Changing the Climate in Science

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What do we mean by a "chilly climate" for women and minorities in science?

- Women and non-whites are underrepresented, and change is slow.
- We think of "scientist" and "woman" as different categories, and "scientist" and "white" as overlapping.
- We evaluate the accomplishments of white men and those of women and racial/ethnic minorities differently.
- Women, persons of color, and LGBTQ+ persons encounter subtle and overt microaggressions, hostility, and harassment.
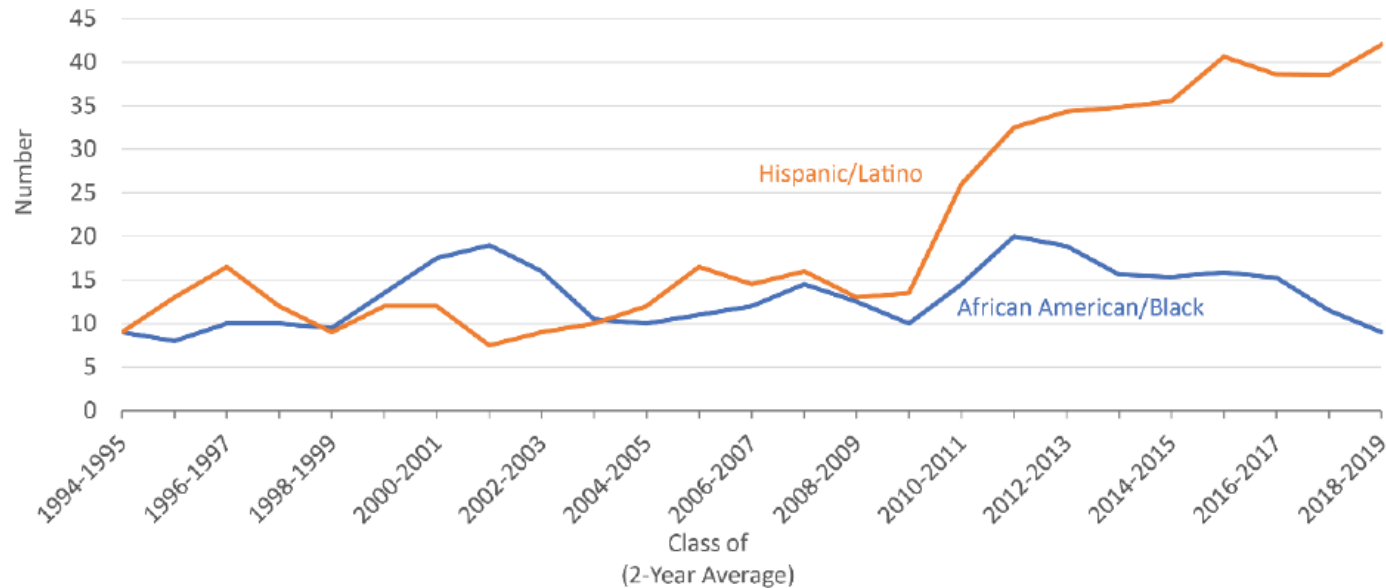
But we can do something about it!

% of PhD degrees to women since 1920

Percent of PhDs Awarded to Women in Specified Fields, Classes of 1920 through 2016
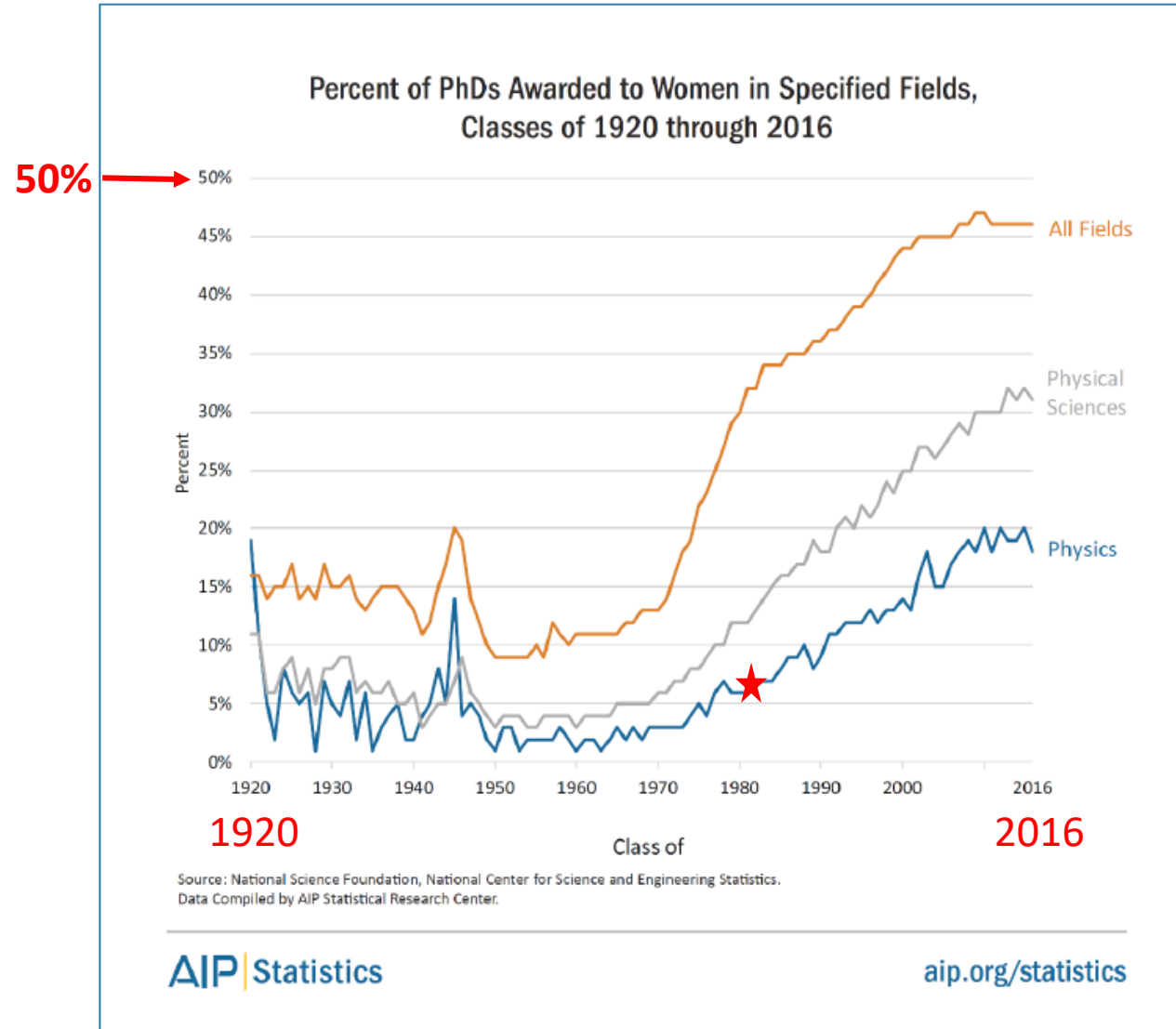
Number (not %!) of physics PhDs to Blacks and Hispanics since 1994
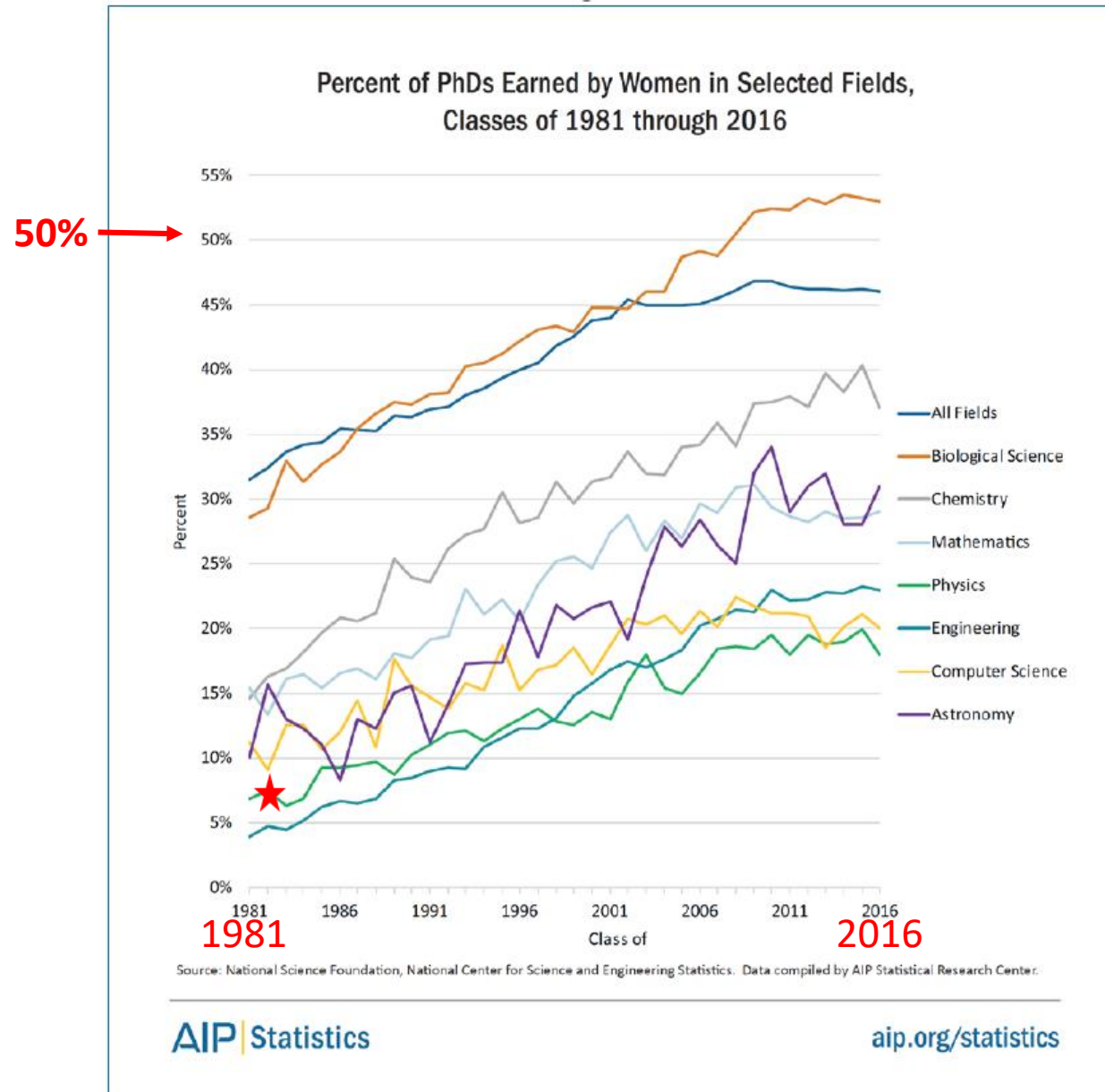
~ half of physics PhDs go to non-citizens

