

WOMEN AND PHYSICS: THE BEST OF TIMES, THE WORST OF TIMES

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WHO THE HECK IS LAURA MCCULLOUGH?

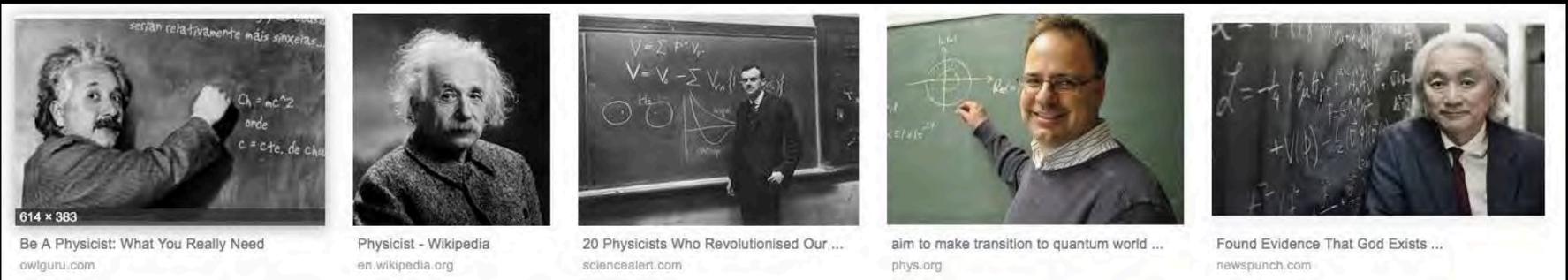
- BA in Physics, Hamline University, St. Paul MN
- MS in Physics, UMN-TC, Minneapolis
- PhD in Science Education, UMN-TC, Minneapolis

- Dad is a PhD physicist
- One mom a middle school math teacher, one mom a MS chemist

- Day 1 of physics grad school: WTH?

