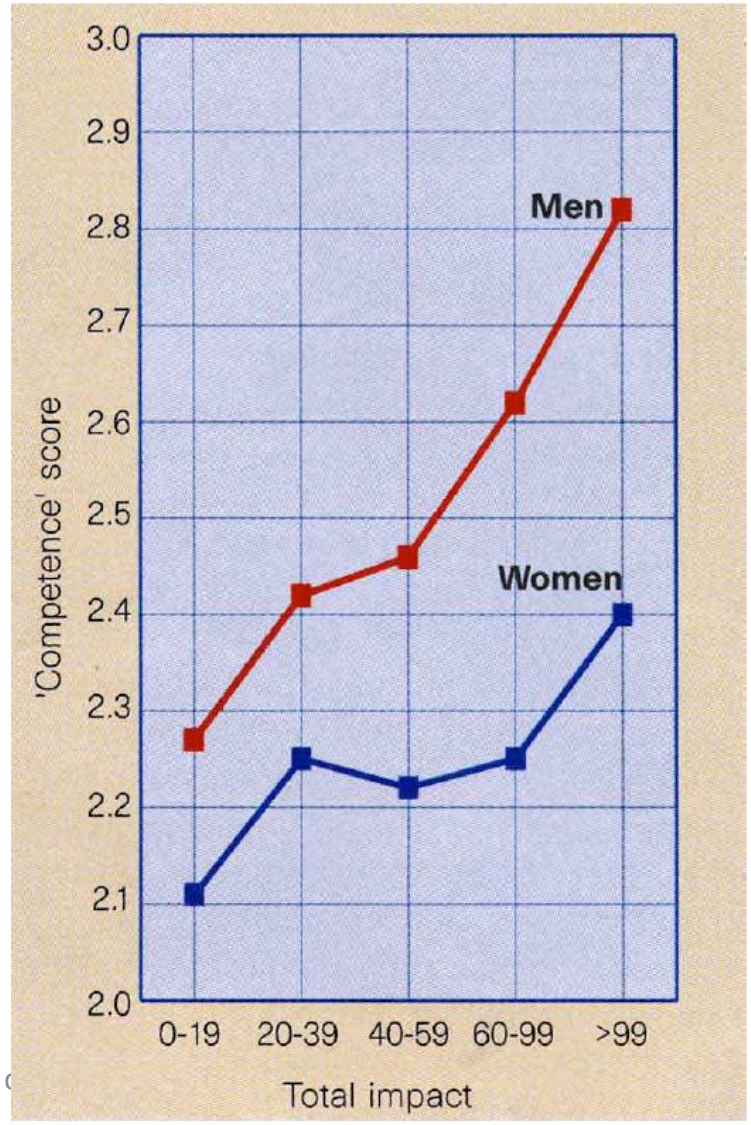
Percentage who 'strongly agreed' that they were confident that their opinions and suggestions would be valued as much as anyone else's.

Tainted Judgements?

- Analysis of peer review scores in medical research grants in 1995
  - Wenneras and Wold (1997)
  - Of 114 applicants, 52 were women
  - Applicants graded on
    - Scientific competence
    - Quality of Methodology
    - Relevance of Proposal to the field
  - Women scored lower on all three criteria

Tainted Judgements?

- Researchers compared "scientific competence" score with "publication track record"
  - Multiple measures for publication track record
- Male (red) scores compared with female (blue) scores
  - 1 impact point = 1 paper in a journal with impact factor of 1