Hispanics receive 4% of physics PhDs to US citizens

Blacks receive 1% of physics PhDs to US citizens

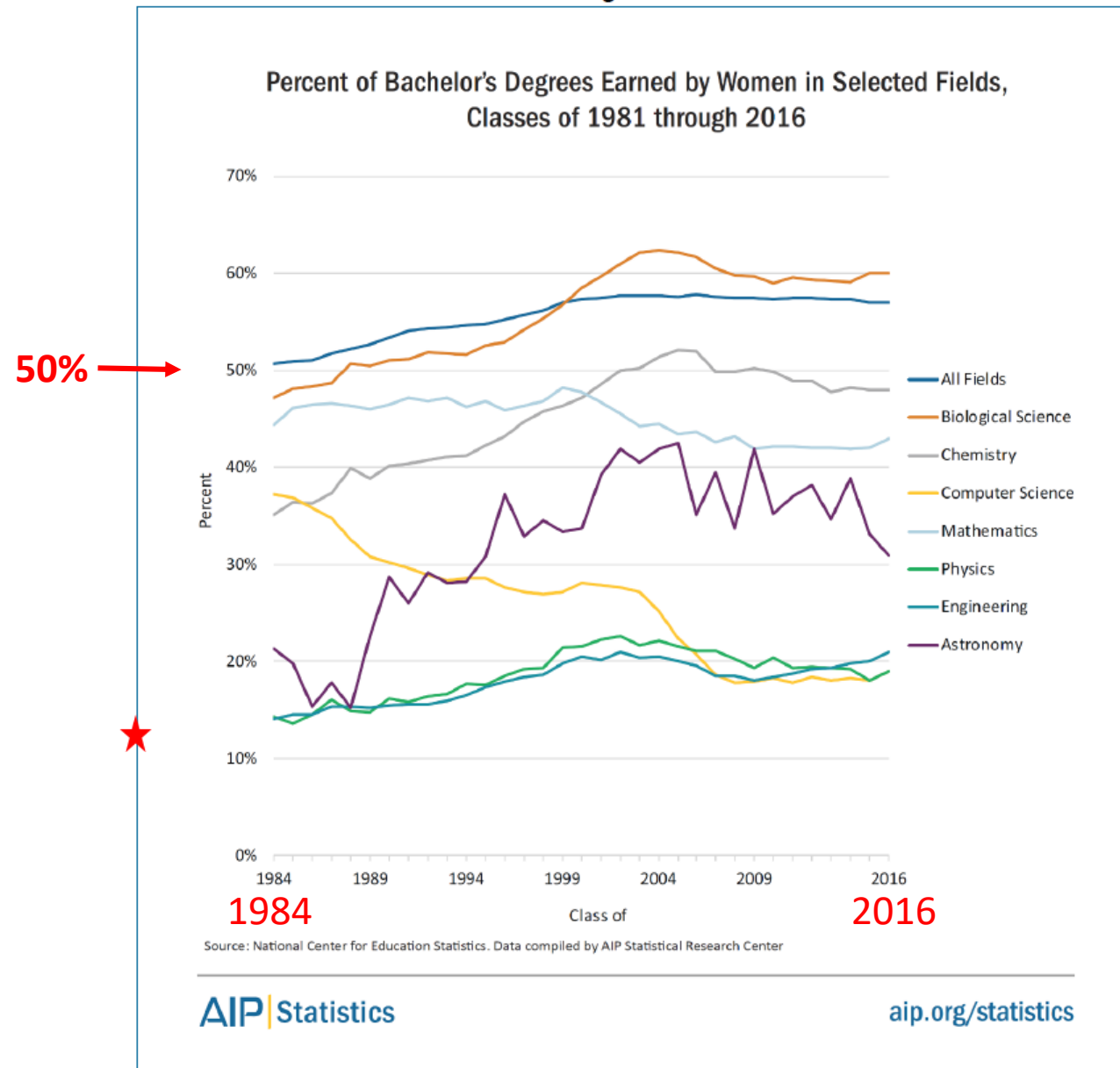Number of African American and Hispanic People Earning a Physics Doctorate, Classes of 1994 through 2019

All sciences are not the same

Percent of PhDs Earned by Women in Selected Fields, Classes of 1981 through 2016

Source: National Science Foundation, National Center for Science and Engineering Statistics. Data compiled by AIP Statistical Research Center.

AIP | Statistics

aip.org/statistics

% of Bachelor's degrees to women since 1984

Percent of Bachelor's Degrees Earned by Women in Selected Fields,
Classes of 1981 through 2016

