

Women in Physics in the United States

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FOR FURTHER INFORMATION

American Institute of Physics Statistical Research Center: www.aip.org/statistics/

American Physical Society Gender Equity Report:
www.aps.org/programs/women/workshops/gender-equity/

Univ. of California Faculty Family Friendly Edge (including articles by Prof. Mary Ann Mason) ucfamilyedge.berkeley.edu/

The Gender Equity Project (including articles by Prof. Virginia Valian):
www.hunter.cuny.edu/genderequity/

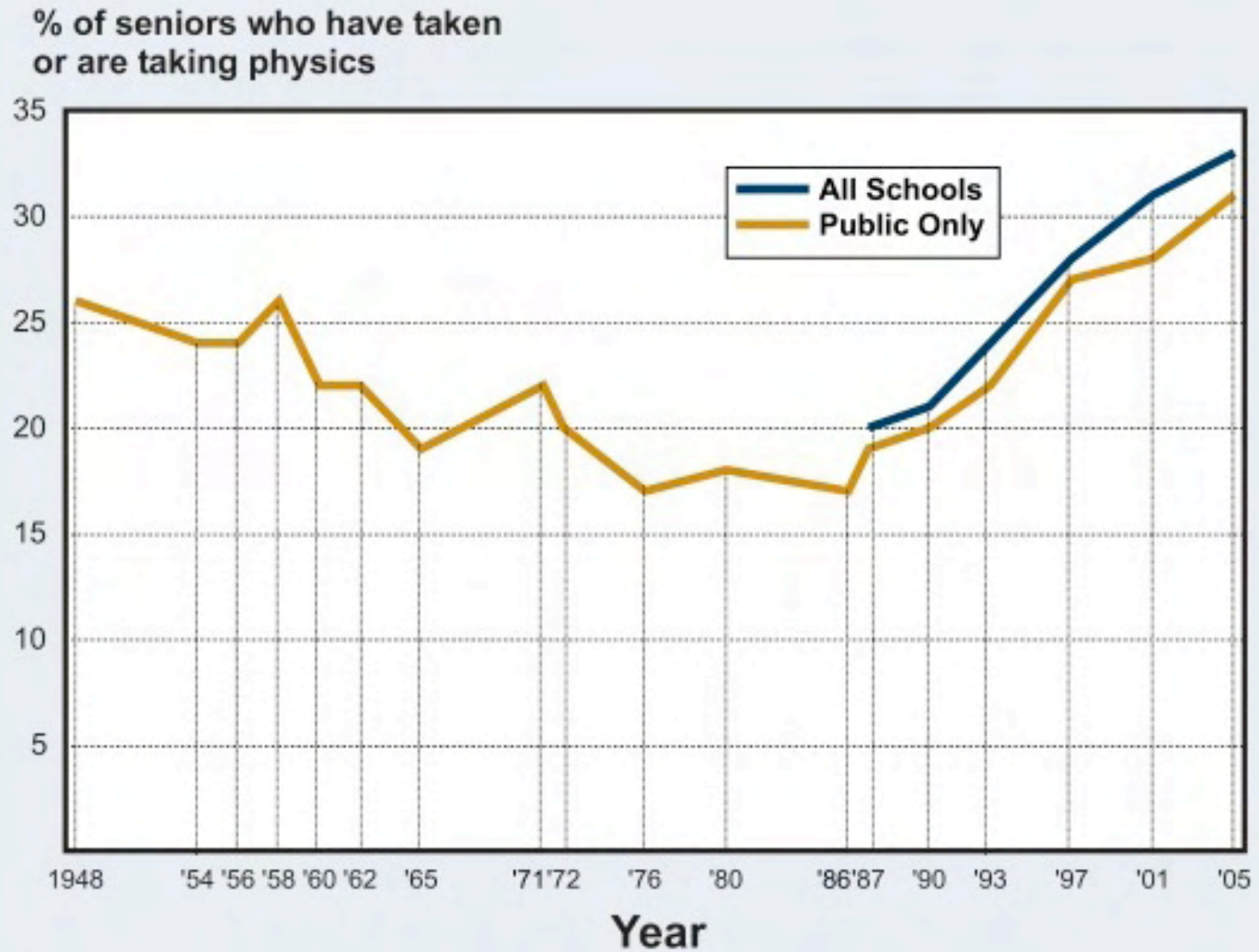
Women Don't Ask [Negotiation and the Gender Divide]: www.womendontask.com/

National Science Foundation ADVANCE Program: www.nsf.gov/crssprgm/advance/
ADVANCE Portal Website: www.portal.advance.vt.edu/