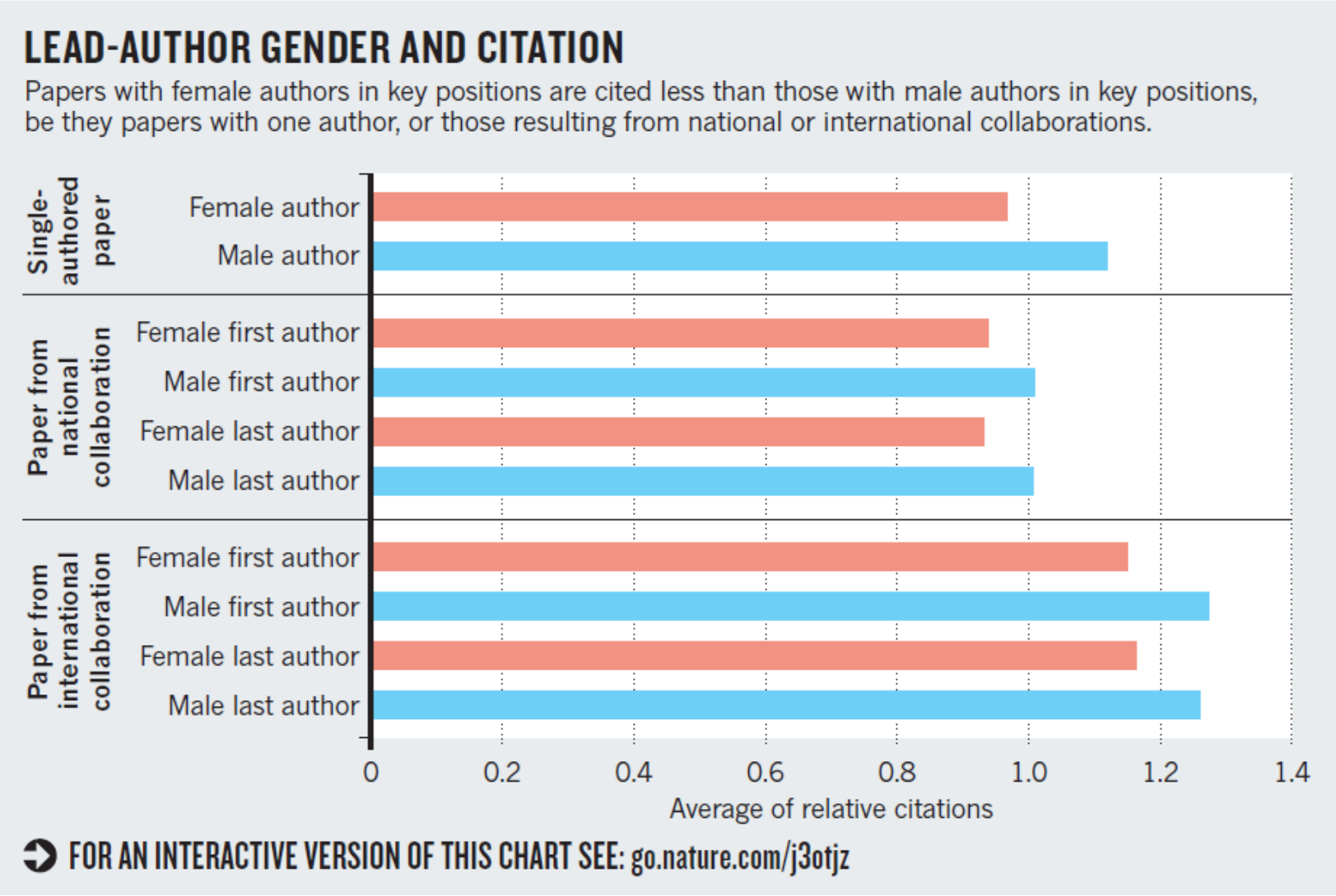


Tainted Judgements?

- Female applicants needed to be 2.5 times more productive than male applicants in order to receive the same rating

- Conclusions from this study
  - Gender bias is pervasive
  - *Even in Sweden (*this research was on Swedish academics)

And for those who make it through…



Conclusions

- Gender differences in outcomes are not inevitable
- Implicit and explicit biases probably both play a role
  - Biases of both males and females
  - In school, university, and beyond
- Biases are often marginal, but have a cumulative role
  - Not always present, so can be changed
- Not all decisions are marginal in impact