50% →

1984   2016

% of physics bachelor's to Blacks and Hispanics since 1994

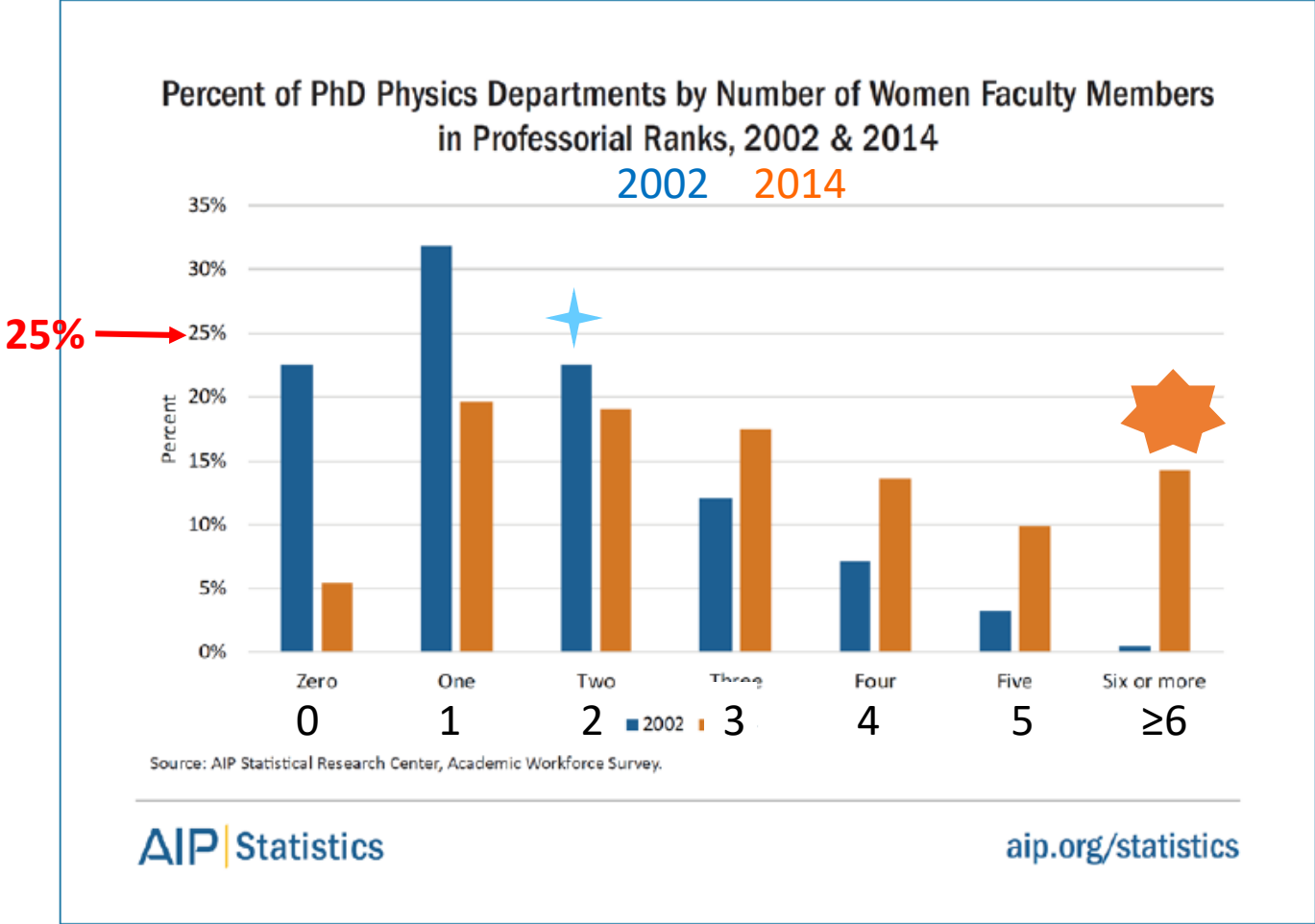The Proportion of Physics Bachelor's Degrees Awarded to African Americans and Hispanic Americans
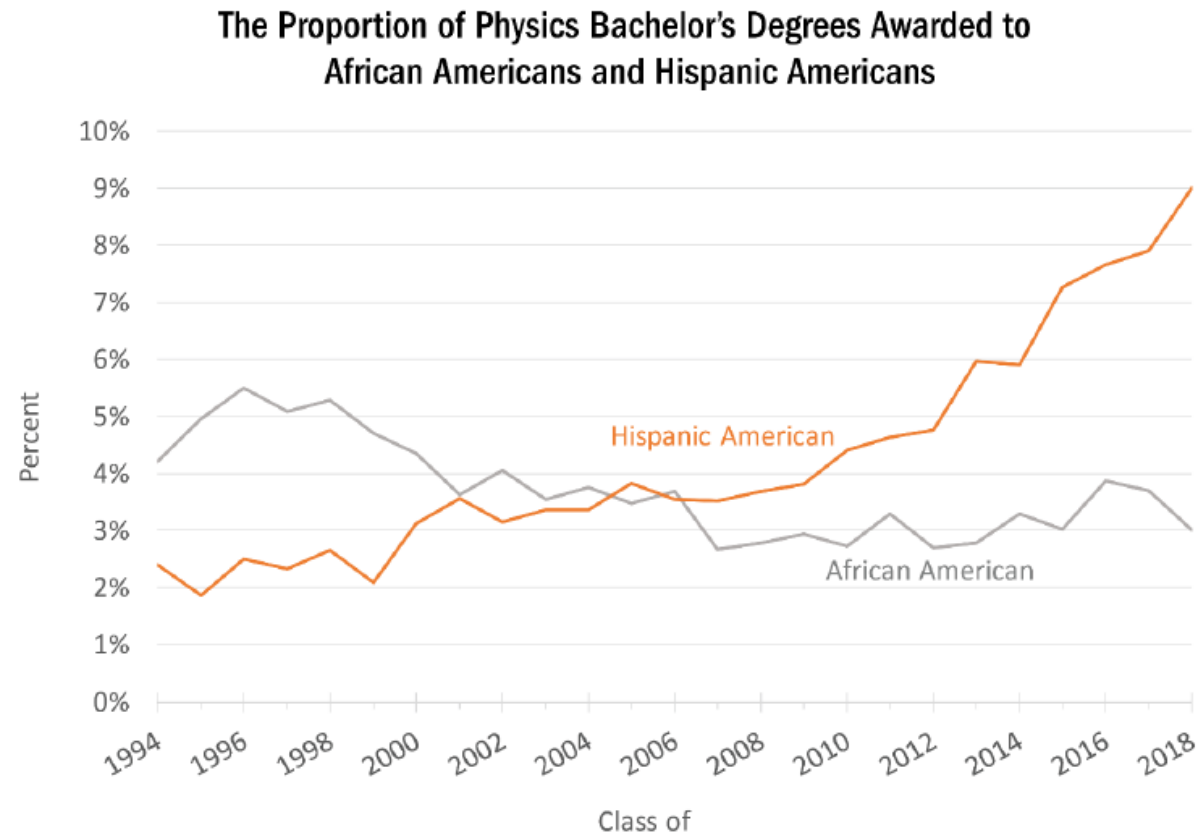
Parallels % receiving bachelor's in all fields

All sciences are not the same (but the trends are)
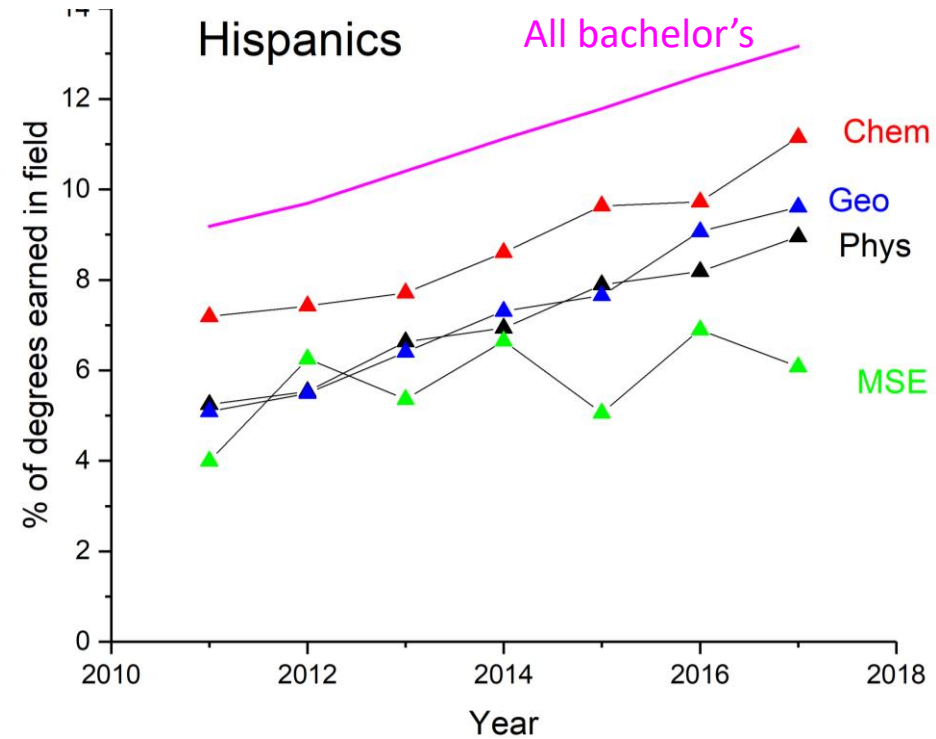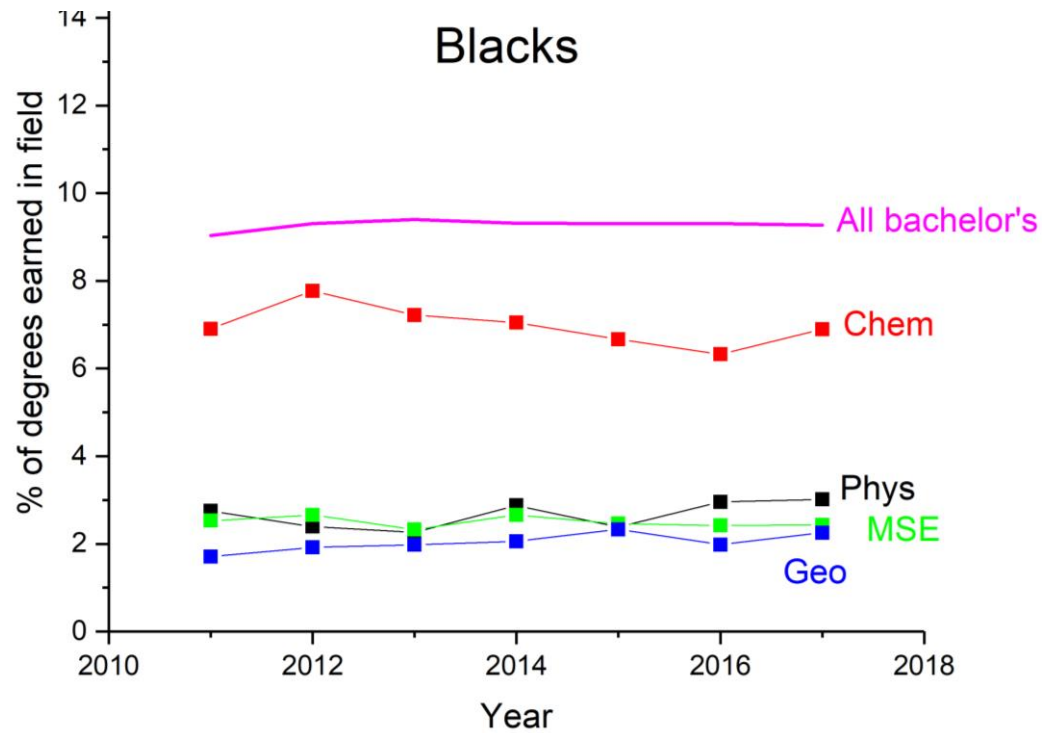
More physics departments now have female faculty members

Percent of PhD Physics Departments by Number of Women Faculty Members in Professorial Ranks, 2002 & 2014

Source: AIP Statistical Research Center, Academic Workforce Survey.

