

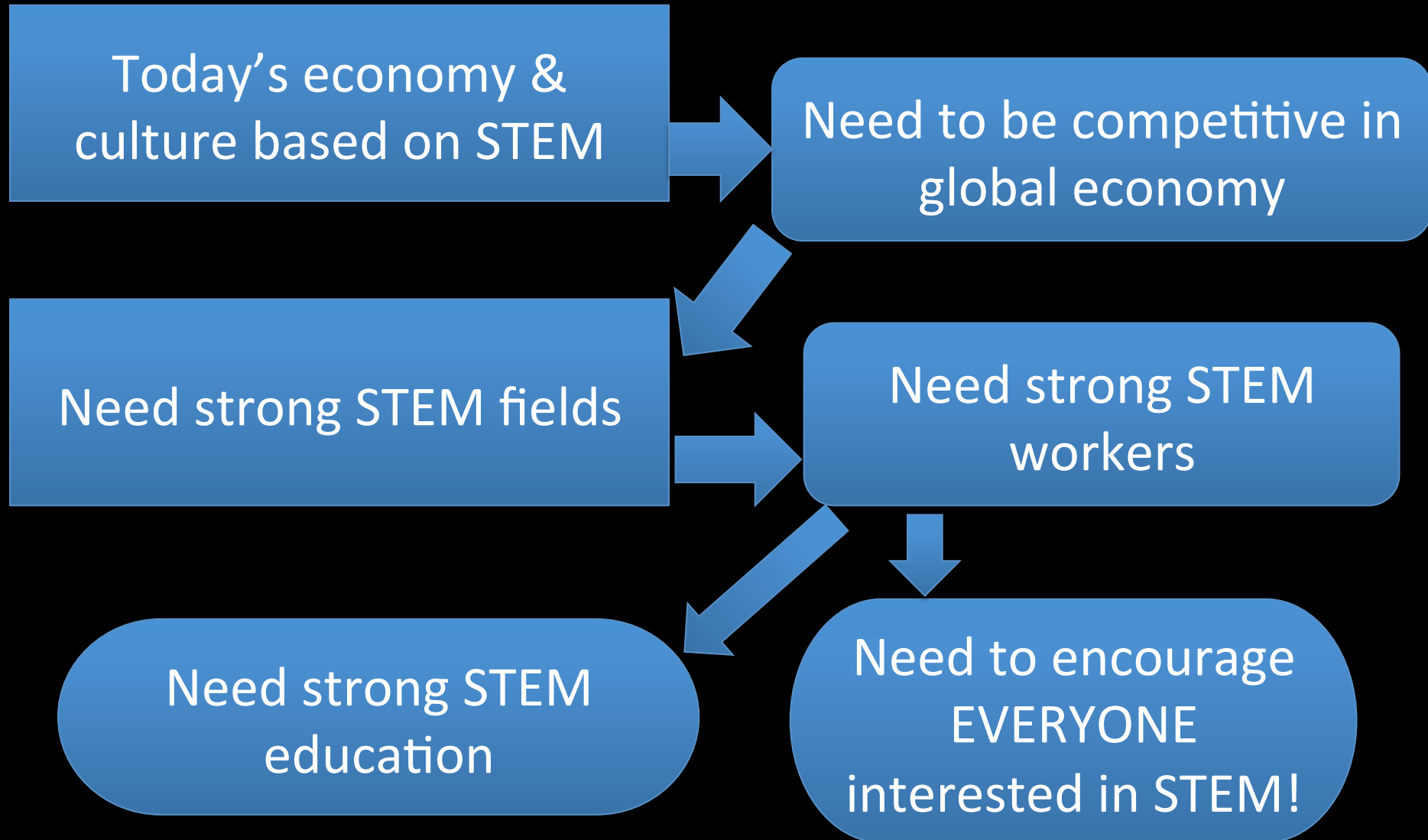
Physics & Gender: What do we know?

Laura McCullough

Professor of Physics

University of Wisconsin-Stout

Why should we care about women's participation in STEM?



Women have a lot to offer STEM

- “Until women can feel as much at home in [STEM] as men, our nation will be considerably less than the sum of its parts. If we do not draw on the entire talent pool that is capable of making a contribution to science, the enterprise will inevitably be underperforming its potential.”
- “Diversity within and between groups helps a whole population to survive and adapt to the changing demands of the environment.”
- “Diversity in the workplace is known to foster innovation; a diversity of experiences and perspective-taking yields greater opportunity for creativity.”
- “Women leaders on average manifest valued, effective leadership styles, even somewhat more than men do.”

Presidents of Stanford, MIT, Princeton. 2005.

Wittmann WW. 2005. Understanding and Measuring Intelligence.

Stout, Grunberg, Ito. 2016. Sex Roles.

Eagly, A. 2007. Psychology of Women Quarterly.

Who are leaders in STEM?

- Professors?
- Administrators?
- Parents?
- Editors of elite journals?
- Nobel Prize winners?
- “Fellows” of scientific societies?
- Can women be leaders in STEM?

What do we know about women's
leadership in STEM?

