

SWPS 101: Why we exist and what we do

September 8, 2016

Sylvia Lewin

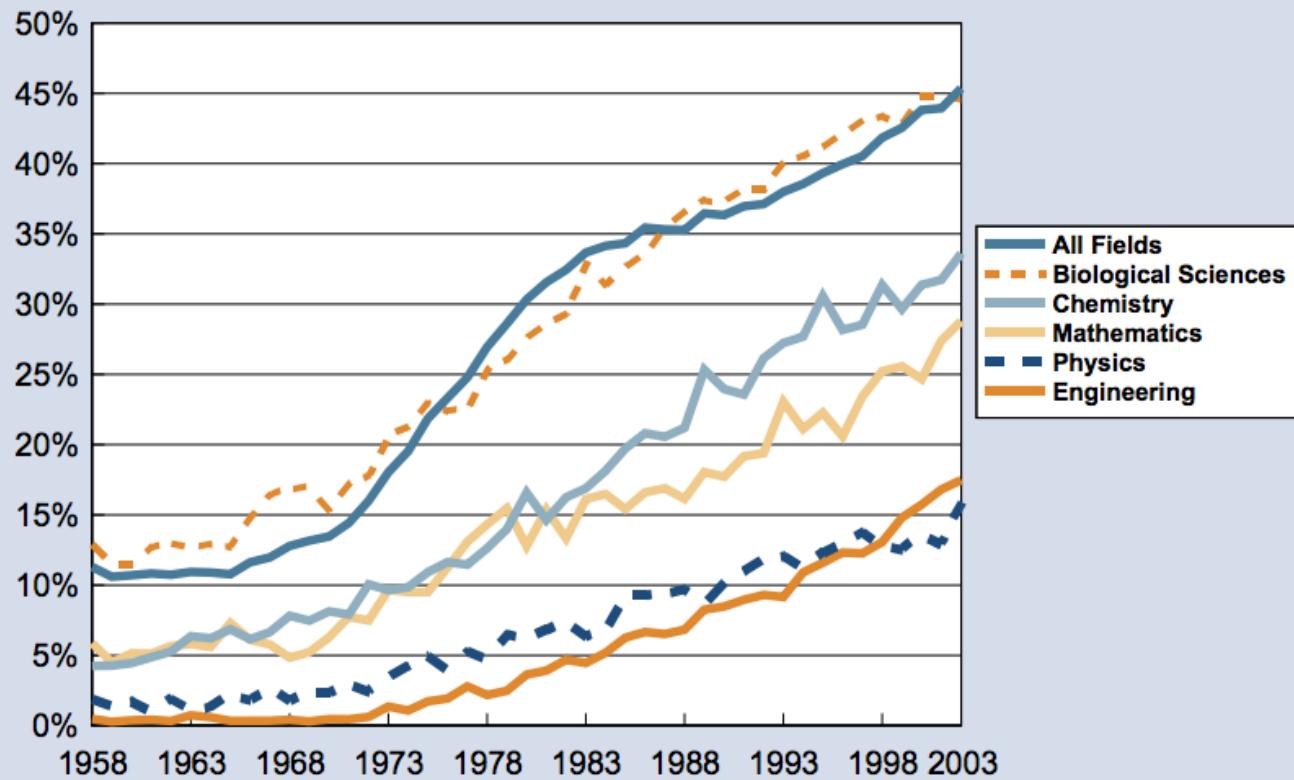
with thanks to Kate Kamdin for the
original version of this presentation

Outline

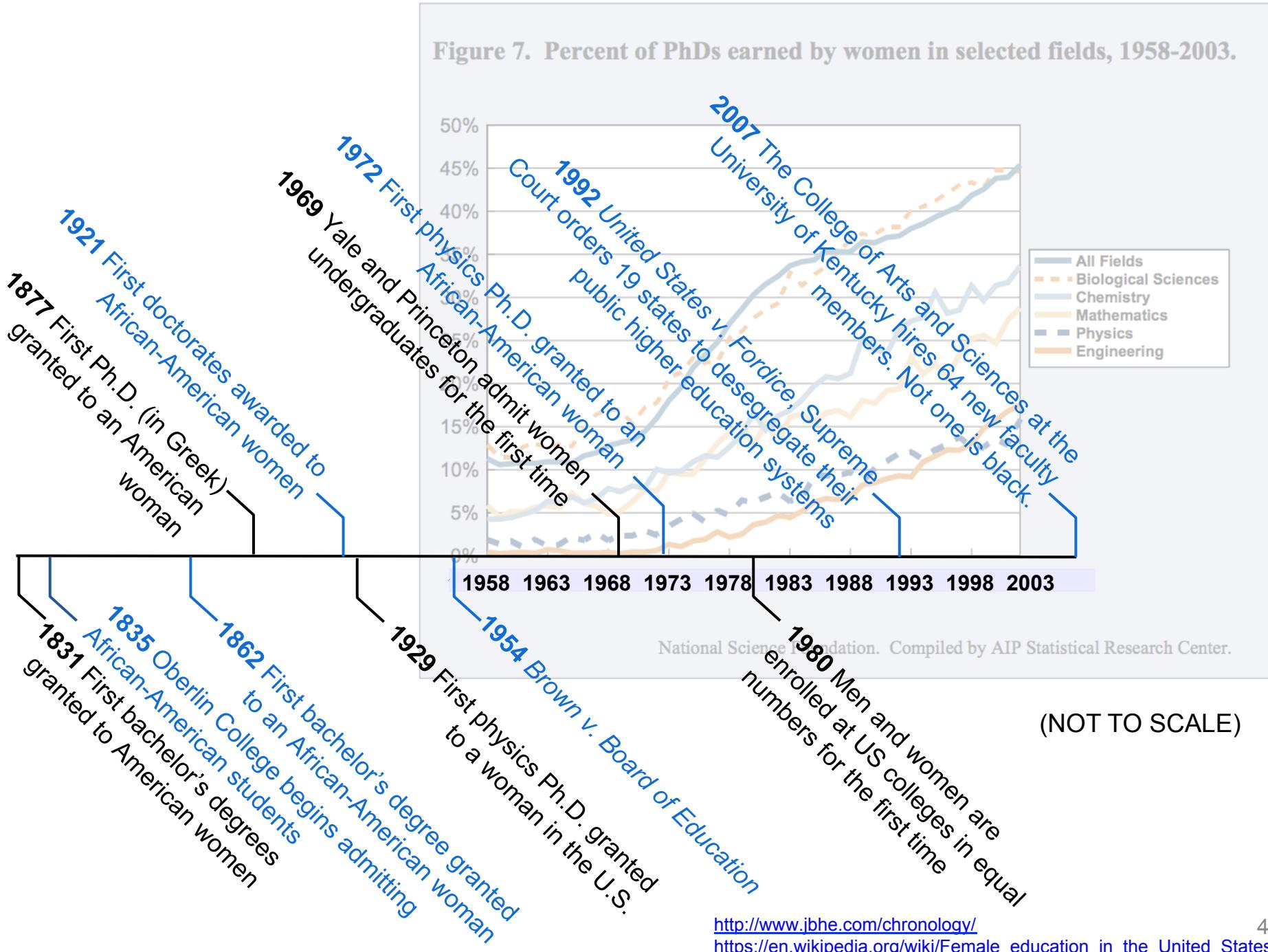
1. The gender gap
2. Possible causes
3. Why representation matters
4. How we can help