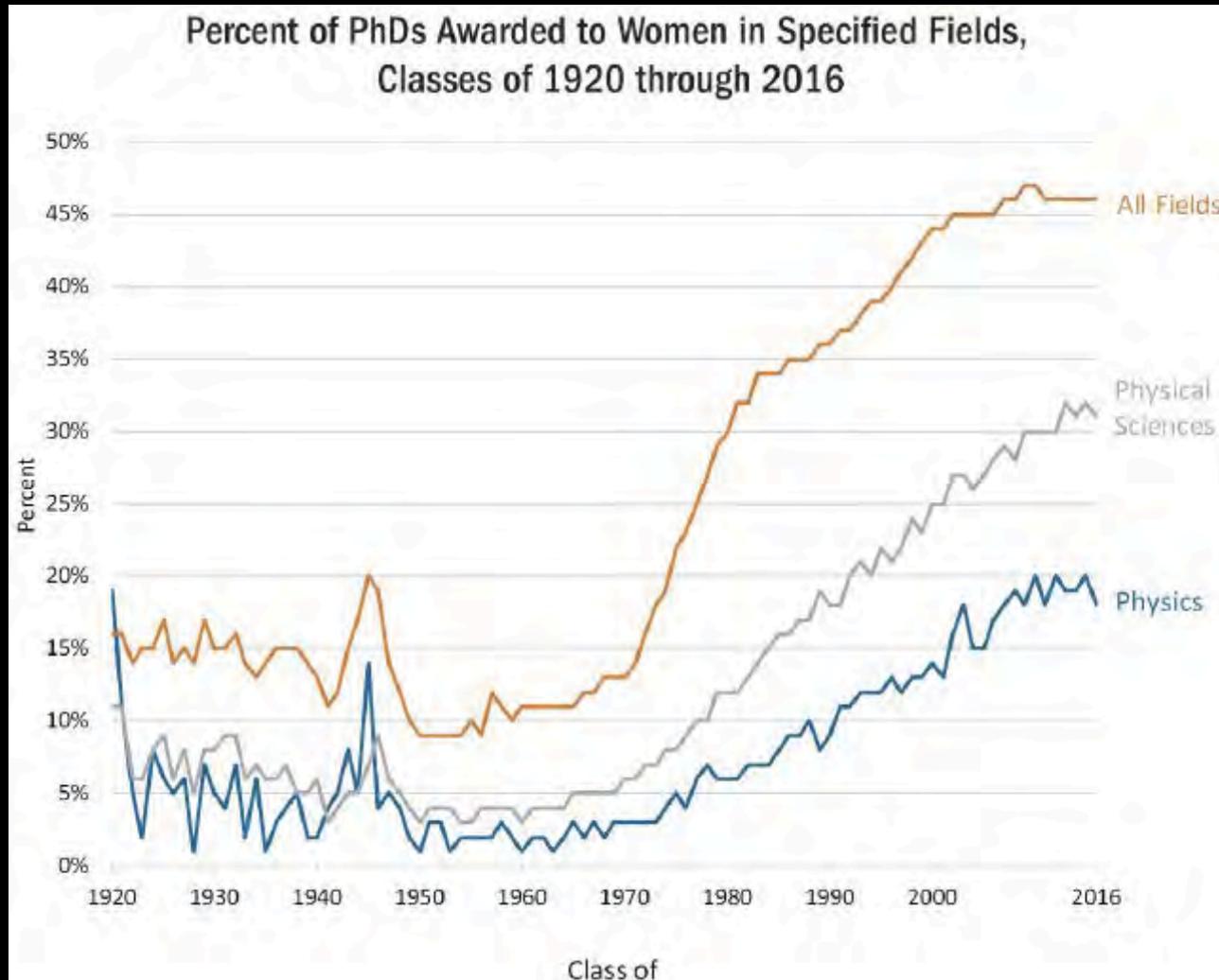
WOMEN AND PHYSICS

- Women have always been in physics!
 - Unrecognized, unpaid, unofficial
- Face of physics is Einstein: old white male



- How are we doing in the 21st century?

THE BEST OF TIMES



THE BEST OF TIMES



woman



cartoon



black



famous



albert einstein



hawking



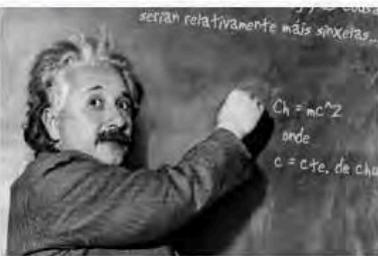
lisa randall



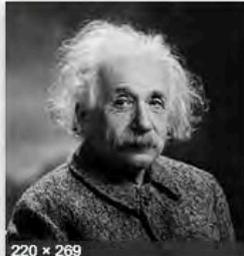
brian cox



wheelc

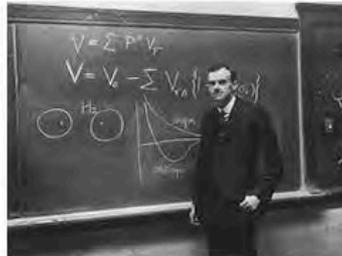


Be A Physicist: What You Really Need
owlguru.com



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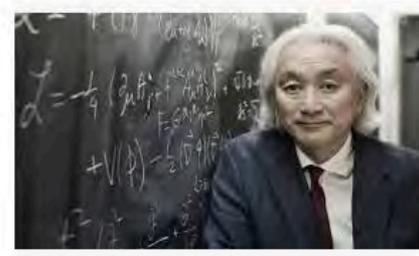
Physicist - Wikipedia
en.wikipedia.org



20 Physicists Who Revolutionised Our ...
sciencealert.com



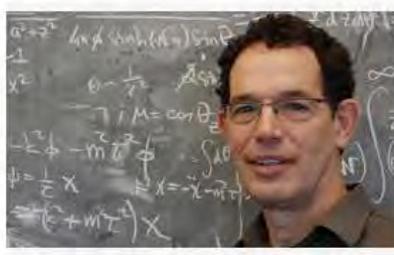
aim to make transition to quantum world ...
phys.org



