Understanding Career Contexts for PhDs in the Life Sciences

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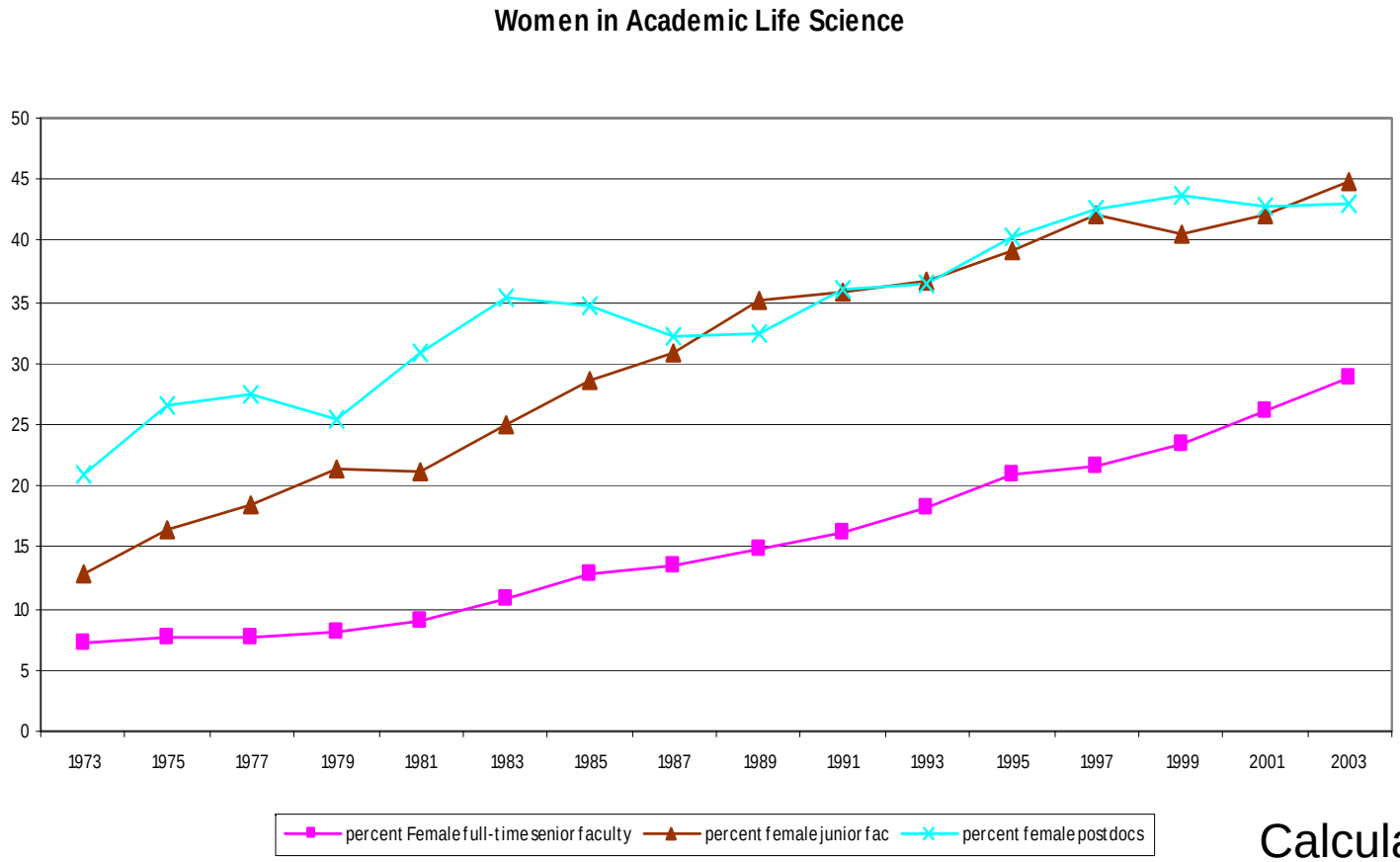
Percent female in academic life science positions (NSF Science & Engineering Indicators 2006)