Nothing

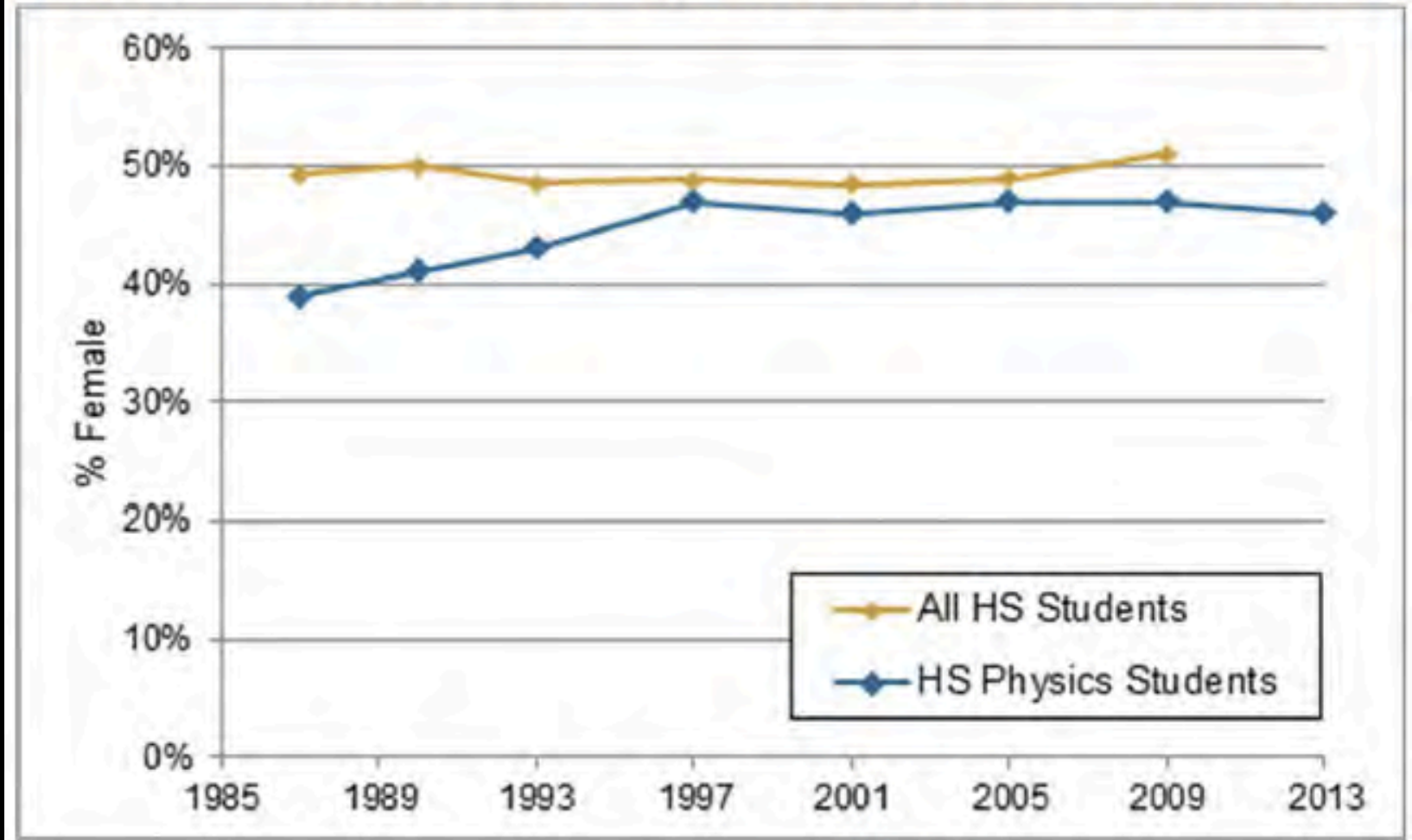
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“Despite evidence that attrition of women from STEM disciplines increases as women progress through college, graduate school, professional, and leadership ranks, surprisingly little research has been conducted on the intersection between STEM and leadership (McCullough, 2011)”

Are there women in STEM?

Of course!