The gender gap

Figure 7. Percent of PhDs earned by women in selected fields, 1958-2003.



National Science Foundation. Compiled by AIP Statistical Research Center.





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TODAY AT BERKELEY LAB

Meet the 63rd Black Woman In American History With A Physics Ph.D.

JUNE 30, 2015



It has been calculated that just 83 Black women have received a Ph.D. in physics-related fields in American history. Chanda Prescod-Weinstein, a cosmologist at MIT, was the 63rd. She spoke to the Huffington Post about why her work for organizations such as the National Society of Black Physicists is just as important as doing her science. [More>](#)

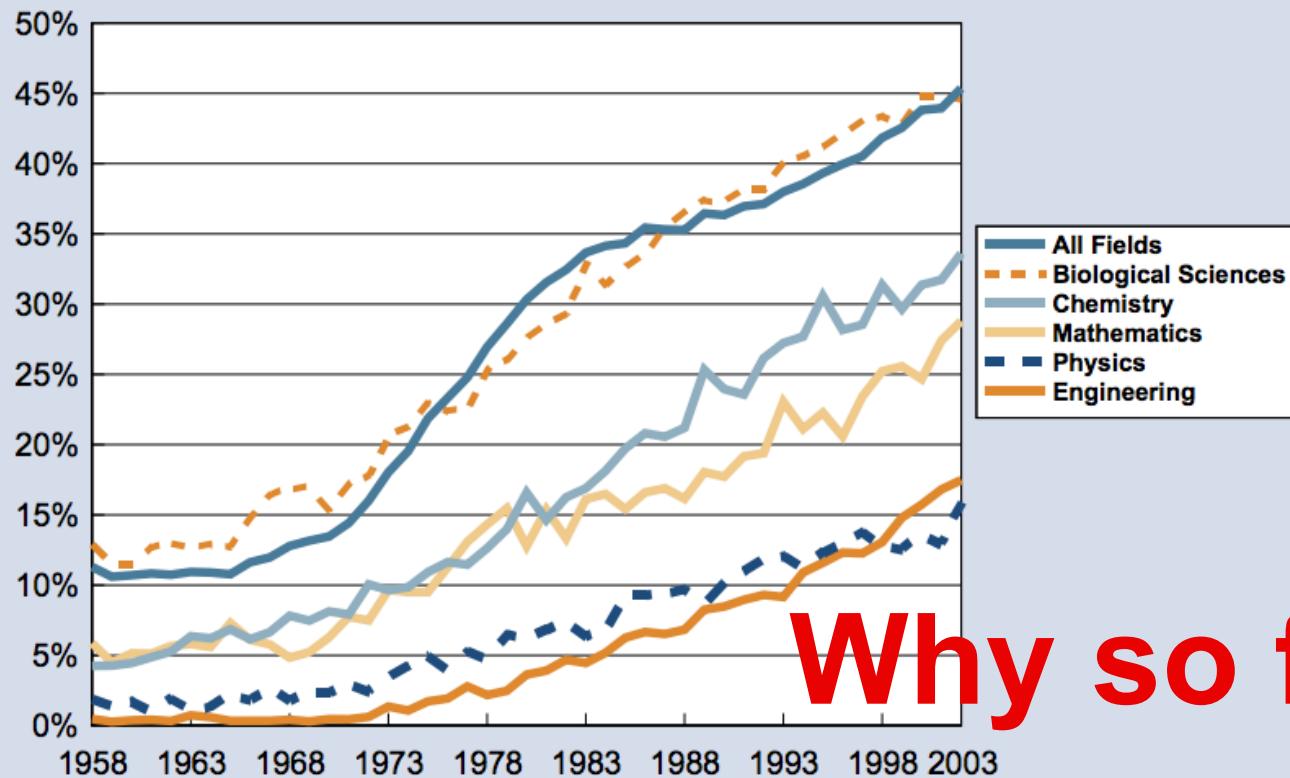
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From 1973-2012, ≈21,700 white men earned PhDs in physics.

The gender gap

Figure 7. Percent of PhDs earned by women in selected fields, 1958-2003.



Why so few?