Michigan State's ADAPP-ADVANCE Project: www.adapp-advance.msu.edu/

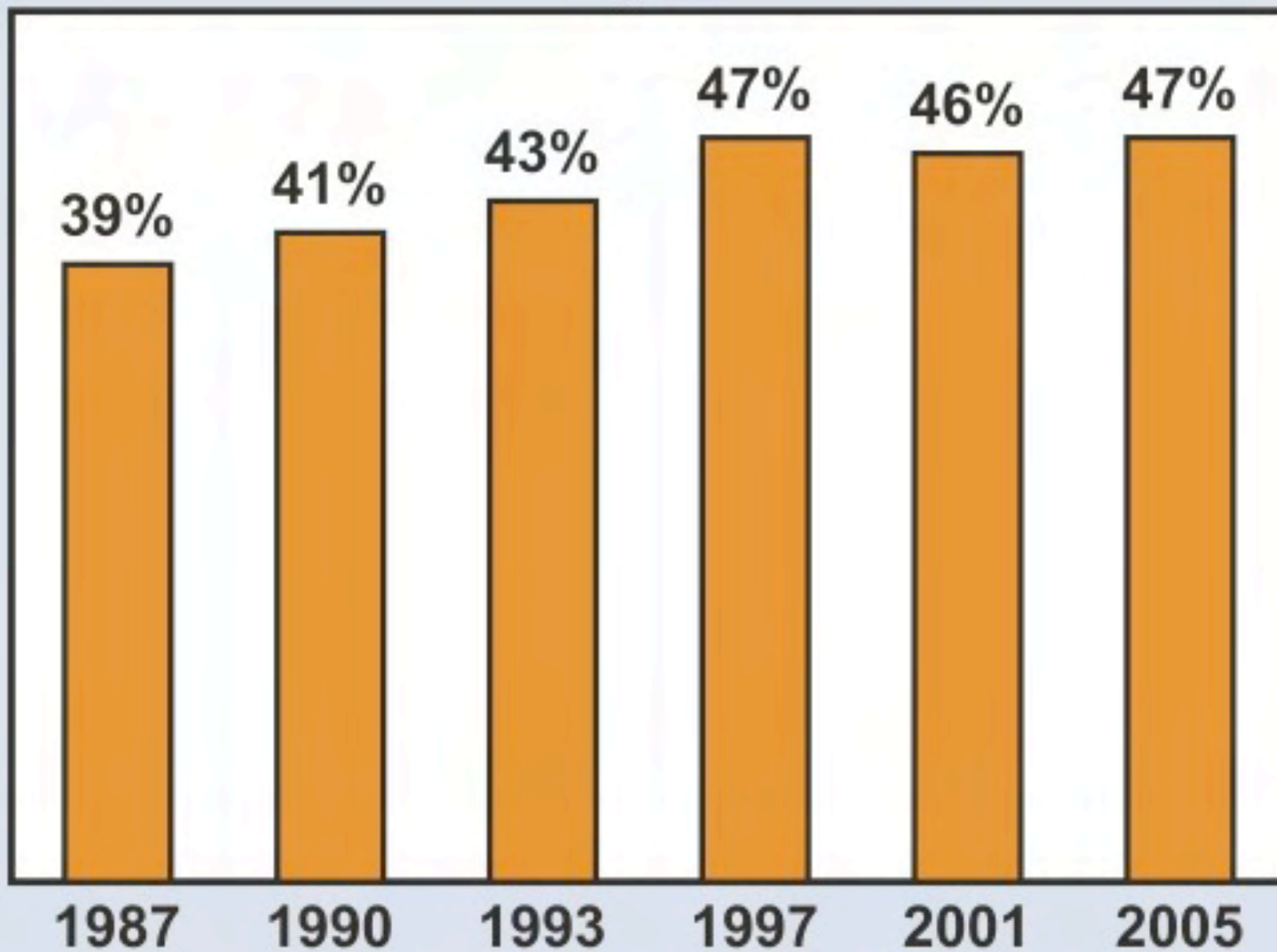
The Numbers

Figure 1. Physics Enrollment in U.S. High Schools, 1948-2005



AIP Statistical Research Center: 1986-87, 1989-90, 1992-93, 1996-97, 2000-01 & 2004-05 High School Physics Surveys;
Pallrand et al. (1985); Dept. of Education., Nat'l Center for Education Statistics (Various Years)

Figure 3. Females as a Percentage of Total Enrollment in High School Physics



AIP Statistical Research Center: 1986-87, 1989-90, 1992-93, 1996-97, 2000-01 & 2004-05 High School Physics Surveys

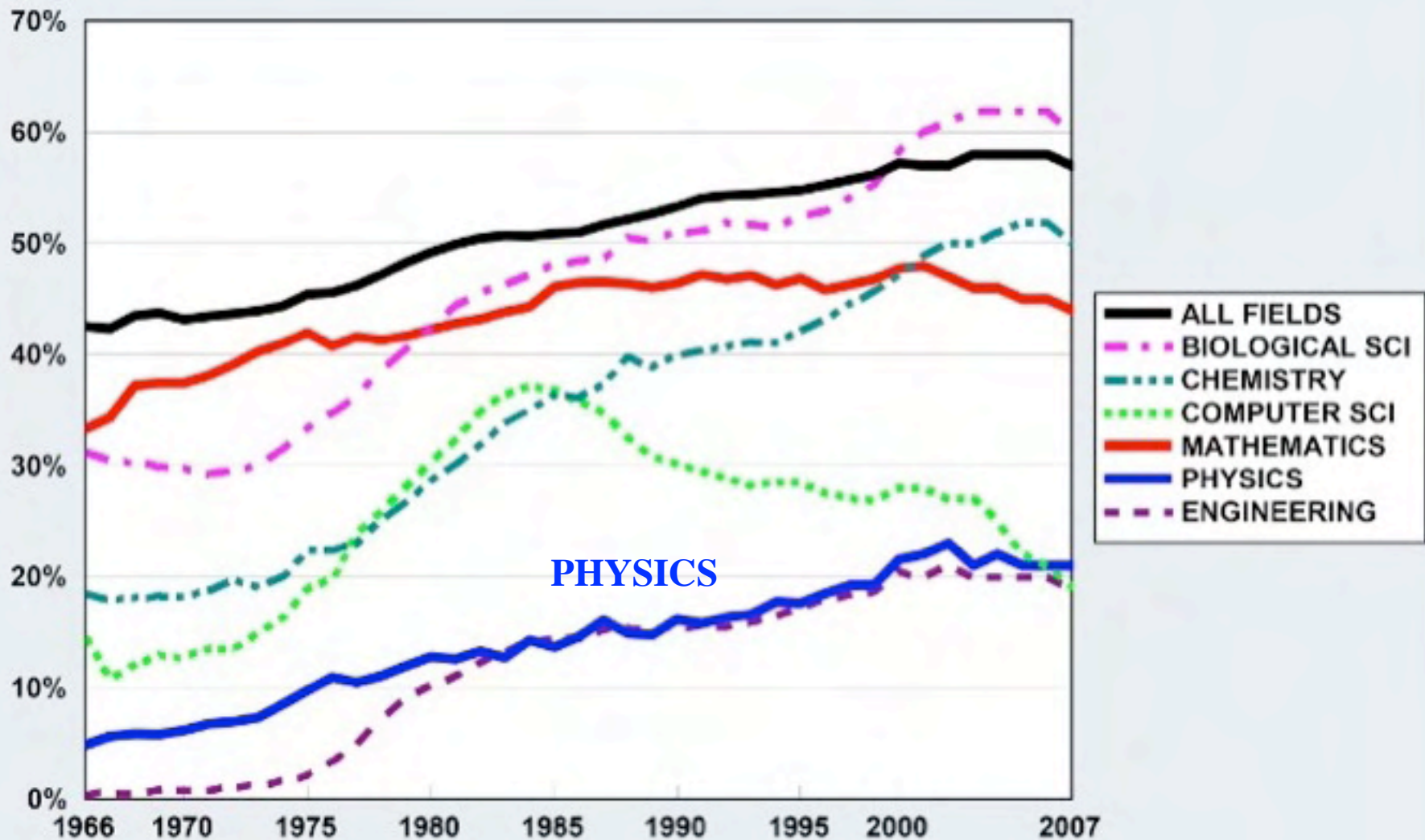
Career Choices Begin Early

Only 8% of US students earning a B.A. in Physics have **not** taken Physics in High School (AIP Pub. # R392.3, 1998).

	Percent
Before secondary school (high school)	15
During secondary school	60
During undergraduate school	17
During graduate school	8

Survey of 1350 women attending 2005 IUPAP Int'l Conf on Women in Physics.