GIRLS AS A PERCENTAGE OF TOTAL ENROLLMENT IN HIGH SCHOOL PHYSICS

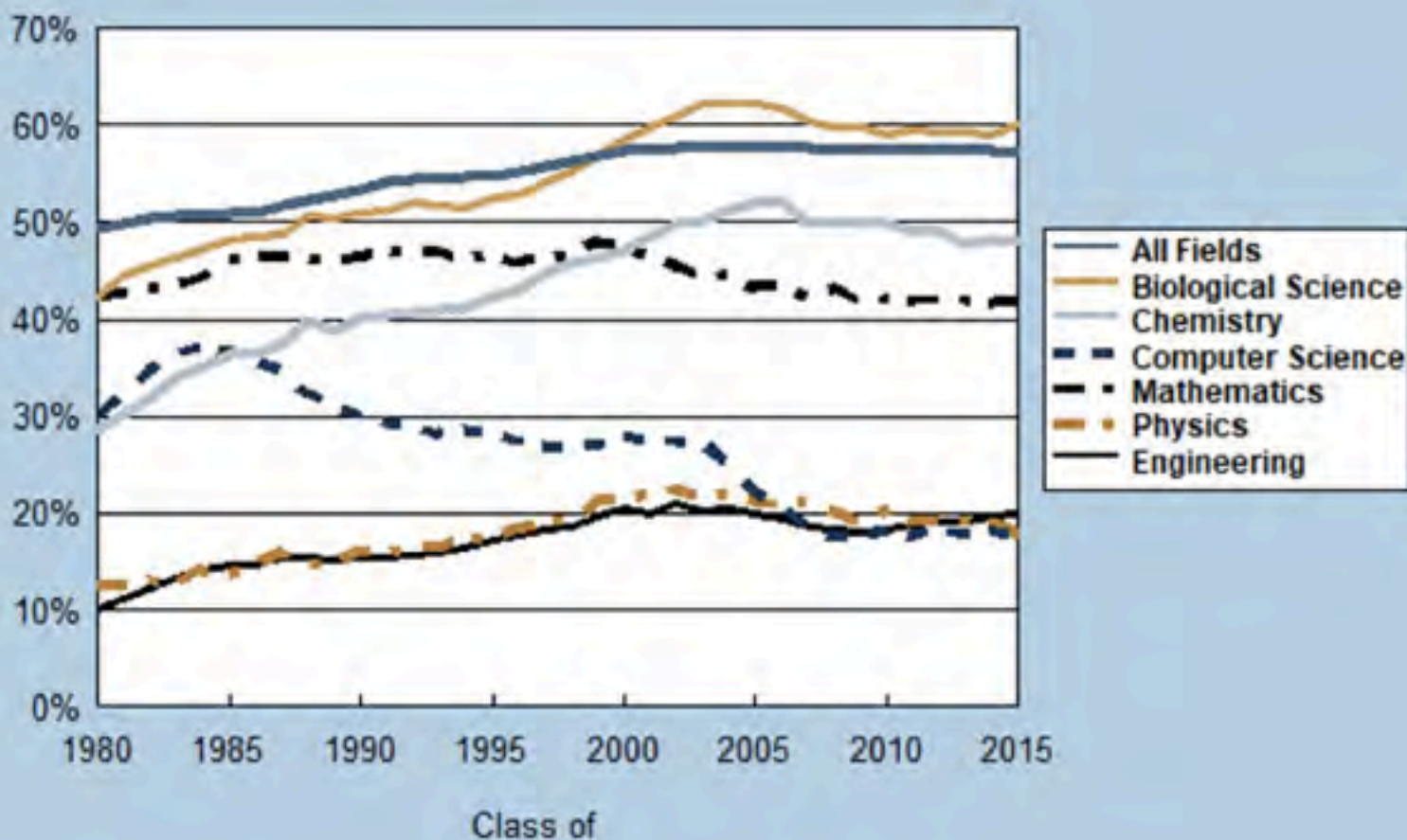


Beyond Representation: Data to Improve the Situation of Women and Minorities in Physics and Astronomy. Rachel Ivie, March 2018. <https://www.aip.org/statistics/reports/beyond-representation-data-improve-situation-women-and-minorities-physics-and>

**Percent of Physics Bachelors and PhDs earned by Women,
Classes of 1976 through 2016.**

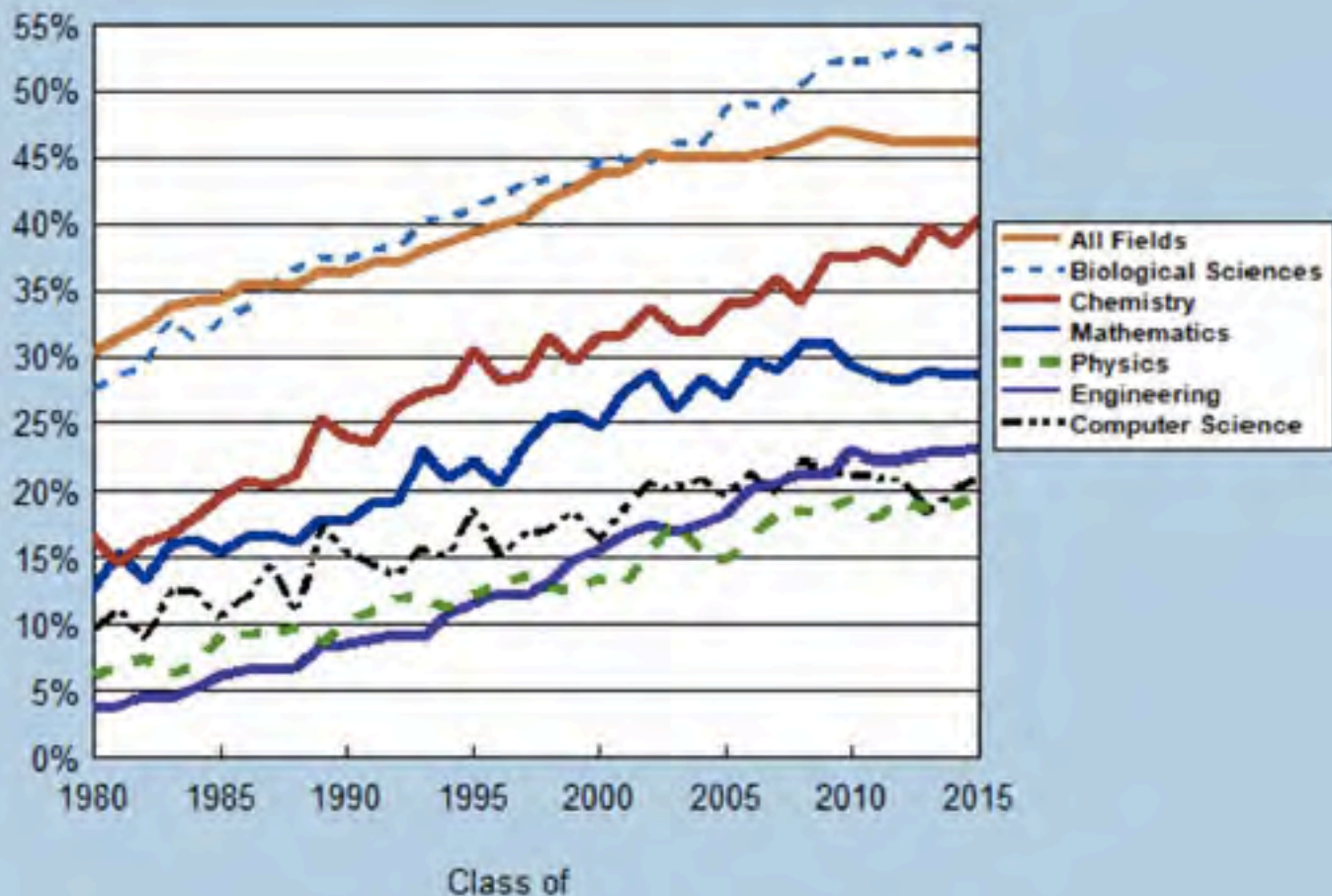


Percent of Bachelor's Degrees Earned by Women in Selected Fields, Classes 1980 through 2015.



