Social factors and underrepresentation, with a focus on women in STEM

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"She was doing everything I was doing, but just like Ginger Rogers, it was backward in heels." Obama on Clinton, DNC, July 27, 2016

Introduction

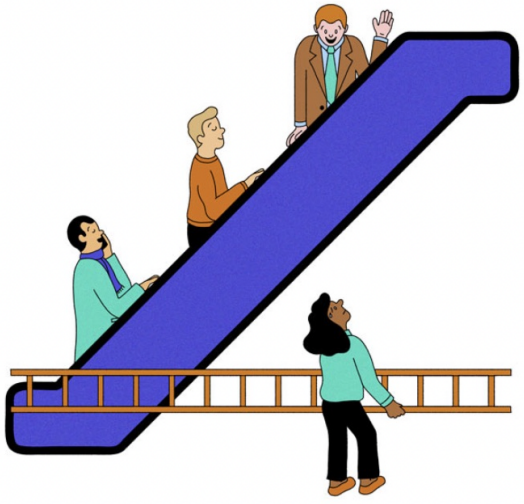
Or perhaps, as suggested by Beth Novey from NRP, we should update this to:

"She did everything he did, but she did it.....

... concurrently, and with inadequate parental leave"
... competently, but still making $0.79 cents to the dollar"
... apologetically, lest she otherwise be labeled a 'bitch' "
... nervously, while trolled on social media"
... stylishly, while criticized for her clothes"
... dauntlessly, while catcalled on the street"
... amiably, so as not to appear 'aggressive' "
... vicariously, through the lives of her children"
... prettily, and preferably in pink"
... wearily, and wishing things were different"

Introduction

An article in the New York Times on October 14, 2021:



Melanie Lambrick.

OPINION

This Is How Everyday Sexism Could Stop You From Getting That Promotion

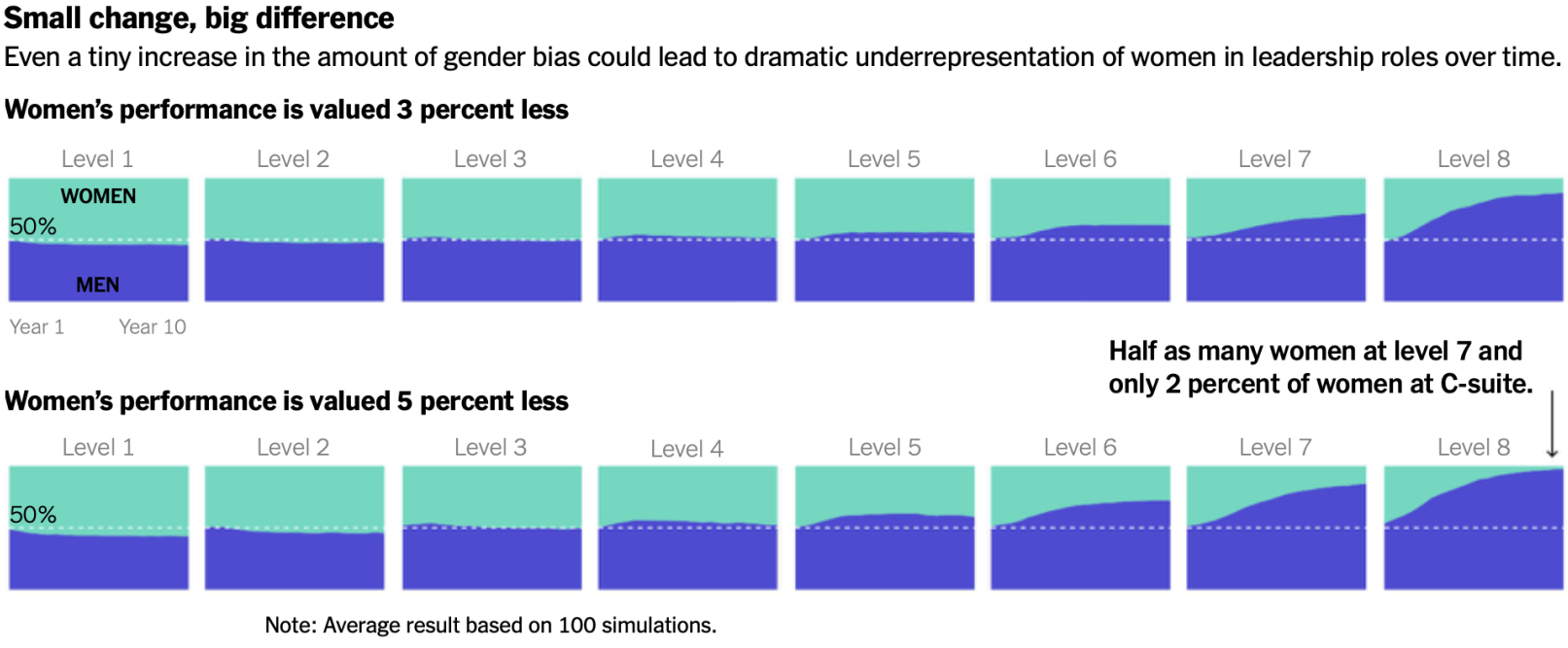
By Jessica Nordell
Graphics by Yaryna Serkez

Created a computer model of a workplace to determine the effects of "routine" gender bias over time

Model shows "how large organizational disparities can emerge from many small, even unintentional biases...over a long period of time"

Introduction

Figure from that article:



In this talk we will explore some of the reasons for "small" or "routine" gender bias and disparities.

Introduction

First, some disclosures:

This is not my field of scholarship. I am a mathematician, and I study dynamical systems and partial differential equations. Roughly speaking, I analyze the ways that we can use mathematical models of systems that change in both space and time to predict their future behavior.