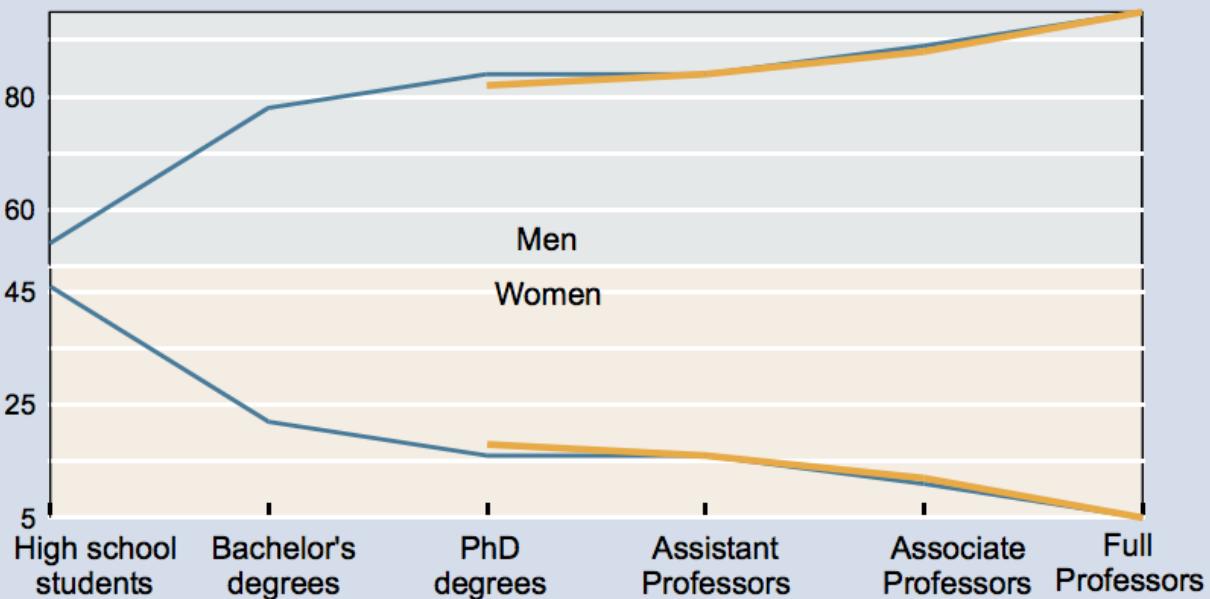
National Science Foundation. Compiled by AIP Statistical Research Center.

The “leaky pipeline” in physics

Figure 11. Actual and expected percentage of women and men in physics in the US.

Actual 2001, 2002

Expected is based on percent bachelor's degrees in the past



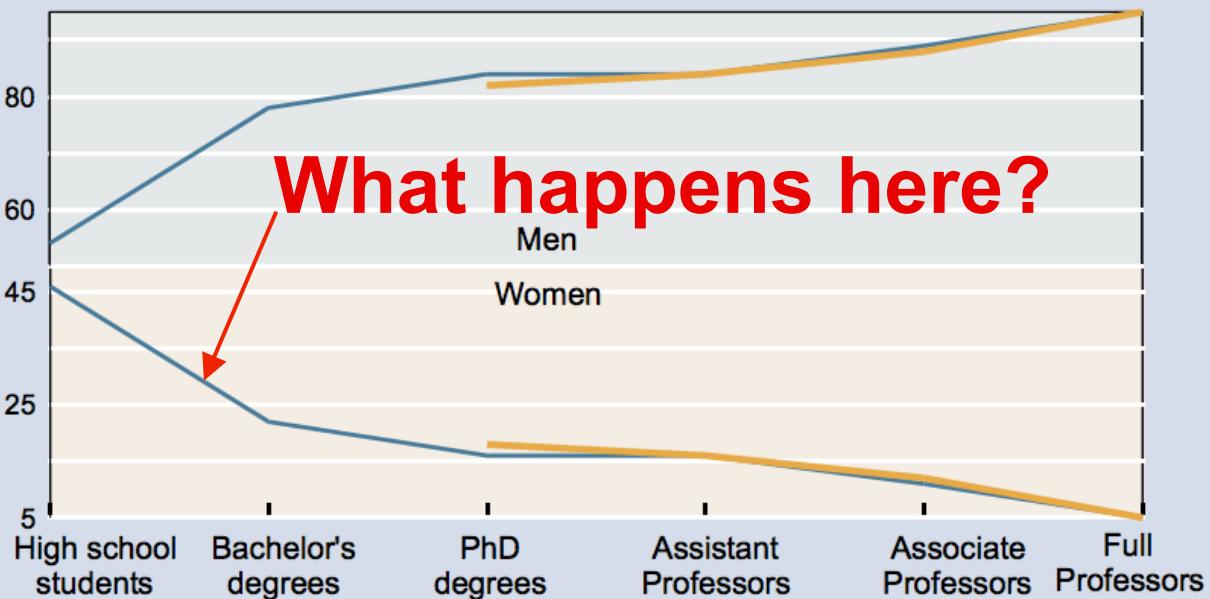
AIP Statistical Research Center.

The “leaky pipeline” in physics

Figure 11. Actual and expected percentage of women and men in physics in the US.

Actual 2001, 2002

Expected is based on percent bachelor's degrees in the past



AIP Statistical Research Center.

Lower aptitude?



“Like many women and minorities, however, I am suspicious when those who are at an advantage proclaim that a disadvantaged group of people is innately less able.”
— Ben Barres, “Does Gender Matter?” *Nature* **442**, pp. 133-136 (2006).

~~Lower aptitude?~~

“There is little evidence that gender differences in maths abilities exist, are innate or are even relevant to the lack of advancement of women in science.”