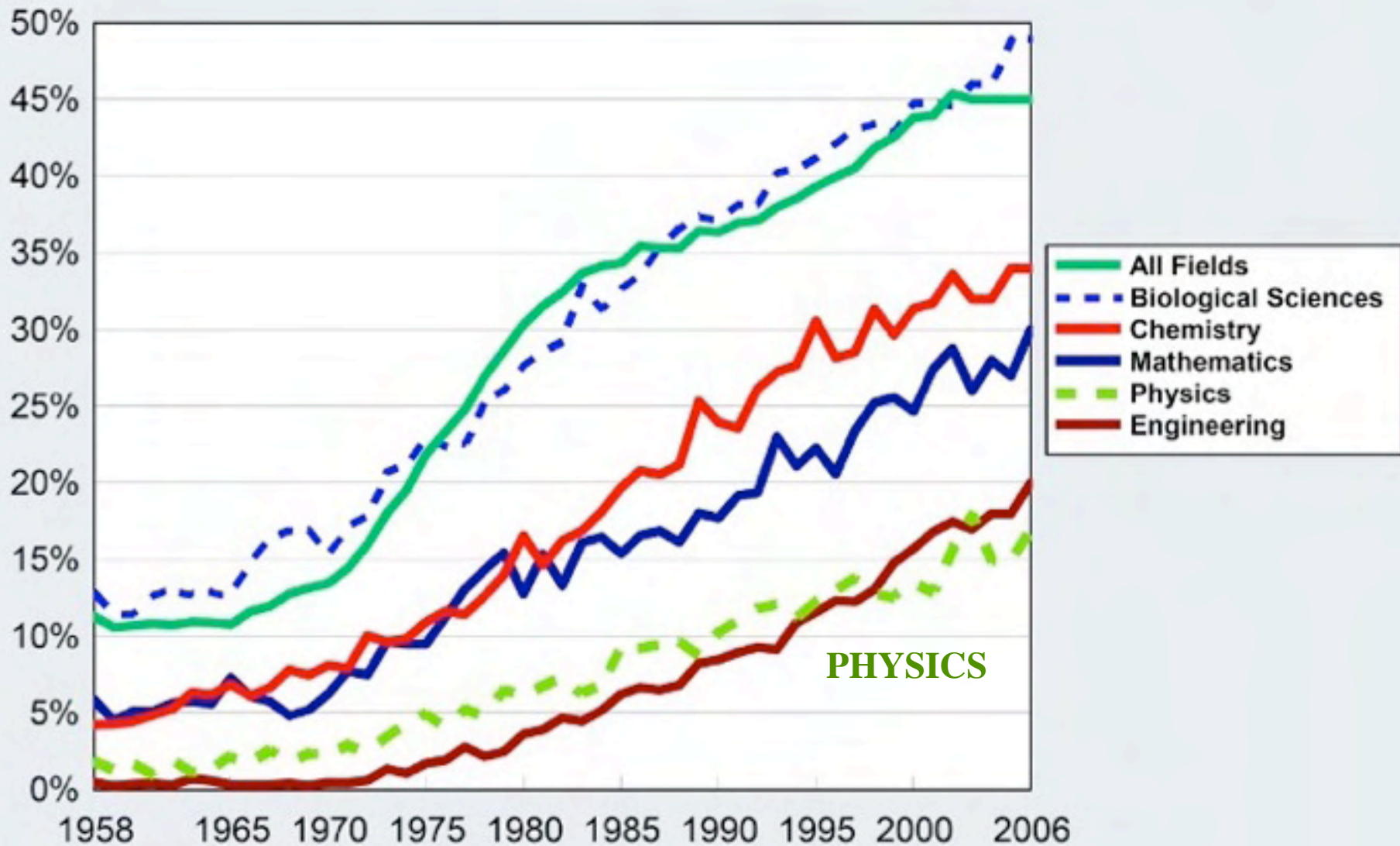
Percent of bachelor's degrees earned by women in selected fields, 1966 - 2007.



National Center for Education Statistics. Data for Academic Year 1999 were not available.

Compiled by American Institute of Physics Statistical Research Center.

Percent of PhDs earned by women in selected fields, 1958-2006



AIP Statistical Research Center. Compiled from data collected by National Science Foundation.

Doctorate recipients in selected physics fields, 1988 - 2006.

Year	All Physics*		Elementary Particle Physics		Atomic, Molecular & Optics		Condensed Matter	
	Total N	Female %	Total N	Female %	Total N	Female %	Total N	Female %
2004 to 2006	3879	16	551	13	667	16	925	14
2000 to 2003	4591	15	557	12	768	16	1143	15
1996 to 1999	5484	13	687	10	884	13	1313	14
1992 to 1995	5829	12	682	8	822	12	1502	14
1988 to 1991	4884	10	652	9	618	9	1227	11

* Not including astronomy & astrophysics

Source: AIP Statistical Research Center; Compiled from data collected by the National Science Foundation.

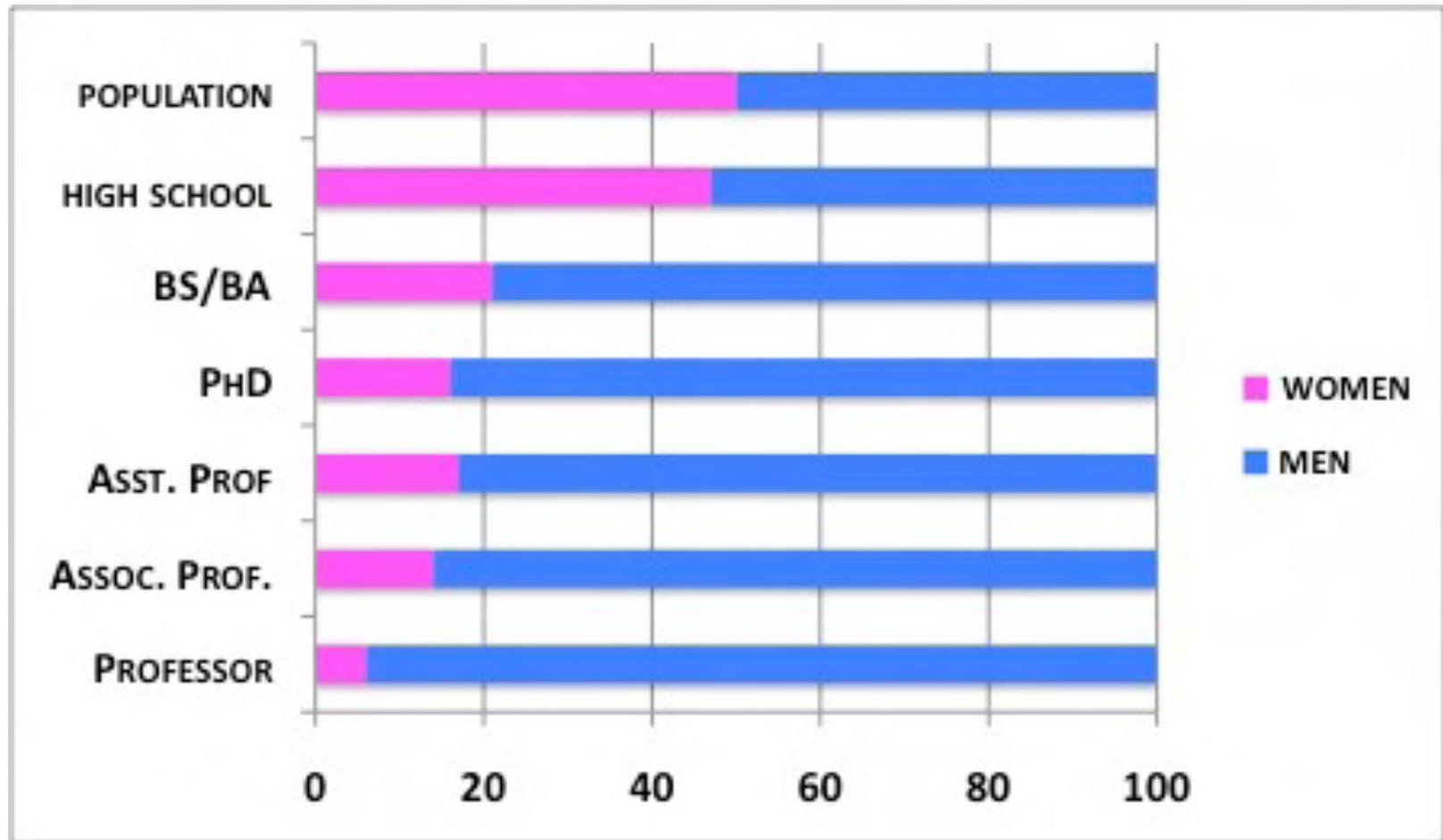
Figure 1. Percent of faculty positions in physics held by women.