Found Evidence That God Exists ...
newspunch.com



The Physicist Who Is Most



Physicist Neil Turok explains the



Stephen Hawking's Future Is Uncertain



What Does a Physicist Do for a



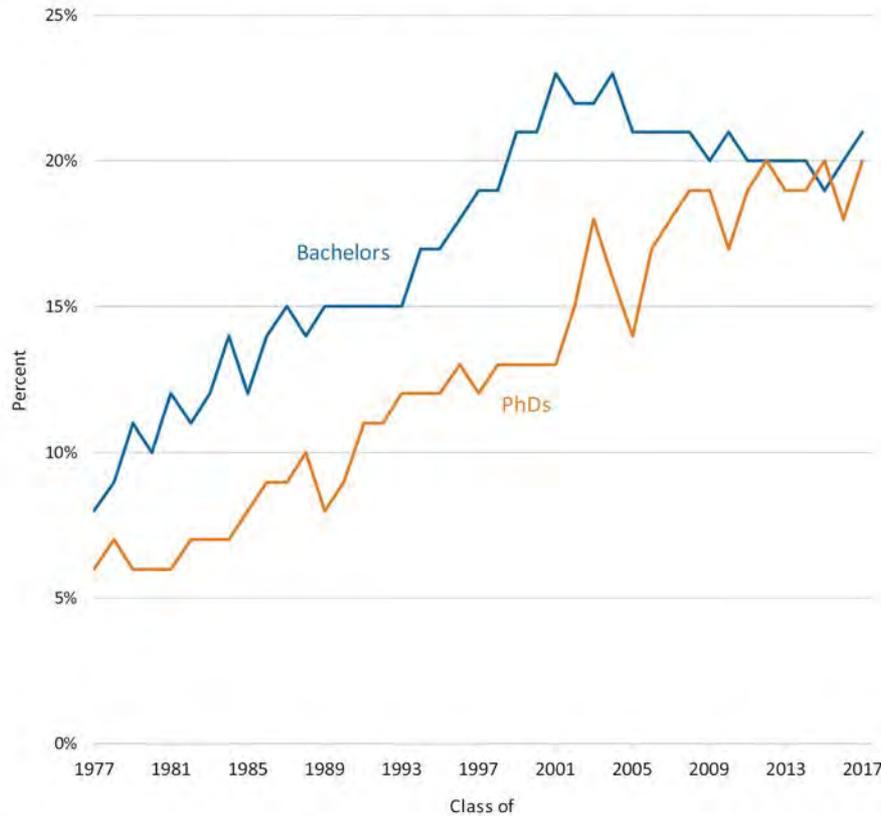
Heard anything about physicist John J. M

THE BEST OF TIMES

- Little overt sexual discrimination
 - No Barbies saying “Math is hard”
 - Few advisors saying “girls can’t do physics”
 - Scholarships and programs supporting women in physics
 - Growing awareness of issues with women and physics
-
- And yet...

UNDER-REPRESENTATION OF WOMEN

Percent of Physics Bachelors and PhDs Earned by Women, Classes of 1977 through 2017



Source: AIP Statistical Research Center, Enrollments and Degrees Survey.

AIP | Statistics

aip.org/statistics

AIP Statistical Research Center, March 2019 "Women in Physics and Astronomy 2019"
Anne Marie Porter & Rachel Ivie

WHY SHOULD WE CARE?

- “Until women can feel as much at home in math, science and engineering 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.” —John Hennessy, Susan Hockfield and Shirley Tilghman
- How much wasted potential?

WHAT MAKES A PHYSICIST?

- Can you think of a famous physicist?
- Can you think of a second one?
- Can you think of a famous female physicist?
- Can you think of a second one?

GROWING A PHYSICIST

- When did you know your career goal? What encouraged you?

| What helps? | What hurts? |
|--|--|
| Elementary school: Family support Positive science experiences | Elementary school: Fear of science contagious |
| Middle school: Family support | Middle school: Peer interactions Lack of role models |
| High school: Discussing under-representation | High school: Poor teaching Climate |

KEEPING A PHYSICIST

- What would make you switch to a different school?
What would make you leave physics?

| What helps? | What hurts |
|--|--|
| College: Good teaching Welcoming climate Graduate school: Good mentoring/advising Support structures Career: Family-friendly policies Supportive environment | College: Bad teaching Graduate school: Hostile climate Bad advising Career: Hostile climate Isolation |