AIP | Statistics

aip.org/statistics

Blacks and Hispanics rare among physics faculty members

In 2012 Blacks were 2.1 % of physics faculty members (6.6% all disciplines)
Hispanics 3.2% of physics (4.0% all disciplines)

Half of all Black physics faculty work in 23 departments (mostly HBCUs), but 78% of Black physics students are in PWI.

% of phys depts that have…	PhD	MS	Bachelor's
Black and Hispanic	8.3%	4.9%	1.6%
Black no Hispanic	9.3%	16.4%	9.1%
Hispanic no black	39.6%	36.1%	10.8%
neither	42.7%	42.6%	74.4%

Intersectionality: In 2012 Black and Hispanic women were 4.8% of female faculty in PhD depts, 8.8% in MS, 5.2% in bachelor's: total of 73 women of 9,050 faculty members = 0.8%
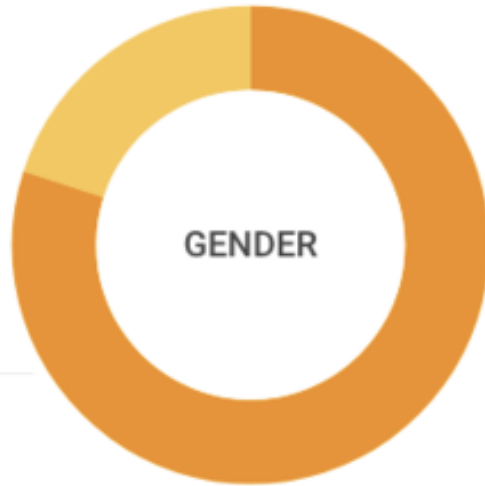
What about the private sector?

- 18% of jobs in engineering, data science, product design etc. are held by women

- 10% of tech jobs at the executive level are held by women, 2.1% by Blacks, 3.1% by Hispanics

- Women hold 57% of all professional positions but only 25% of computing positions.

- Women leave computing-related jobs sooner than non-STEM professional jobs

Women in Tech: The Facts (National Center for Women & Information Technology 2016)
https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf

Race and ethnicity at Google 2017

Facebook, Apple, Twitter, Microsoft very similar

Women
20%

Men
80%

GENDER

ETHNICITY

Other
<1%
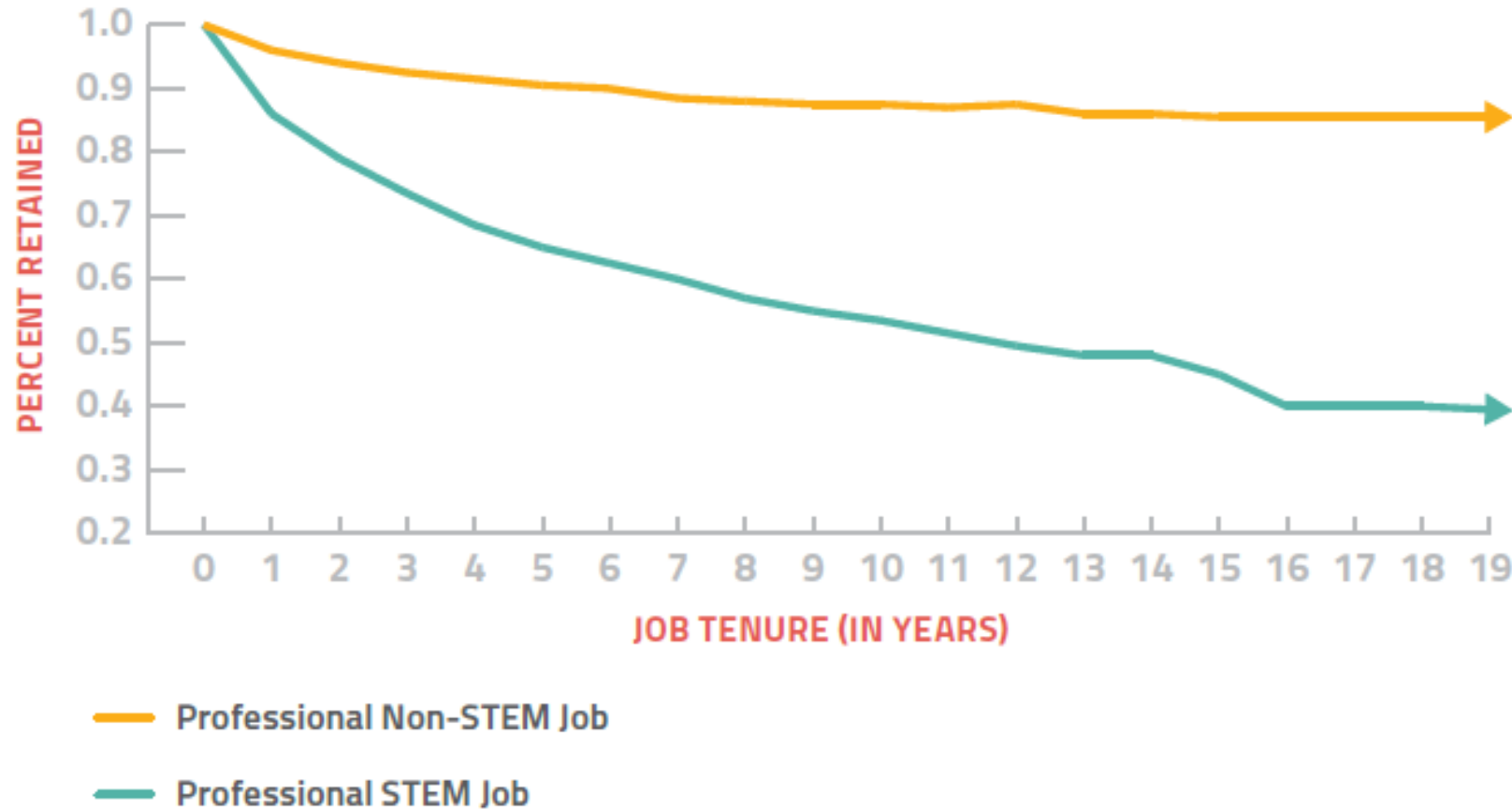
Black
1%

Hispanic
3%

Two or more races
3%

Asian
39%

White
53%

* Data from Jan 2017 – Gender data are global, ethnicity data are US only.