— Ben Barres

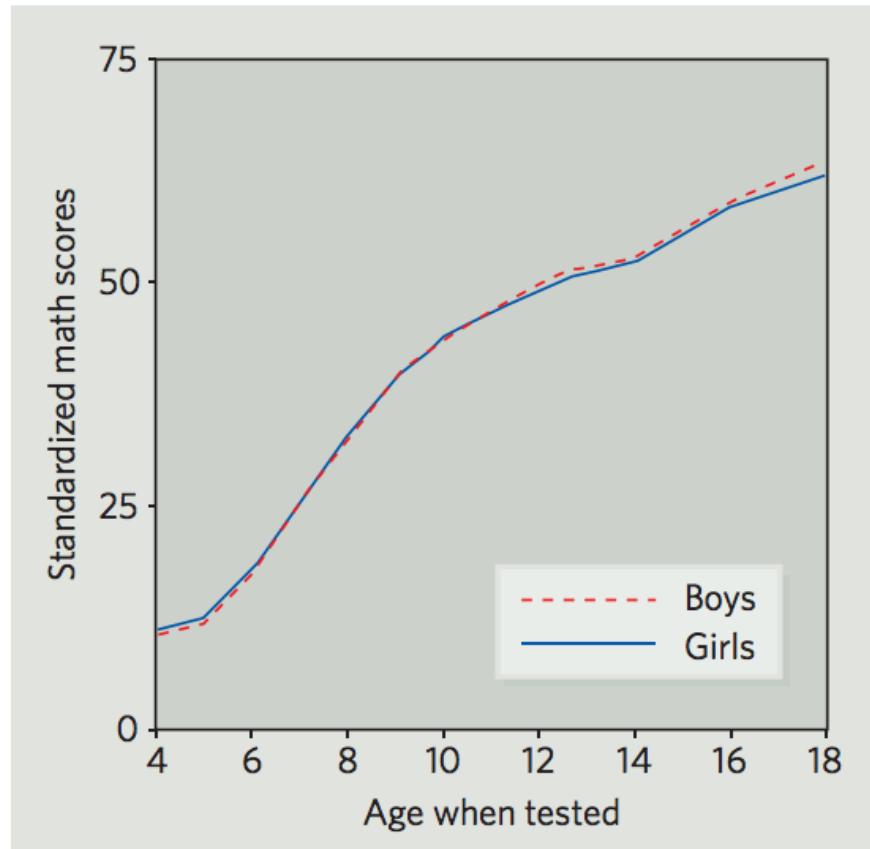
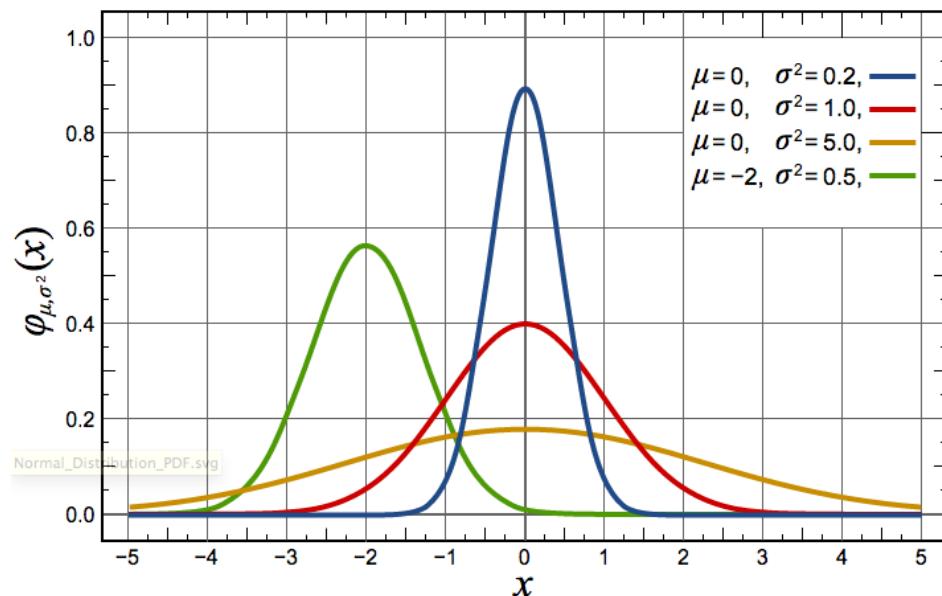


Figure 1 | Maths-test scores for ages 4 to 18. In the United States there is little to distinguish the maths-test scores of boys and girls throughout school.

Higher variance?

Larry Summers, President of Harvard, 2005:
A “different availability of aptitude at the higher end” explains the underrepresentation of women in the top positions in STEM.

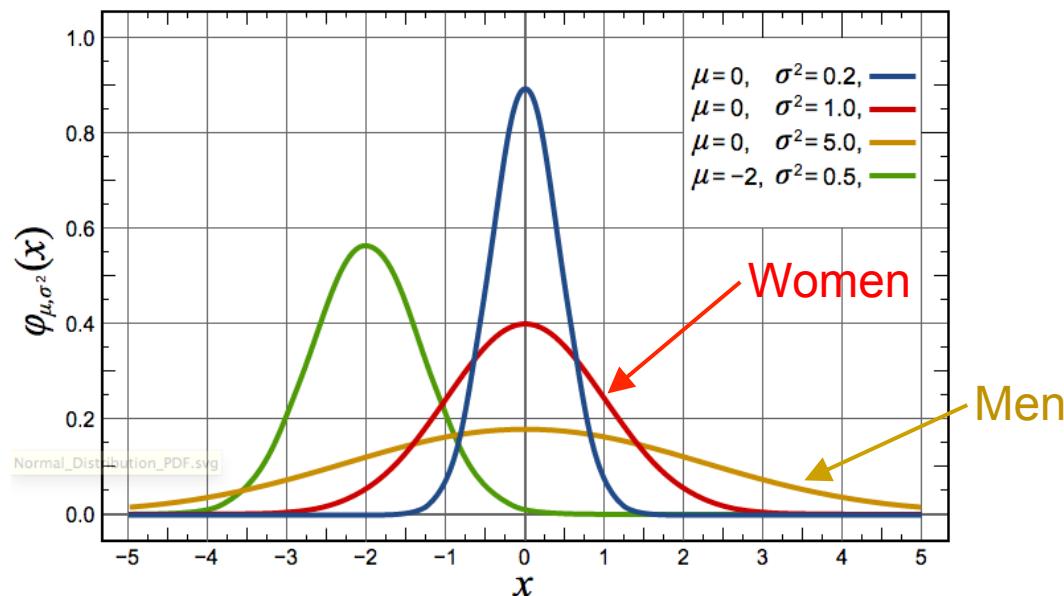


Full text of Larry Summers' remarks:
[http://www.harvard.edu/president/
speeches/summers_2005/nber.php](http://www.harvard.edu/president/speeches/summers_2005/nber.php)

Figure: "Normal Distribution PDF" by Inductiveload - self-made, Mathematica, Inkscape. Licensed under Public Domain via Commons

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Higher variance?