National Center for Education Statistics. Compiled by AIP Statistical Research Center.

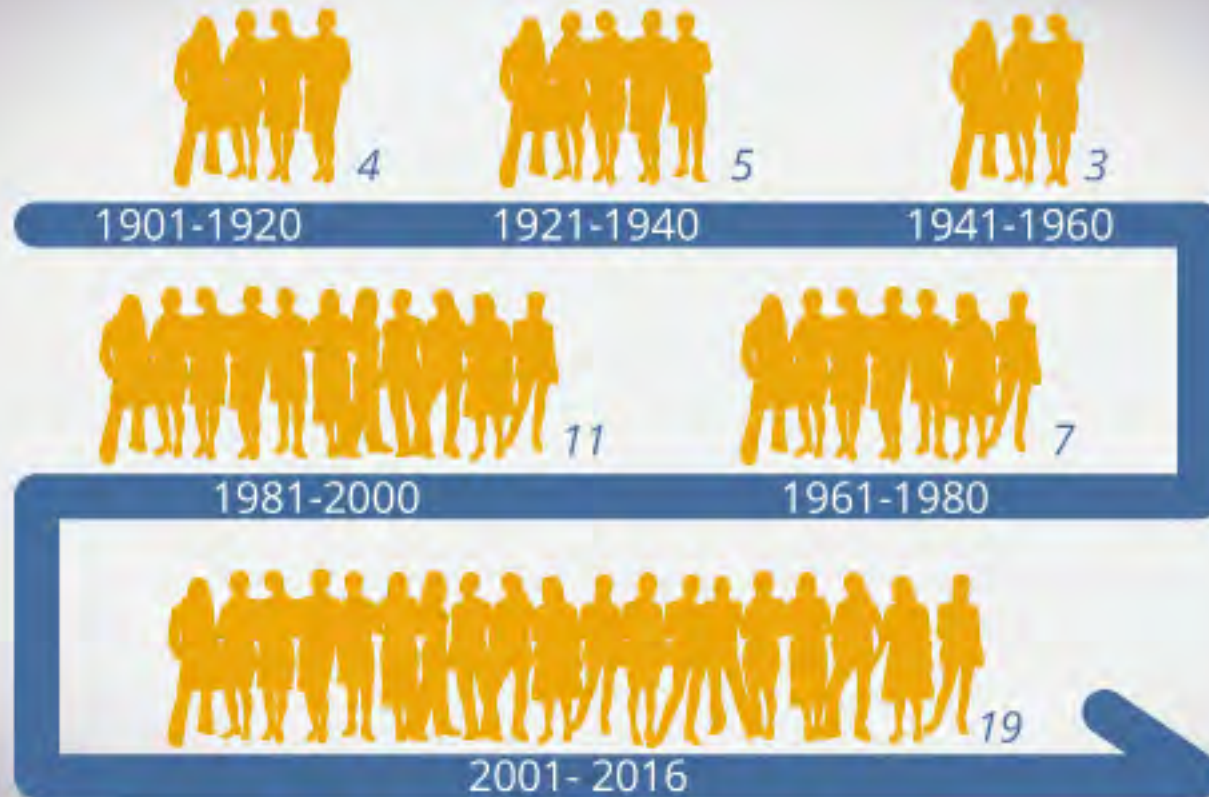
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Are there women leaders in STEM?

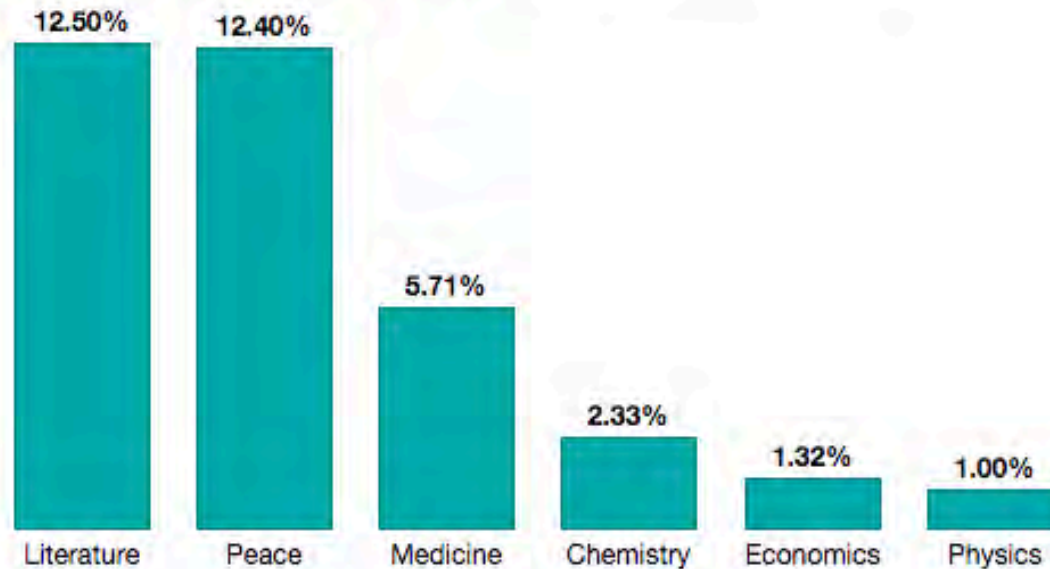
Yes.

