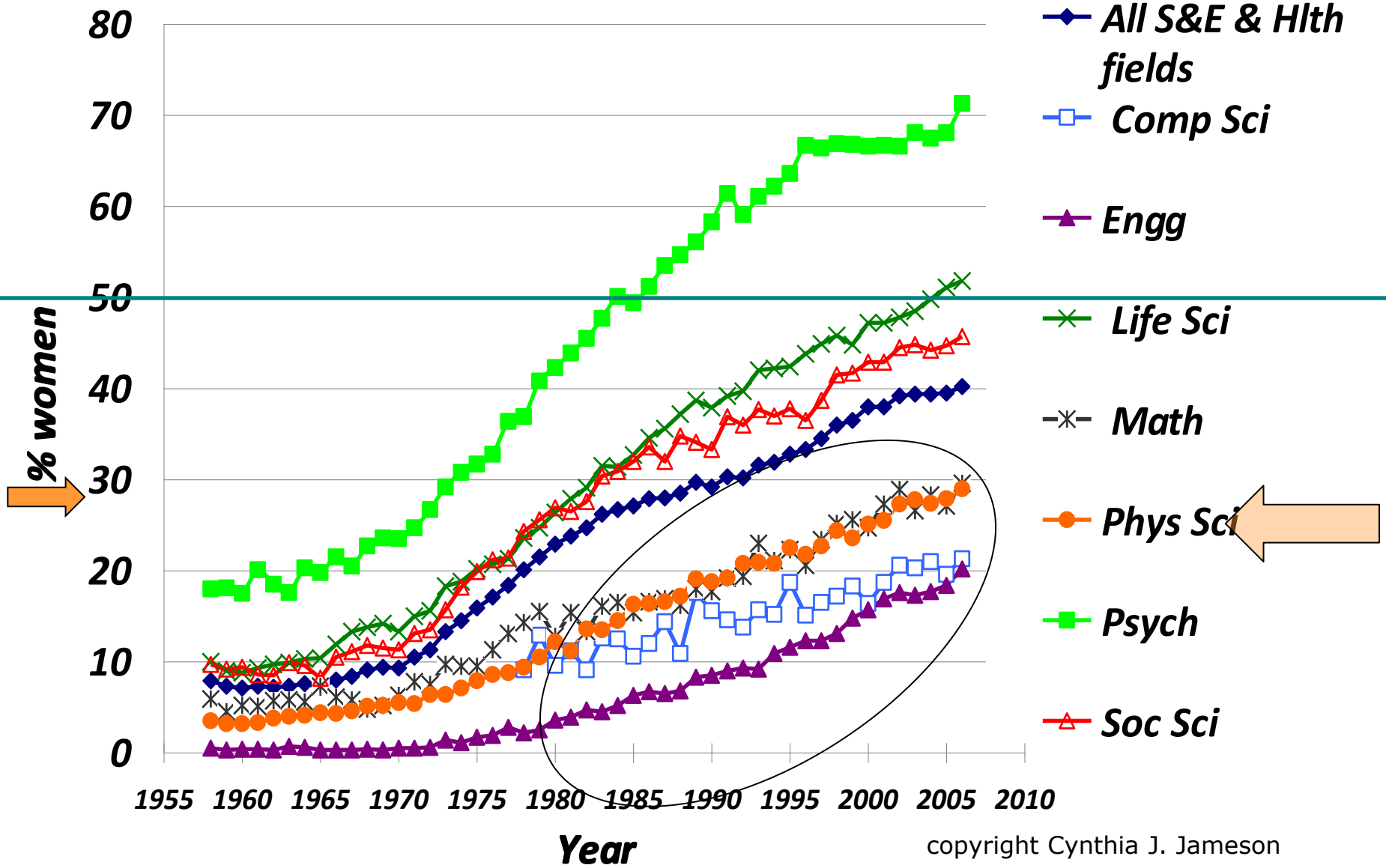
Why So Few?

Data & Research

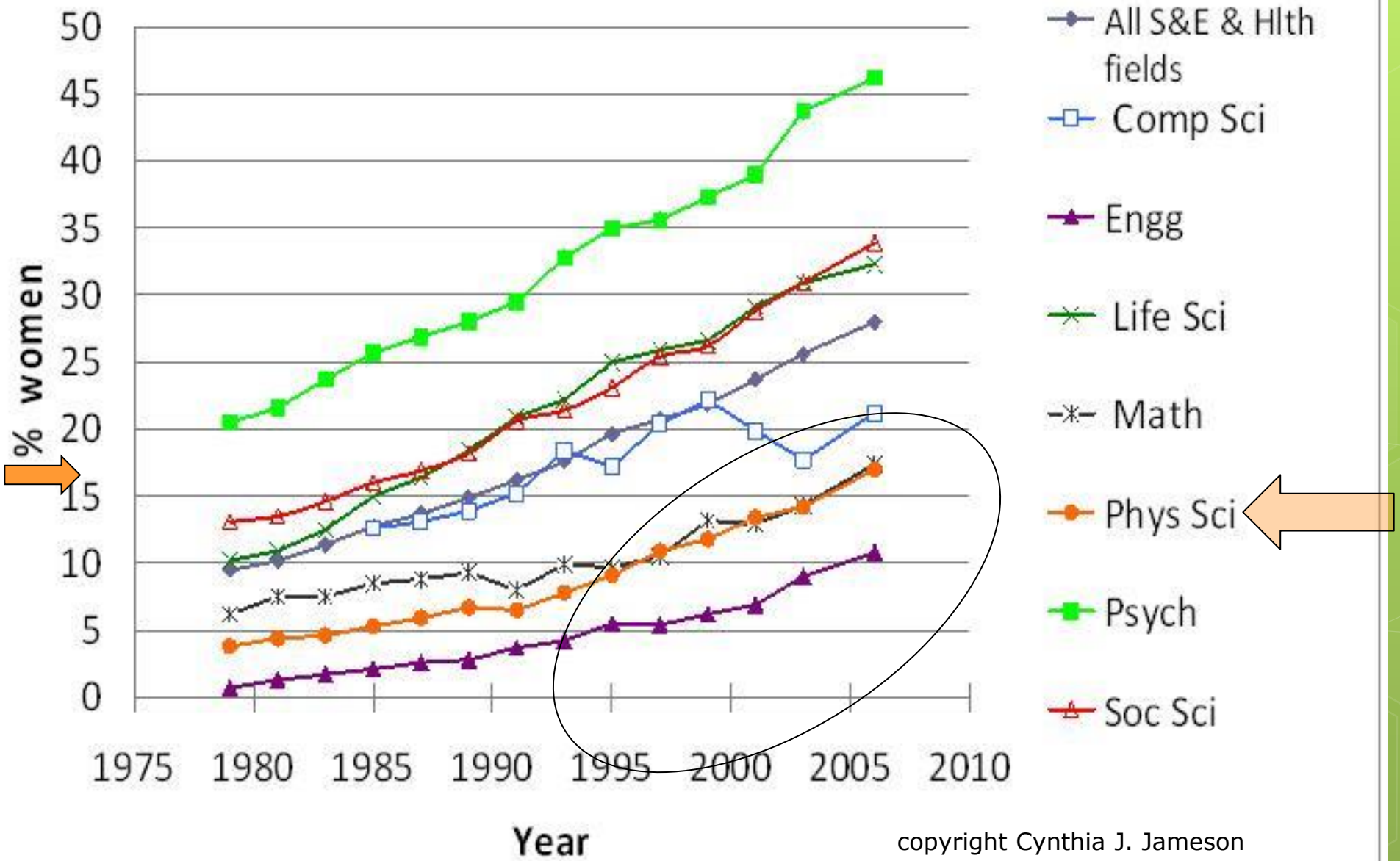
NSF DATA

from Table 1&5 NSF report 08-308, “33 years of women in S&E faculty positions”