PISA & TIMSS: international
standardized math tests

Variability Ratio (**VR**) = male
score variability : female
score variability

$(SD_M - SD_F)/SD_w > 0$ indicates
male scores have a higher
variance; < 0 indicates female
scores have a higher
variance

Table 2. Differences in variability in math performance between boys and girls among some selected nations

Country	2003 PISA 15 year olds, M/F VR [†]	1995 TIMSS 17 year olds $(SD_M - SD_F)/SD_w^‡$
Canada	1.24*	0.05
Czech Rep.	1.07	0.11
Denmark	0.99	0.01
Germany	1.12*	-0.05
Iceland	1.24*	0.04
Indonesia	0.95*	ND
Ireland	1.07	ND
Lithuania	ND	-0.06
Mexico	1.08*	ND
Netherlands	1.00	-0.13
Thailand	1.10*	ND
Tunisia	1.03	ND
Russian Fed.	1.20*	0.02
Slovenia	ND	0.01
Switzerland	1.11*	0.02
UK	1.06*	ND
USA	1.19*	0.09

*, VR significantly different from 1.0, $P < 0.05$. ND, not determined.

[†]Variance ratios taken from table S2 of Machin and Pekkarinen (19).

[‡]Calculated from data presented in table 2 of Penner (20); P values are not known.

Higher variance?

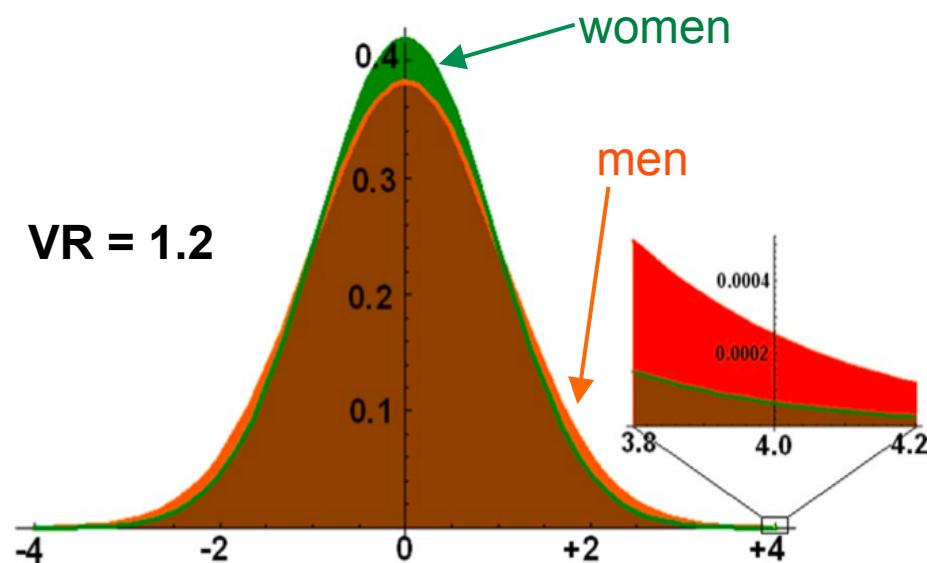


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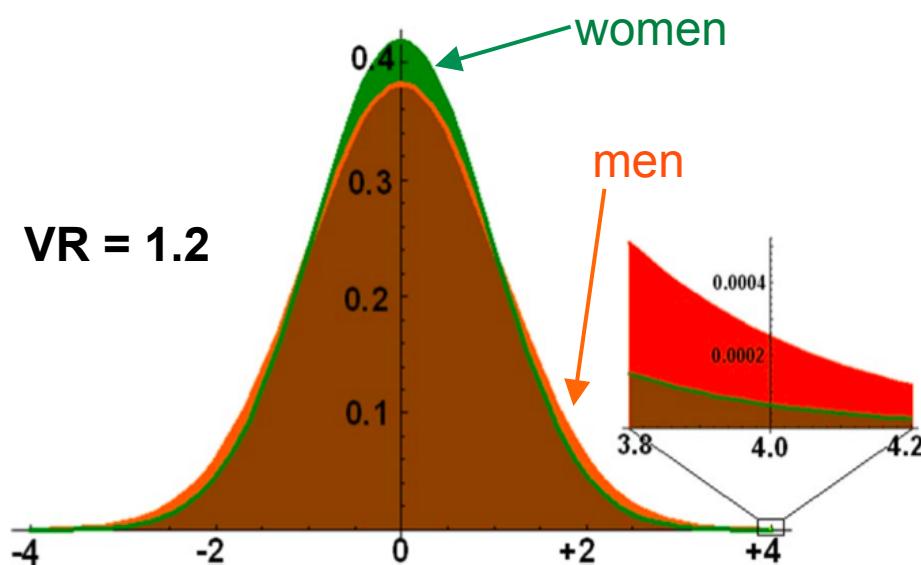
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~~Higher variance?~~



Theoretical ratio of men to women:

- 95th percentile: 1.34:1
57% men, 43% women
- 99.9th percentile: 2.15:1
68% men, 32% women

Reality in physics: 82% men, 18% women

Only makes sense if all physics PhDs are $> 4\sigma$ in math
(roughly the top 0.003%)

Why so few?

Socio-cultural factors:

- Stereotype threat
- Cultural messages about gender
- Bias (implicit and explicit)

Stereotype threat

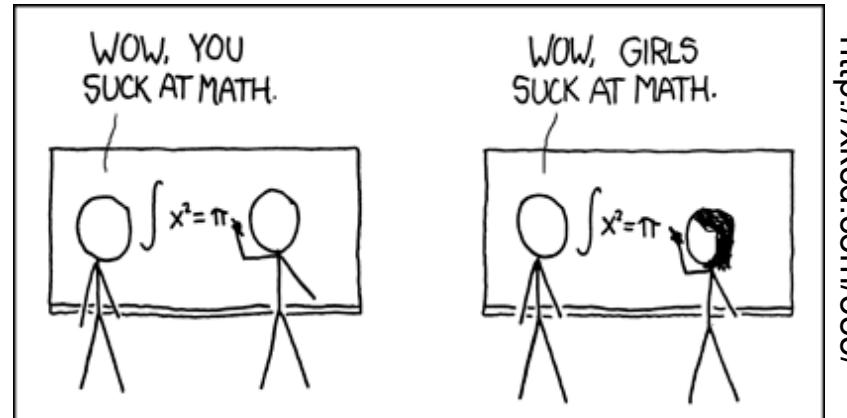
Stereotype threat describes the **anxiety** and **impaired performance** that occurs when a person could confirm a negative stereotype associated with one or more of their identities.