By most measures, I am very privileged. Nevertheless, I have faced difficulties in my career related to my gender.

This talk focuses on women and men because that's what most studies do; I acknowledge there are other genders that are even more marginalized.

The purpose of this talk it to learn about some key social factors, so that we can help not just ourselves but especially those with less privilege.

So, how did I come to be speaking to you today?

Through my own experiences.....

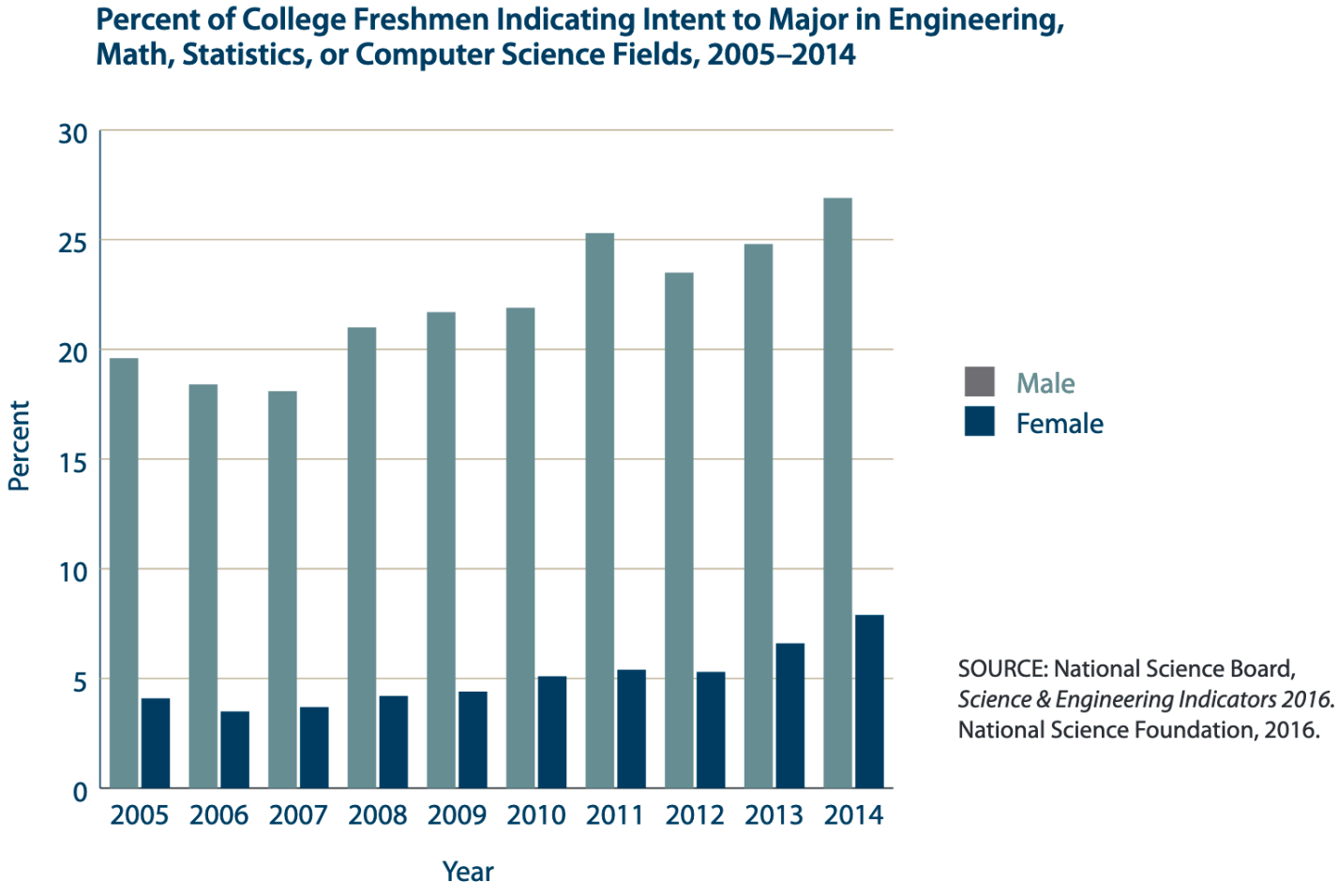
Warm up activity

Make a list of your personal strengths.

There are no right or wrong answers. These could be academic strengths (good at subject x, good at remembering facts, good at solving problems, etc), but I also encourage you to think more broadly (eg the ability to work with others, organizational skills, good at completing tasks on time, good at communicating, leadership qualities, strong sense of integrity, etc).

This is private, just for yourself; you need not show it to anyone.