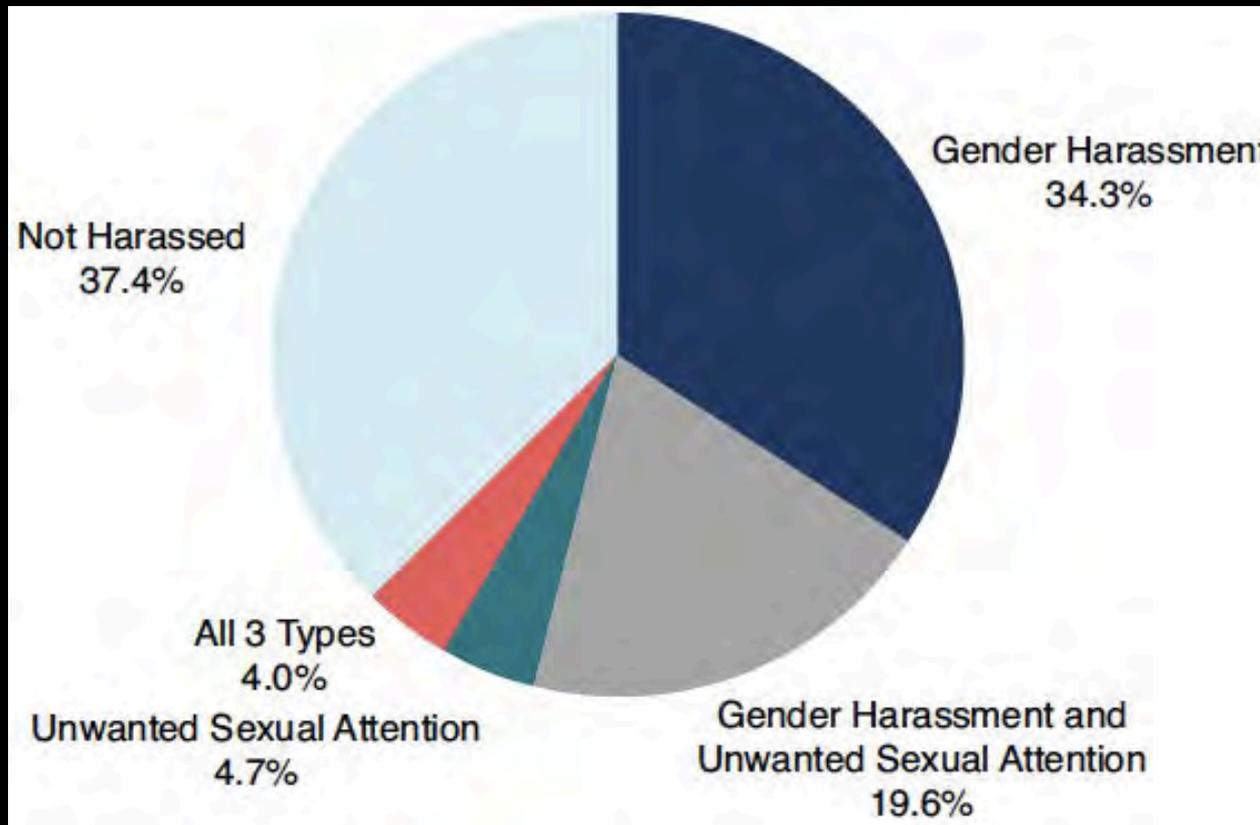
CLIMATE

- What aspects of a department might discourage women?
- Microaggressions
- Sexual harassment
- Inequity in resources and responsibilities
- Physical space
- Lack of others who look the same
- Others?