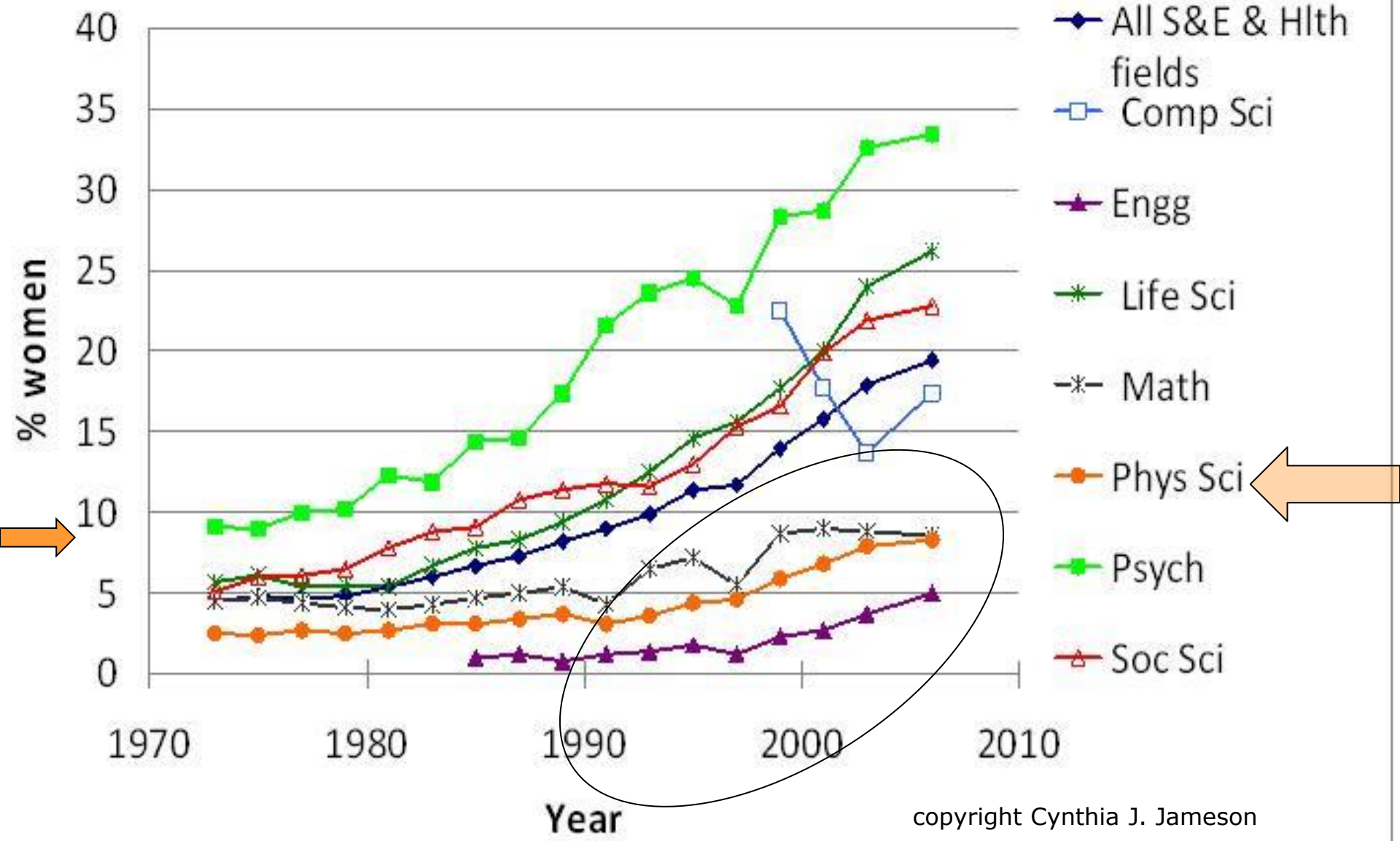
Women as a percentage of science, engineering, and health doctoral degrees awarded, by field of doctorate



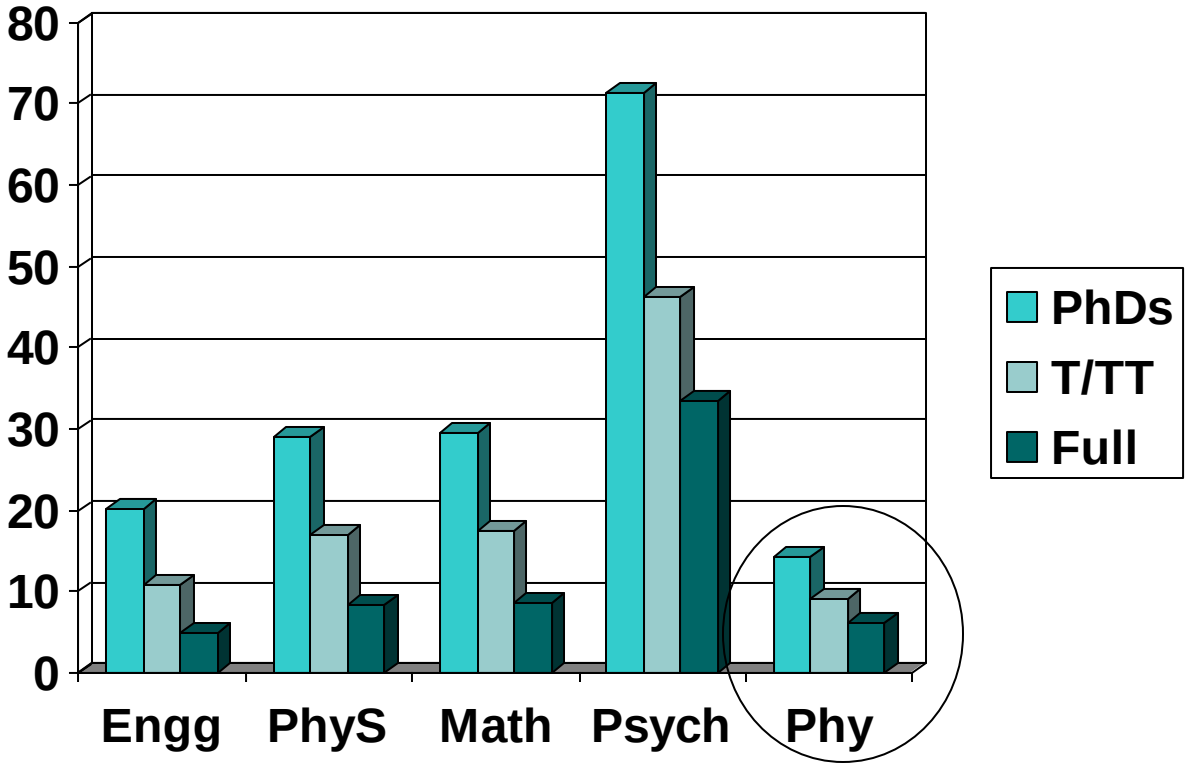
Women as a percentage of full-time tenured/tenure-track faculty, by field of doctorate



Women as a percentage of full-time full professors by field of doctorate



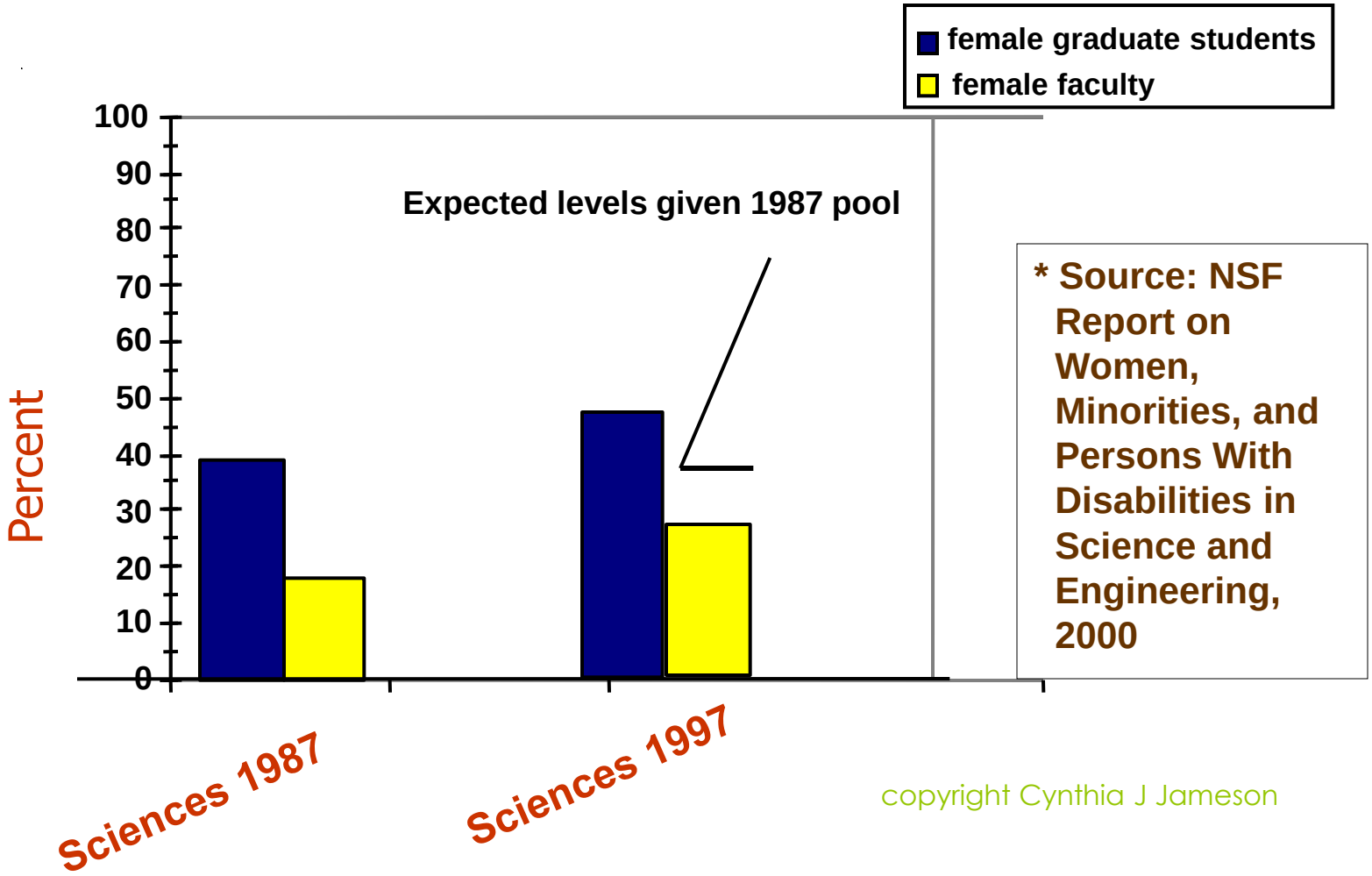
% Women (NSF Data 2006)



from Table 1&5 NSF report 08-308, "33 years of women in S&E faculty positions"

Physics data from D. Nelson 2007 depts 1-100

National Percentages of Female Graduate Students and Faculty in Science: 1987 and 1997*



* Source: NSF Report on Women, Minorities, and Persons With Disabilities in Science and Engineering, 2000

Gender Schemas Lack of Critical Mass Cumulative Bias

What the research shows us….