Stereotype threat

Example

Stereotype: “women are worse than men at math”

Anxiety related to confirming the stereotype:



Result: artificially lower math test performance by women

Stereotype threat: an example

Study 1:

Easy math test → no gender difference in performance

Hard math test → women underperformed relative to men

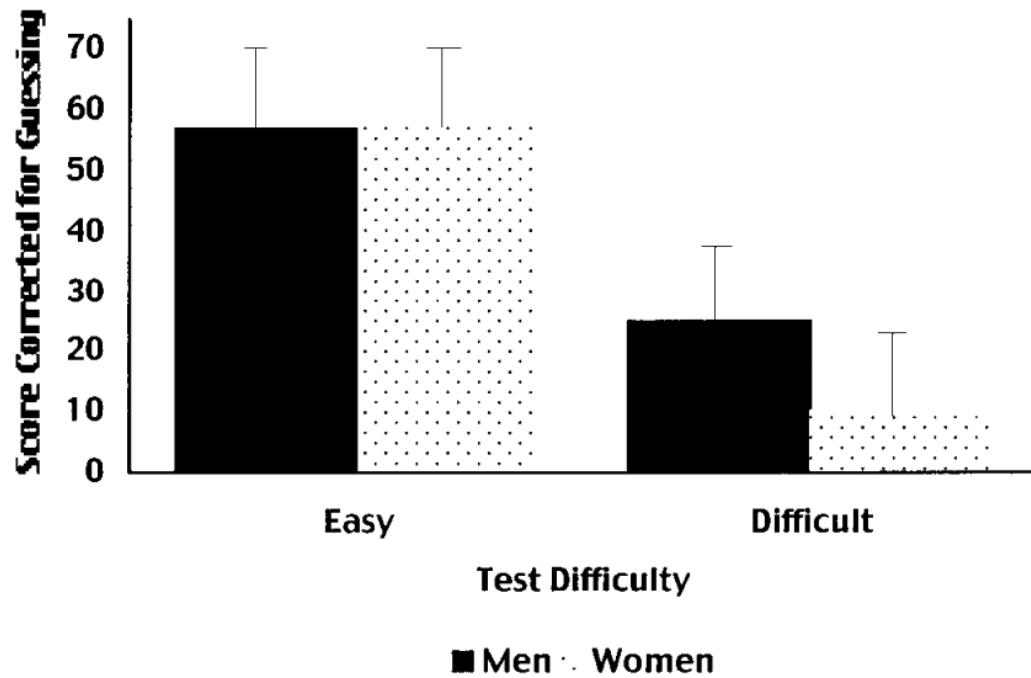


FIG. 1. Performance on a math test as a function of sex of subject and test difficulty

*Easy test:
general GRE math
Hard test:
math subject GRE*

S. J. Spencer, C. M. Steele, and D. M. Quinn, "Stereotype Threat and Women's Math Performance", *Journal of Experimental Social Psychology* 35(1), pp. 4-28 (1999)

Stereotype threat: an example

Study 2:

Explicitly eliminating stereotype → no gender difference

Explicitly reinforcing stereotype → women underperform

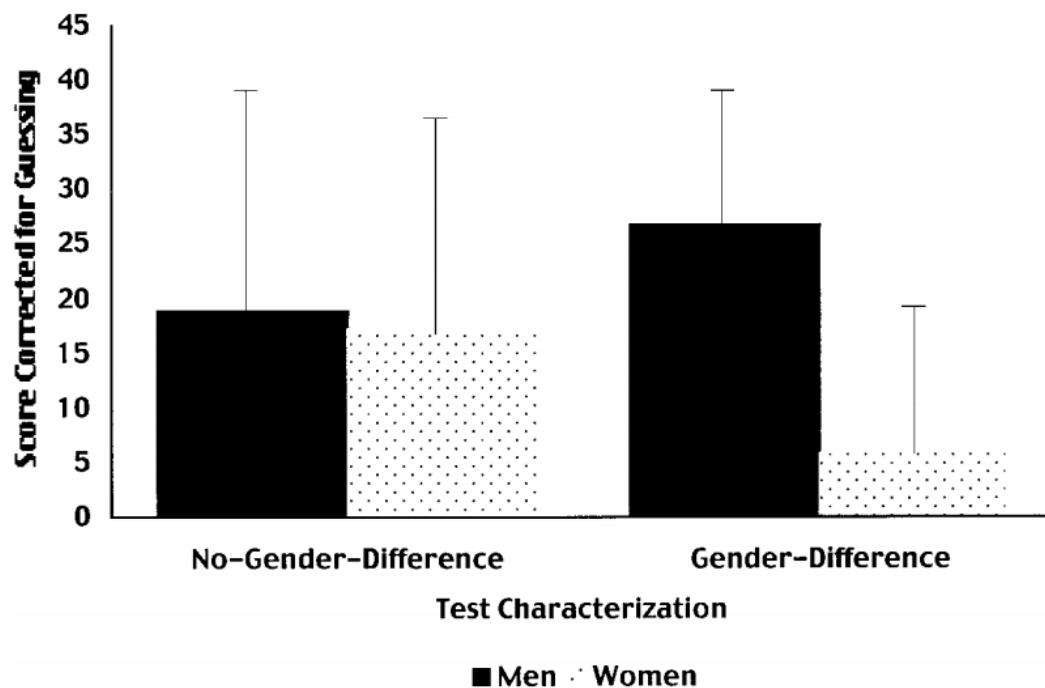


FIG. 2. Performance on a difficult math test as a function of sex of subject and test characterization

*Hard test:
math subject GRE*

S. J. Spencer, C. M. Steele, and D. M. Quinn, "Stereotype Threat and Women's Math Performance", *Journal of Experimental Social Psychology* 35(1), pp. 4-28 (1999)