SEXUAL HARASSMENT

- What do you think of when you hear “sexual harassment”?
- National Academies of Science, Engineering, and Mathematics report 2018 “Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine”
 - Gender harassment
 - Unwanted sexual attention
 - Sexual coercion

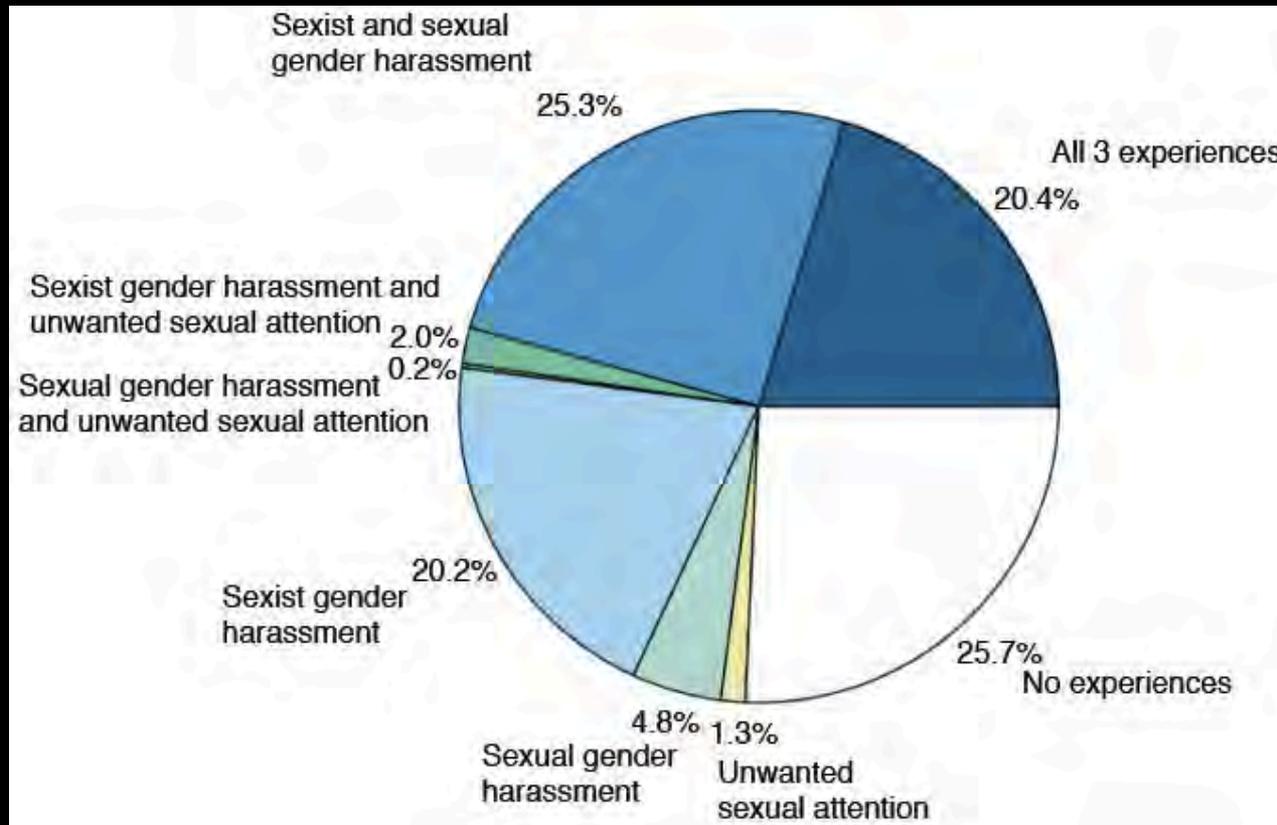
SEXUAL HARASSMENT – FEMALE UNIVERSITY EMPLOYEES



WHAT SUPPORTS HARASSMENT

- Male dominated environment
 - Like physics...
- Organizational tolerance for this behavior
 - Failing to take complaints seriously
- Hierarchical and dependent relationships
 - Students, postdocs
- Isolating environments
 - Labs, field sites

SEXUAL HARASSMENT OF UNDERGRADUATE WOMEN IN PHYSICS



"Sexual harassment reported by undergraduate female physicists"

Phys. Rev. Phys. Educ. Res. March 2019

Lauren M. Aycock, Zahra Hazari, Eric Brewster, Kathryn B. H. Clancy, Theodore Hodapp, and Renee Michelle Goertzen

WHAT IS CAUSING THIS?

- These are symptoms, not the actual illness
- What is the true culprit?
- Culture!
- What is it about our culture?