**See our EEO-1 report for more information. Ethnicity refers to the EEO-1 categories which we know are imperfect categorizations of race and ethnicity, but reflect the US government reporting requirements.
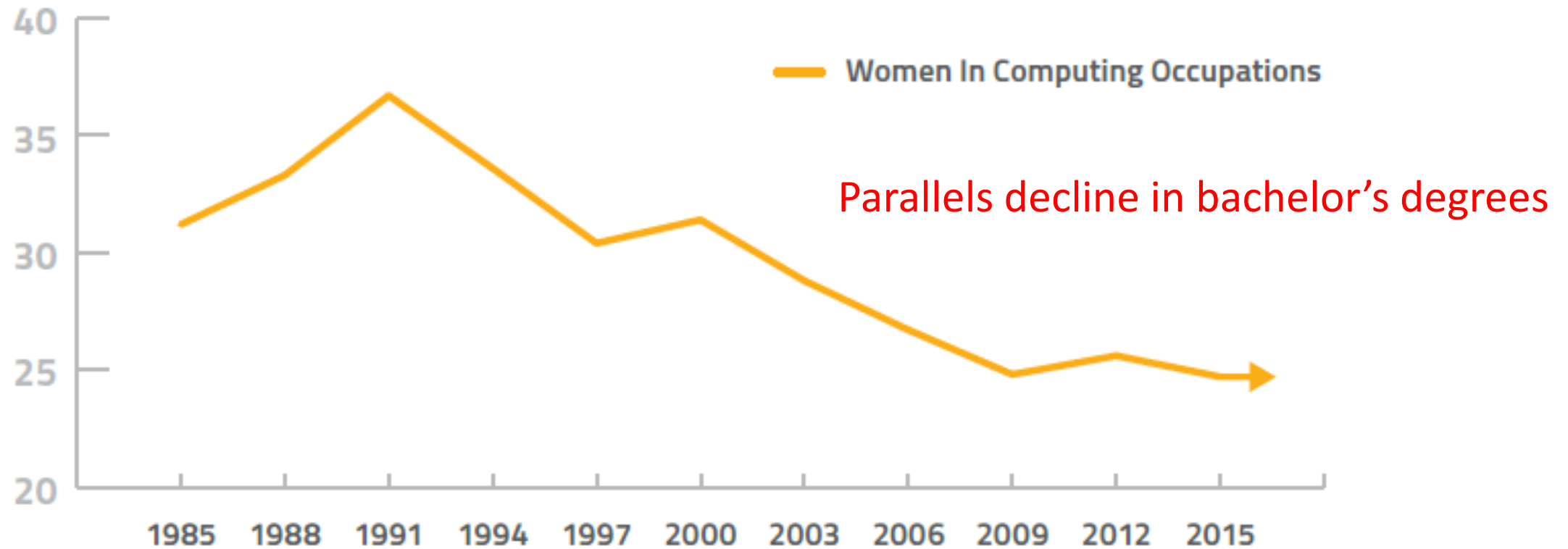
***Other includes American Indian/Alaskan Native and Native Hawaiian/Pacific Islander.

Women are more likely to leave STEM jobs than other professional positions

PERCENT RETAINED (y-axis: 0.2 to 1.0)
JOB TENURE (IN YEARS) (x-axis: 0 to 19)

— Professional Non-STEM Job
— Professional STEM Job

Rerendered from Glass et al., 2013

Women in Tech: The Facts (National Center for Women & Information Technology 2016)
https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf

Women's employment in computing has declined for decades

Women In Computing Occupations

Parallels decline in bachelor's degrees

Women in Tech: The Facts (National Center for Women & Information Technology 2016)
https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf
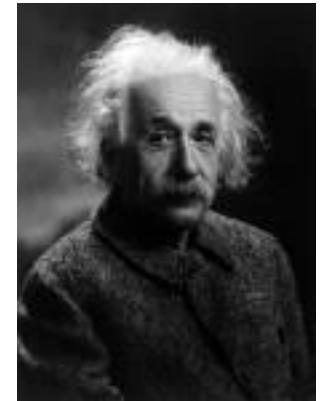
Why?

Gender schemas

Gender schema: unconscious hypothesis about sex differences, assigning certain psychological traits to males and females
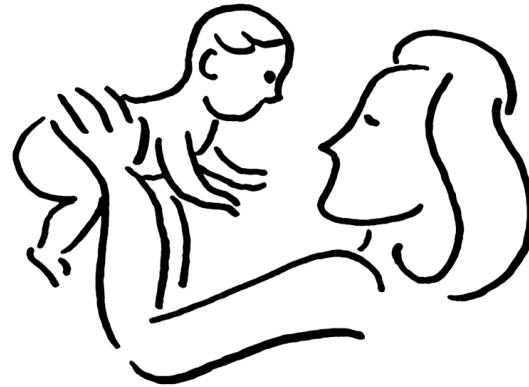
We associate certain traits with occupations

Even though we hold egalitarian views!

Valian, *Why So Slow?* (1998)

Scientist ≠ woman

Gender schemas lead us to think of "woman" and "scientist" as incompatible

• What happens when you ask someone to "draw a scientist"?

• Stereotyping starts early

• "Scientist" = "man," not "woman" (and has for a long time)

• You don't look like a scientist!

Draw a scientist

Children asked to "draw a scientist" will draw a standard image:

- Male
- Lab coat
- Eyeglasses
- Facial hair or disheveled hair
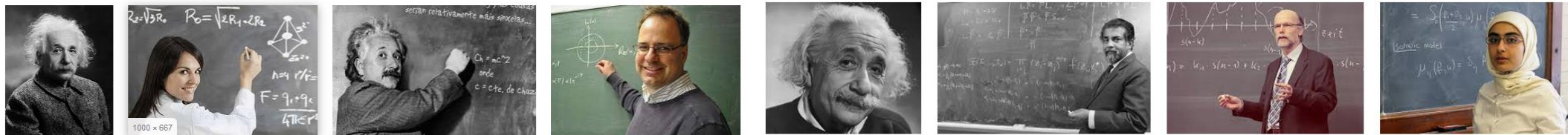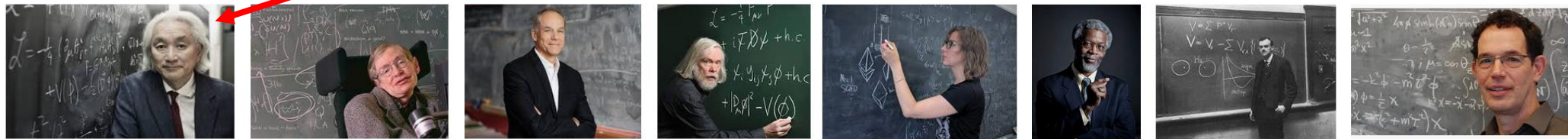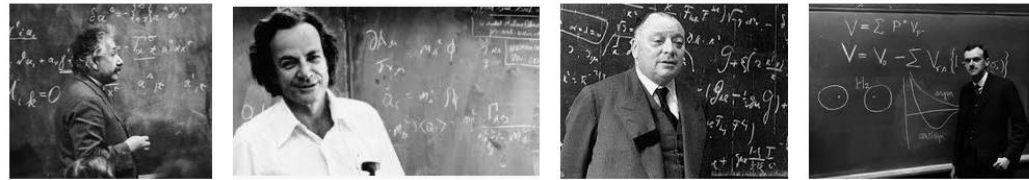- Laboratory equipment

Einstein in a lab coat!

Adults (including future teachers!) make very similar drawings

Sci. Ed. **67**, 255 (1983), *Am J. Phys.* **65**, 774 (1997)

What does Google say?

Google "physicist" and of the first 100 images:

- 12 are female
- 5 are Albert Einstein
- 8 are Stephen Hawking
- 41 are dead
- 80 are white
- 6 are Asian (3 are Michio Kaku)

"Scientist" = "man," not "woman"

Undergraduates asked to associate descriptive terms with men, women, or successful scientists
- Strong overlap of traits associated with men and with scientists
- No overlap of traits associated with women and with scientists
- Men and scientists rated high on "agency" scale
- Women rated high on "communion" scale
- Males and females responded alike

Responses in 2014 very similar to those in 1983

You don't look like a scientist!

MY TEAM IS GREAT.
EVERYONE IS
SMART, CREATIVE
AND HILARIOUS.

ISIS WENGER
PLATFORM ENGINEER

2015 recruiting poster from tech firm OneLogin with full-stack engineer Isis Wenger

Social media exploded with doubts about authenticity: she is "too attractive" to be a "real engineer."

You don't look like a scientist!

Adults shown photos of STEM faculty members from elite departments
- Rate photos on masculine/feminine, attractiveness
- Likelihood they were a scientist or an early-childhood educator
- The less feminine a woman looked, the more likely she was judged to be a scientist
- The less attractive, the more likely judged to be a scientist (men or women)
- Males and females responded alike

Backlash to OneLogin ad led to #ilooklikeanengineer campaign
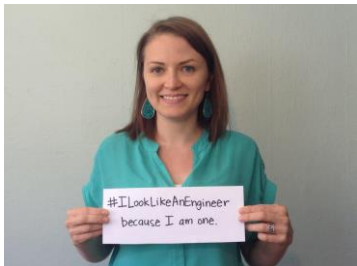
Gender schemas affect our evaluations

- Whom would you hire as a lab manager?
- Ben Barres and his "sister"

Whom would you hire as a lab manager?

Faculty members in physics, chemistry and biology asked to evaluate resumes of candidates for lab manager position
- Résumés were qualified but not outstanding
- Same résumé, male or female name
- Males viewed as more *competent*
- Males viewed as more *hirable* and would be offered *higher salary*
- Males viewed as *more worthy of faculty mentoring*
- Male and female faculty members responded alike

PNAS **109**, 16474 (2012)

Ben Barres and his "sister"
Professor of Neurobiology, Stanford University
National Academy of Sciences 2013

Transgender man, made public transition at age 43

Overheard soon after Barres made his public transition:

"Ben Barres gave a great seminar today, but then his work is much better than his sister's."
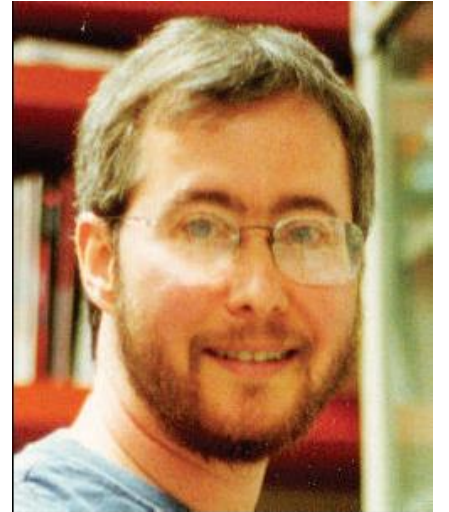
1954-2017

"By far, the main difference that I have noticed is that people who don't know I am transgendered treat me with much more respect: I can even complete a whole sentence without being interrupted by a man."