- Unconscious gender-based assumptions and stereotypes are deeply embedded in the patterns of thinking of both men and women
- Women and work performed by women consistently receive lower evaluations than men and work performed by men (by both men and women evaluators)
- These cumulative disadvantages impede women's progress toward full participation in academia

Valian, 1998, *Why So Slow? The Advancement of Women*, MIT

Perception

Discrimination is only practiced by a small set of ignorant people.

Research shows that everyone — whether male or female — perceives and treats women differently from men.

Valian, 1998, *Why So Slow? The Advancement of Women*, MIT

Perception

Since many of the problems encountered by female faculty are minor, this emphasis on remedies to improve the climate is an over-reaction.

Over time, small disadvantages accumulate into significant ones that have large impacts on career success and satisfaction.

Valian, 1998, *Why So Slow? The Advancement of Women*, MIT

Lack of critical mass

- If women are more than 30% of the applicant pool they are judged more positively than if they are 25% or less of the pool

- When women make up more than a third of a work group they are judged more positively

Heilman & Stopeck (1985) *Journal of Applied Psychology*, 70, 379-388;

Heilman (1980) *Organizational Behavior & Human Performance,* 26, 386-395

What are Gender Schemas?

- Non-conscious hypotheses about sex differences that guide everyone's perceptions and behaviors
- Expectations or stereotypes that define "average" members of a group
  - Men are instrumental, task-oriented, competent
  - Women are nurturing, emotional, and care about relationships
- Schemas are necessary
- Both men and women have the same schemas

Valian, 1998, *Why So Slow? The Advancement of Women*, MIT

Gender and Behavior

DESCRIPTIVE: How men and women actually behave

PRESCRIPTIVE: Subconscious assumptions about the way men and women "ought" to behave:

- Women: Nurturing, communal, nice, supportive, helpful, sympathetic
- Men: Decisive, inventive, strong, forceful, independent

RELEVANT POINTS:

- Leaders: Decisive, inventive, strong, independent
- Social penalties for violating prescriptive gender assumptions

Overestimating height

- College students were shown photos of other students and asked to estimate their height
- Photos contained a reference such as desk or door
- Photos were matched so that for every photo of a male of a given height there was a female of the same height
- Both male and female judges underestimated women's height and overestimated men's height

Biernat, Manis, & Nelson (1991) *Journal of Personality and Social Psychology,* 66, 5-20.

Leadership cues and schemas

- Observers shown a slide of 5 people seated at a table. Reliably pick the person sitting at the head of the table as the leader when:
  - All the participants are male
  - All the participants are female
  - The group has a mixed sex composition and the person at the head of the table is male

- But with a mixed sex group at the table and the person at the head female
  - Observers choose her as leader half the time and a male seated on either side of the table half the time

Porter & Geis (1981), *Gender and nonverbal behavior.*

Evaluation and gender bias

- "Blind" auditions can explain 30 to 55% of the increase in women winning orchestral jobs (Goldin & Rouse (2000) *The American Economic Review*, 90, 715-741)

- University psychology professors prefer 2:1 to hire "Brian" over "Karen", even when the application packages are identical
  (Steinpreis, Anders & Ritzke (1999) *Sex Roles*, 41, 509)

- Women applying for a postdoctoral fellowship had to be 2.5 times more productive to receive the same competence score as the average male applicant (Wenneras & Wold, (1997) *Nature*, 387, 341)

Swedish Postdoc study

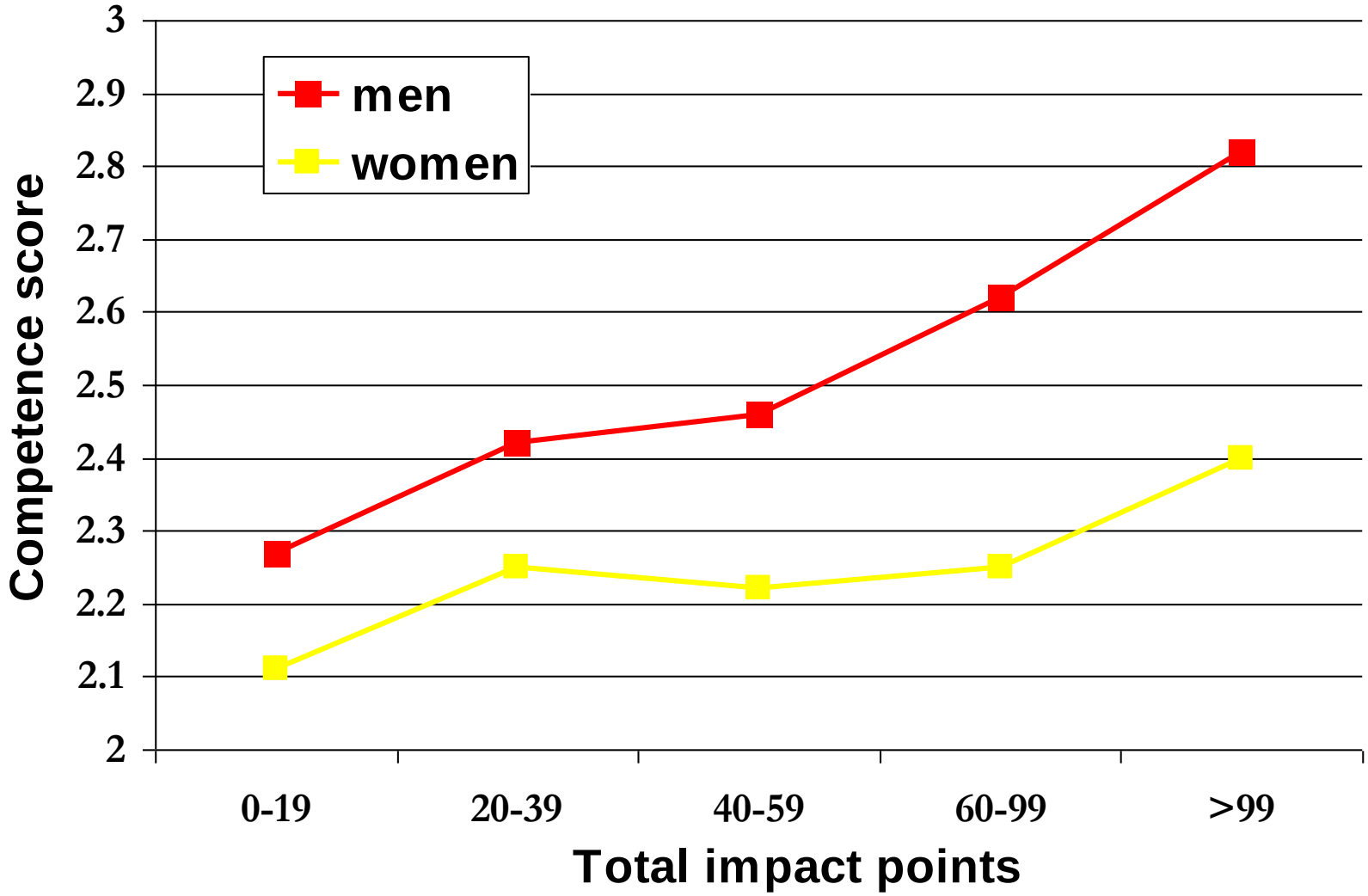
Wenneras and Wold, Nature, 1997

- 114 applications for prestigious research postdocs to Swedish MRC (52 women)
- Judged applications by "competence score"
- Vast majority went to men

Study:

- Standardized metric developed based on publication record = impact points

Wenneras and Wold, Nature, 1997



Swedish Postdoc study

Wenneras and Wold, Nature, 1997

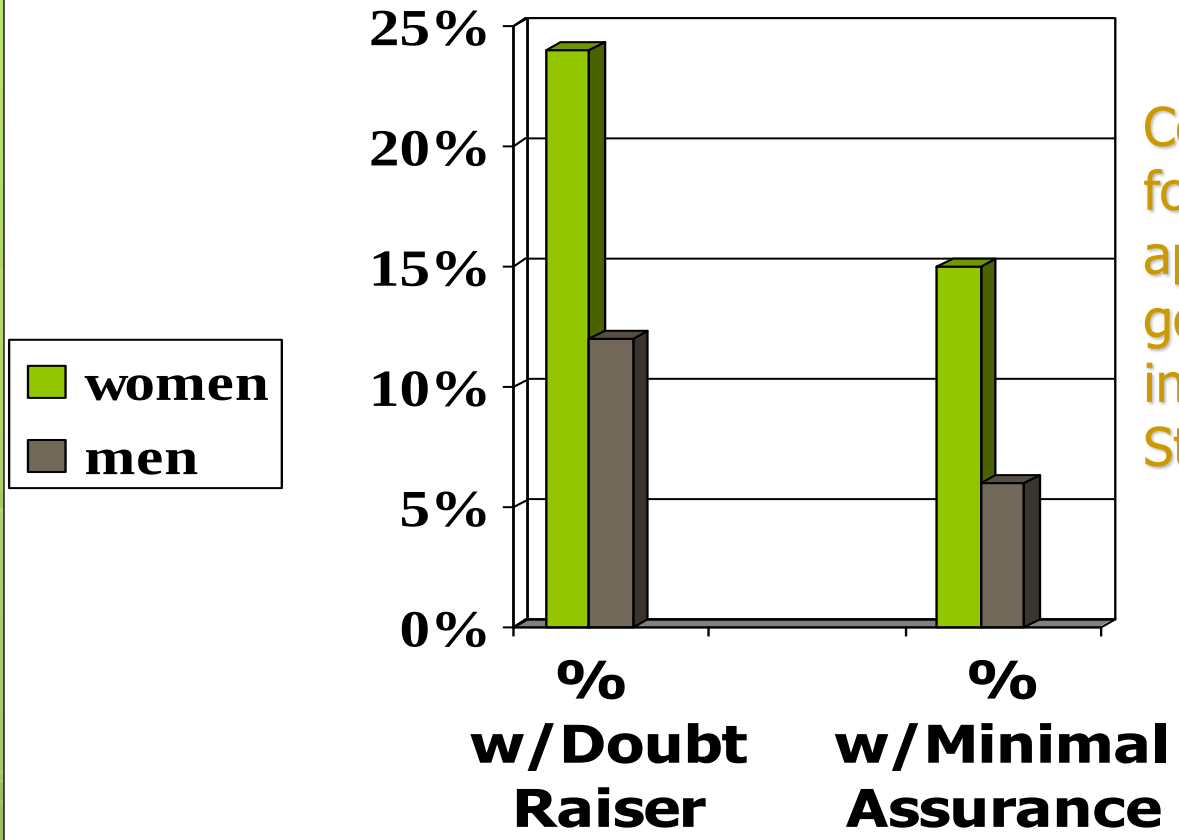
- With the same number of impact points (based on pubs, citations), women were consistently scored lower by the judges, especially in "competence"
- Women had to be 2.5x as productive as men to get the same score
- To even the score, women needed equivalent of 3 extra papers in a prestigious journal like Science or Nature

Letters of Recommendation

- 312 letters of recommendation for faculty hired at large U.S. medical school
- Letters for women vs men:
  - Shorter
  - 15% vs 6% of *minimal assurance*
  - 10% vs 5% with *gender terms* (e.g. "intelligent young lady"; "insightful woman")
  - 24% vs 12% *doubt raisers*
  - *Stereotypic adjectives*: "Compassionate", "related well…" vs "successful", "accomplished"
  - 34% vs 23% *grindstone adjectives*
  - Fewer *standout adjectives* ("outstanding" "excellent")

Trix and Psenka, Discourse & Soc 14:191 2003

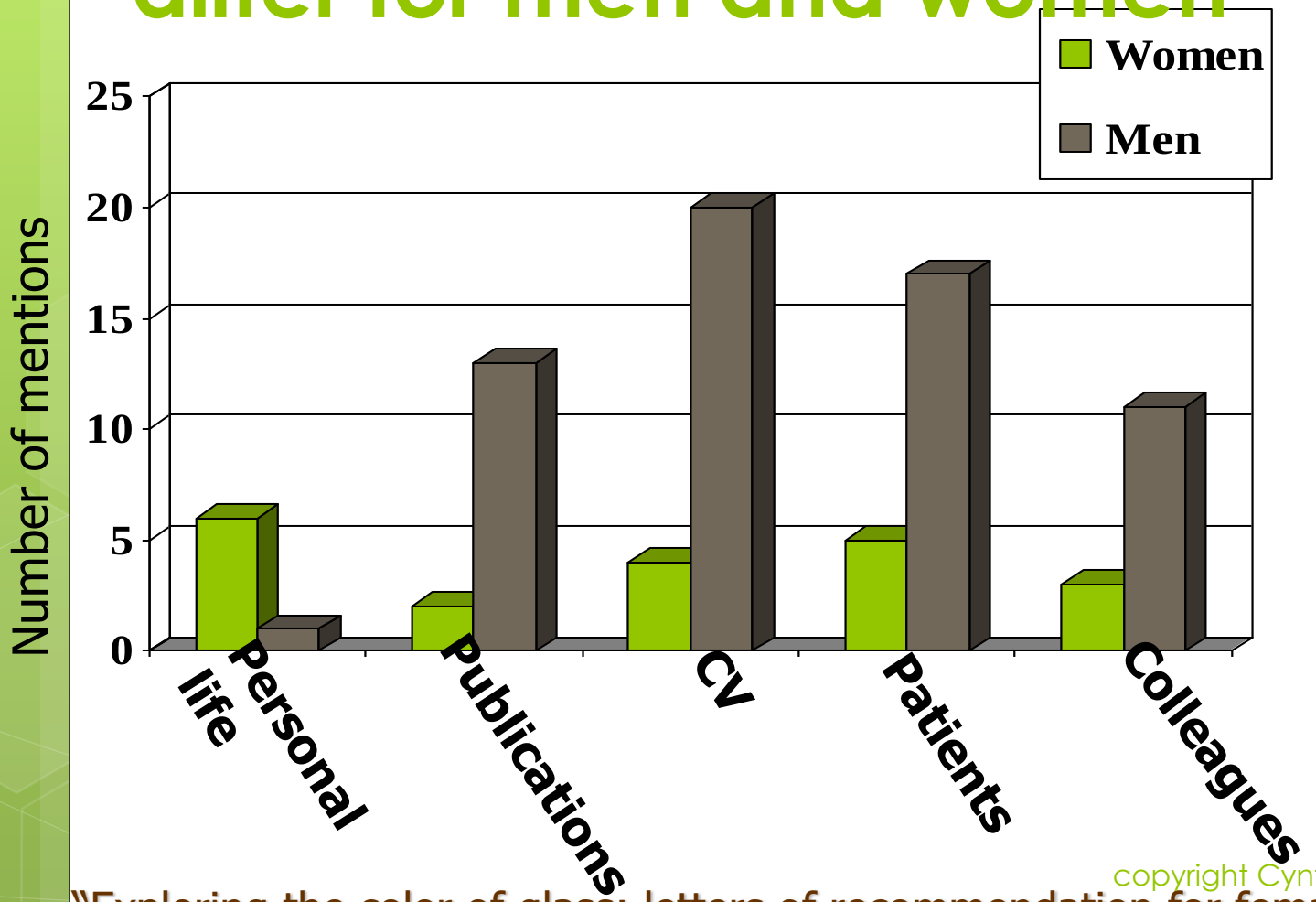
Letters of recommendation differ for men and women



Comparison of letters for male and female applicants all of whom got jobs at this institution (Wayne State University).

Trix, F. and Psenka, C (2003) "Exploring the color of glass: letters of recommendation for female and male medical faculty," *Discourse & Society,* 14(2):191-220, 2003

Letters of recommendation differ for men and women



Distinctive content following possessives (his/her)

"Exploring the color of glass: letters of recommendation for female and male medical faculty," *Discourse & Society,* Vol 14(2):191-220, 2003

Accumulation of advantage and disadvantage

- Like interest on capital, advantages accrue
- Like interest on debt, disadvantages accrue
- Very small differences in treatment can, as they accumulate, have major consequences in salary, promotion, and prestige
- Small cases of group-based bias add up