	1998	2002	2006
Academic Rank			
Full Professor	3	5	6
Associate Prof.	10	11	14
Assistant Prof.	17	16	17
Instructor/Adjunct	N/A	16	19
Other ranks	13	15	12
Type of Department			
PhD	6	7	10
Master's	9	13	16
Bachelor's	11	14	19
OVERALL	8	10	13

AIP Statistical Research Center, 2006 Academic Workforce Survey.

Summarizing these results yields the famous “leaky pipeline” for women physicists

[data from AIP Statistical Division]



This is a problem for Physics!

Causes and Solutions

As the NSF ADVANCE website notes:

... women's representation and advancement in academic STEM positions are affected by many external factors that are unrelated to their ability, interest, and technical skills...

Implicit Bias

The Gender Equity Project, Virginia Valian

- We are all (women and men) prone to unintentional bias
- This affects affects many decisions we make in the course of our professional duties
- Relevant concepts include:
 - gender schemas
 - accumulation of disadvantage
 - stereotype threat



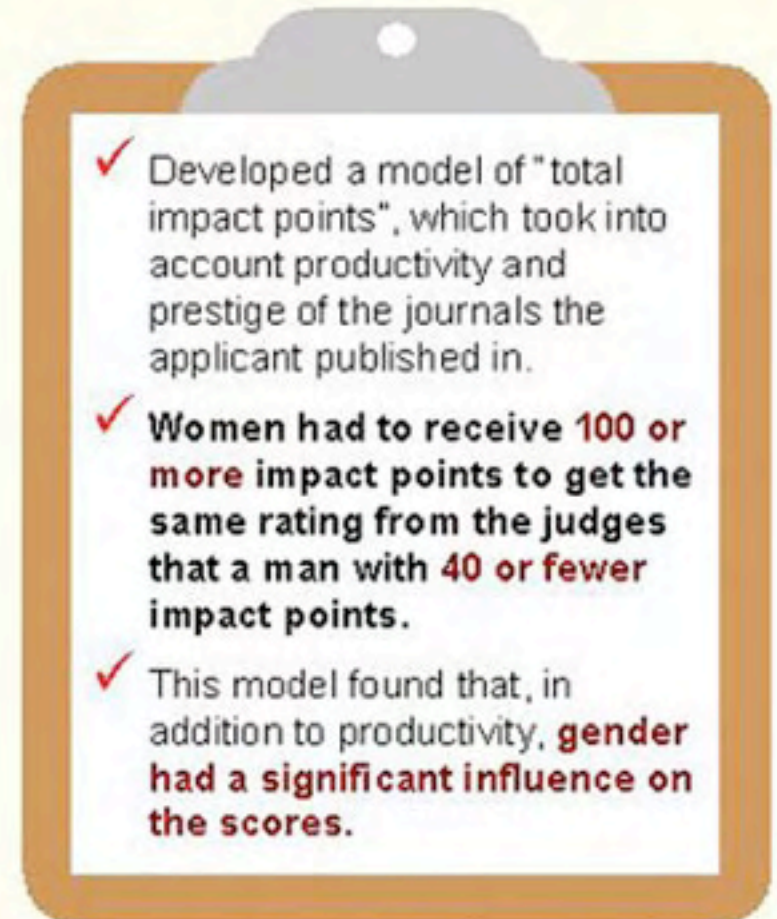
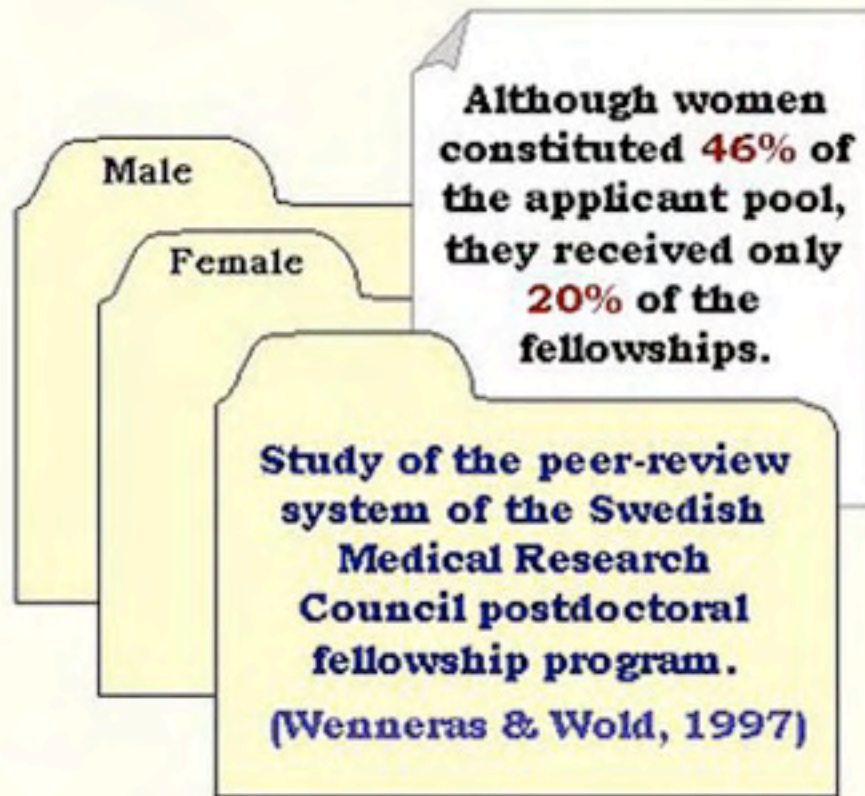
What are Gender Schemas?