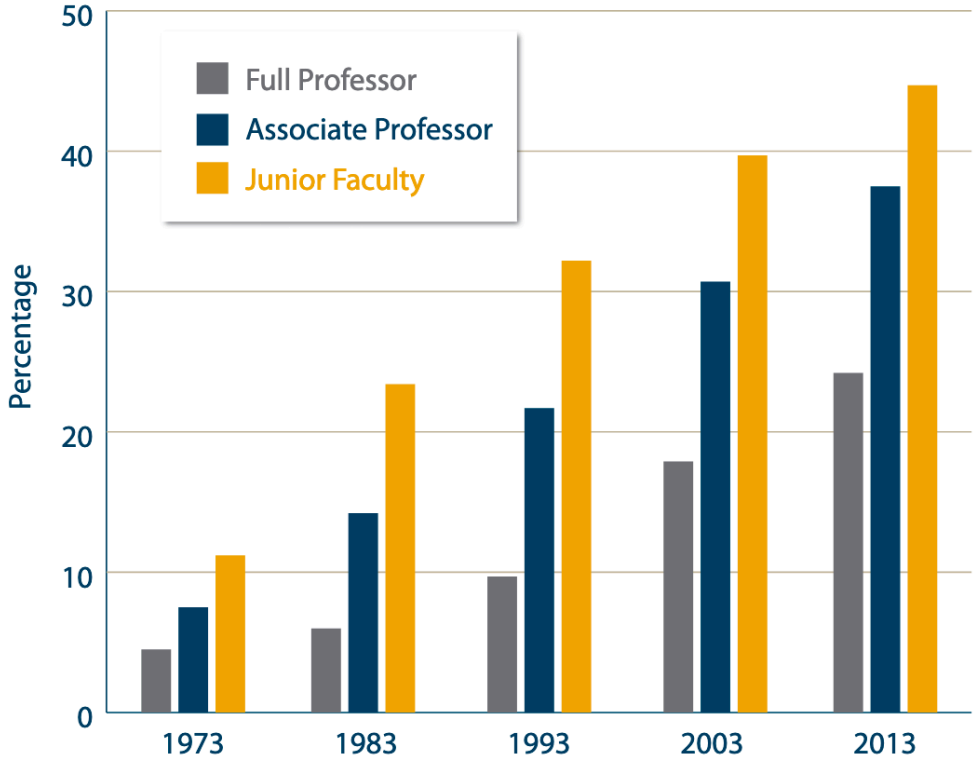
Some data on Women in STEM



National Coalition for Women and Girls in Education report "Title IX at 45" (2017).

Some data on Women in STEM

Women as a Percentage of Science & Engineering Doctorate Holders Employed Full Time in Academia, by Academic Rank, 1973–2013



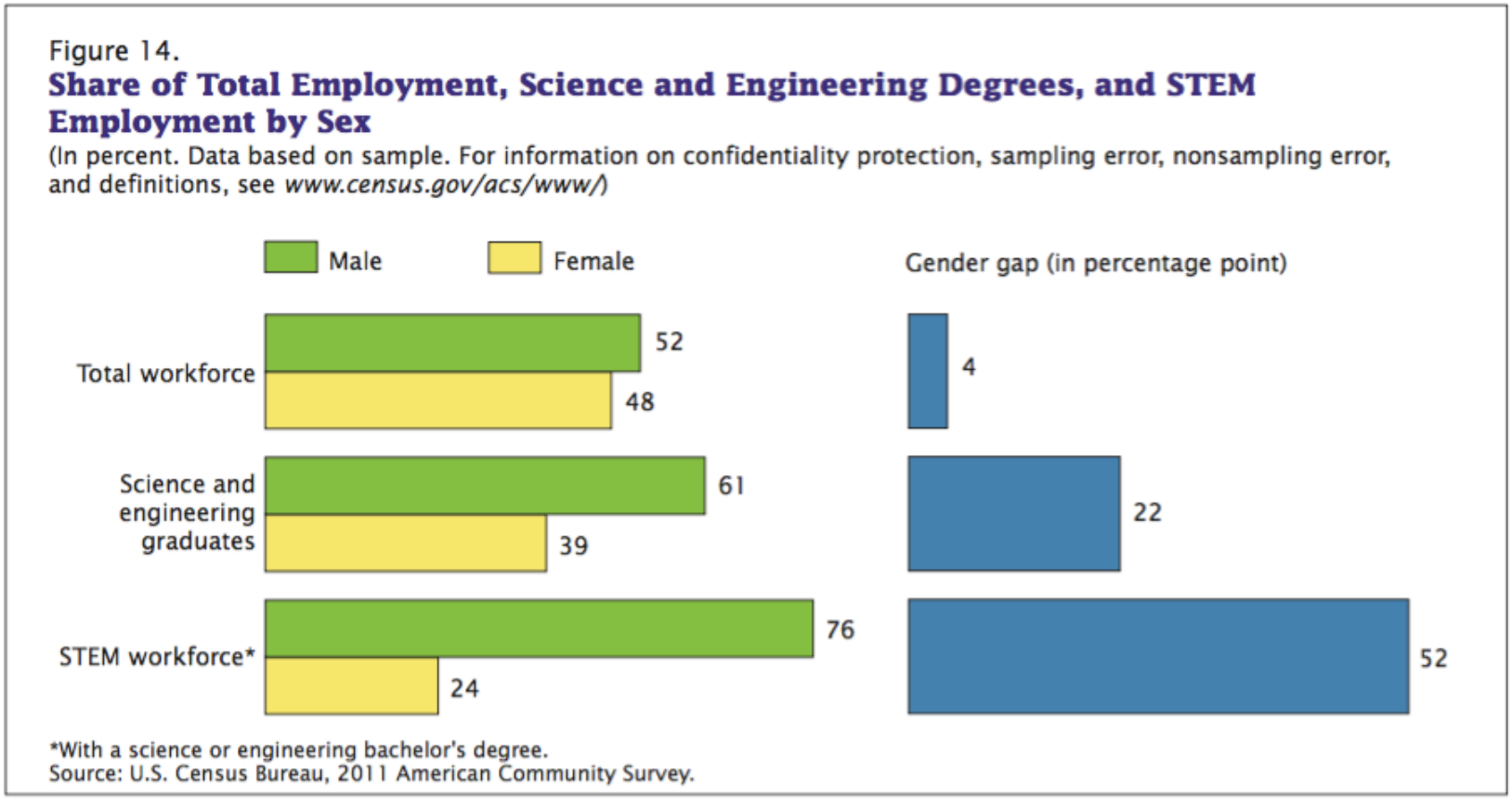
NOTES: Academic employment is limited to U.S. doctorate holders employed at 2– or 4-year colleges or universities, medical schools, and university research institutes, excluding those employed part time who are students or retired. Junior faculty includes assistant professors and instrocutors in 1973, 1983, and 1993; in 2003 and 2013, junior faculty includes assistant professors.