How to mitigate this?

Best practices in candidate selection (not followed in these studies!) can reduce unconscious bias

- Unconscious bias awareness and training
- Don't make decisions on limited information
- Allow plenty of time for decisions
- Use concrete, objective criteria for selection (specified in advance!)
- Consider blind résumé review

Unwelcoming climate

Sexual harassment

The cumulative effect of sexual harassment is a significant and costly loss of talent in academic science, engineering, and medicine, which has consequences for advancing the nation's economic and social well-being and its overall public health.
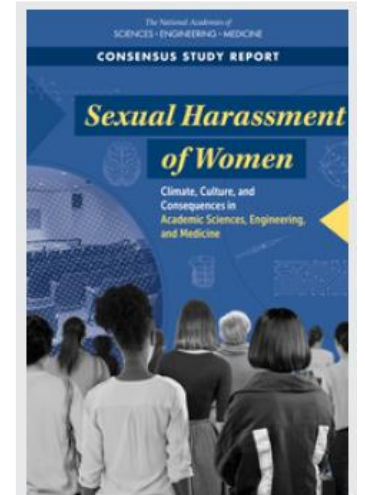
By far, the greatest predictor of the occurrence of sexual harassment is the organizational climate in a school, department, or program, or across an institution.

National Academies report on sexual harassment

National Academies report

Sexual harassment: *gender harassment* (verbal and nonverbal behaviors that convey hostility, objectification, exclusion, or second-class status), *unwanted sexual attention*, *sexual coercion*

- Gender harassment is the most prevalent

- > 50% of academic female faculty and staff experience harassment

- 20-50% of female science and medicine students experience harassment (75% of female physics undergraduates)

- Factors making harassment more likely:
  - Perceived tolerance for harassment
  - Male-dominated environment
  - Hierarchical power structure
  - Lack of leadership on the issue

Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine. (National Academies Press 2018); *Phys. Rev. Phys. Ed. Res.* **15**, 010121 (2019)

The iceberg of sexual harassment
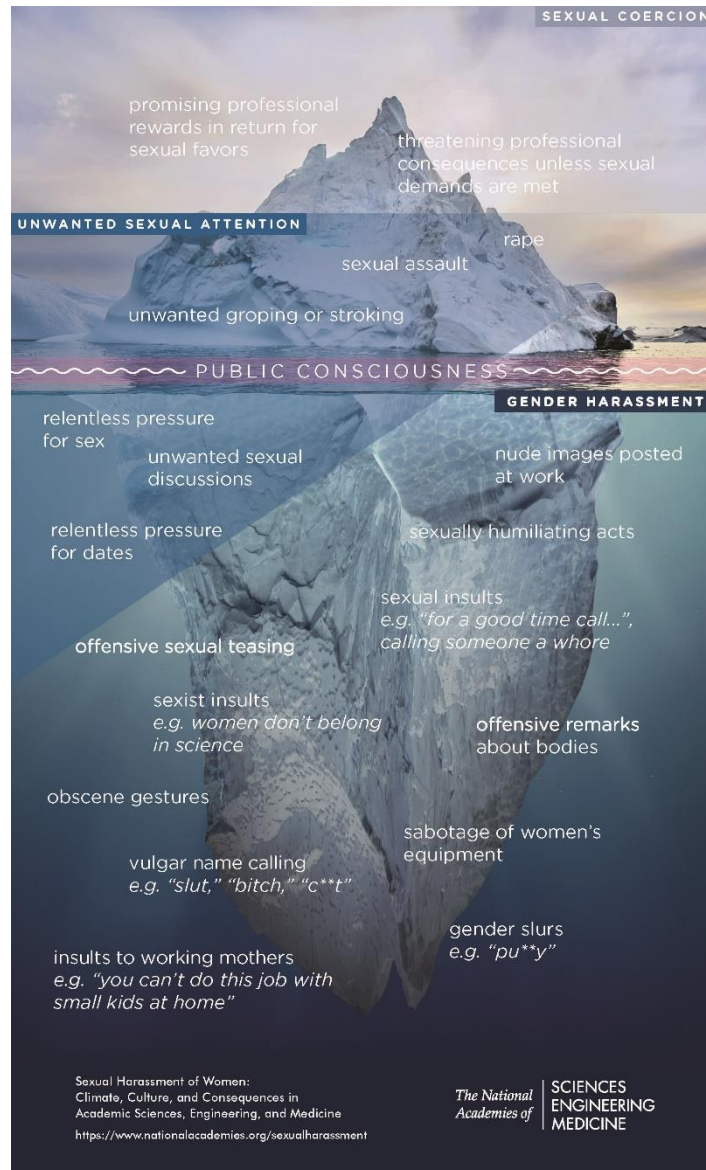
Quid pro quo

Sexual assault

Unwanted sexual attention and pressure for dates

Sexual insults and offensive teasing

Sexist insults and offensive remarks about bodies or looks

Sabotage of women's experiments

Appropriation of women's work

Vulgar name-calling and gender slurs

LGBTQ+ also experience harassment
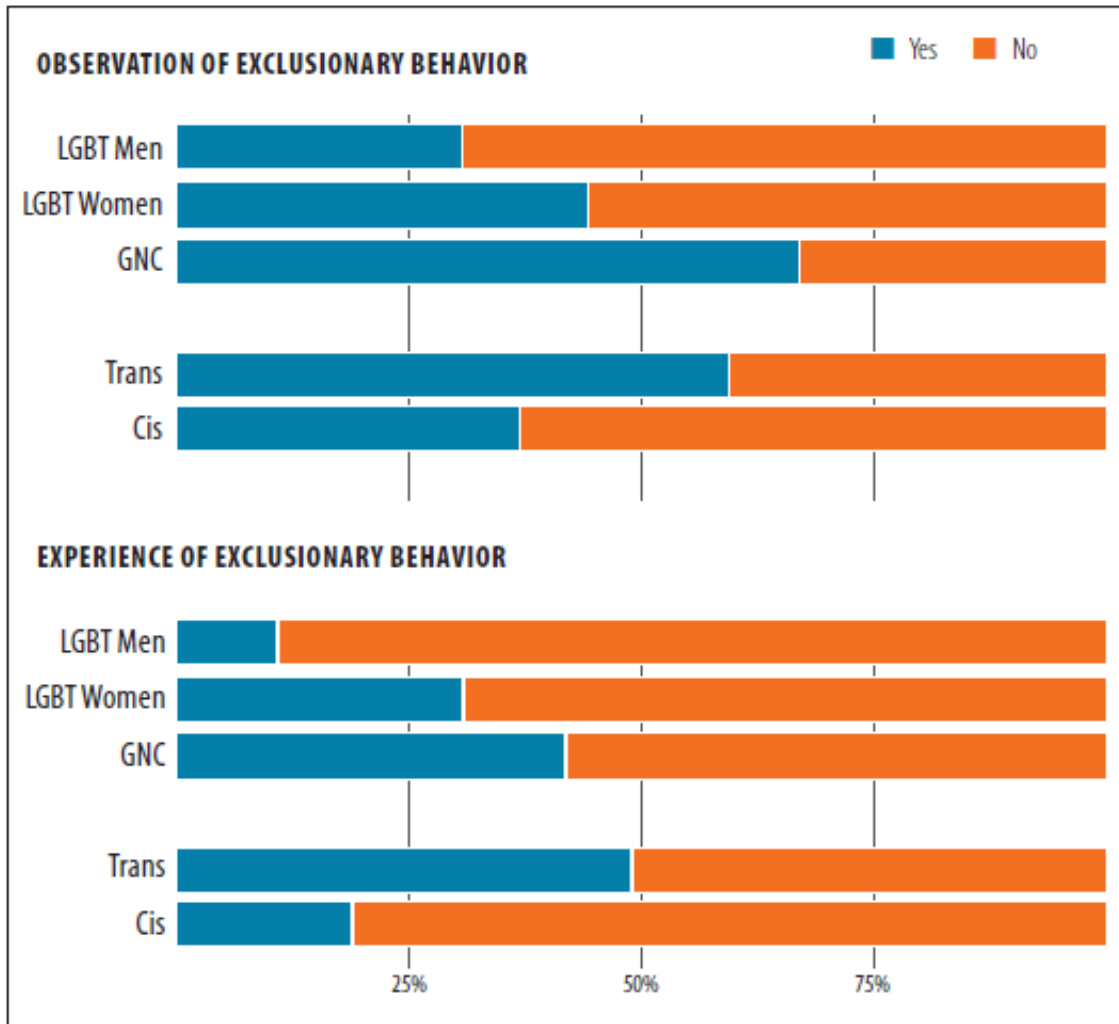
22% of LGBTQ+ physicists surveyed *experienced* exclusionary behavior due to gender, gender expression, gender identity, sexual orientation, and/or sexual identity and 39% *witnessed* it.