- Gender schemas are hypotheses about what it means to be male or female.
- We all - male and female alike - share these hypotheses.
- Schemas assign different psychological traits to males and females (Martin and Halverson, 1987).



The Gender Equity Project, Virginia Valian 2006

Gender Bias in Peer Review



IMPACT

Women have to meet a higher standard in order to receive the same recognition that men do.

Accumulation of Disadvantage

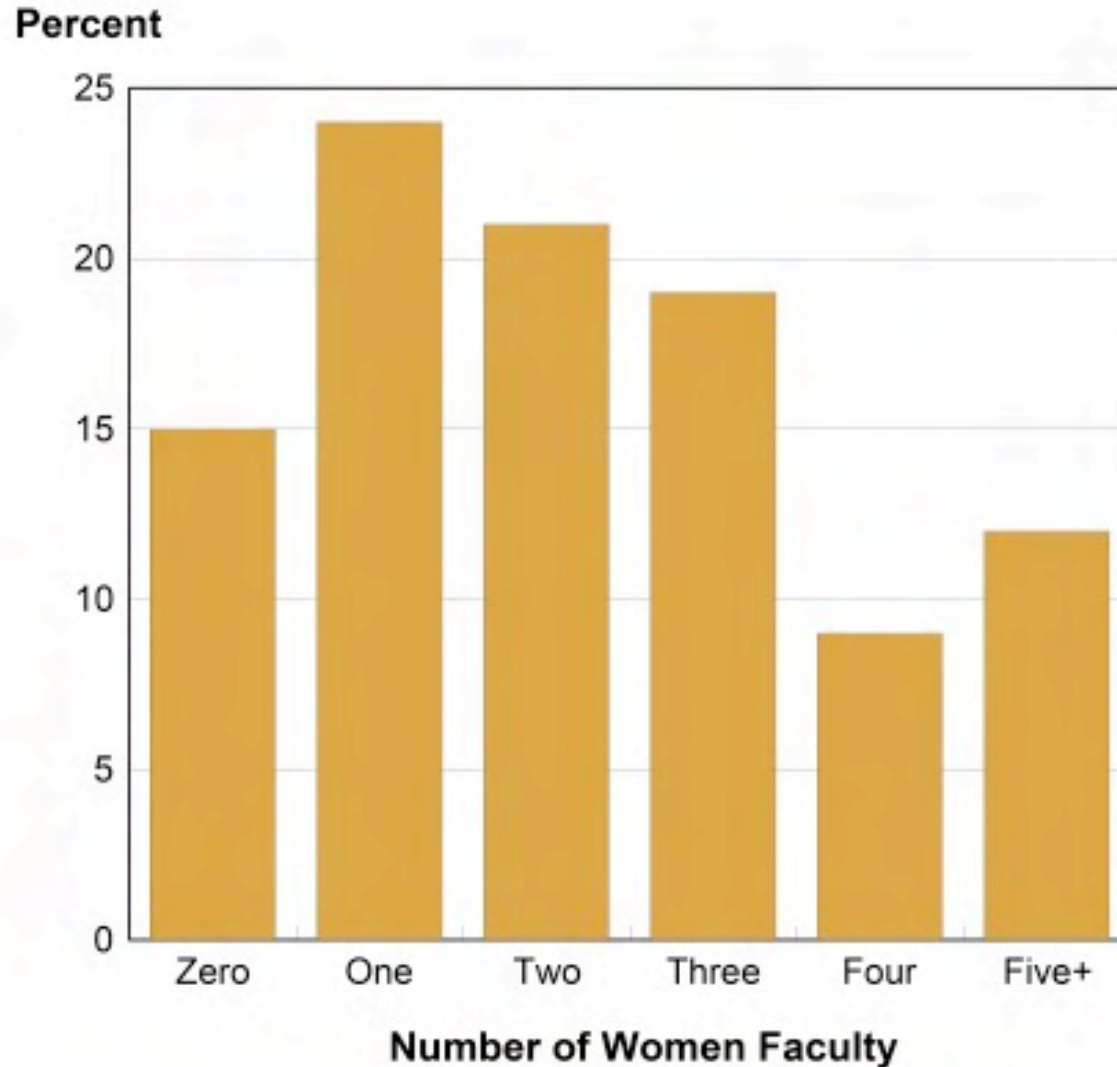
Martell, Lane, and Emrich's (1996) model assumed a tiny bias in favor of men, which accounted for only 1% of variance in promotion.

After many iterations the top level was 65% male.



Operating at a systematic minute disadvantage can have substantial long term effects.

Percent of PhD physics departments by number of women in professorial ranks, 2006



There are 189 such departments and the median number of faculty is 25.

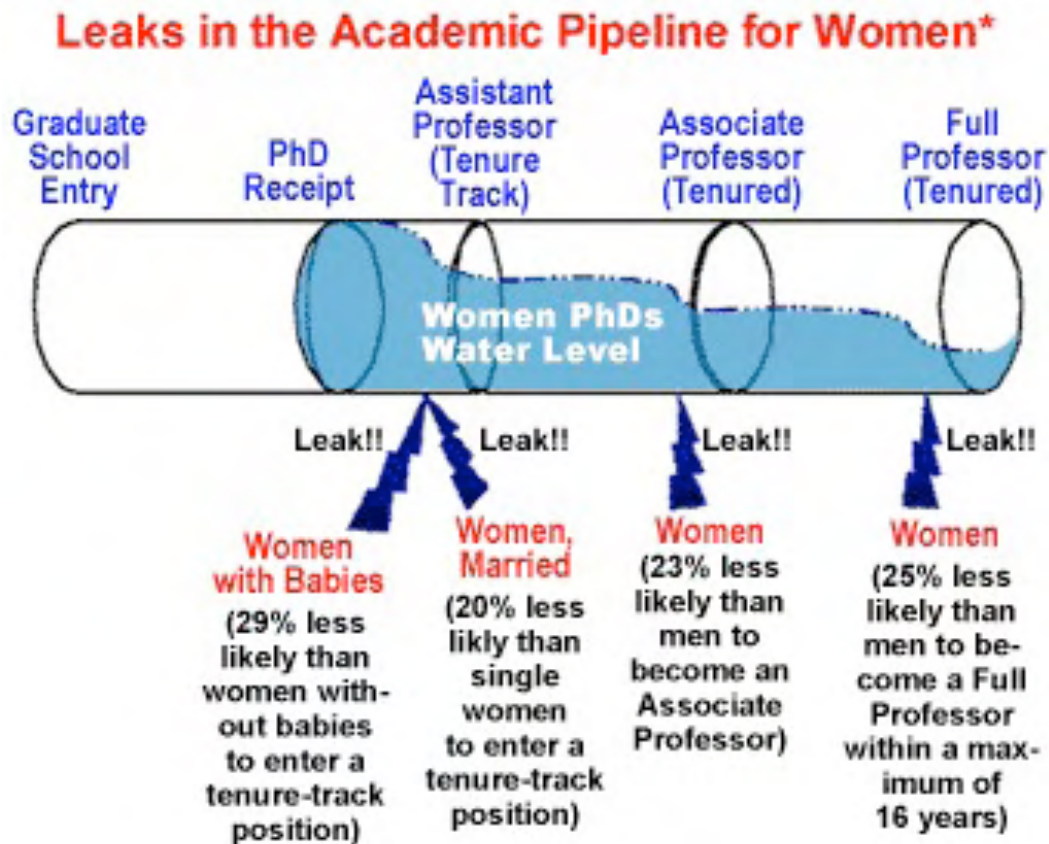
What is it like to be 1 woman in a faculty of 25?