SOURCE: National Science Foundation, *Science & Engineering Indicators 2016.*

Note the leaky pipeline!

National Coalition for Women and Girls in Education report "Title IX at 45" (2017).

Some data on Women in STEM



Another perspective on the leaky pipeline.

American Community Survey Reports "Disparities in STEM Employment by Sex, Race, and Hispanic Origin" (2013).

Why So Few?

We'll look at some factors and partial explanations for underrepresentation of women in STEM, keeping in mind that biases and stigmas are far stronger against other groups and identities.

- Implicit bias
- Stereotype threat
- Imposter syndrome
- Microaggressions and intersectionality

Implicit Bias

What is implicit bias?

- Results from thoughts and feelings outside of conscious awareness and control.
- Can activate stereotypes and result in bias.
- Deeply ingrained and nearly-universal social messaging creates associations of white/male with intelligence and leadership qualities.

Where is implicit bias found? Absolutely everywhere that people need to rate or evaluate each other.

Where Is Implicit Bias Found?

Implicit gender bias in science faculty [Moss-Racusin et al 2012]:

- Faculty at research-intensive universities asked to rate student applicants
- Applicants randomly assigned male or female name
- "Faculty participants rated the male applicant as significantly more competent and hireable than the (identical) female applicant"
- Male applicants offered higher starting salary and more mentoring
- Gender of the faculty participant did not affect the response

Citation analysis across STEM:

- Articles with women in dominant-author positions received fewer citations then those with men in the same positions [Sugimoto et al 2013]

Implicit Bias in Letters of Recommendation

Letters for female applicants to medical faculty were [Trix and Psenca 2003]:

- Shorter and contained fewer status terms, e.g., scientific terminology
- Higher percentage of "doubt raisers," e.g., health issues, unmet goals
- "women as teachers and students"; "men as researchers and professionals."

Findings extremely robust across many independent studies: [Madera et al 2009], [Schmader et al 2007], [Biernat-Eidelman 2007], [Heilman et al 1988]

Implicit Bias in Letters of Recommendation

From [Trix and Psenca 2003]:

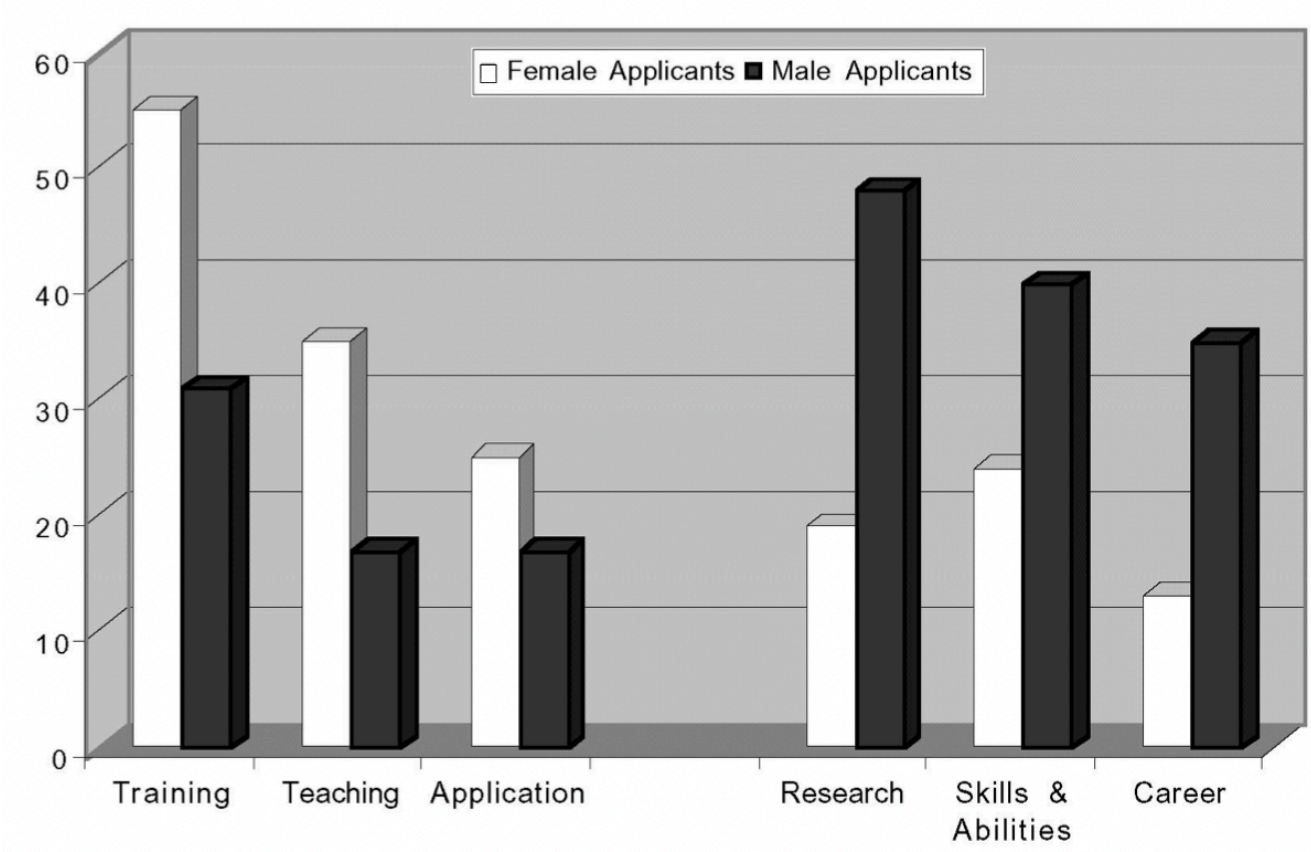
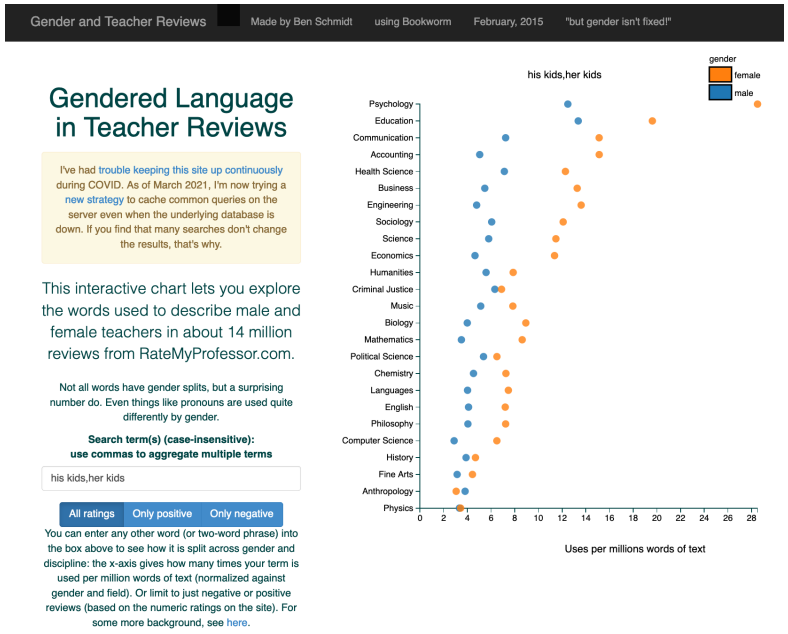