Women as Nobel Laureates



Women as Nobel Laureates

**Percentage of Nobel Prizes awarded to women
between 1901 and 2015***



**The first Sveriges Riksbank Prize in Economic Sciences was awarded in 1969*

Source: NobelPrize.org

FORTUNE

Women as Elements?

Symbol and #	Name	Gender of name
Sm 62	Samarium	M
Am 95	Americium	M
Bk 97	Berkelium	M
Bh 107	Bohrium	M
Cn 112	Copernicium	M
Cm 96	Curium	M & F
Es 99	Einsteinium	M
Fm 100	Fermium	M
Fl 114	Flerovium	M
Ga 31	Gallium	M
Gd 64	Gadolinium	M
105	Hahnium/Dubnium	M
Lr 103	Lawrencium	M
Mt 109	Meitnerium	F
Md 101	Mendelevium	M
No 102	Nobelium	M
Og 118	Oganesson	M
Rg 111	Roentgenium	M
Rf 104	Rutherfordium	M
Sg 106	Seaborgium	M

Women as Editors of Journals

	Science	Cell	Nature	PLOsone
# of women on Editorial Board	3 of 7	7 of 10	3 of 5	4 of 6

Women as Editors of Physics Journals

	AJP	AJP Adv. Board	PhysRev Letters	PhysRevX
# of women on Editorial Board	0 of 9	1 of 9	0 of 4	1 of 3
	PhysRev PER	TPT	TPT Edit. Board	
# of women on Editorial Board	1 of 2	7 of 11	5 of 12	

Women as Directors of National Societies/Foundations/Institutes

	National Science Foundation	National Institutes of Health	National Academy of Science	Amer. Assn. for the Advancement of Science	National Labs
# of women	3 of 17 Directors (historical)	1 of 16 Directors (historical)	3 of 5 Officers	3 of 5 Officers	3 of 20 Directors
			8 of 12 Councilors	6 of 9 Board Members	3 of 18 Deputy Directors

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But 10 physicists!

