Status of Women in Physics 2016

Physics Colloquium August 30, 2016

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Dedicated to Bunny Clark

Professor Emerita of Physics

Women in STEM: some good news

- Over the past 50 years, girls and women have been increasingly drawn to studying STEM subjects
- Girls have closed the achievement gap on standardized math tests (SAT, AP) and grades in high schools

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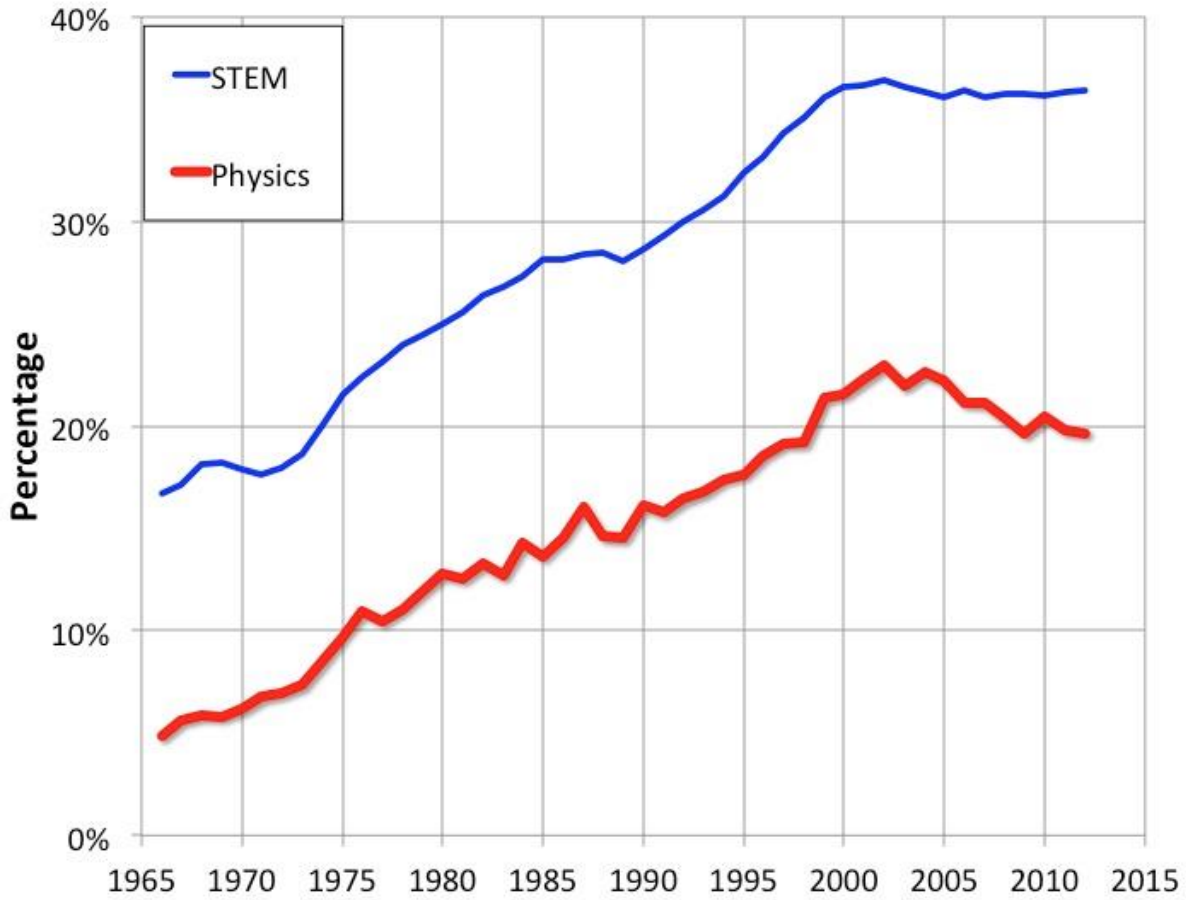
and yet….

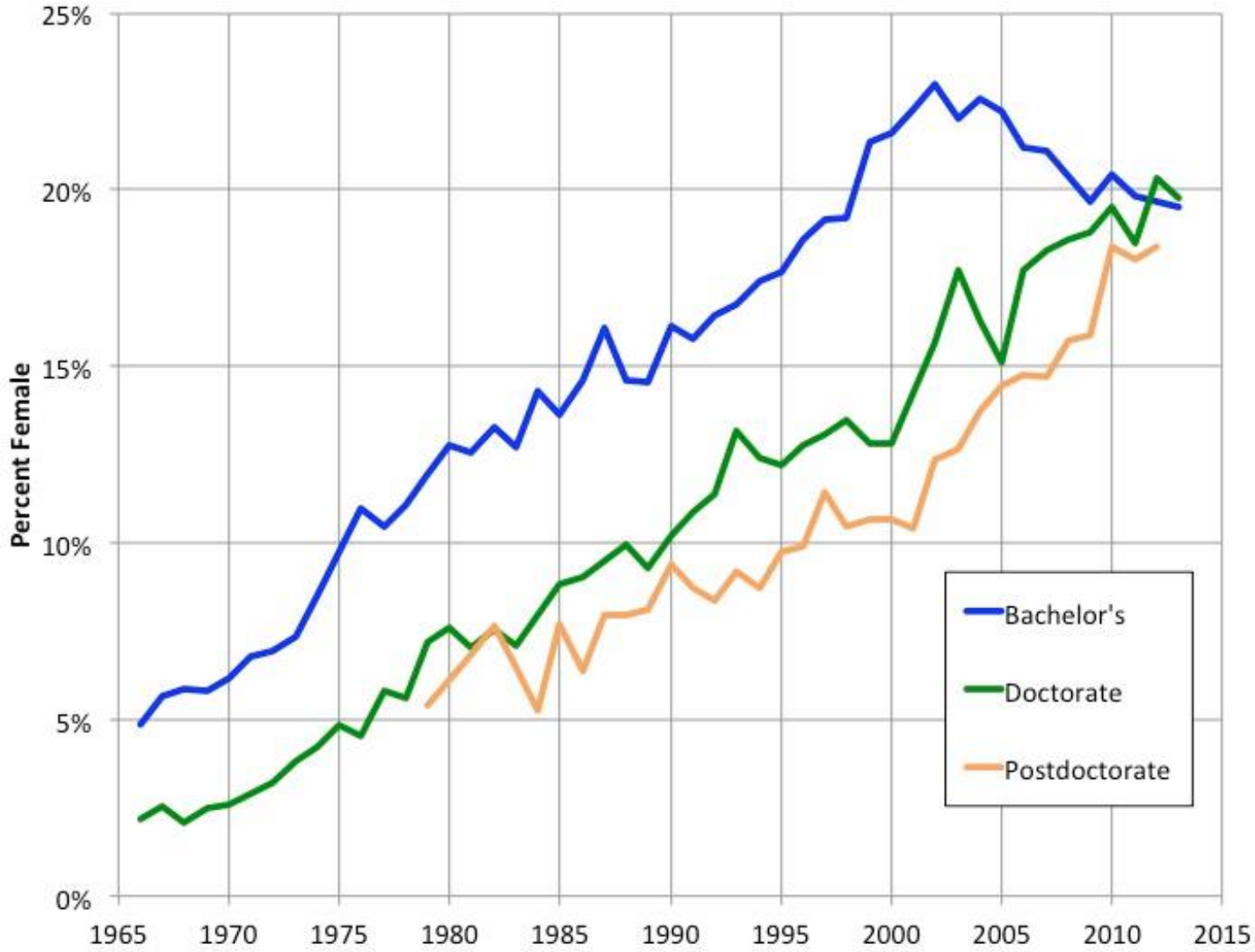
25% of British 14-year-olds confused Marie Curie with Mariah Carey