FIGURE 3. *Semantic realms following possessives. Rank-ordered within gender sets from equal numbers of letters 'her training'; 'his research'*

Implicit Bias in Evaluations

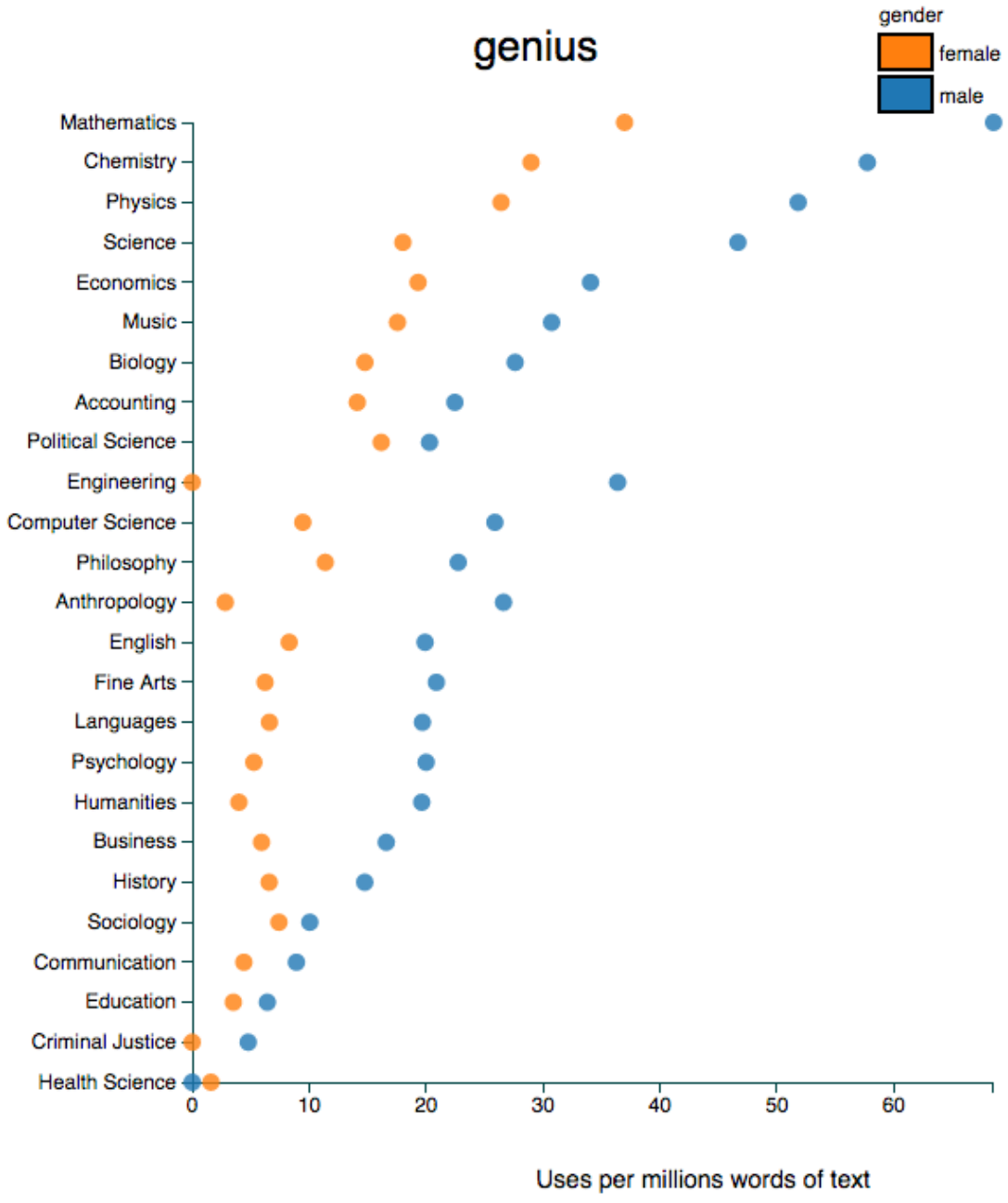
"Men are more likely to be described as a star, knowledgeable, awesome or the best professor. Women are more likely to be described as bossy, disorganized, helpful, annoying or as playing favorites."