- **solutions** include:

- * leaders emphasize importance of diversity for achieving institutional goals
- * institutions make criteria and processes for hiring, tenure, promotion, awards clear and easily available to all
- * departments frame faculty searches broadly
- * hiring/award committees
 - * are trained to recognize and minimize implicit bias
 - * explicitly use multiple dimensions to evaluate candidates' qualifications (e.g. number of publications, research impact, teaching accomplishments, potential for funding, area of specialization)
- * departments and professional societies offer professional development opportunities for women at all levels

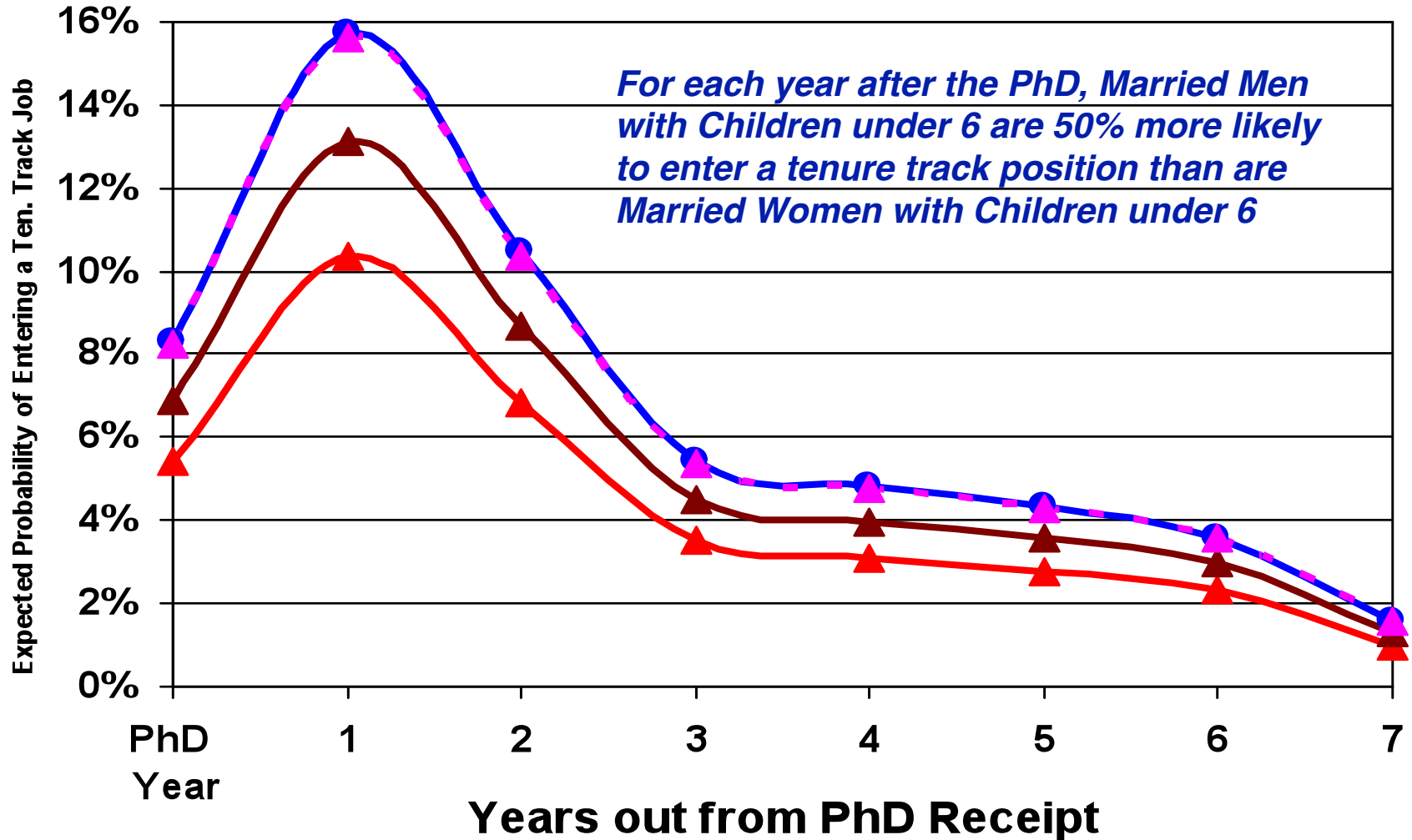
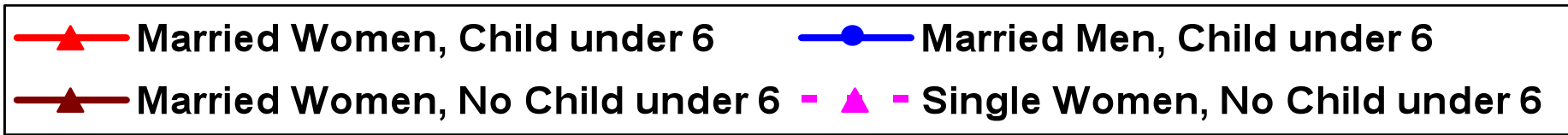
Family Responsibilities

Report on the UC Work and Family Survey; Mary Ann Mason, Angelica Stacey, and Mark Goulden, 2004; *Do Babies Matter?* Mary Ann Mason and Mark Goulden 2002