Physics degrees and gender

In 2014, women earned 20% of all bachelor's degrees in physics



Women physicists become scarcer in graduate school

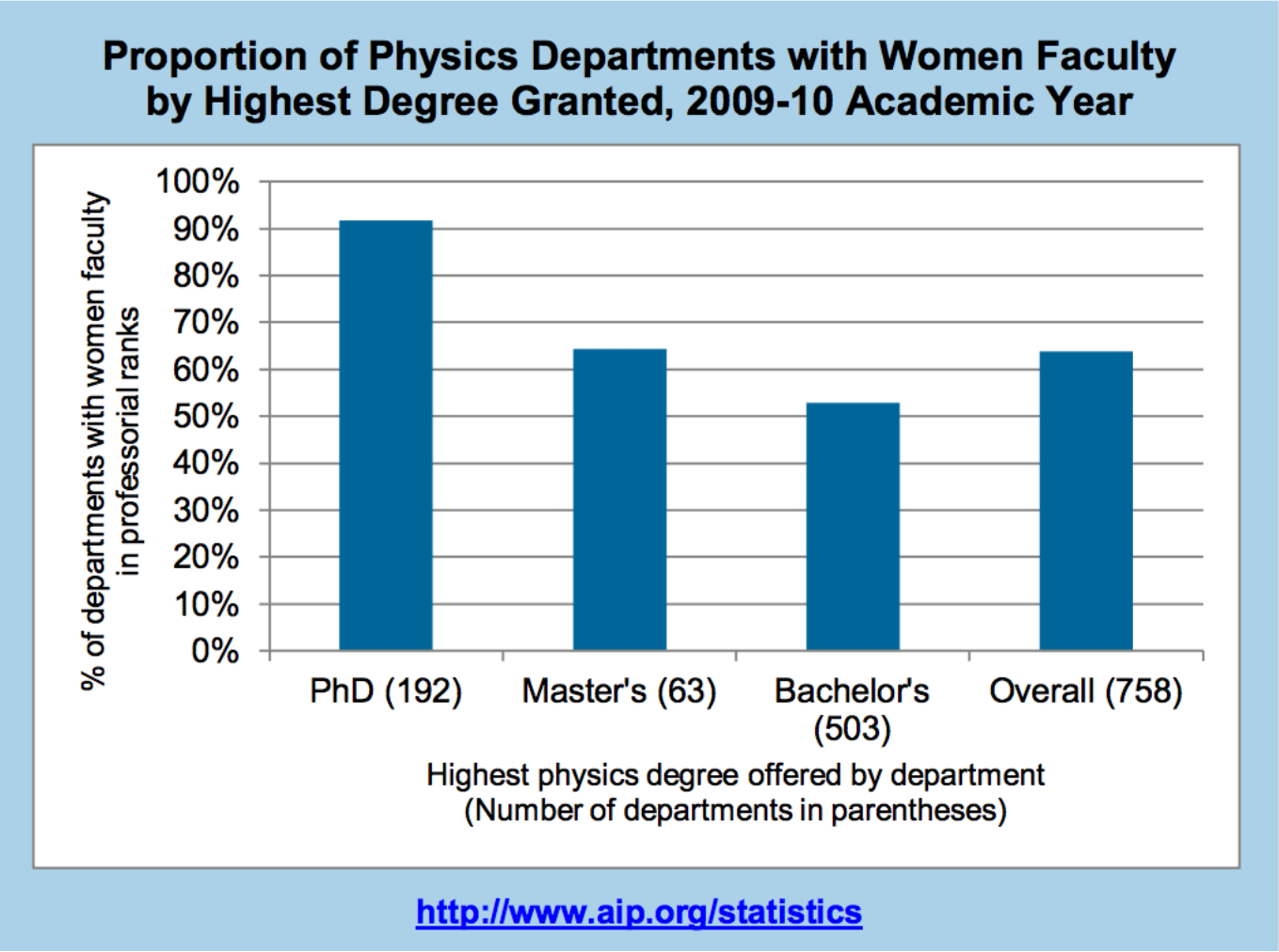


Women on Physics Faculties (%)

	1998	2002	2006	2010
Full Professor	3	5	6	8
Associate Prof	10	11	14	15
Assistant Prof	17	16	17	22
Instructor		16	19	21
other	13	15	12	18

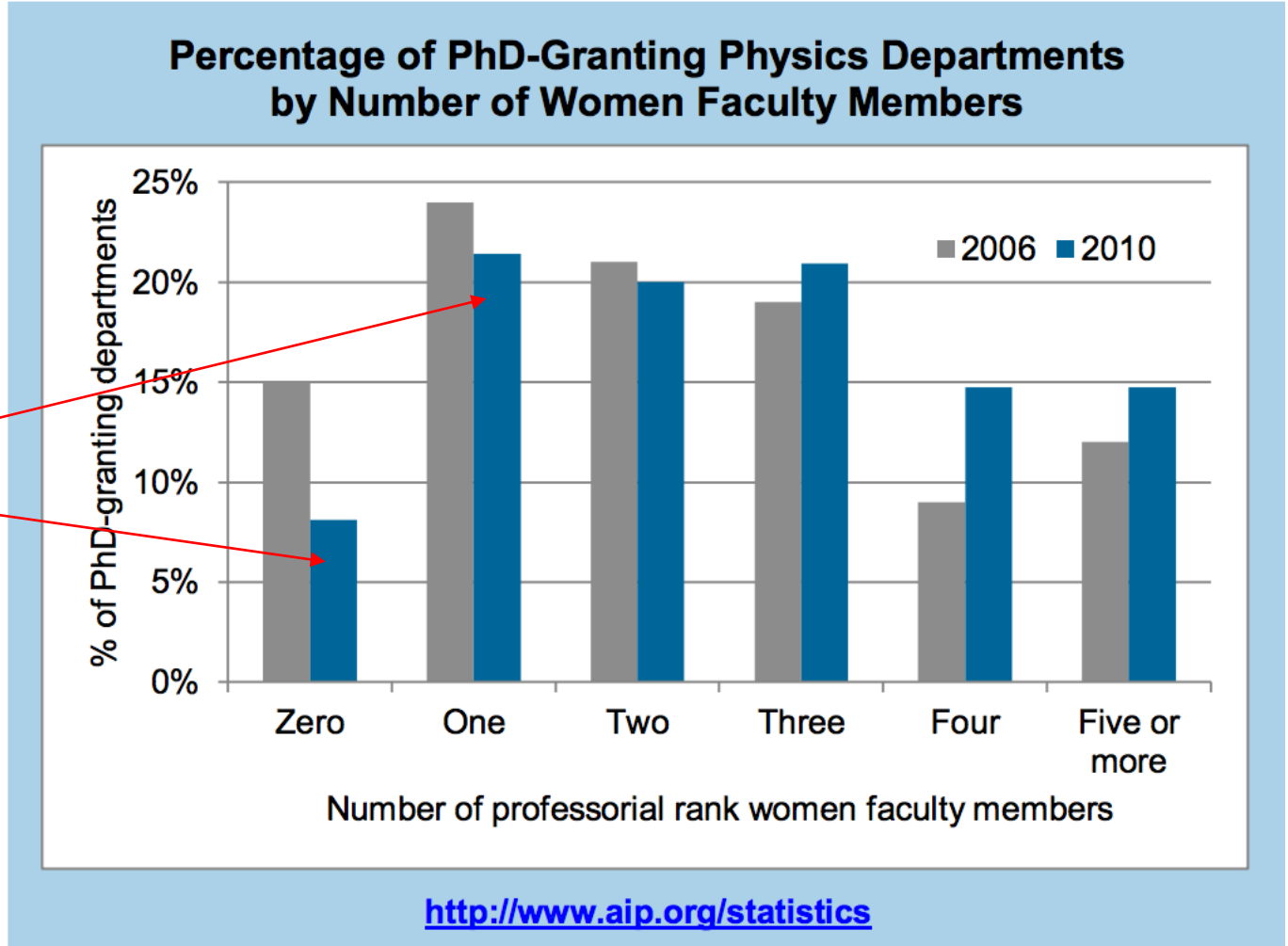
American Institute of Physics

One-third of physics departments have no women faculty



In PhD programs, women faculty are isolated

30% of PhD programs have one or zero women faculty

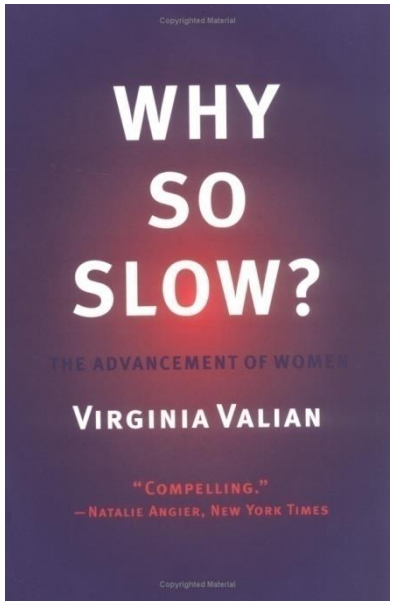


Women remain under-represented in physics

WHY?