Women Award Winners

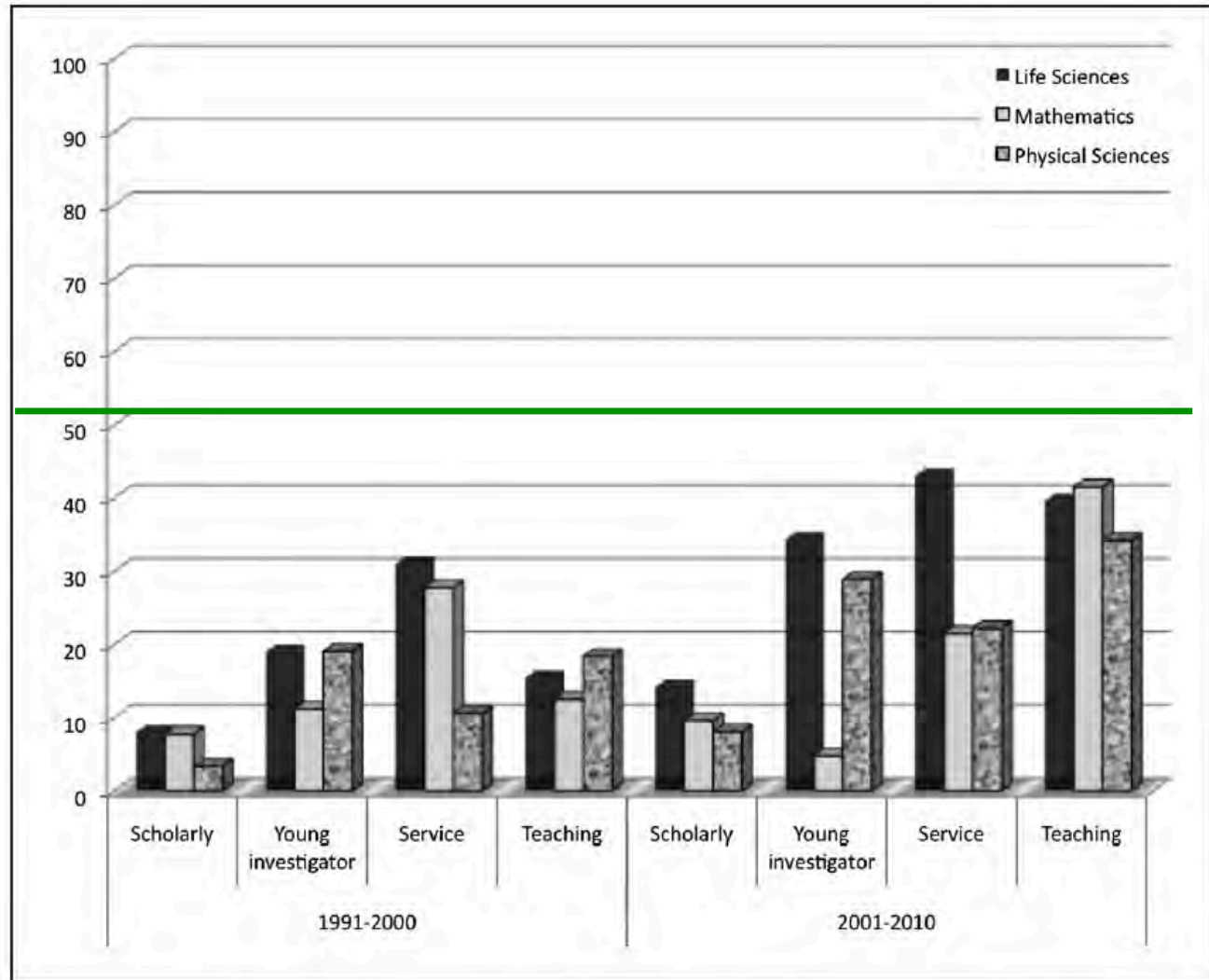


Figure 1. Percentage of female winners by award type and field, 1991–2010

Women Award Winners, part 2

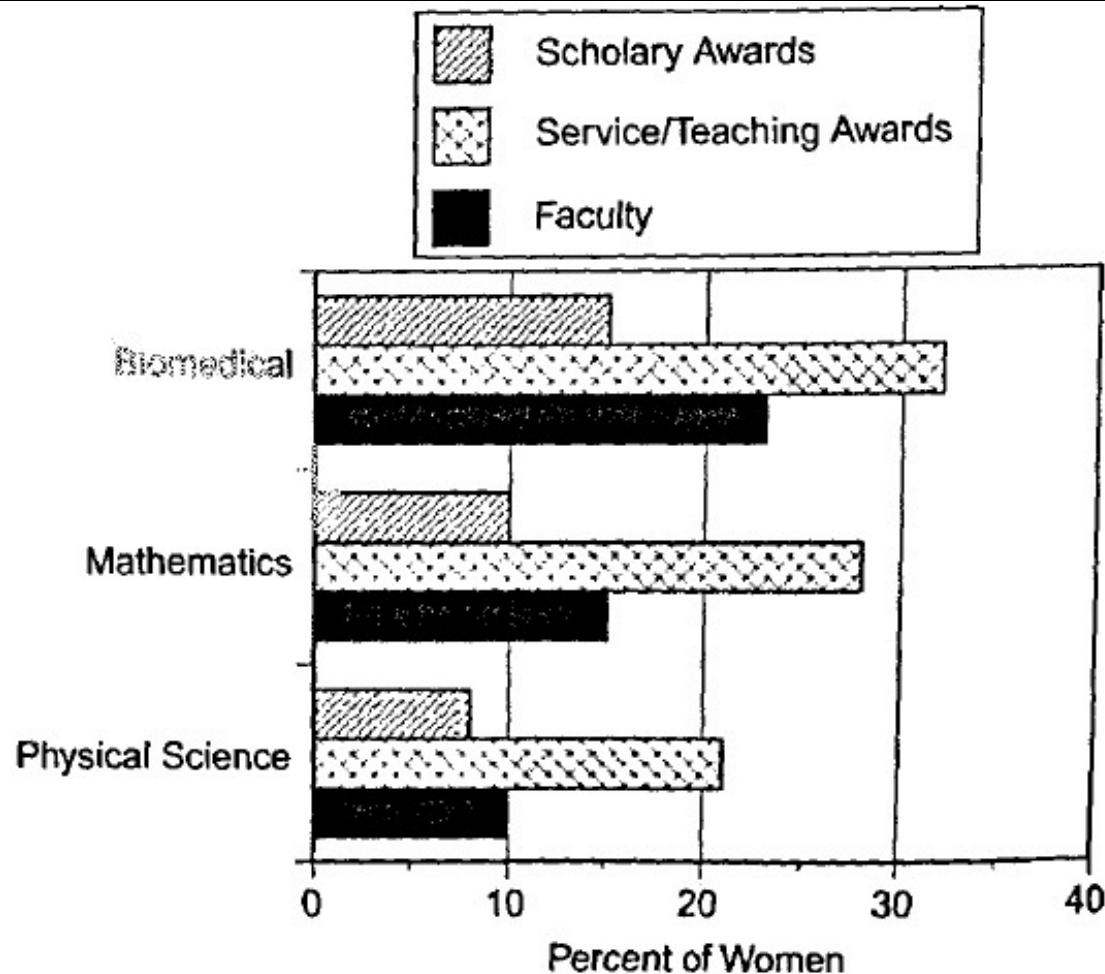


Fig. 1. Proportion of Female Award Recipients for Scholarly and Service/Teaching Awards from Disciplinary Societies Grouped by Field of Study, Compared to the Proportion of Female Faculty (2001–2010).

Women as Department Chairs

	Biology	Chemistry	Physics	Math
Random 30 departments in US	8 of 30	8 of 28	3 of 30	7 of 28
Top 20 departments in world*	No ranking	3 of 18	2 of 19	2 of 20
Top programs (AIP 2005)			2 of 18	
Women's Colleges			13 of 24	

Houston, we have a problem

- We need strong STEM fields
- Women as leaders offer advantages
- Need more women leaders in STEM!

- “The Larry Summers question: What’s up with chicks and science?”
- Call out what you know or guess about barriers for women in STEM

- What's up with women and STEM leadership?
- Call out what you know or guess about barriers for women LEADERS in STEM

Barriers for women in STEM

- Gender discrimination (overt or covert)
 - Weaker letters of recommendation
 - Fewer resources
 - Discounting women's achievements
 - Weaker evaluations
 - Microaggressions
- Increased domestic responsibilities (work/life)
- Lack of role models

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Are these the real problem?

- These are all actions that suppress women's participation; what's behind the actions?

The real problems

- Implicit (unconscious) bias
- Stereotype threat
- Mindset

Implicit (Unconscious) Bias

- Growing up → culturally instilled values
- Pervasive: everyone has them
- Different from explicit biases (can be same or different)
- May differ from our declared beliefs
- Tend to favor our own in-group
- Malleable—thank goodness!