Women and gender-nonconforming were more likely to experience or observe exclusion, and trans were more likely than cis.

36% considered leaving their institution in the past year (exclusionary behavior made it more likely).

Barthelemy *et al., Physical Review Physics Education Research* **18**, 010124 (2022)

It isn't just physics

Survey of > 25,000 scientists (> 1000 LGBTQ+) found that compared to their (matched) peers, LGBTQ+ persons were:

- Less likely to have opportunities for professional development
- Less likely to have access to resources needed to do their jobs well
- Less likely to be treated as having comparable professional skills
- More likely to be socially excluded
- More likely to experience harassment
- More likely to have considered leaving their job or their field

Nondisclosure of identity ("in the closet") was strongly correlated with fewer papers published

Nelson *et al.*, *PLoS ONE* **17**, e0263728 (2022)

Cech & Waidzunas, *Sci. Adv.* **7**, eabe0933 (2021)

Microagressions

Brief daily verbal and behavioral indignities (intentional or not) that communicate negative messages, often used to reinforce or raise one's own social advantage.

- Sexual objectification
  - Physics major asks male professor for advice on getting into a good doctoral program; he suggests that she flirt more at conferences.
- Use of sexist language and humor
  - "Don't act like a chick"
- Assumption of inferiority
  - Undergraduate adviser to female student interested in PhD in physics: "You know physics is hard. Are you sure you want to try to do that?"

Microagressions, cont.

- Restrictive gender roles
  - Annual plasma physics lab clean-up: women assigned to sweep floors, men to disassemble and clean apparatus
- Denial of the reality of sexism
  - "Maybe the reason women get paid less than men is that they don't work as hard."
- Invisibility
  - "A lot of my suggestions are brushed off. If, later, they turned out to be correct, people forget that I ever made them."

Racial/ethnic microagressions

- You are "not like the others" of your race/ethnicity
- You are "articulate"
- You are "angry" or "too sensitive"
- Mistaken for someone else of same race/ethnicity
- Excluded from meetings relevant to position
- Stopped on site and asked to prove your right to be there
- "Some of my best friends are…"
- "I'm not racist"

"Being Black in Corporate America," Center for Talent Innovation (2019)

Peer hostility

- Landmark study of students who started science majors and either persisted or switched

"An apparent difficulty in seeing physical attractiveness and intellectual capacity as other than mutually exclusive qualities in women who choose certain SME majors was a marked feature of the behavior and attitudes of their male peers."

- Persistence of women in graduate program correlated with number of women in cohort

Sci. Ed. **79**, 437 (1995), *Talking About Leaving* (1997), Nat. Bureau of Econ. Res. Working Paper (2018)

Why do we care?

- ## Resource utilization

  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.

  Presidents of Stanford, MIT, and Princeton (February 2005)

  Some 1.2 million computing jobs were available last year, yet United States universities are producing only 39 percent of the graduates needed to fill them.

- ## Efficacy

  More diverse groups explore a broader range of problems and solve them more effectively.

- ## Equity: why should white men have all the fun?

  It is simply unjust for a profession to organize itself, intentionally or unintentionally, in such a way as to exclude a significant proportion of the population.

  Shirley Tilghman, President of Princeton (2003)

- ## What is good for women and minorities is good for humans

https://news.stanford.edu/news/2005/february16/henop-021605.html   http://killamlaureates.ca/doc/2003KillamLecture.pdf
https://www.ncwit.org/sites/default/files/resources/btn_02282014web.pdf

We expect that science will continue to generate new ideas and discover new knowledge, thereby creating further economic growth, enhanced national security, and increased well-being.

Se vogliamo che tutto rimanga come è, bisogna che tutto cambi.

Guiseppe Tomasi di Lampedusa, *The Leopard*

(*If we want things to stay as they are, things will have to change.*)

# What makes the climate warmer?
Institutional

- Diverse members (along many measures)
- Family-friendly policies (not limited to heterosexual married couples)
  - Two-body problem
  - Parental leave
  - Childcare
  - Family-friendly atmosphere
- Awareness that experience of underrepresented groups may be different
  - Harassment
  - Stereotype threat
  - Impostor phenomenon

© Jim Craigmyle/Corbis

Stereotype threat

Stereotype threat: facing judgment based on societal stereotypes about your group

- If told that a (difficult) math test had showed gender differences in the past, women did much more poorly than (equally-qualified) men

- If told that the test had *not* showed gender differences, men and women performed the same

- Similar results for racial/ethnic minorities
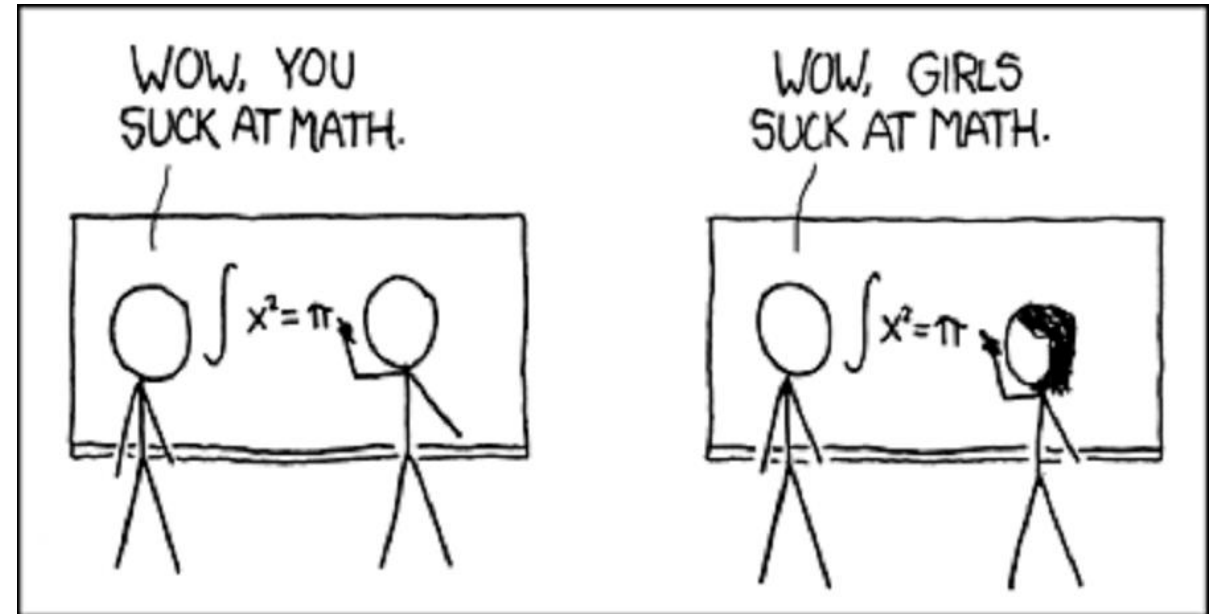
Impostor phenomenon

Impostor phenomenon: doubting one's accomplishments and having a persistent fear of being exposed as a "fraud;" incorrectly attributing one's success to luck, or to having deceived others into thinking one is more intelligent than one perceives oneself to be.

- High-achievers who attribute their success to "some mistake in the selection process"

- Feeling that others achieve by "natural genius" rather than hard work (especially in fields that emphasize this: math, physics, philosophy, economics)
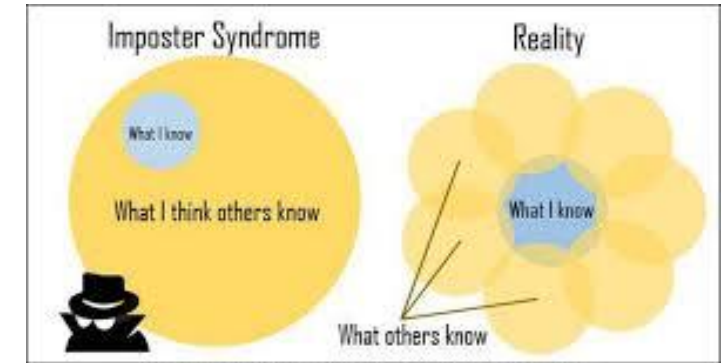
What makes the climate warmer? Communication and procedures

- Appoint a Diversity Liaison or Committee so that the climate is someone's "job"
- Climate surveys and feedback mechanisms
- Communicate importance of inclusion for health of department; promote use of inclusive language everywhere (including classrooms)
- Provide research-based training in fostering inclusive learning environments
- Mentoring, professional development and networking activities for all
- Minimize effect of unconscious biases on recruitment and advancement ("blinded" review, specific criteria)
- Cultivate "belonging" by getting to know students as individuals, affirming, recognizing and representing to enhance science identity
- Fix the culture, not the underrepresented population

What makes the climate warmer?