- Unconscious bias
- The work environment
- Family issues
- The culture of physics

Implicit/Unconscious Bias



Virginia Valian describes how *gender schemas* impede women's progress

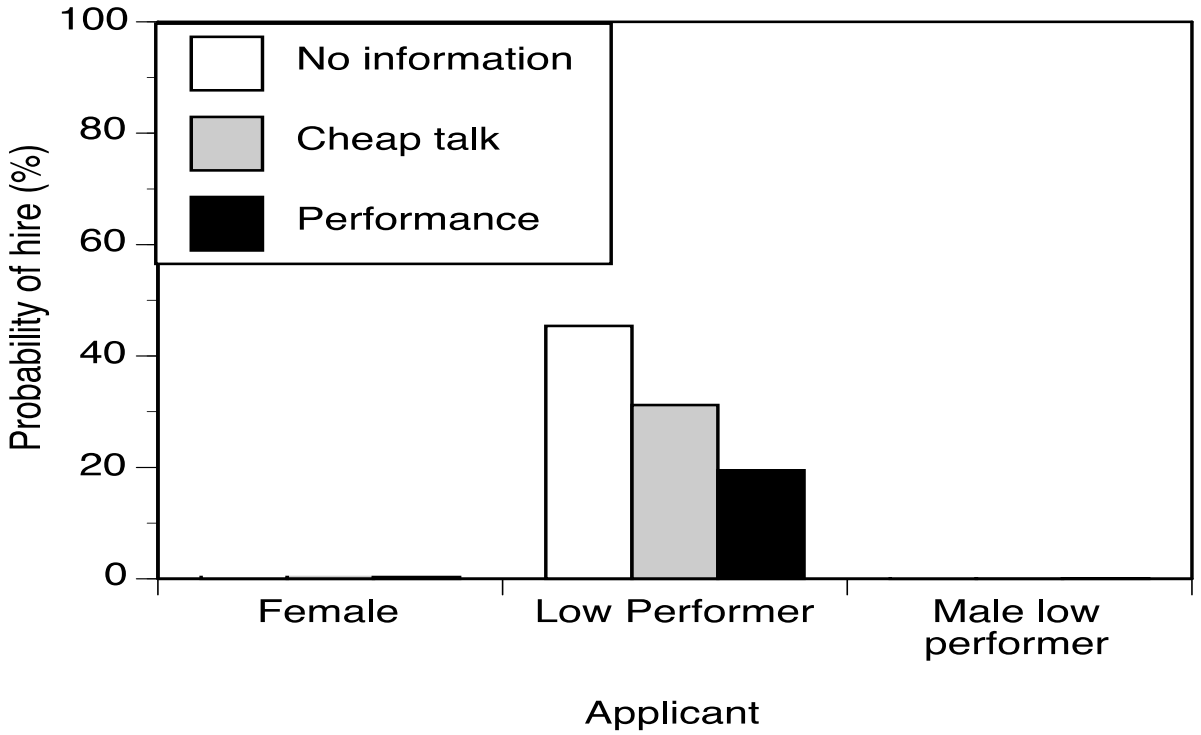
- Women are underestimated when in leadership positions
- Women's credentials are implicitly devalued
- Women face unconscious bias in competitions for fellowships, journal space, recognition by prestigious societies
- Microinequities repeated over time create major inequities

Don't believe it? Take a test at https://implicit.harvard.edu/implicit/

Hiring bias

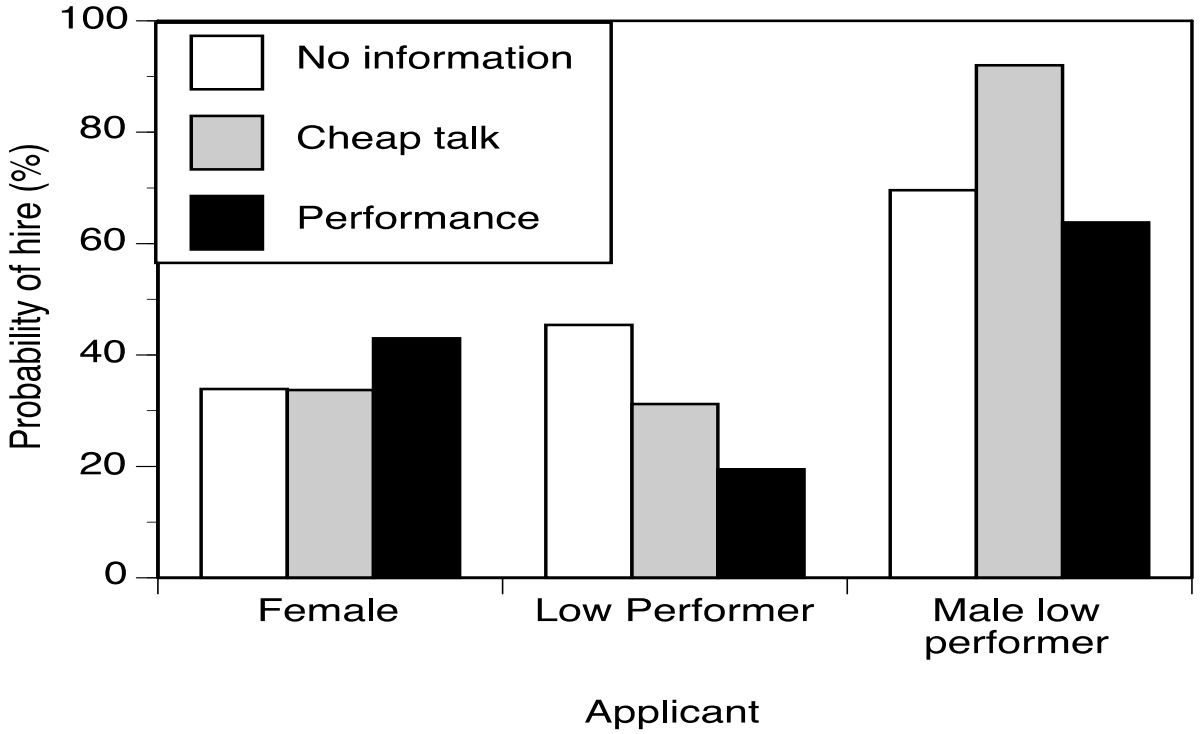
- Individuals asked to do a rote arithmetic test
- They then were separated into “employers” and “job candidates”
- Employers were given one of three kinds of information about candidates
  - 1) Appearance
  - 2) Performance on the arithmetic test
  - 3) Candidate self-assessment (“cheap talk”)