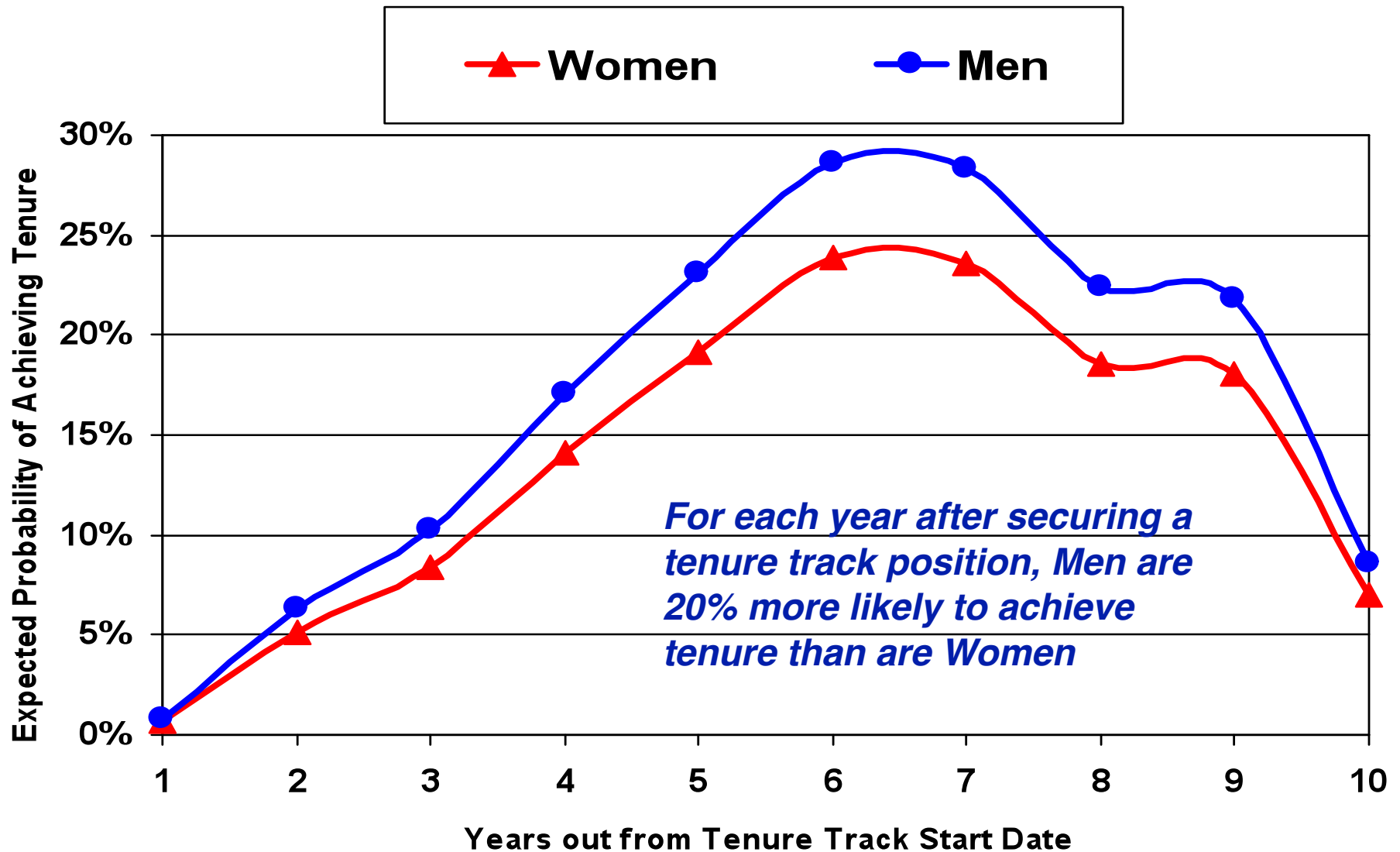
Mason, Stacy, and Goulden, 2004; Data from NSF Survey of Doctorate Recipients 1981-1995

Leaks in the Pipeline: PhD to Tenure Track Position



Mason, Stacy, and Goulden, 2004; Data from NSF Survey of Doctorate Recipients 1981-1995

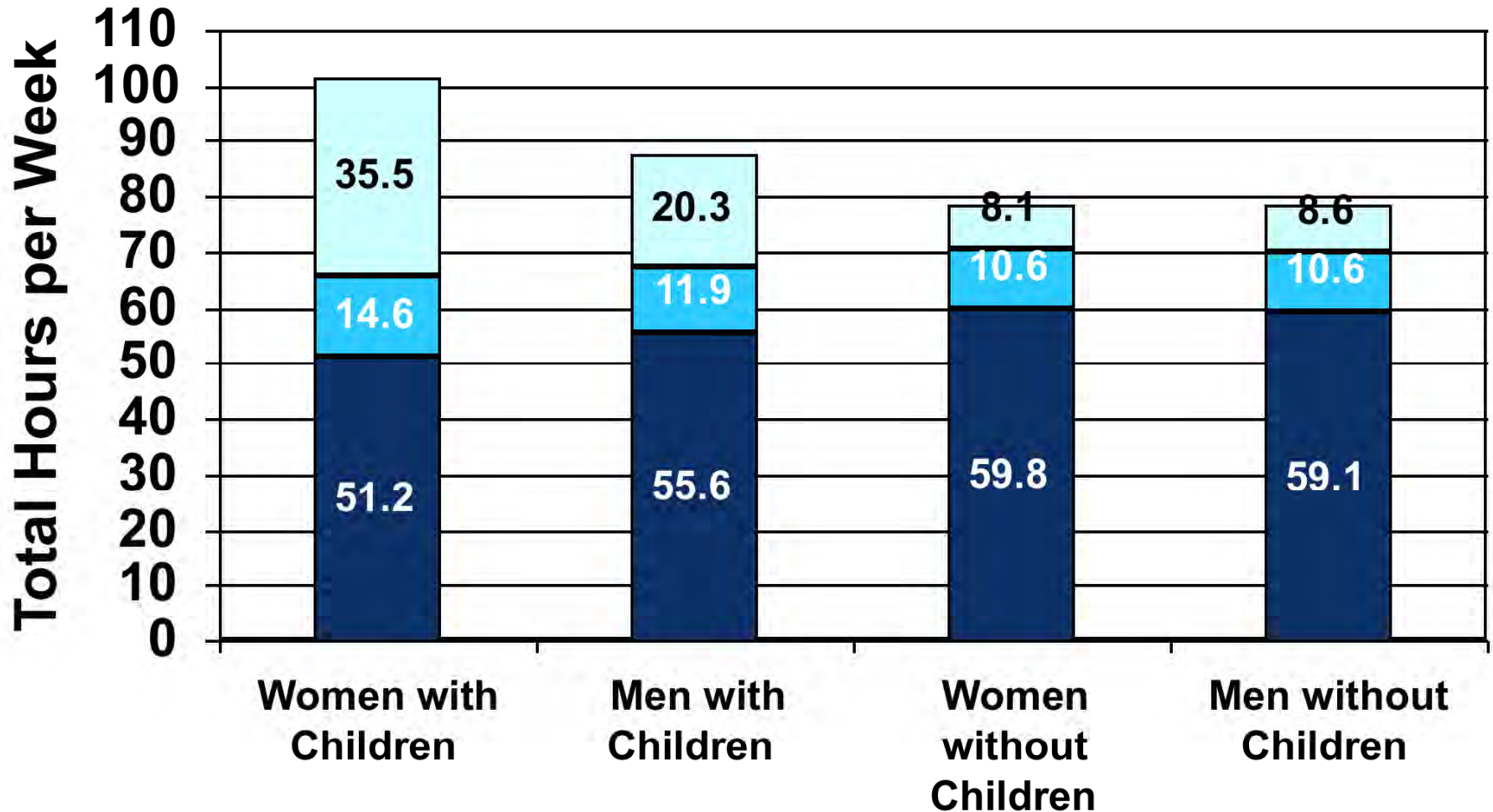
Leaks in the Pipeline: Tenure Track to Tenure