- Learn how t
  - Improves
  - Underrepr
- Have introd
  faculty mem
- Connect co
- Learn how t
  than weed,
- Communica
  respect
- Educate stu

"It is important to me to apply my expertise in my major to benefit the community I belong to"

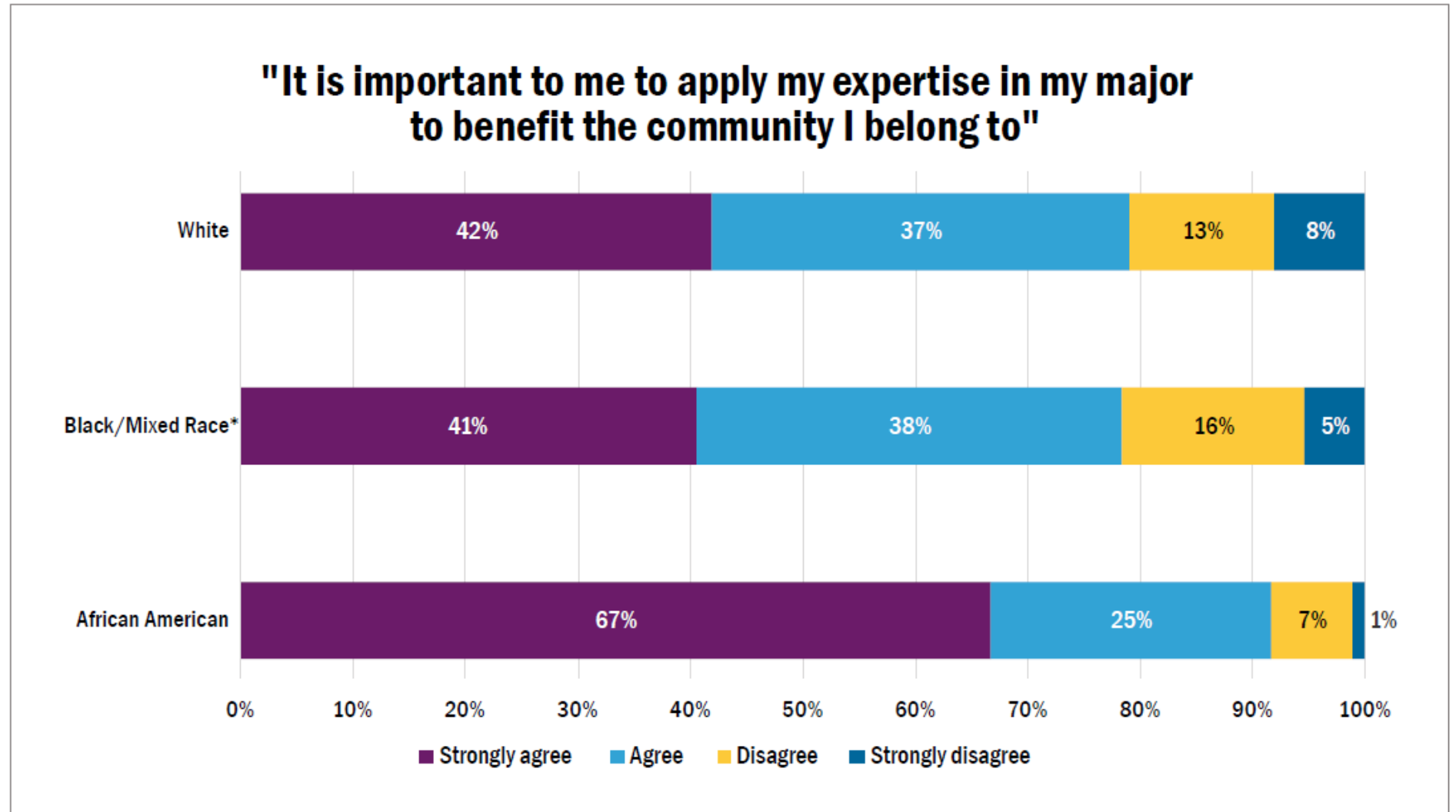|	Strongly agree	Agree	Disagree	Strongly disagree
White	42%	37%	13%	8%
Black/Mixed Race*	41%	38%	16%	5%
African American	67%	25%	7%	1%

Figure 14: Students' motivation to benefit their community by race
Source: TEAM-UP Student Survey

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What makes the climate warmer? Student culture

- Safe environment
- Student lounge
- Tutorial services, incl. peer
- Learning Assistants
- Seminars of interest to students
- Student club (Soc. of Physics Students, MRS Student Chapter, Math Club,…)

- Faculty model (and monitor) professional, inclusive behavior and language
- Foster cooperation rather than competition
- Make women and minorities visible
  - Mention prominent underrepresented scientists
  - No "dude wall"
  - Invite women and minorities to visit
- Outreach activities

We think we are helpless to foster change

Even well-intentioned, progressive white males believe they are powerless to effect change, because:
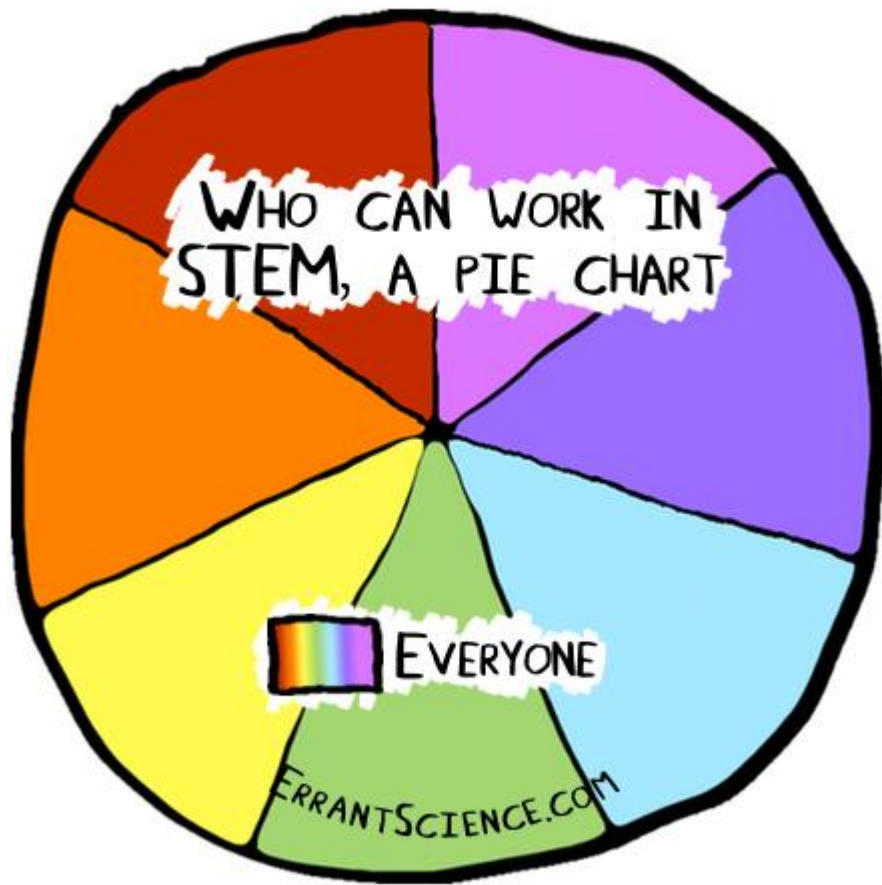
- Inequity happens far away, not here
  - *Not in my classes, department, institution, scientific field, region, …*
  - *I know this is true (but haven't talked to women or persons of color about it)*
- It's the fault of grand societal structures they can't do anything about
  - *HS teachers discourage women, people of color go to under-resourced schools*
  - *Historical legacy of sexism/racism (wait for the old white guys to retire)*
  - *Parenting and women's choices*
- They are helpless to act, and so won't
  - *I don't see what is in front of my face*
  - *I don't want to experience discomfort, or make others uncomfortable*
  - *I don't know what to do, so it's somebody else's job, or can't be fixed*

What does it take to change the climate?

- Accept that your experience of the environment is not universal
- Recognize that widely-shared characteristics may not be necessary for good science
- Recognize your own implicit biases; take steps to minimize their effects
- Do not tolerate harassment of anyone, by anyone
- Cultivate classrooms that maximize success for all
- Foster a student-centered culture with professional development for all

You can make a difference!