Hiring decisions



PNAS 2014

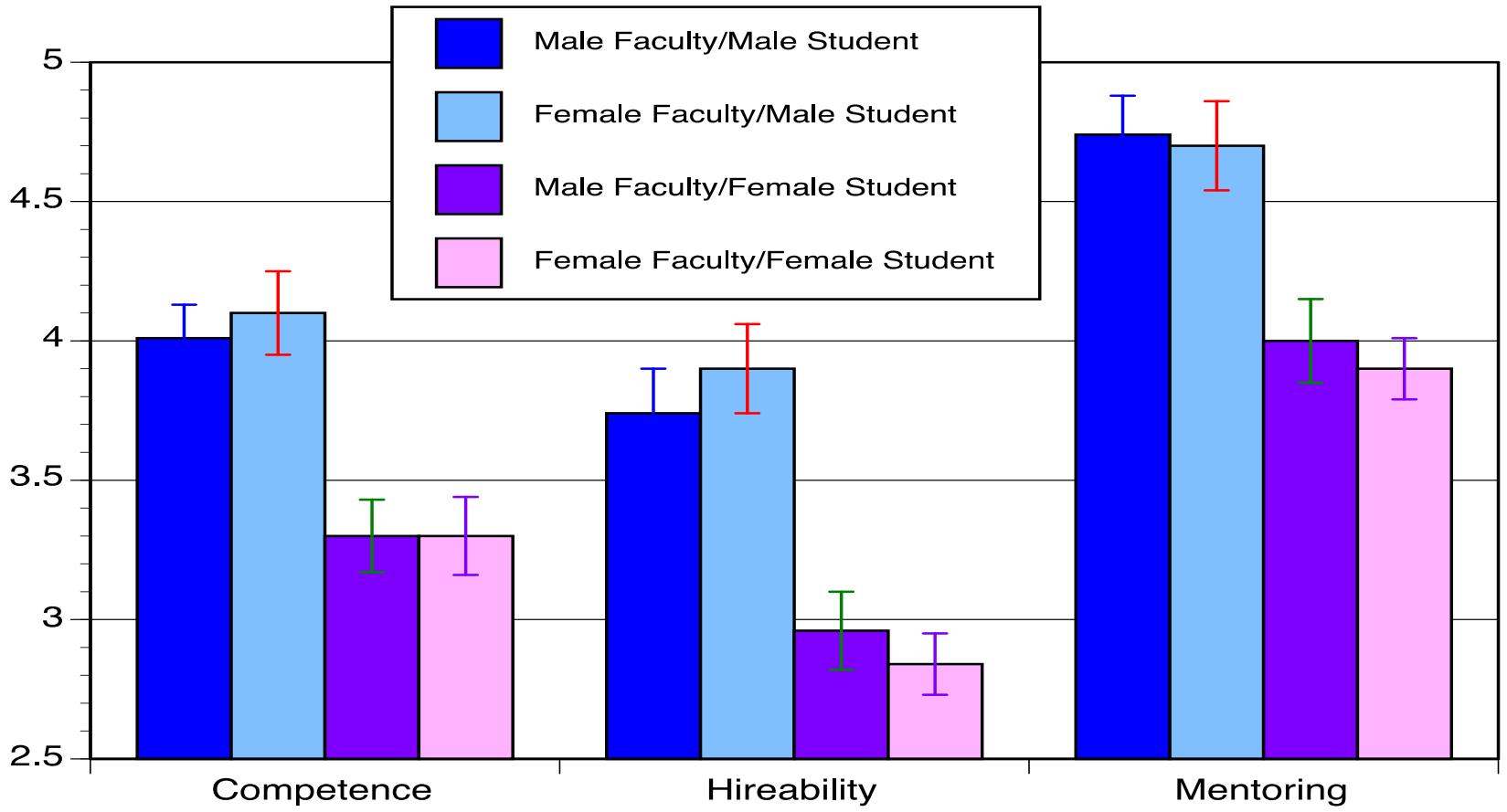
Hiring decisions

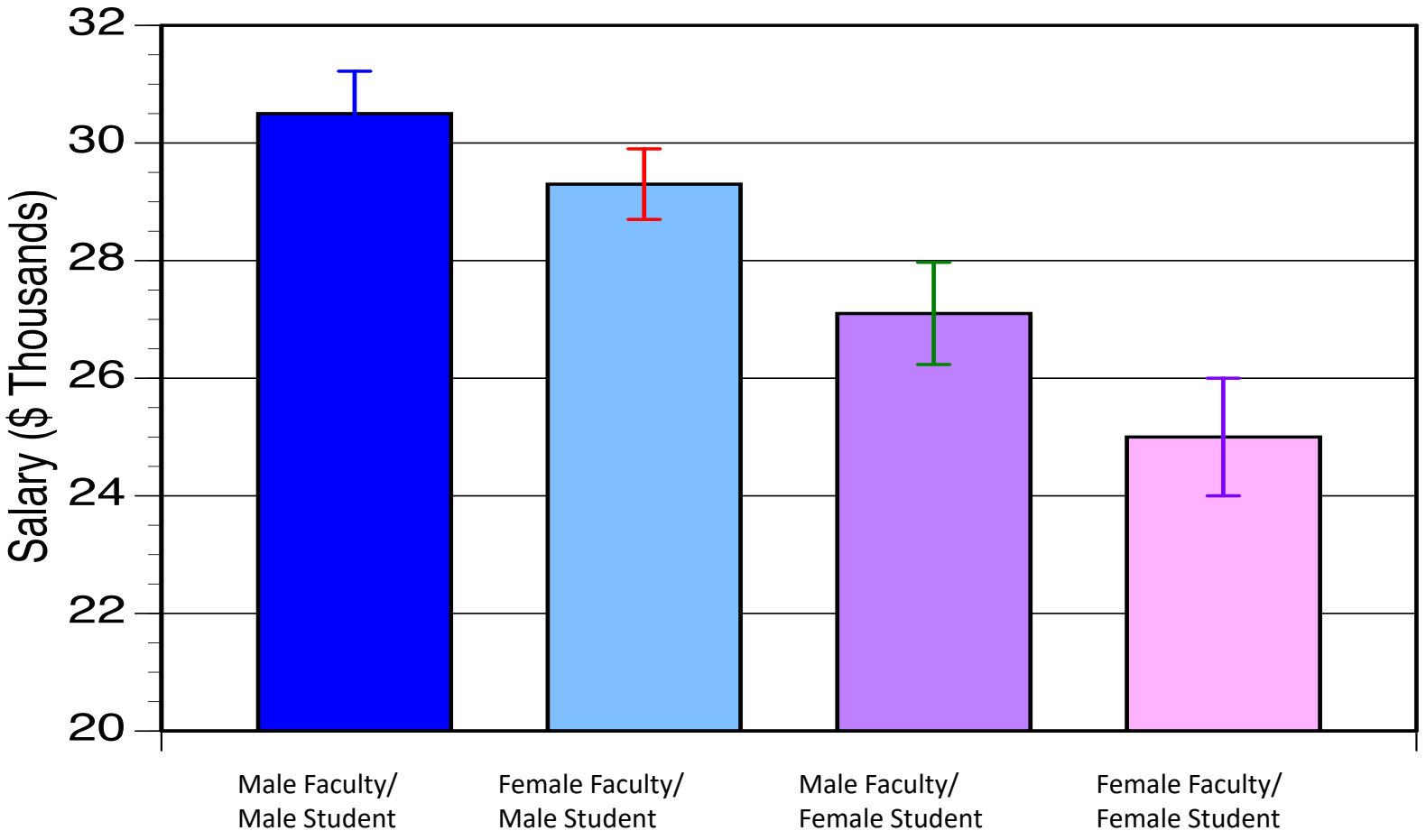


PNAS 2014

What about science faculty?