Merton (1948) *Antioch Review*, 8, 193-210 and (1968) *Science*, 159, 56-63

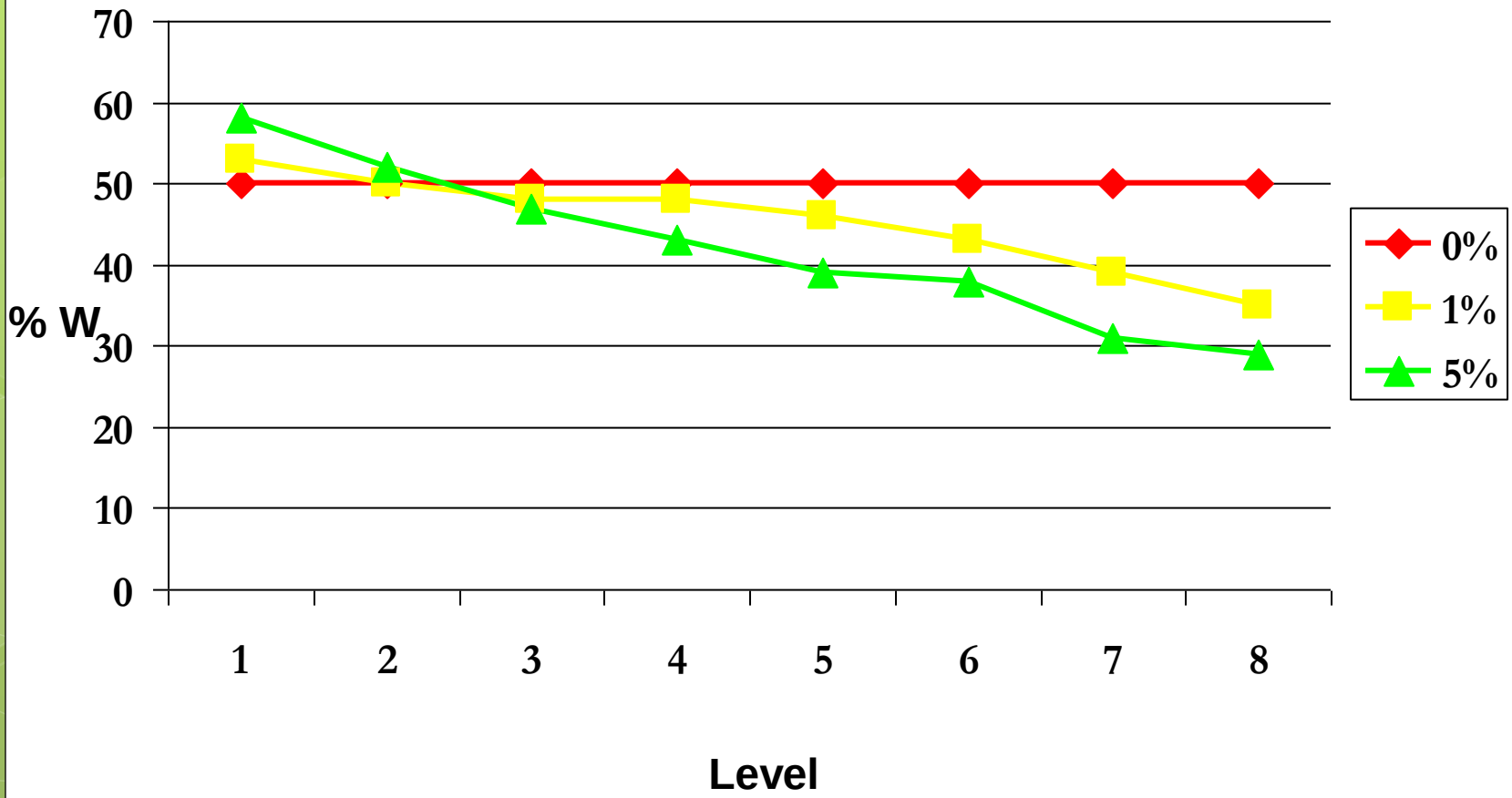
Computer simulation of cumulative bias

Martell et al. 1996

- Computer simulation of organization's 8-level pyramidal hierarchy
- Staff at each level with equal ratio men and women
- Assume 1% bias in favor of promoting men
- Run simulations through series of promotions till complete turn over
- At the end, the highest level in organization was 65% male

Martell, Lane, & Emrich (1996) *American Psychologist*, 51, 157-158.

How trivial bias works against women within organizations



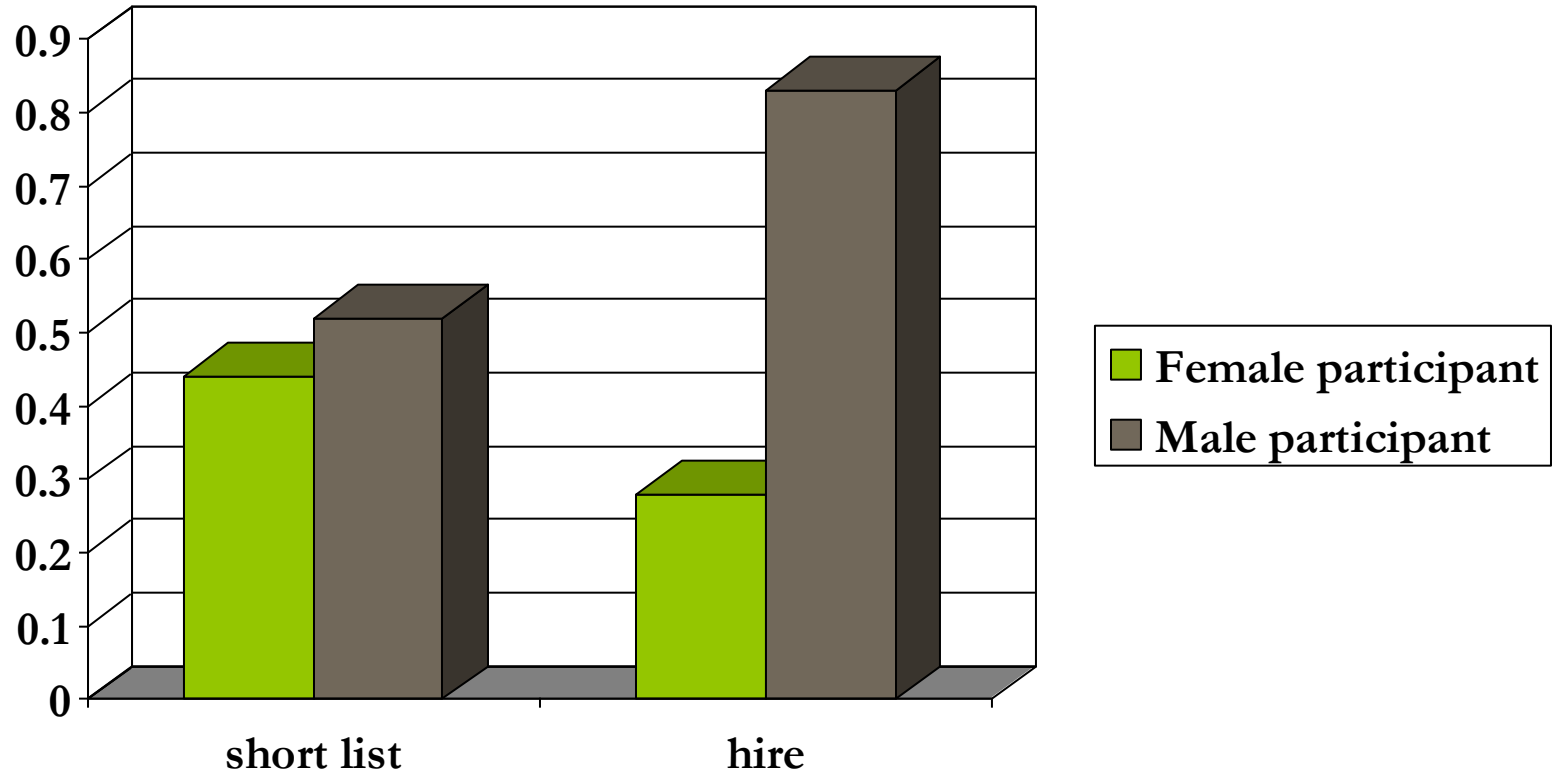
Simulated Search Committee

Biernat et al, 2001

- Simulations of hiring process (175 graduate students; 88 F; 87 M)
- Same resume but half with "Katherine Marie Anderson" and half with "Kenneth Michael Anderson"; also 3 letters of recommendation