`http://benschmidt.org/profGender/`

"Is the Professor Bossy or Brilliant? Much Depends on Gender," NYTimes, 2015

Implicit Bias in Evaluations



How to counteract implicit bias?

Be aware of your biases, for example by taking an implicit bias test.

`https://implicit.harvard.edu/implicit/takeatest.html`

Everyone has them; education doesn't prevent them. Awareness helps. Also, seek out information that contradicts stereotypes; connect with people whose experiences are different from yours. From the Harvard Business Review:

Cognitive Bias

Unconscious Bias Training That Works

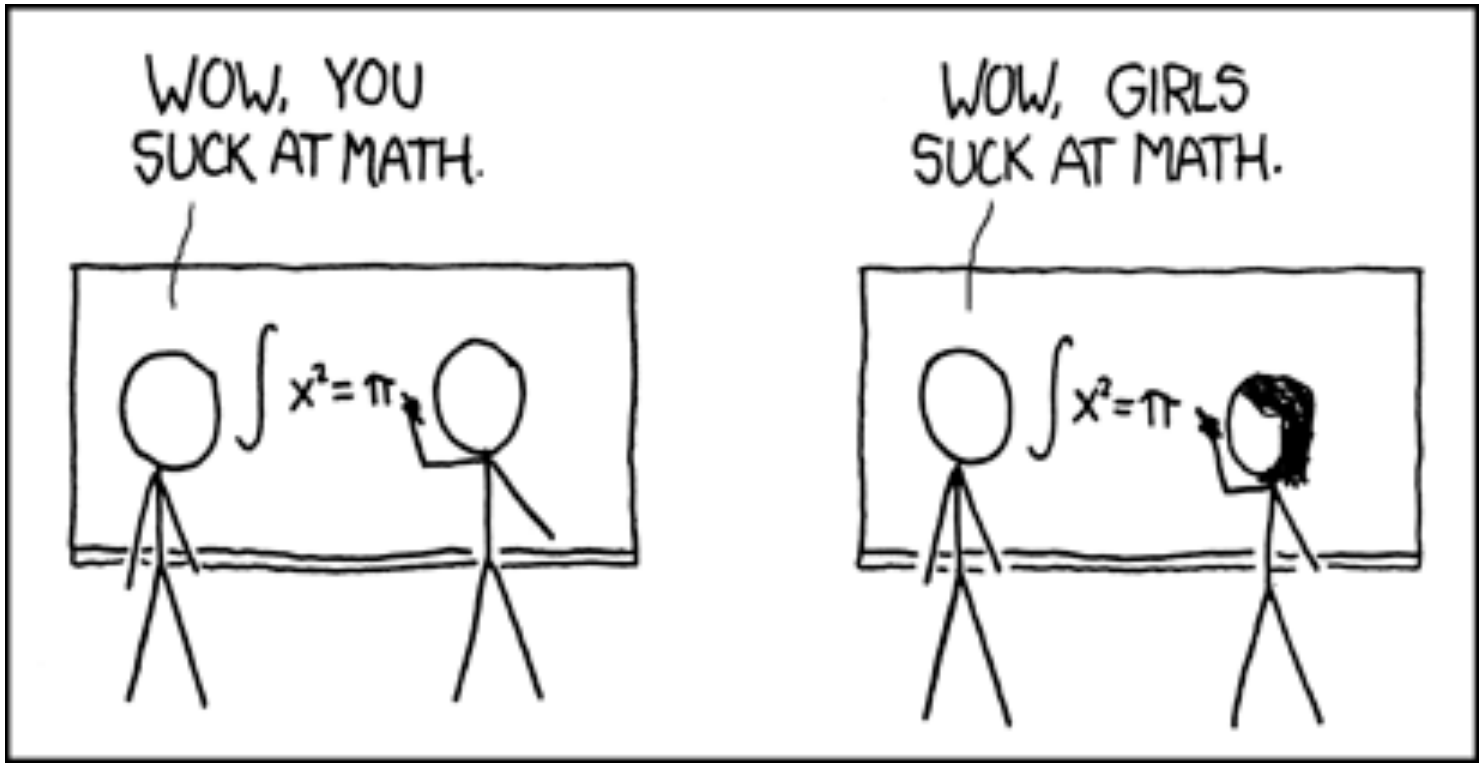
Increasing awareness isn't enough. Teach people to manage their biases, change their behavior, and track their progress. by Francesca Gino and Katherine Coffman

From the Magazine (September–October 2021)

Mark Harris; woman: oonal/Getty Images

Stereotype threat

http://xkcd.com/385/



Stereotype threat

Stereotype: generalized expectation or belief applied to group.