- 127 Biology, Chemistry, and Physics faculty at three public and three private research universities in the US
- Each was sent a resume for an undergrad interested in going to grad school and who applied for a technician job
- Faculty were asked to rate competency and hireability, to suggest starting salary and indicate how likely they would be to mentor such a student
- Half were named John and half were named Jennifer; otherwise the materials were identical


Male Faculty/Male Student
Female Faculty/Male Student
Male Faculty/Female Student
Female Faculty/Female Student
5
4.5
4
3.5
3
2.5
Competence
Hireability
Mentoring


Salary ($ Thousands)
32
30
28
26
24
22
20
Male Faculty/
Male Student
Female Faculty/
Male Student
Male Faculty/
Female Student
Female Faculty/
Female Student

Ben Barres
Professor of Neurobiology
Stanford University

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"Ben Barres gave a great seminar today, but his work is much better than his sister's work"

The study of implicit bias shows unequivocally:

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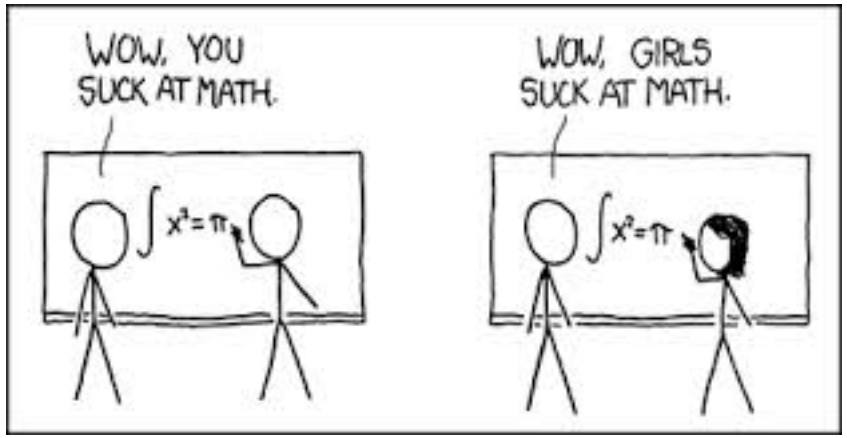
- We all have biases: if you are human, you are biased in some ways
- Biases can be surprising: both men and women unconsciously show gender bias against women
- Individuals who believe themselves to be unbiased are in fact *most likely* to display evidence of unconscious bias
- Simple interventions can counteract the strength of bias in decisions:
  - Having clear *a priori* criteria for hiring, promotion, advancement and not letting other criteria come in to play
  - Provide sufficient time for decisions: hasty decision-making breeds implicit bias
  - Talking about it during decision-making processes lessens its effects
  - You can prime yourself prior to entering situations where unconscious bias may affect your decisions

The work environment is different for men and women physicists

Tokenism: individuals from under-represented groups are viewed as representative of their entire group



What about resources and job assignments?

Here at OSU, we studied salaries, space, teaching assignments and service loads, as well as faculty satisfaction

- No gender differences in salary
- No gender differences in space
- Hints that women teach more of the larger lower-division classes
- Dossiers submitted for promotion to Professor show a distinct service gap: women faculty on average present 20% more service assignments than do men

- Sexual harassment: 2011 survey of graduate students in the APS
  - 25% had experience physical harassment and/or assault
  - 53% had experienced verbal or online harassment
  - Harassment came from colleagues and superiors alike
  - Yet only 8% reported being harassed or followed up with a complaint
  - 24% report feeling unsafe at work due to their gender

- Microinequities:
  - Women with feminine appearance are judged less competent
  - Women are 40x more likely to be told they are aggressive or abrasive
  - Questions are addressed to men when women are the experts
  - Etc etc etc

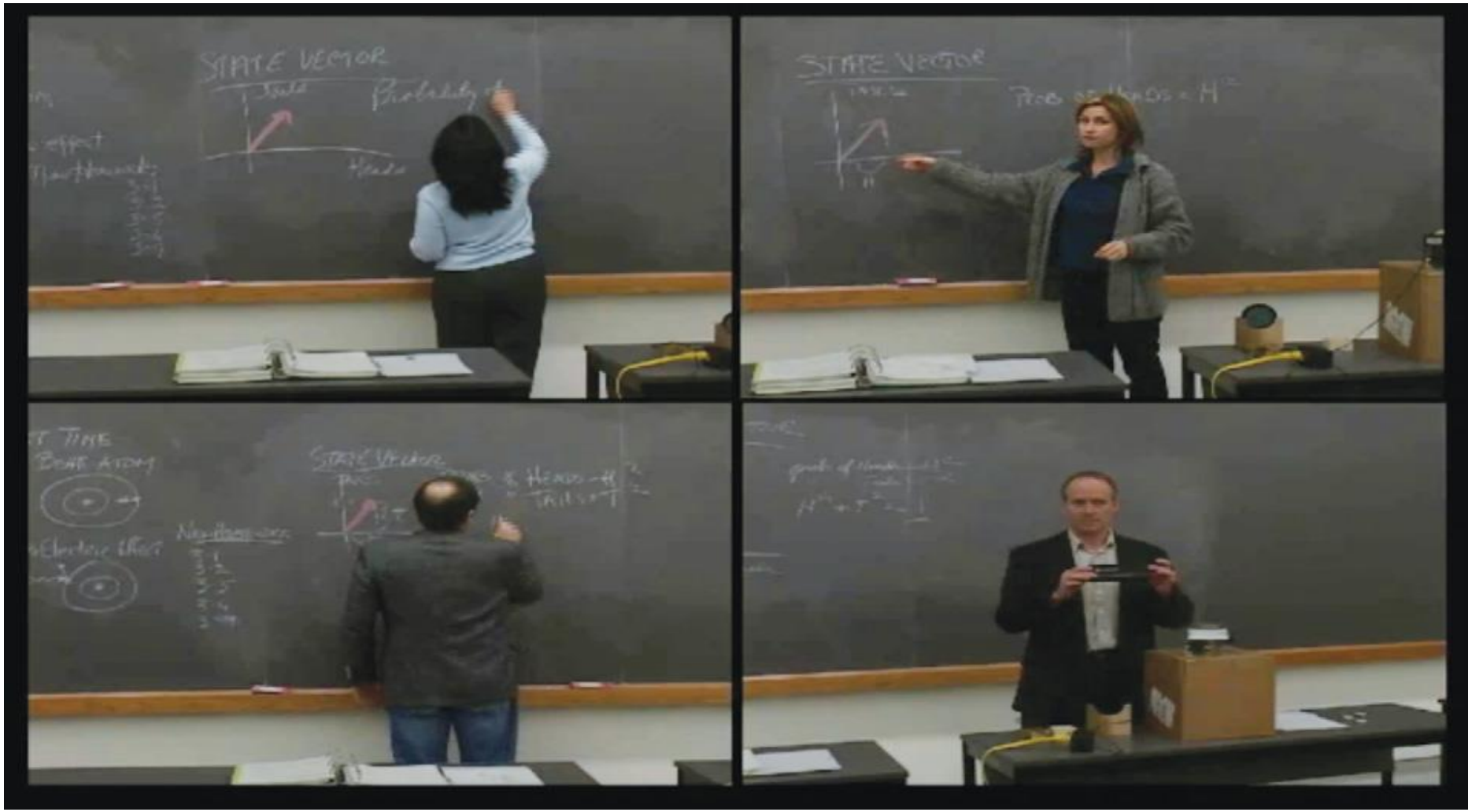
Interactions with students

A recent meta-analysis of student evaluations

- Two data sets:
  - 23001 evaluations of 379 instructors by 4423 students in six mandatory first-year courses
  - Four sections of an online course
  - Compared evaluations with learning outcomes
- Gender bias among students affects how they evaluate instructors, even on objective criteria such as how quickly exams are returned or whether class starts on time
- In all cases female instructors received lower evaluations
- Even when students learned less from male instructors, they rated them more highly

Stark et al. 2016. *Science Open Research*

And this experiment from a Swarthmore physicist



Student Responses

- Male students overwhelmingly rated male actors as better teachers
- Female students rated teachers of both genders the same
- Questions about knowledge/equipment use showed male actors better rated by both male and female students
- Questions about approachability /well-organized: female students rated female actors more highly and male students rated male actors more highly

Amy Bug, *Physics World*, August 2010, pp 16-17

And use of words in student evaluations differ

- Benschmidt.org/Profgender analyzed more than 14 million reviews on *Ratemyprofessor.com*
- Searchable database shows use of particular words as a function of discipline and instructor gender

Negotiation, imposter syndrome, stereotype threat, mindset….