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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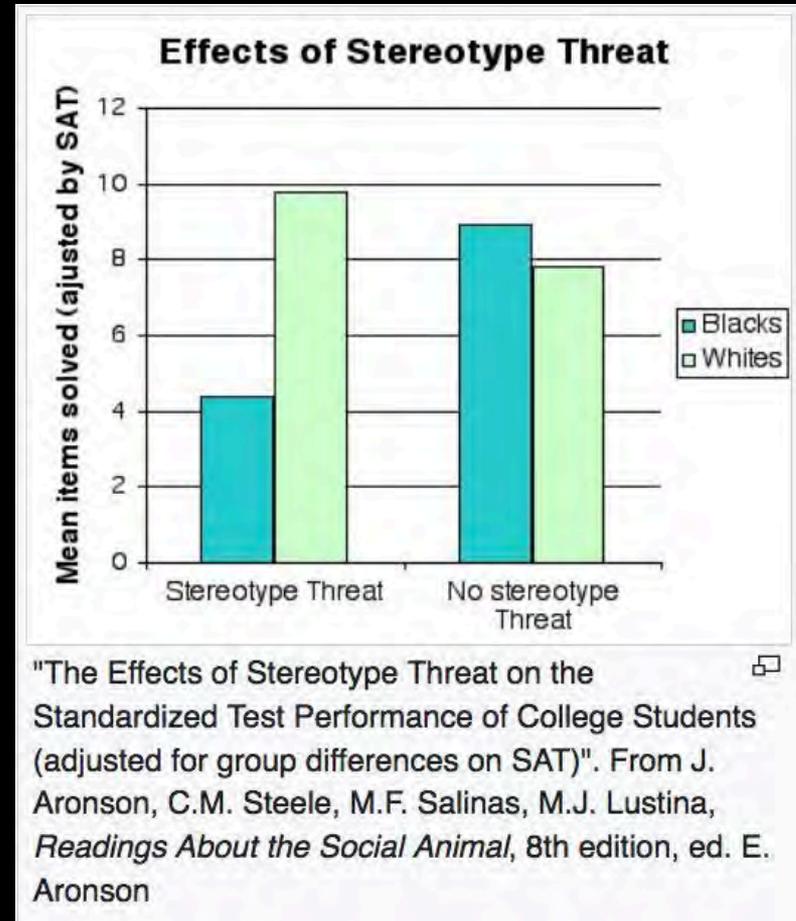
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CHANGING BIASES

- Become aware
 - Project Implicit: <https://implicit.harvard.edu/implicit/>
- Counter-stereotypes
 - Women who succeed
- Start noticing—help each other
- Start analyzing
 - Pickup trucks