Stereotype threat: an example

Study 3:

Explicitly eliminating stereotype → no gender difference

Not mentioning stereotype → women underperform

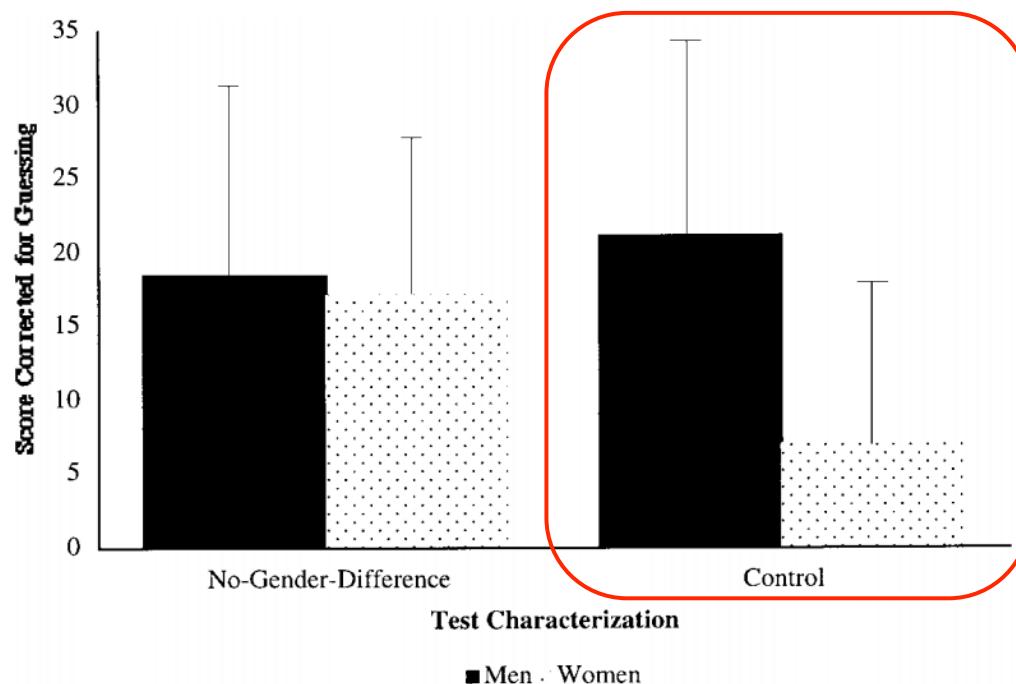


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*Hard test:
math subject GRE*

S. J. Spencer, C. M. Steele, and D. M. Quinn, "Stereotype Threat and Women's Math Performance", *Journal of Experimental Social Psychology* 35(1), pp. 4-28 (1999)

Stereotype threat: an example

Implication: Women (and men) already carry the stereotype in our heads. Not mentioning gender is equivalent to reinforcing the stereotype.

Where do these ideas about women's abilities come from?

Cultural messages can be blatant...



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Forever 21

http://www.huffingtonpost.com/2011/10/20/newest-anti-math-tee_n_1021429.html

...or subtle...



<http://thesocietypages.org/socimages/2009/12/29/girls-need-less-power/>

...or subtle...



<http://thesocietypages.org/socimages/2009/12/29/girls-need-less-power/>

...or somewhere in between.



<http://www.blogher.com/math-hard-lands-end-new-mattel>

Cultural ideas about scientists

Seventh graders describe scientists before and after a visit to Fermilab



Before



After

Before:

The scientist has big square-shaped glasses and a big geeky nose with brown hair and blue eyes. I see a scientist working in a lab with a white lab coat . . . holding a beaker filled with solutions only he knows. Scientists are very interesting people who can figure out things we don't even know exist.

After:

My picture of a scientist is completely different than what it used to be! The scientist I saw doesn't wear a lab coat. . . . The scientists used good vocabulary and spoke like they knew what they were talking about.

— Beth

<http://ed.fnal.gov/projects/scientists/index.html>

Implicit bias

“...introspectively unidentified (or inaccurately identified) traces of **past experience** that mediate favorable or unfavorable **feeling, thought, or action** towards social objects.”

— A. G. Greenwald and M. R. Banaji,
“Implicit Social Cognition,”
Psychological Review 102(1), pp. 4-27
(1995).

The Implicit Association Test (IAT)

- Measures implicit attitudes that people may be unwilling or unable to report
- A few findings:
 - 75% of men and women implicitly associate “male” with science and “female” with liberal arts
 - 75% of whites and >50% of blacks express an implicit preference for white over black

B. A. Nosek, M. R. Banaji, and A. G. Greenwald. “Harvesting Implicit Group Attitudes and Beliefs From a Demonstration Web Site.” *Group Dynamics: Theory, Research, and Practice* 6(1), pp. 105-115 (2002).