Mason, Stacy, and Goulden, 2004; Data from NSF Survey of Doctorate Recipients 1981-1995

Everybody is Very Busy

■ Professional ■ Housework ■ Caregiving



Mason, Stacy, and Goulden, 2004; Data on UC faculty, ages 30-50

solutions include:

- * employers provide parental leave, tenure-clock adjustment, modified duties for parental or elder care and ensure these will not impact evaluation for promotion or tenure
- * employers ensure policies are clear, well-advertised, and framed as entitlements, not exceptions [to minimize “bias avoidance” behavior]
- * department heads and mentors openly offer support and advice on work-life balance to all new faculty, so this is seen as a normal aspect of professional life
- * departments schedule all meetings during business hours
- * departments and professional societies offer childcare grants for faculty attending conferences

Dual-Career Couples

- a pervasive issue in physics

(Dual-Science-Couple Survey, McNeil & Sher, 1998; 1990 APS Survey)

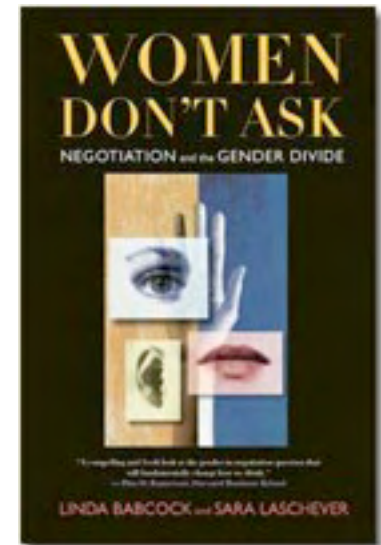
- **68%** (**18%**) of **married** physicists have scientist spouses
- **31%** (**6%**) of **all** physicists < 31 yrs have scientist spouses
- In 85% of couples, man is older [thus, more senior in job]
- Dual-science-couples seeking first faculty jobs reported
 - short-term career goals affected by these issues (**86%**)
 - one partner (usually woman) was under-employed (**60%**)
- **solutions** include:
 - * Employers offer clear, well-advertised spousal hire policies
 - * Employers reframe dual-career assistance as recruitment tool
 - * Employers form Higher-Education Recruitment Consortia
 - * Job candidates raise dual-career issues with employers

Negotiation

Women Don't Ask: Negotiation and the Gender Divide (Linda Babcock & Sarah Laschever, 2003)

- Women avoid negotiation because they are
 - unsure what they “deserve”; fear asking too much
 - worried about harm to relationships
 - less optimistic about benefits of negotiation
 - not confident of their negotiation skills
 - relatively risk-averse
- In negotiations, women tend to
 - * ask for less -- and therefore receive less
 - * use “interest-based” negotiation approach, focused on underlying needs/motives rather than narrow concrete goals

(*Getting to Yes: Negotiating Agreement Without Giving In*, Roger Fisher & William Ury, 1990)



- **Solutions** include

- * Professional organizations offer workshops on negotiation skills
e.g. APS Professional Skills Development Workshops offered annually at major physics meetings (sponsored by NSF); has impacted > 250 women physicists since 2005
<http://www.aps.org/programs/women/workshops/skills/>
- * Mentors teach women (and men) that interest-based negotiation is very effective and improve professional relationships
- * Employers offer clear directions to job finalists to avoid unintended bias in discussions of salary and start-up packages

Toward large-scale solutions: the NSF “ADVANCE” Program

Increasing the representation and advancement of women in STEM (science, technology, engineering, mathematics) by

- helping universities and professional societies address aspects of academic culture and institutional structure & practice that pose differential barriers to women
- supporting research on effective practices
- creating a community of researchers and practitioners

Over the last 9 years, \$130M has been invested in grants to 100+ universities and organizations across the country.



MSU's ADVANCE project focuses on ensuring that clear, consistent policies are formulated and followed in faculty

- Recruitment and Hiring
- Annual Evaluation
- Promotion and Tenure
- Leadership Development
- Mentoring

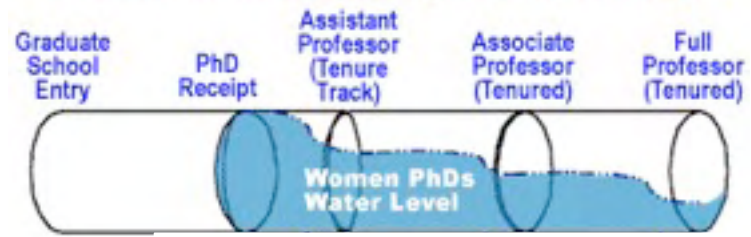


Solutions include

- * Establishing and communicating clear, consistent, objective evaluation criteria for faculty
- * Training administrators
- * Standardized electronic faculty records
- * Resources & guides for administrators and faculty
- * Assistance for units to develop mentoring programs, adopt inclusive search practices, etc.

Conclusions

Leaks in the Academic Pipeline for Women*



- The Leaky Pipeline:

Women's participation rate in physics continues to be low compared to that of men. The scope of the problem is larger than in many other science fields.

Social Science research reveals numerous causes: family responsibilities, dual-career issues, implicit bias, negotiation skills, isolation...

- Research also identifies **solutions** involving individuals, institutions, and funding agencies
 - Clear, known, consistent, family-friendly practices
 - Open discussion of the importance of inclusion
 - Role models, skill-building and mentoring

What can you do?

What can you do?



**EDUCATE
YOURSELF**

What can you do?



**EDUCATE
YOURSELF**



**ACT LIKE
A LEADER**