Stereotype threat: "a situational predicament in which individuals are at risk...of confirming negative stereotypes about their group" and this threat triggers reduced performance. [Inzlicht and Schmader 2012]

Stereotypes of math ability [Steele 2011, Shih et al 1999]:

- Direct: Reminding women of sexist stereotypes leads to reduced performance on test
- Indirect: White men perform worse if reminded of stereotype that Asians are better at math
- Implicit: Even having women fill out a gender field on a test suffices to trigger this effect

Stereotype threat can result in avoidance and attrition from high-threat situations, which can drive stigmatized groups out of STEM fields

Stereotype threat

How can you reduce stereotype threat?

- Have students reaffirm their self-integrity, the extent to which they see themselves as virtuous and efficacious.
- Remove cues that trigger worries about stereotypes, such as physical cues that suggest that the environment is defined by the majority group.
- Convey that diversity is valued, and create a critical mass.
- Value students' individual identities.
- Improve cross-group interactions.
- Convey high standards and students' ability to meet those standards.
- Promote a growth mindset about intelligence; people are not "born" to be good at something. Intelligence is like a muscle - it is not fixed and will grow with effort.

`https://ed.stanford.edu/sites/default/files/interventionshandout.pdf`

Stereotype threat

Various activities, such as values affirmations and social belonging interventions, have been shown to promote learning and self-acceptance in the face of stereotype threat or other threats to students' identities.

Values affirmation is effective, for example, in closing the gender gap in student performance in a college-level introductory physics class [Miyake et al, 2010].

The exercise you did at the beginning of the talk was my variation of this.

Imposter Syndrome

- Term coined in 1978 by Clance and Imes referring to high-achieving women who thought they were not really bright despite numerous achievements.
- Can affect anyone, regardless of race, gender, etc, but it can be particularly detrimental to stigmatized groups when combined with other factors.
- Can be reinforced by well-meaning programs to promote diversity, eg "I only got this job/fellowship/grant because I'm a woman..."

(Micro)aggressions

`everydaysexism.com`

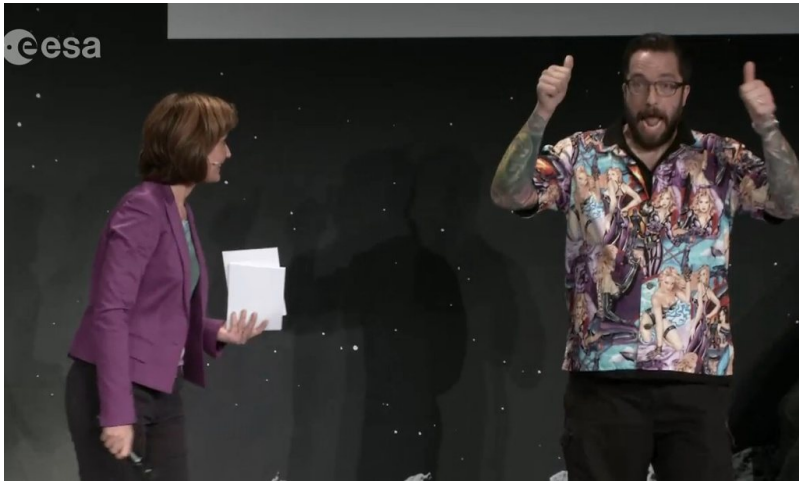
Famous examples of aggressions:

- Tim Hunt, nobel laureate, said labs should be gender segregated because women cause men to fall in love with them and cry when criticized. Lead to #distractinglysexy

(Micro)aggressions

Famous examples of aggressions:

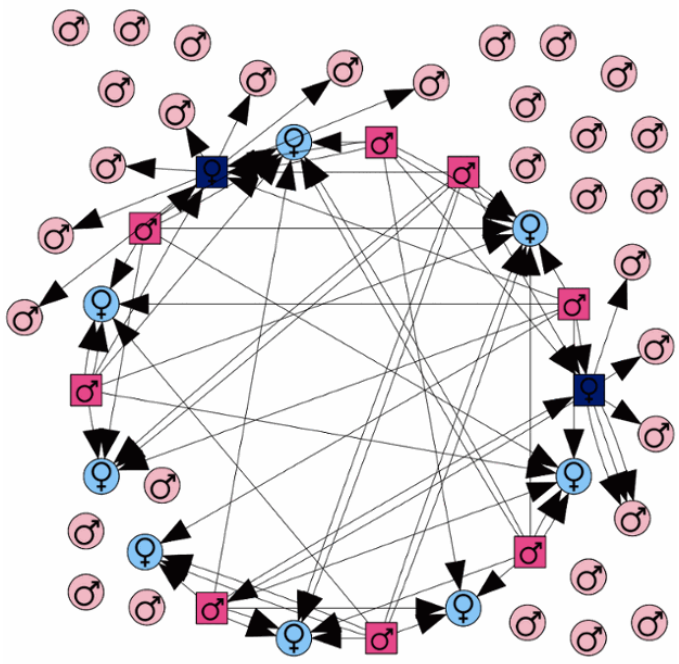
- Matt Taylor of the Rosetta mission at press briefing: it was "the sexiest mission there's ever been. She's sexy, but I never said she was easy."
- Shrinivas Kulkarni, astronomy and planetary science professor at CalTech during NPR interview said "Many scientists, I think, secretly are what I call 'boys with toys.'"