- There is a hefty literature on these subjects that treat gender as a variable
- For all these psycho-social effects, women are disadvantaged relative to men: they are axes of male privilege
- Intersectionality studies show that women of color, LGBT women, and women with disabilities are further disadvantaged
- Even so, relatively few of these studies break out science disciplines

Men and women faculty have different home lives

Family life for scientists and engineers

Women and men STEM faculty have very different family situations:

	Men	Women
Married with children	70%	44%
Married without children	15%	19%
Single without children	11%	26%
Single with children	4%	19%

Married STEM faculty have very different home situations:

	Men	Women
Spouse works full-time	45%	89%
Spouse works part-time	20%	5%
Spouse not employed	35%	6%
Spouse is also a scientist	48%	78%

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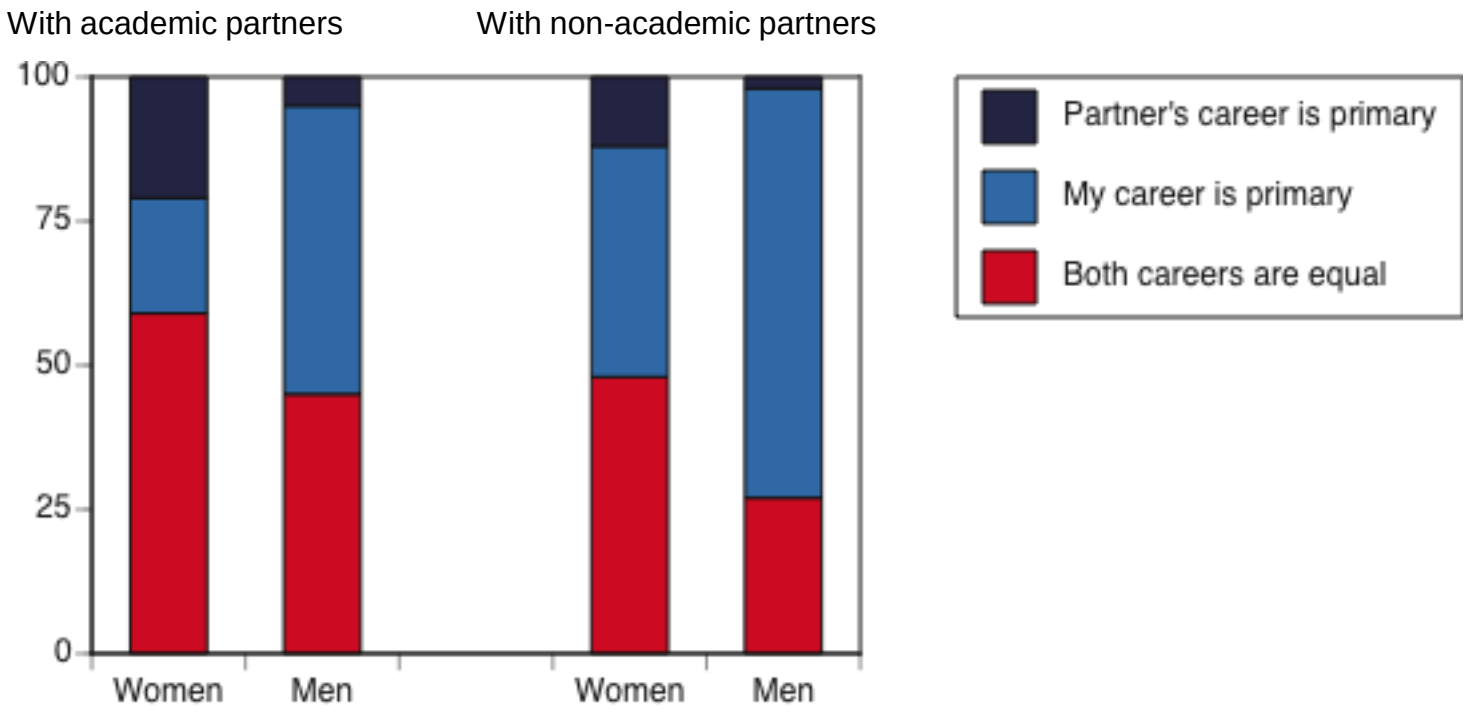
In physics this is over 90%

Academic men and women differ in their attitudes towards their employed partners



Dual-Career Academic Couples: What Universities Need to Know, Stanford University, Michelle R. Clayman Institute for Gender Research, August 2008

Women physicists have less discretionary time

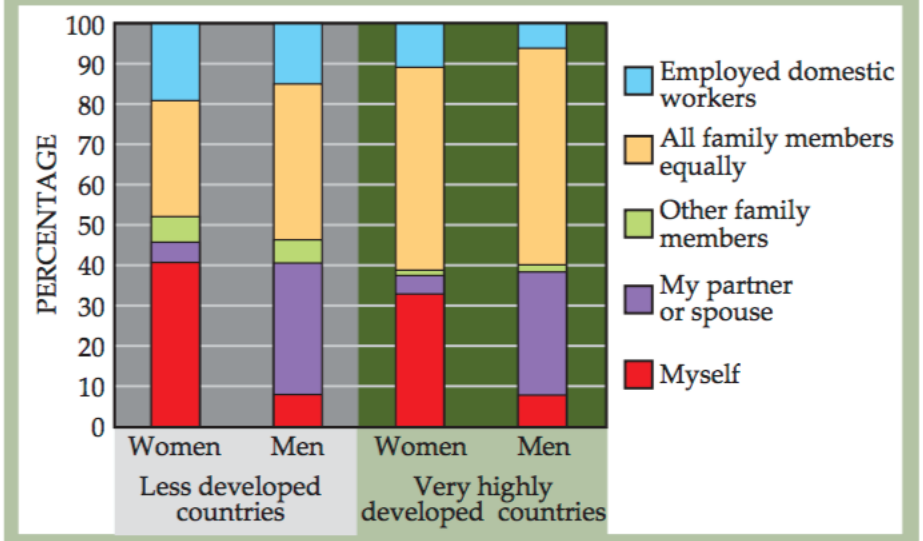


Figure 1. The majority of housework is more likely to be done by women than by men. The results shown here were derived from the responses to a global survey conducted by the American Institute of Physics and filled out by almost 15 000 physicists. To generate this graph we disregarded the responses of those physicists whose spouse or partner was not employed. The disproportionate burden of housework on women holds independent of level of development of the respondent's country.

Ivie & Tesfaye, *Physics Today (2012)*

The maternal wall

Academic mothers have different patterns of employment, have less career success, and take longer to achieve benchmarks than fathers and childless women (Mason, Wolfinger and Goulden, *Do Babies Matter?)*