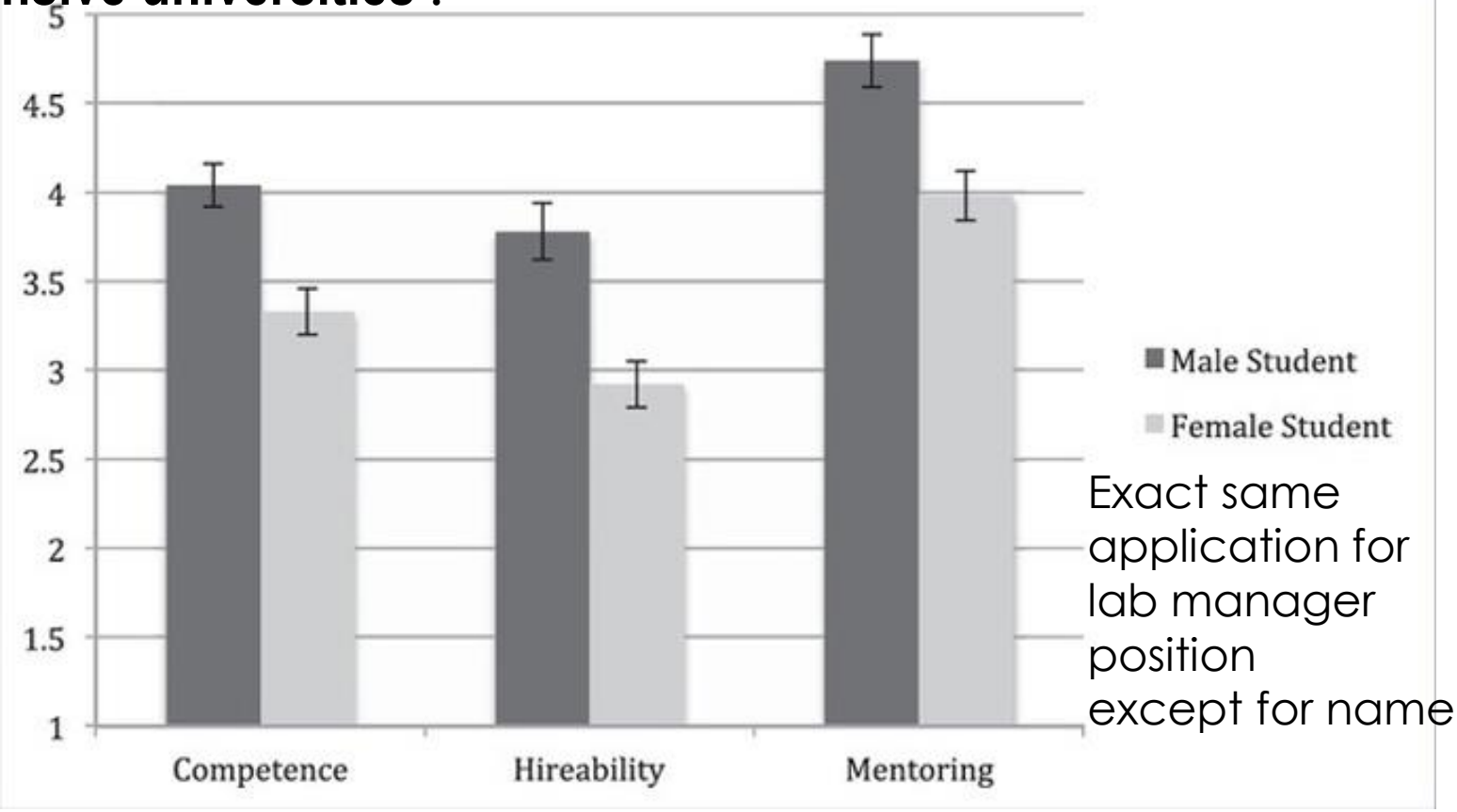
Biernat & Fuegen, J Soc Issues 57:707-24, 2001

Proportion of female applicants short-listed and hired



Biernat & Fuegen, J Soc Issues 57:707-24, 2001

Candidates" were ranked for competence, hireability and mentoring, scale of 1 to 7, by science faculty from research-intensive universities .



Exact same application for lab manager position except for name

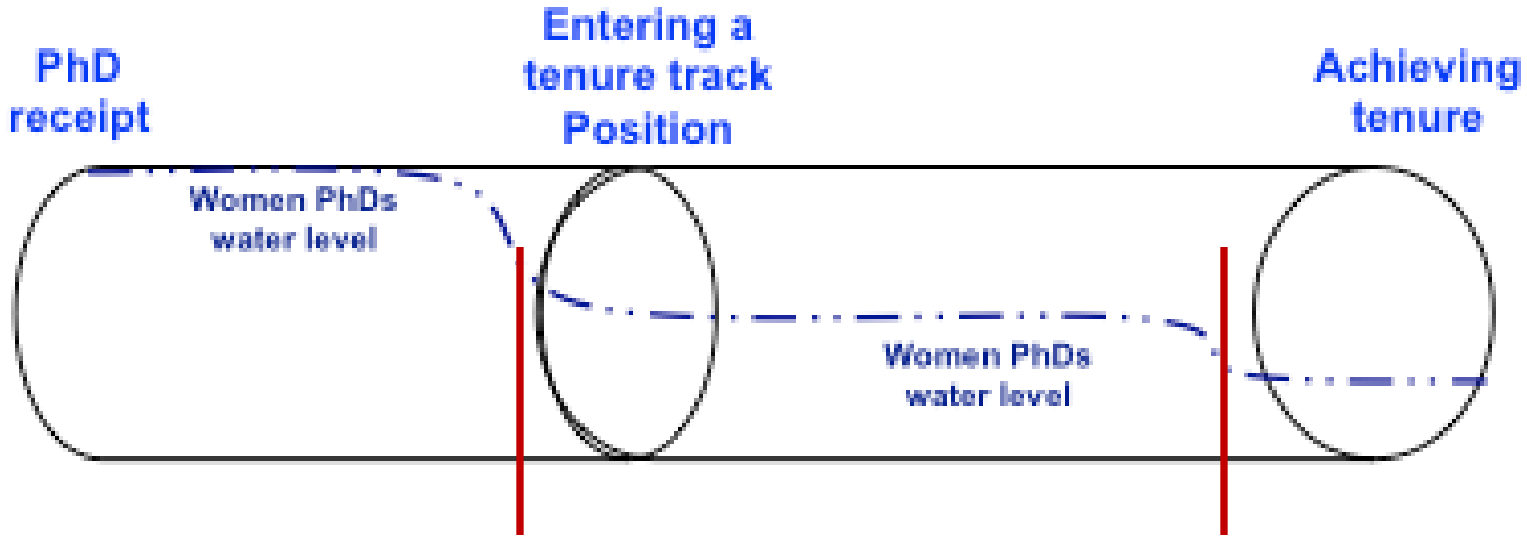
Moss-Racusin et al. PNAS 109, 16474–16479 (2012)

Leaky Pipeline Issue

Survival Analysis for women PhDs in the Sciences

Survival analysis of 'The Survey of Doctorate Recipients' biennial longitudinal study following ~170,000 Ph.D. recipients all disciplines until age 76.

Leaks in the Pipeline to Tenure for Women PhDs in the Sciences*



http://www.americanprogress.org/issues/2009/11/women_and_sciences.html

Drop-off between PhD and entry TT

Married women with young children

- **35** percent lower odds than married **men** with young children to get a tenure-track position
- 28 percent lower than married women without young children
- 33 percent lower than single women without young children

Married women without young children

- **8** percent lower odds than married **men** without young children to get a tenure-track position
- 10 percent lower than single women without young children

Drop-off between enter TT and achieve tenure

Married women with young children

- **27** percent lower odds than married **men** with young children to get tenure
- 13 percent lower than married women without young children
- 4 percent lower than single women without young children

Different groups have different survival statistics.
But in all groups women are worse off than men.

Why women engineers leave

We know they do, but why and when?

From an NSF study by Fouad & Singh

What Do We Know:

- 1-in-4 women leave engineering compared to 1-in-10 men
- Women comprise more than 20% of engineering school graduates, but only 11% of practicing engineers
- Girls are just as likely as boys to do as well in math, science subjects in high school (no ability differences)
- Early intervention programs found to be effective in encouraging women to consider engineering as a career

Need systematic answers to

- *why* women leave
- *when* do they leave

Nadya A. Fouad, Ph.D, Romila Singh, Ph.D
University of Wisconsin-Milwaukee
3-year, NSF-funded longitudinal study

Engineering alumnae targeted across different life and career stages (graduates spanned over six decades: 1947-2010
> 5,700 women, 200 colleges & 30 universities
Stemming the Tide, NSF Full Report 2012
Stemming the tide: Predicting women engineers' intentions to leave, Singh et al., J. Vocational Behavior 2013, 83, 281-294

A substantial group of women engineers *(14% of sample)* never even entered the engineering profession after earning their undergrad in engineering.

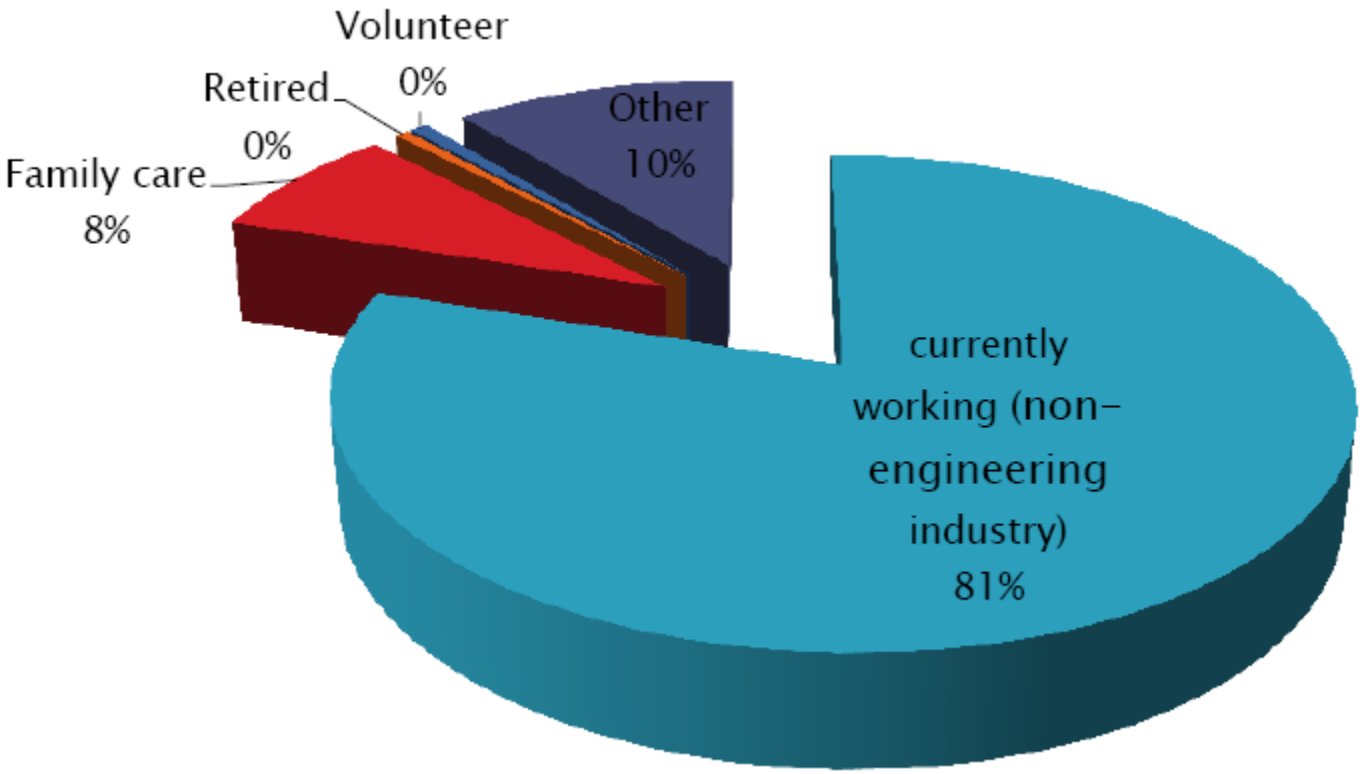
WHY?