STEREOTYPE THREAT

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



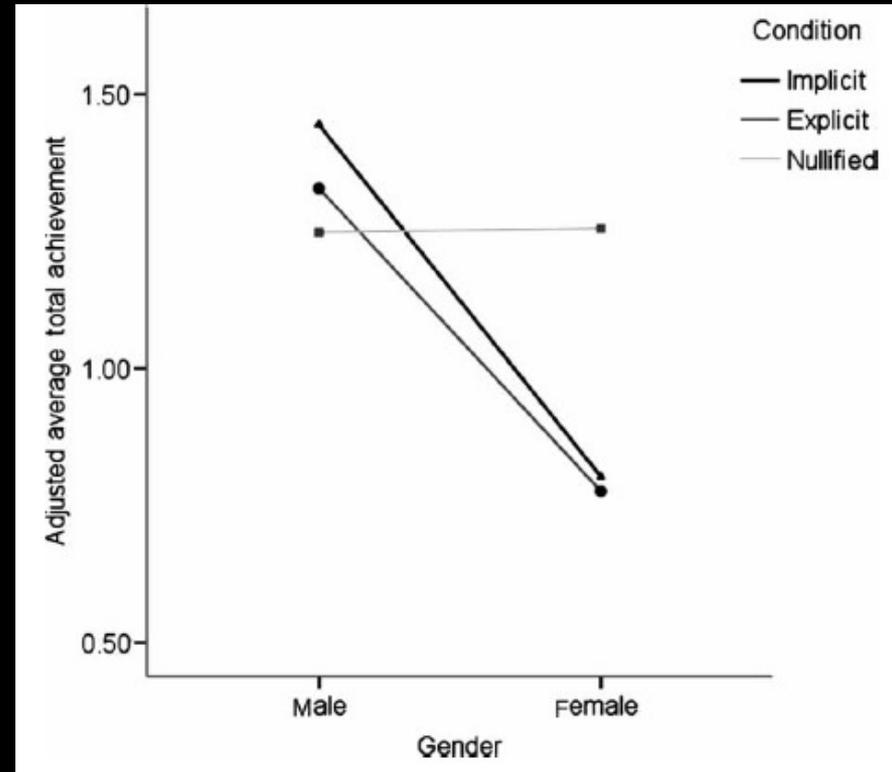
STEREOTYPE THREAT IN PHYSICS

(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

- 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.”

MINDSET WORDS

- *Effort, not ability*
- *Good work, not nice job*
- *Not yet, not fail*

- Women can't do physics = fixed mindset

WHAT TO DO?

- How can we promote women's participation in STEM?
What are your ideas?
- Climate
- Teaching
- Professional development (for everyone)



CLIMATE

- What Works? research:
 - lounge space for students
 - informal faculty-student interactions
 - SPS chapter
- Zero-tolerance policy on harassment
- Family-friendly policies encouraged for everyone
- Clear and transparent policies for students, staff, faculty
- Assessment of equity issues: workload, climate, resources, etc.

TEACHING

- Get Jennifer Blue's slides from her Fall 2018 presentation [here](#) at UMD!

STEP UP 4 WOMEN

- High school curriculum
 - Careers in physics
 - Under-representation of women in physics
- Encouraging young women in high school classes
- Pilot testing done; implementation roll-out continuing

CUWIP

- Conference for Undergraduate Women in Physics
- Annually in January; multiple sites across US
 - UMN-TC in 2020!
- Bringing together undergraduate women
 - Networking
 - Reduce sense of isolation
 - Professional development
- Reaching nearly every UG woman in physics in US!

CLIMATE SITE VISITS

- Teams visit departments
 - Interview members of department
 - Provide recommendations to department
 - Focus on women, or women and minorities
- Program running since 1990!
- Interest in program increasing in last 5 years
 - ~2/year to ~6/year

EFFECTIVE PRACTICES

- Guides on different topics
 - Undergrads
 - Grad students
 - Postdocs
 - Faculty
 - Meetings
- In development: Effective Practices for Physics Programs

<https://www.aps.org/programs/women/reports/cswppractices/index.cfm>

<https://www.aps.org/programs/education/ep3/index.cfm>

INDIVIDUAL ACTIONS

- Find your own implicit biases (Project Implicit)
- Use gender-neutral language
 - "Campers" vs "girls"; "students" vs "guys"
- Encourage *everyone* to learn STEM
- Talk about effort instead of ability
- Listen for microaggressions
- See the other side: Try replacing male for female and vice versa when consuming media
- See who is assigned what tasks: who is the "social director"? the party planner? the note-taker?

OTHER USEFUL IDEAS

- Assessing equity
 - Lab space
 - Start up funding
 - Student researchers
 - TAs/LAs
- Talk about it!
 - Create a safe space
 - Have safe confidante for people in subordinate positions
- Develop supporting environments
- Send the NASEM report on Sexual Harassment to administrators

IMPROVING CAMPUS/DEPARTMENT CLIMATE

- Start with your goal: what does your ideal environment look like? What types of diversity do you want?
- Who are your stakeholders?
- Who are the controllers?
- What resources are needed?
- Research: what opposes, what boosts
- What is shown to work?
- Remember the "first" has a really rough time! (Pixar's short film Purl)
- Having a female in a position doesn't guarantee the culture will let her excel/move upward/stay

IT'S EVERYONE'S JOB!

- It takes a village to raise a child
- It takes a culture to discourage a young woman
- Culture must change to get more women in physics
 - Slow
 - Frustrating
 - Imperative

THANK YOU!

- Download this presentation and others here:

<http://lauramccphd.com/index.php/home/research/selected-presentations/>