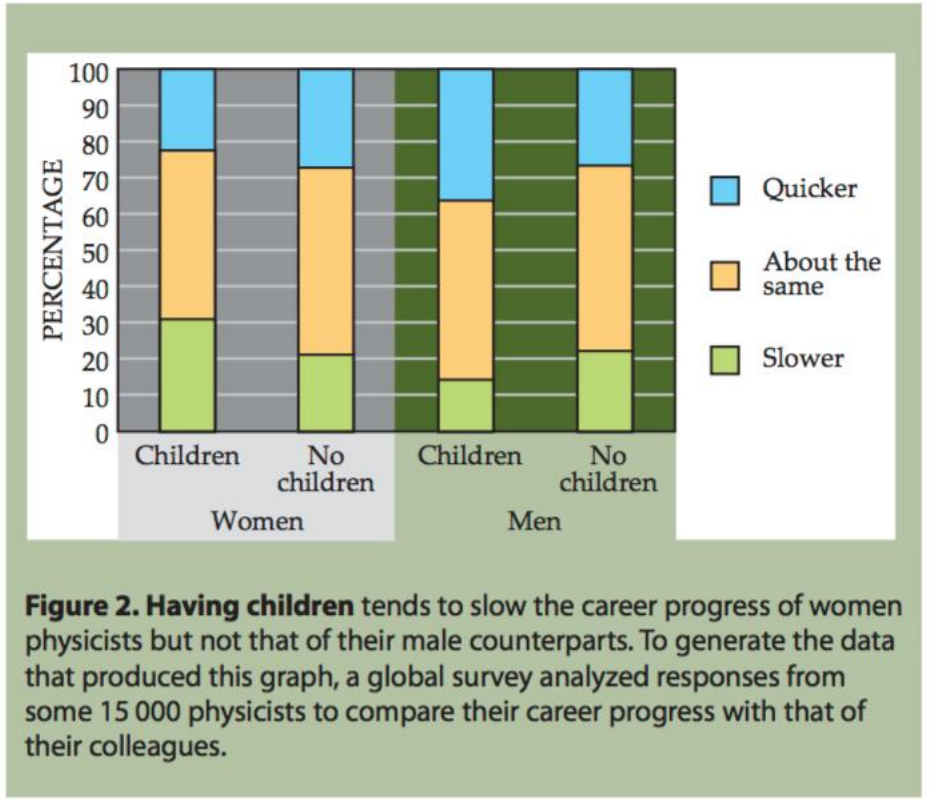
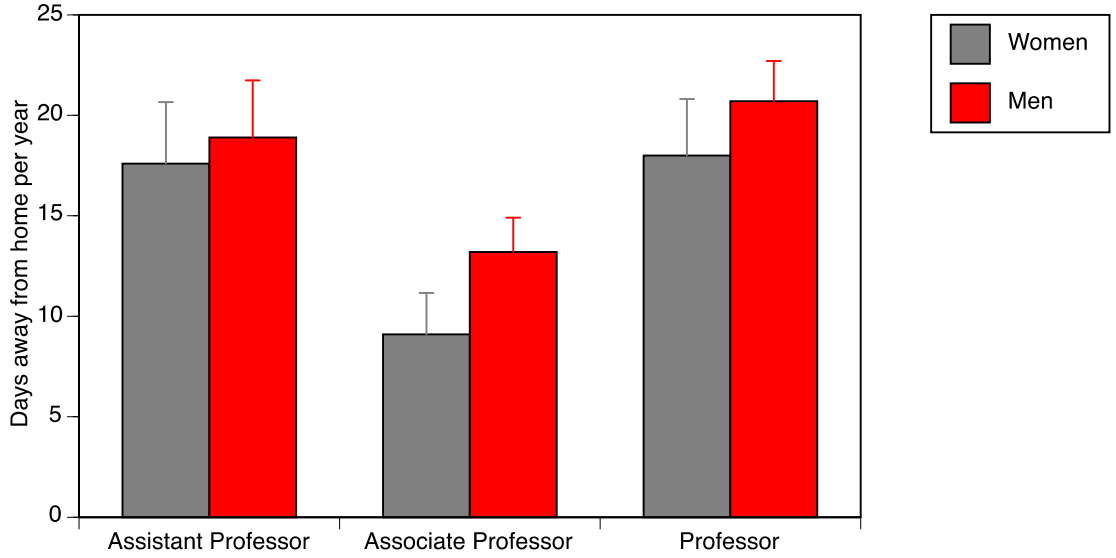


Figure 2. Having children tends to slow the career progress of women physicists but not that of their male counterparts. To generate the data that produced this graph, a global survey analyzed responses from some 15 000 physicists to compare their career progress with that of their colleagues.

Ivie & Tesfaye, *Physics Today (2012)*

The critical role of professional societies

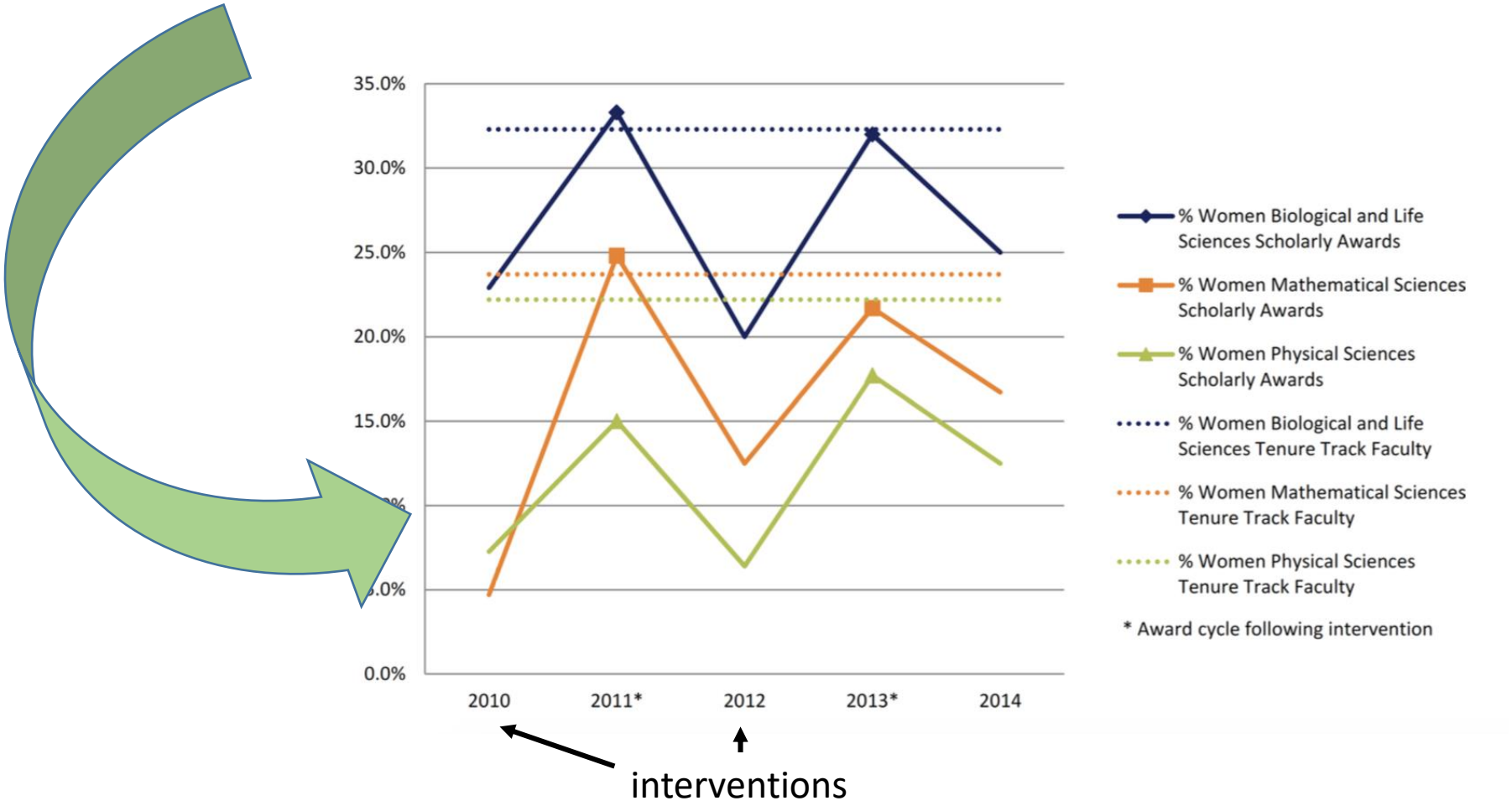
- Societies mount conferences
  - Symposium and panel presentations signal perceived expertise
  - Key networking events promote research collaborations
  - Travel to such conferences is difficult for scientists with family constraints: travel data for NMS faculty at Ohio State



The critical role of professional societies

- Societies give awards
  - The Association for Women in Science (AWIS) worked with 15 professional societies, including the APS and AAS
  - Two workshops offered, in 2010 and in 2012
  - Society leaders were trained on implicit bias and shown the data for their awards programs that universally showed women under-represented for scholarly awards and over-represented for teaching and service awards
  - Each society developed an action plan to mitigate the effects of unconscious bias

Awards programs in physics and astronomy



Metcalf H. CBE Life Science Education. 2016

Best practices: Project Juno (UK)

The Institute of Physics recognizes five principles

1. A robust organizational framework to deliver equality of opportunity and reward
2. Appointment and selection processes and procedures that encourage men and women to apply for academic posts at all levels
3. Department structures and systems which support and encourage the career progression and promotion of all staff and enable men and women to progress and continue in their careers
4. Departmental organization, structure, management arrangements and culture that are open, inclusive and transparent and encourage the participation of all staff
5. Flexible approaches and provision that enable individuals, at all career and life stages, to optimize their contribution to their department, institution and SET

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16 Juno champions have demonstrated all 5

14 Juno practitioners have embarked on an approved action plan

19 Juno supporters have endorsed the principles and are committed to develop an action plan

Why has physics been so slow to change demographics relative to other natural sciences?