Reasons given

- Not interested in engineering
- Didn't like the engineering culture
- Had always planned to go into another field
- Wanted to start their own business

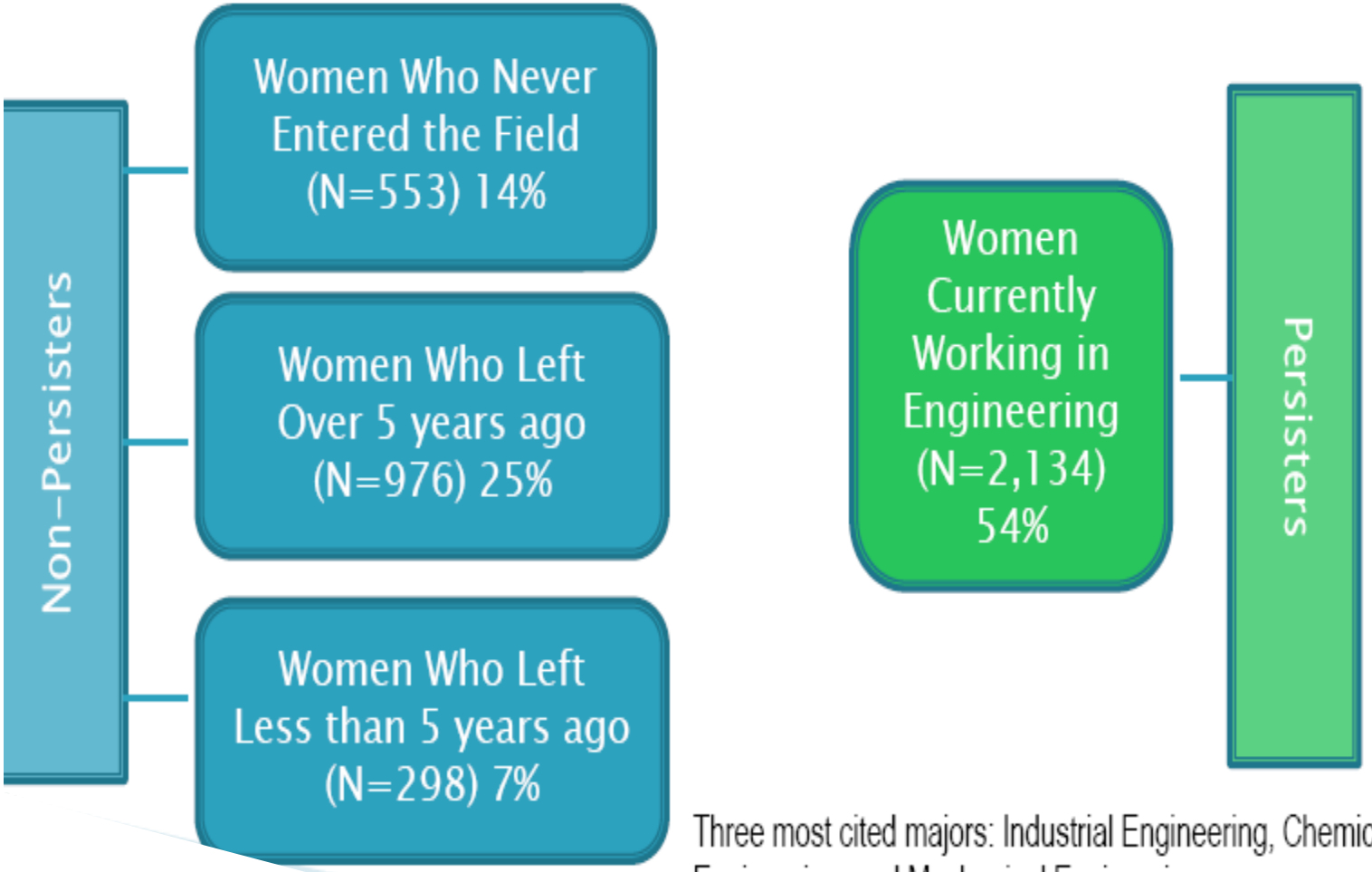
These reasons did not differ significantly across different age groups or years of graduation

Instead



Stemming the Tide,
Fouad & Singh 2012

Participants



Three most cited majors: Industrial Engineering, Chemical Engineering, and Mechanical Engineering

From Fouad&Singh 2012 WEPAN Conf.

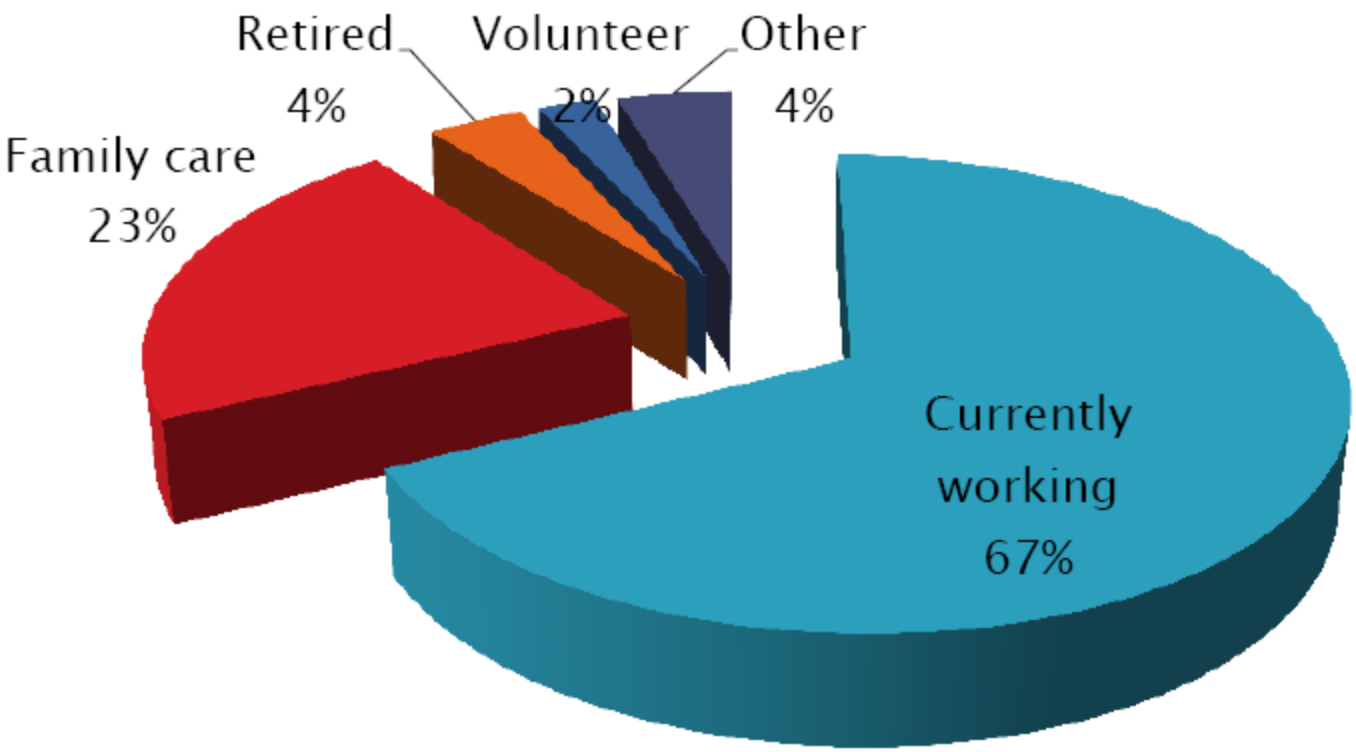
Those who pursued their careers in Engineering

1 in 4 left more than 5 years ago
7% left less than 5 years ago

1 in 4 left more than 5 yrs ago. So why did they leave?