The Petrie Multiplier

Thought experiment by Karen Petrie (Dundee, CS) popularized in blog post by Ian Gent (St Andrews, CS)

Math model explains why, in the presence of very imbalanced group ratio, even casual "microaggressions" can be magnified to create a hostile atmosphere

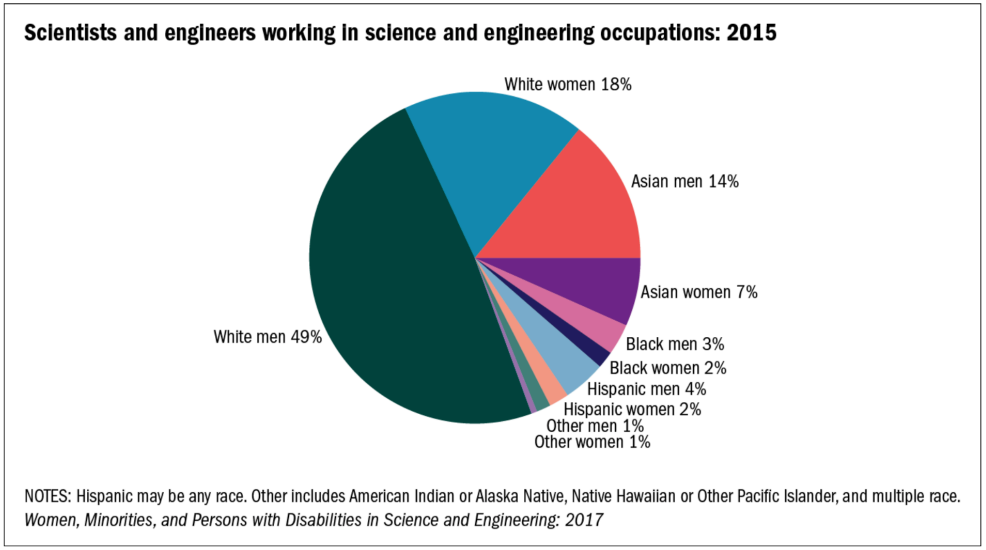


- Assumption: Group A and Group B are equally likely to make a clueless or snarky remark to a person of the other group.
- Result: If ratio of A to B is $1/R$, A members receive R^2 as many snarky remarks as B.
- Reasoning: There are R times as many B to give snark, so R times as much B-snark is given. There are R times fewer A to receive it, so each A is R times as likely to receive a given remark.

`http://blog.ian.gent/2013/10/the-petrie-multiplier-why-attack-on.html`

Intersectionality

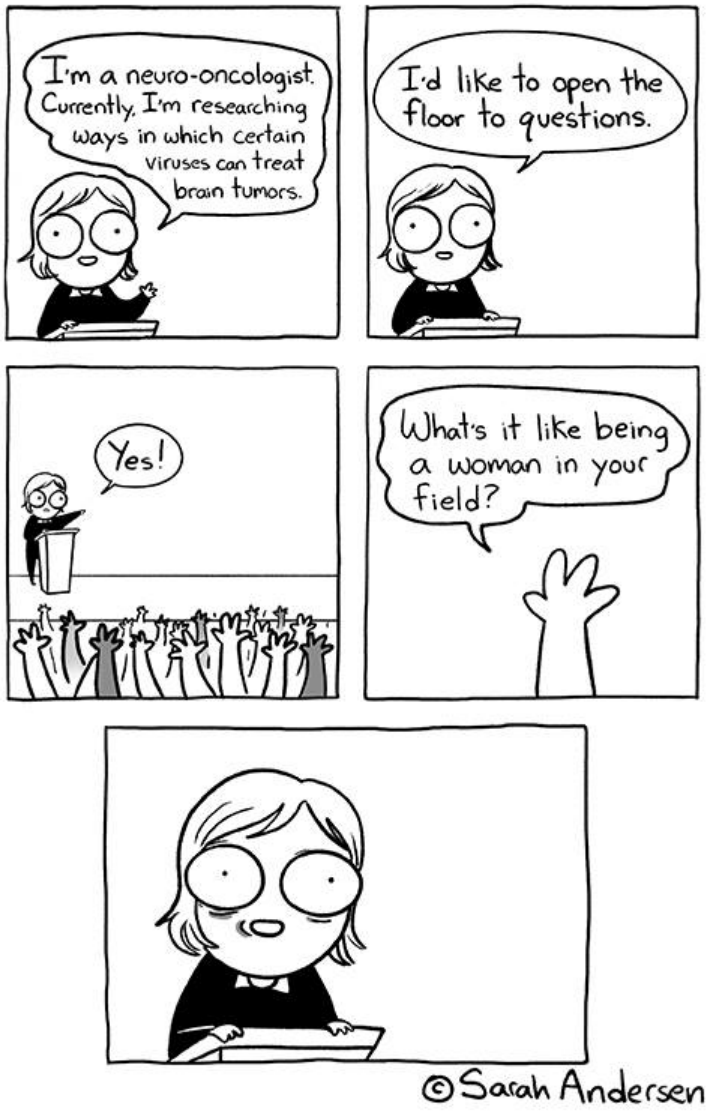
Intersectionality describes how multiple identity factors (gender, race, sexuality, class, mental health, etc) can overlap and interact.



Now rerun the Petrie multiplier on, say, *three* overlapping stigmatized identities...

But keep in mind "To reduce intersectionality to a mere attention to difference is to forgot its power...The central insight...is that any liberation movement...that focuses only on what all members of the relevant group...have in common is a movement that will best serve those members of the group who are least oppressed" - Amia Srinivasan in "The Right to Sex"

Improving the Climate



http://sarahcandersen.com/

Build community. Practice self-care.

Work on "effortful thinking" to counter stereotypes, stigmas, and implicit bias.

With respect to higher-status groups that you are in, make space for marginalized groups to center their own narratives. Step aside when it's appropriate and speak up when you can. Fight against defensiveness.

Become a mentor. Lots of evidence shows that the best way to accept advice is to give it.

Find a mentor for yourself.

Remember that it is everyone's responsibility to correct inequities, especially those with privilege.

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