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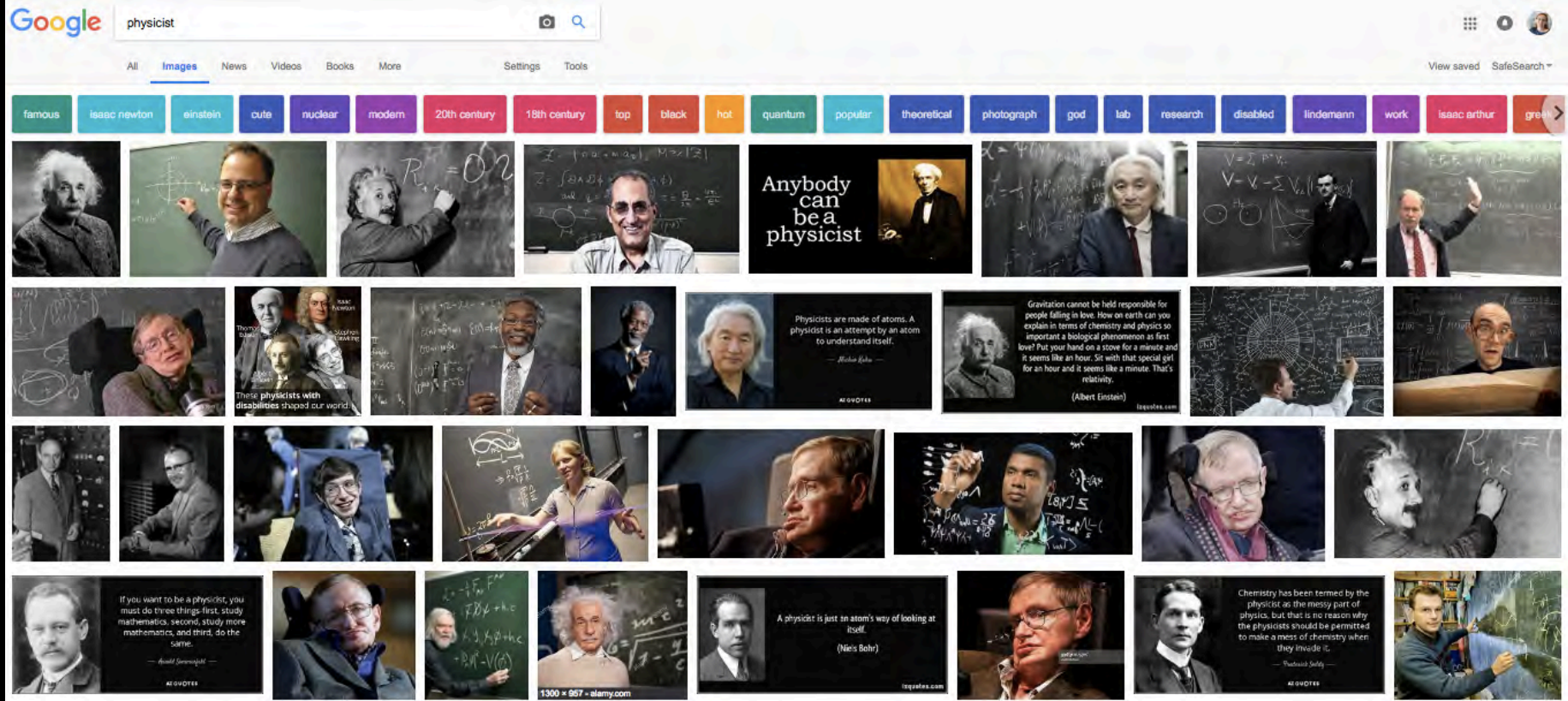
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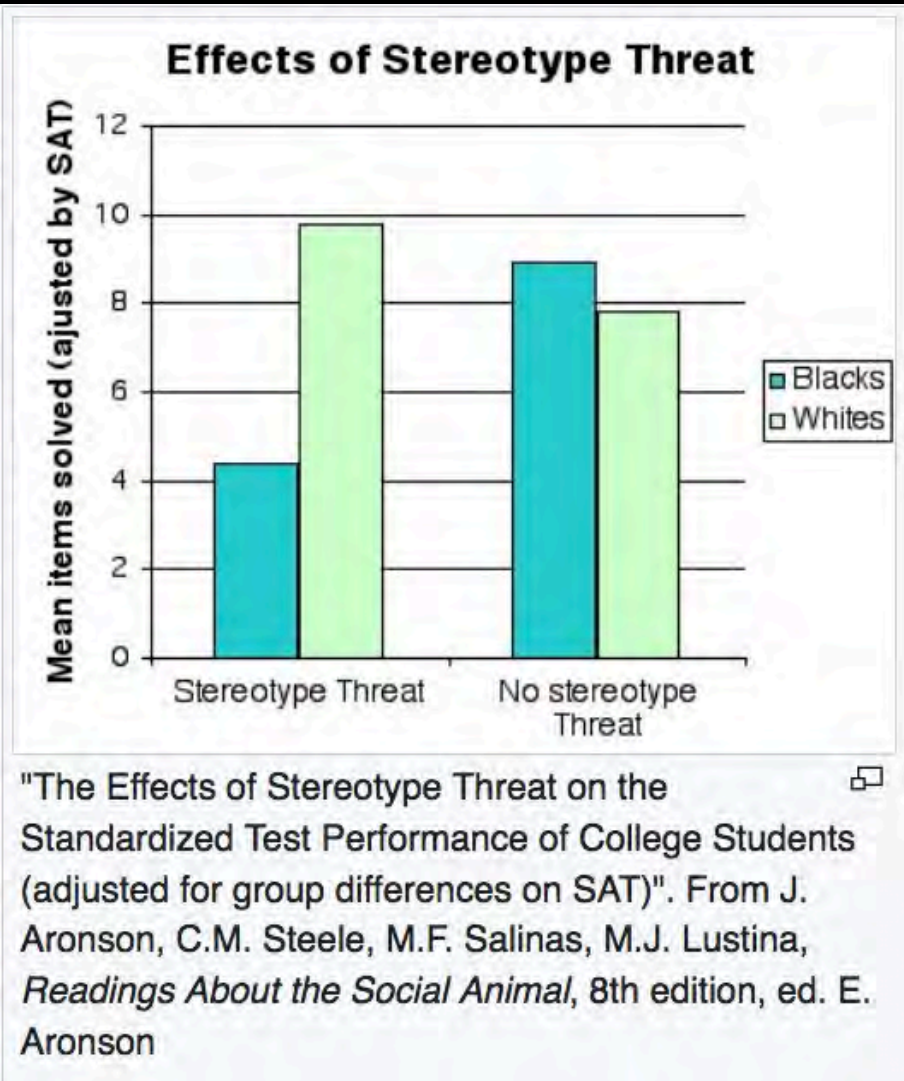
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Stereotype Threat