- 17% said they left the field to spend more time with family
- 12% left because they were not offered any opportunities for advancement
- 12% said they lost interest in engineering
- They did not like engineering tasks (10%), the engineering culture (7%), their boss (7%), or working conditions (6%)

Instead



Stemming the Tide,
Fouad & Singh 2012

7% left less than 5 yrs ago. So why did they leave?

- 1/3 left to stay home with the children (because company was not flexible enough with accommodating work-life concerns)
- 2/3 left to pursue opportunities in other fields and organizations

Profile of women currently working in engineering

- 87% work > 40 hrs/wk, avg 8 years with the organization, earning $76K- 125K
- ½ are individual contributors, 1/3 managers, 16% in executive roles
- Those in management supervise 1-5 individuals
- Most work in groups predominantly male; a smaller number (18%) work in a gender-balanced group

Why do they stay?

- Satisfied with their jobs & careers
- Supportive bosses & co-workers
- Their organizations "get it". How do they show it?
  - They recognize women's contributions & care about their well-being
  - They invest in their training & professional development
  - They have supportive work-life policies <u>and</u> a work culture that supports work-life balance for all

Are current women engineers a flight risk? Yes

- Women are thinking of leaving their organizations because of
  - Excessive workload w/o enough resources, conflicting work demands and unclear expectations about work goals & standards
  - A career plateau with few advancement opportunities
  - Low satisfaction with jobs & careers
  - A variety of climate-related barriers

Workplace climate that hinders Persistence: Undermining & uncivility at work

- Undermining behaviors, targeted at women, by their managers & co-workers [belittled, insulted, talked about behind their back] or [being pulled back when trying to succeed at work]
- Companies where women are treated in a condescending manner by managers & co-workers

Workplace climate that hinders persistence: No support for managing multiple life roles

- Companies did not offer flexible work-life policies
- Companies with poor work-life cultures stressed:

  Face time
  Taking work home on weekends & evenings
  Working > 50+ hrs/wk to get ahead
  Regularly putting work before family

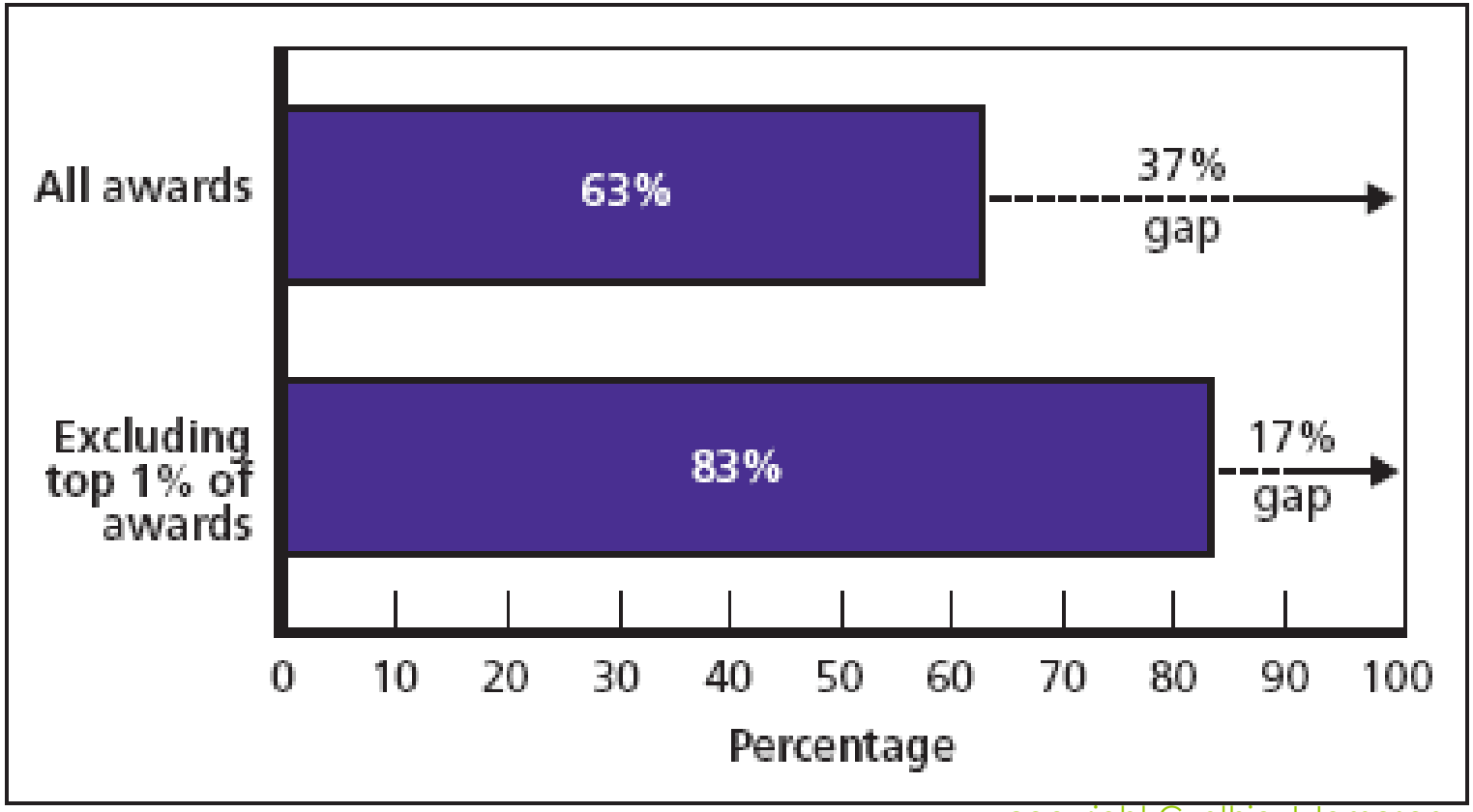
Companies need <u>both</u> supportive climate and work-life policies – to attract & retain employees

Gender Differences

NIH Funding Rates

Gender Gap NIH Funding

Percentage of Funding Received on Average by Women from NIH Relative to Men (FY 2001–2003)



Rand.org 2005

Sex Differences in Application, Success, and Funding Rates for NIH Extramural Programs

J. R. Pohlhaus et al. *Academic Medicine*, 2011, 86(6)- 759-767

Success rates, longitudinal study 2008 data:

R01 new applications:
Women were equally or more successful than men both as first-time investigators and as experienced investigators submitting *new applications*.

R01 renewals:
Men were more successful than women as experienced investigators submitting *renewal applications*.

Multiple concurrent awards:
Women are a smaller percentage of those who hold concurrently two or more R01s

Awards in Science Engineering Mathematics & Medicine

RAISEproject.org

Of the more than 1,000 awards tracked by RAISEproject, 1/3 never have been won by a woman. Others have had remarkably few female recipients.

Women Are Underrepresented as Recipients of Many Prestigious Awards

National Medal of Science
13.9% women

Nobel Prize in Medicine
11.5% women

ACE Priestly Medal
6.1% women

Fields Medal
3.1% women

First woman 2014

From 1911 to 2005 the Willard Gibbs Medal had only been won by one woman: Marie Curie, 10 years after she won her 2nd Nobel (Chemistry) prize.

NIH Pioneer Awards 2004

Candidates had to be nominated
Only 21% of those nominated were women
Only 2 of 21 finalists were women

60 of the 64 judges were men

All 9 awardees were male.

NIH Pioneer Awards 2005

Change of rules:

Candidates can nominate themselves
Available to early & mid-career
26% of applicants were women
6 of 20 finalists were women

NIH Director's Pioneer Awards

- All 9 went to men in the first round (2004)
- In subsequent rounds, women received:
  - 2005 = 43%
  - 2006 = 31%
  - 2007 = 33%
  - 2008 = 25%

Were women doing better science after 2004?

What made the difference?

gender priming

- Priming an individual with words picture or media images that align with gender stereotypes promotes gender bias in subsequent behavior

Wording of 2004 RFP included:

"aggressive" "risk-taking" "high-risk"

"technological breakthroughs"

(Words stereotypically associated with males)

2004 from Molly Carnes, UW	≥ 2005
Characteristics of target scientist and research	
Risk-taking emphasized: • "exceptional minds willing and able to explore ideas that were considered risky" • "take…risks" • "aggressive risk-taking" • "high risk/high impact research" • "take intellectual risks" • URL includes "highrisk"	Emphasis on risk removed: • "pioneering approaches" • "potential to produce an unusually high impact" • "ideas that have the potential for high impact" • "highly innovative" • URL no longer includes "risk"
Instructions to evaluators	
Technological advances highlighted as desirable: • "support the people and projects that will produce tomorrow's conceptual and technological breakthroughs"	Mention of technological breakthroughs removed; human health added: • "encourage highly innovative biomedical research with great potential to lead to significant advances in human health."

Other factors

Stereotype threat and performance

Stereotype threat

"When women perform math, unlike men, they risk being judged by the negative stereotype that women have weaker math ability. We call this predicament **stereotype threat** and hypothesize that the apprehension it causes may disrupt women's math performance. Performance-depressing stereotype threat emerged in these studies only when the test was at the limits of their skills."

Spencer, Steele & Quinn, Journal of Experimental Social Psychology 35, 4–28 (1999)

Reuben, Sapienza & Zingales PNAS 111, 4403-8 (2014)