- It cannot be about inherent difficulty: there are more women in astronomy, astrophysics and pure math
- The **field-specific abilities hypothesis** derives from Dweck's work on mindset

Field-specific abilities hypothesis

- 1820 Faculty, postdocs, and grad students from 30 disciplines were surveyed
- Respondents were asked about
  - how many hours they worked
  - how selective their graduate programs were
  - The importance of thinking systematically versus intuitively/emotionally
  - agreement with statements such as “being a top scholar in my disciplines requires abilities that just cannot be taught”
- Data were evaluated via multiple regression with the % of women among PhDs as the primary dependent variable; average GRE scores and other measures of ability were included as covariates

Field-specific abilities hypothesis:

The *only* variable that explained women's participation across fields was beliefs about abilities

It explained patterns of gender disparity across both STEM and humanities/social science disciplines

Field-specific beliefs also explained representation of African-Americans

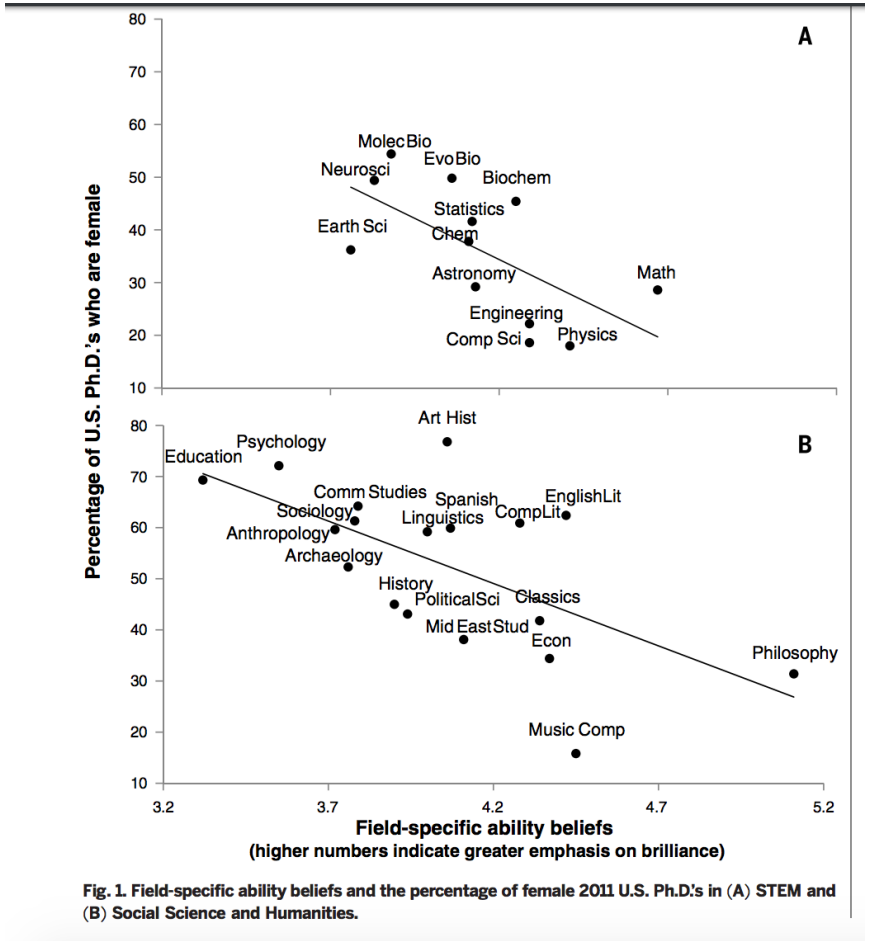


Fig. 1. Field-specific ability beliefs and the percentage of female 2011 U.S. Ph.D.'s in (A) STEM and (B) Social Science and Humanities.

Leslie et al. 2015. *Science* 347:262

The culture of physics reinforces male privilege

Sexual harrassment in Astronomy

- Geoff Marcy, UC-Berkeley resigned after allegations
- Timothy Slater left Arizona under a cloud and is now at Wyoming; he does not deny allegations of sexual misconduct at Arizona
- Cal Tech suspended Christian Ott for harassment
- American Astronomical Society survey
  - 89% heard sexist remarks from peers
  - 44% heard sexist remarks from supervisers
  - 9% reported sexual harrassment

American Physical Society is proactive in assessing culture

- Committee on Women in Physics
  - Any department can request a site visit, which focuses on issues of gender
  - Since 1990 68 institutions have had Site Visits (5 more than once)
  - They give self-reported data on “women-friendliness” of departments for 154 institutions
  - A committee reported on promoting LGBT inclusivity in March 2016
- However, there do not appear to be broad survey data (other than the grad student survey)

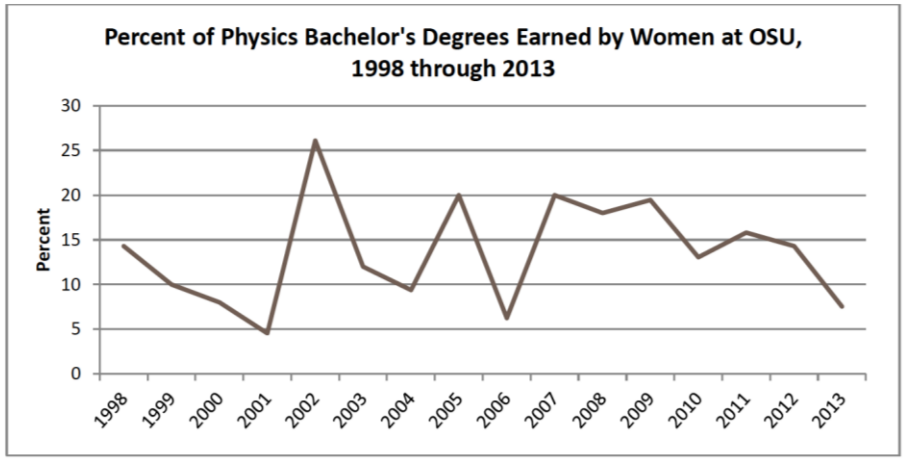
Physics at Ohio State

- Has had two site visits from the APS
- Hosted the Women in Physics conference last spring, which is demonstrably effective in improving the representation of women
- Supports student groups
- Hosts a long summer camp for middle-school girls
- Has a gender-specific scholarship

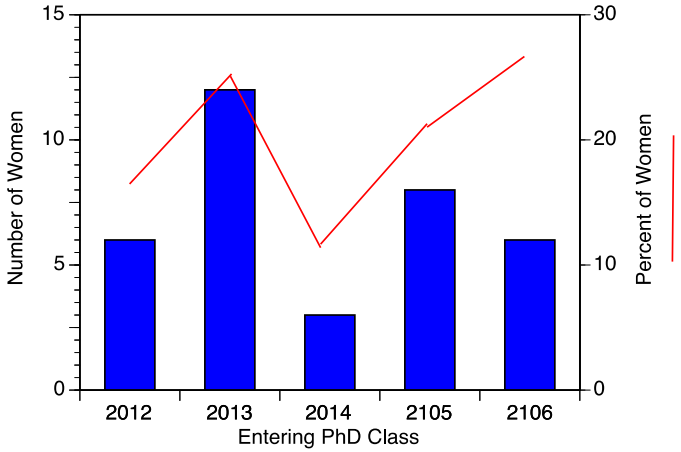
Physics at Ohio State

- Undergrad enrollments

Graduating Students



- Incoming Graduate Students



Summary

- Women in physics share many of the same challenges as others in STEM
- However, their numbers remain stubbornly lower than other physical sciences and some branches of engineering: physics has not yet reached the tipping point
- The culture of physics discourages women from full participation
- Cultural change in physics is being pushed by professional organizations but must pervade academic departments