- Risk of confirming a negative stereotype
- Triggered by mentioning stereotype
- Lowers performance of stereotyped groups



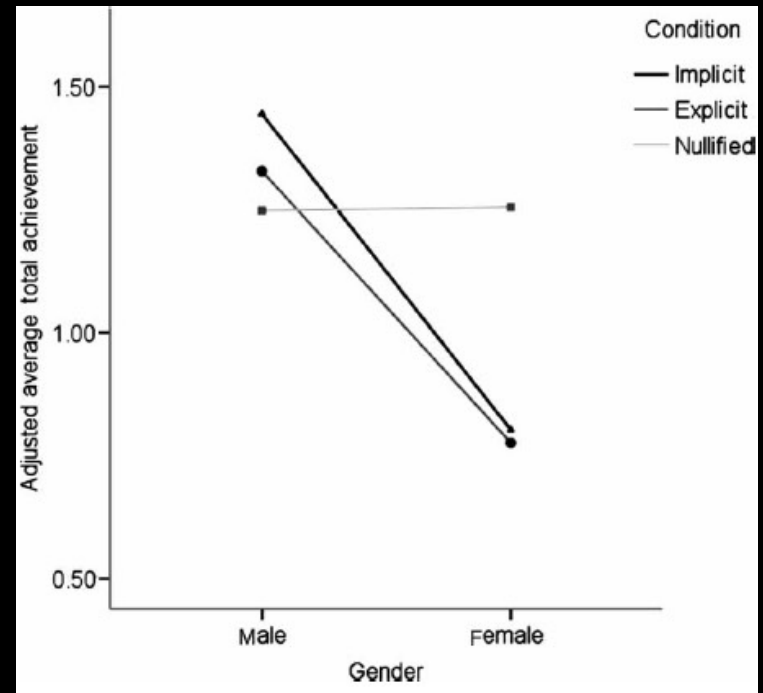
Stereotype Threat in Physics

(HS physics students in US)

Implicit: You will be given four physics problems to solve. These problems are based on physics material that you have already covered.

Explicit: You will be given four physics problems to solve. These problems are based on physics material that you have already covered. This test has shown gender differences with males outperforming females on the problems.

Nullified: You will be given four physics problems to solve. These problems are based on physics material that you have already covered. No gender differences in performance have been found on this test.



Mindset

- Your belief about your characteristics and qualities and how changeable they are

Mindset check

- You can learn new things, but you can't really change your basic intelligence.
- Your intelligence is something about you that you can't change very much.
- You have a certain amount of intelligence and you really can't do much to change it.

Mindset

- Fixed mindset: your qualities are set and unchangeable
- Growth mindset: your qualities can be cultivated and developed

Mindset in Physics

- “If a student had a growth mindset coming in to the class, that student had a statistically significant higher probability of achieving greater FCI gains than if the student had a fixed mindset.
- The mean FCI gain of students identified as having a growth mindset was higher than the mean FCI gain of students identified as having a fixed mindset.”

How do these explain the gender gap in STEM?

- Implicit biases cause a lot of the behaviors
- Stereotype threat reduces women's willingness to enter STEM and their self-efficacy in STEM fields
- Mindset
 - Discipline needs “brilliance”? Fewer women!
 - Meritocracies/ “objective” fields MORE likely to show bias

How do these explain the leadership gap in STEM?

- Implicit biases
- Stereotype threat
- Mindset?

- “Resistance to women’s leadership is strongest in highly masculine domains...” Eagly & Carli, 2007 pg. 167
- “All of these presidents either majored or stated that they would have majored...in math or science.” Madsen, 2008 pg. 94 (ten women who are presidents of universities)

What's the solution?

We are!

What can YOU do?

- Classrooms
 - Find your own implicit biases
 - Shift to a growth mindset
 - Encourage friends to explore STEM
 - Encourage young family members to explore STEM
 - Use gender-neutral language
 - Don't accept gender-biased textbooks and examples
 - Encourage your department to hire women as tutors, TAs
 - Remind each other that physics is for everyone and can be done by everyone

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PHYSICS



Welcome

What can YOU do?

- Parenting
 - Find your own implicit biases (Project Implicit)
 - Teach a growth mindset
 - Encourage all children to explore science
 - Encourage leader behavior in children
 - Use gender-neutral language
 - Use and support resources like “A Mighty Girl” and GoldieBlox

What can YOU do?

- Everyone
 - Find your own implicit biases
 - Listen for biased language (jokes, phrases, names)
 - Ensure women's voices are heard and women's ideas are attributed
 - Don't use men as a standard
 - View the other side: replace "men" with "women"

Cultural change

- Slow
- Comes from within
- Worth it!

Thank you!

www.lauramccphd.com