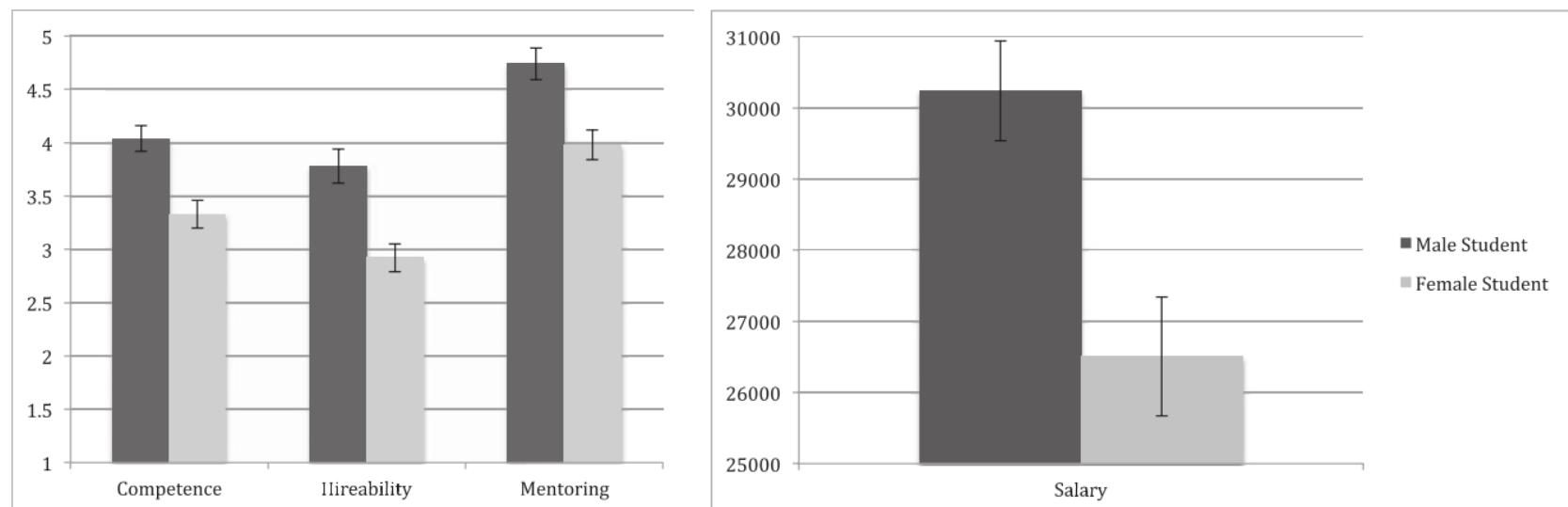
- These attitudes have been correlated with real-world behavior

K. A. Lane, J. X. Goh, and E. Driver-Linn. “Implicit Science Stereotypes Mediate the Relationship between Gender and Academic Participation.” *Sex Roles* 66, pp. 220-234 (2012).

Implicit bias in science hiring

The lab manager hiring experiment:

- Identical résumés were randomly assigned male or female names and sent to science faculty in the U.S.
- Faculty were asked to rank the résumés
- Even young faculty and female faculty favored the male applicant



C. A. Moss-Racusin et al. "Science faculty's subtle gender biases favor male students." *Proceedings of the National Academy of Sciences* **109**(41), 2012

Explicit bias

- Negative messages
- Hostile behavior
- Sexual harassment

Beyond gender

Stereotype threat and bias affect many marginalized groups:

- Minorities
- LGBTQ+ people
- People with disabilities
- People at the intersection
- And more...

In addition, each group has their own unique challenges and barriers to overcome.

Why does this matter?

For marginalized groups:

- The opportunity to pursue a career of one's choice
- Access to high-prestige and high-income STEM jobs

Why does this matter?

On principle:

- Americans value meritocracy more than most developed countries

S. Kunovich and K.M. Slomczynski. "Systems of Distribution and a Sense of Equity: A Multilevel Analysis of Meritocratic Attitudes in Post-industrial Societies." *European Sociological Review* 23, pp. 649-663 (2007).

- Scientists aim to be objective

Why does this matter?

For science:

- Failing to control for bias artificially restricts the talent pool of scientists
- Diversity of problem-solvers leads to better group performance

L. Hong and S.E. Page. "Groups of diverse problem solvers can outperform groups of high-ability problem solvers." *Proceedings of the National Academy of Sciences USA* **101**, 16385 (2004).

What can we do?

In our daily lives:

- Recognize our biases:

Take an **Implicit Association Test** (or three!) to learn what your unconscious biases are:

<https://implicit.harvard.edu/implicit/takeatest.html>

Knowing your biases won't get rid of them, but it may be able to help you control for them

E.L. Uhlmann and G.L. Cohen. "I think it, therefore it's true": Effects of self-perceived objectivity on hiring discrimination." *Organizational Behavior and Human Decision Processes* 104, pp. 207-223 (2007).

- **Diversify your media diet:** expose yourself to voices and characters who challenge your unconscious biases
- **Tell your friends** and colleagues

What can we do?

Within academia:

- Adopt **best practices** for grading, peer review, etc.
 - Use objective standards, not gut feelings
 - When possible, eliminate identities from tests, résumés, etc.
(Example: double-blind peer review increases acceptance rate of papers with female first authors)
A.E. Budden, T. Tregenza, *et al.*. “Double-blind review favours increased representation of female authors.” *Trends in Ecology and Evolution* 23, pp. 4-6 (2008).
- As instructors/GSIs, spread the **growth mindset**: Emphasizing the plasticity of the brain and valuing effort over natural ability has been shown to offset the impacts of stereotype threat

<http://www.nais.org/Magazines-Newsletters/ISMagazine/Pages/Brainology.aspx>

What can we do?

As students and postdocs: **mentoring**

- Mentors serve as role models and inspiration
- Mentors can help navigate the norms of a field
- Graduate women who are mentored by faculty:
 - Publish more papers
 - Publish more papers in top journals
 - Earn more federal grant money

<https://www.insidehighered.com/news/2010/01/04/mentor>

SWPS



We are undergraduates, graduate students, and postdocs in the physical sciences, including physics, astronomy, EPS, and chemistry.

We aim to encourage women and other marginalized groups to study the physical sciences and to create a friendly and supportive environment in these departments for all students.

What we do in SWPS

- Community building: dinners and other social events for undergrads, grads, and postdocs



- Career development:
 - Talks with visiting speakers
 - Events to help undergraduates find research positions, create résumés, etc.

What we do in SWPS

- Mentoring: all-inclusive mentoring program for grads, undergrads, and postdocs at all stages
- Outreach:
 - Expand Your Horizons
 - BASIS
 - BHS Steminist Day
 - And more!



For more info on SWPS:

- Visit swps.berkeley.edu ; you can find our upcoming events under the “Calendar” tab
- Find us on Facebook: *UC Berkeley Society of Women in the Physical Sciences*
- Join our mailing lists to get messages about upcoming events and opportunities to get involved

Thank you for listening!

Suggested further reading:

- On **stereotype threat**: *Whistling Vivaldi* by Claude M. Steele
- On **implicit bias**: *Blindspot* by Mahzarin R. Banaji and Anthony G. Greenwald

There are many great books and articles out there; we'd be happy to help you find more.