Calculated from appendix table 5-23, NSF Sci&Eng Ind 2006

Table 12. Female Professors by Rank and Year at Top 50 Departments

Discipline	FY2002*				FY2007			
	Assistant	Associate	Full	All Ranks	Assistant	Associate	Full	All Ranks
Chemistry	21.5%	20.5%	7.6%	12.1%	21.7%	21.3%	9.7%	13.7%
Math	19.6%	13.2%	4.6%	8.3%	28.0%	15.5%	7.2%	12.1%
Computer Sci	10.8%	14.4%	8.3%	10.6%	19.5%	11.3%	11.5%	13.5%
Electrical Engr	10.9%	9.8%	3.8%	6.5%	14.5%	14.1%	6.2%	9.7%
Mechanical Engr	15.7%	8.9%	3.2%	6.7%	18.2%	12.0%	4.9%	9.0%
Physics	11.2%	9.4%	5.2%	6.6%	17.5%	12.6%	6.8%	9.5%
Civil Engr	22.3%	11.5%	3.5%	9.8%	25.3%	14.3%	7.1%	12.7%
Chemical Engr	21.4%	19.2%	4.4%	10.5%	23.7%	17.8%	8.3%	12.9%
Astronomy**	20.2%	15.7%	9.8%	12.4%	25.3%	21.6%	12.3%	15.8%
Economics	19.0%	16.3%	7.2%	11.5%	30.7%	16.0%	8.5%	15.1%
Political Science	36.5%	28.6%	13.9%	23.5%	35.9%	30.1%	17.4%	25.6%
Sociology	52.3%	42.7%	24.3%	35.8%	57.9%	45.6%	28.0%	39.7%
Psychology	45.4%	40.1%	26.7%	33.5%	44.8%	41.9%	29.9%	36.0%
Biological Sci	30.4%	24.7%	14.7%	20.1%	36.0%	30.9%	17.7%	24.8%
Earth Sciences	not available				28.6%	21.7%	10.6%	16.1%

*Chemistry and astronomy data are for FY2003. **Top 40 departments

Donna Nelson, 2007,
http://cheminfo.chem.ou.edu/~djn/diversity/Faculty_Tables_FY07/07Report.pdf

Women as percent of scientists in 2003

- Life Scientists employed in business/industry: 42%
- Life Scientists employed in academia: 44%
- Physical Scientists employed in business/industry: 30%
- Physical Scientists employed in academia: 28%

Calculated from NSF, 2006, *Women, Minorities and Persons with Disabilities in Science & Engineering*, table H-19

Women's entrepreneurship in academic life sciences

Fiona Murray (Murray & Graham 2007; Ding, Murray & Stuart 2006)

- Entrepreneurship is faculty founding, patenting, scientific advisory boards, industry coauthors.
- Firm founding predicted by prestige of institution and faculty rank.
- Of academic entrepreneurs, only 4.7% of founders, 5.6% SAB members are women.

Understanding the gender gap in science

- 1. Social psychological studies of cognitive bias
- Individual level studies of career attainment—i.e., work/family roles, discrimination
- ✓ Organizational level studies
  - Most often focus only on academic settings
  - ✓ My focus—looking at life science careers across academic and industry contexts

Unconscious bias—one example

- Randomized experiment on 238 faculty members (Steinpres et al. 1999)
  - Evaluating CV's of tenure candidates,
  - Evidence of bias by both male/female respondents when CV had female name
- Test yourself online: https://implicit.harvard.edu/implicit/research/

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The double standard: two examples of discrimination

- Life sciences (Wenneras and Wold 1997)

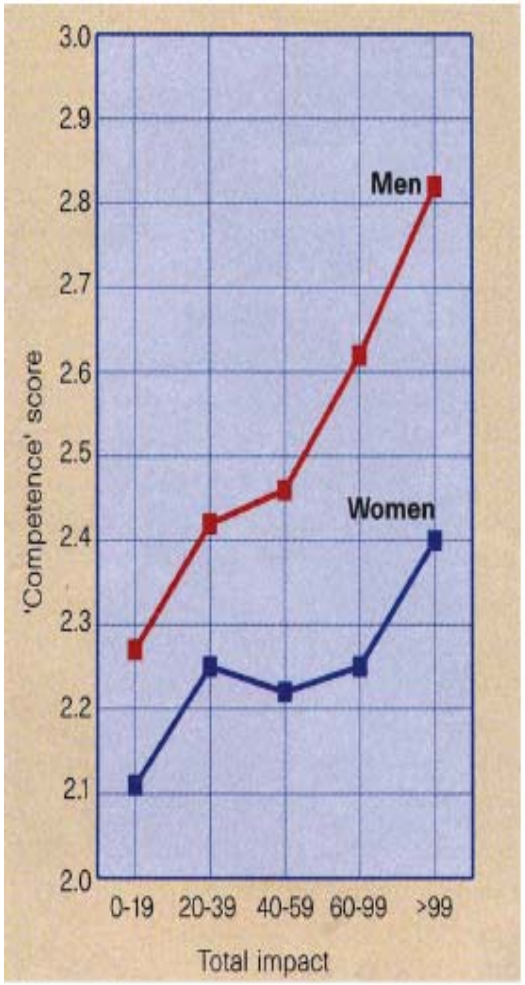

Figure 1 **The mean competence score given to male (red squares) and female (blue squares) applicants by the MRC reviewers as a function of their scientific productivity, measured as total**

- Physics (Towers 2008)
  - Fermilab experiment, Run II Dzero
  - Women postdocs more productive than men postdocs, but awarded 1/3rd as many conference paper presentations on average

Understanding the gender gap in science

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An organizational example: Academic Entrepreneurship (Murray, Ding & Stuart)

- In life sciences, women academics:
  - invited less often to commercialize,
  - have smaller networks, and
  - less propensity toward “selling science” than men academics.

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Network Organizations v. Hierarchies

- Network Organizations:

  Indefinite and sequential interaction structure, norms govern relations, partners pool resources, expectations foster collaboration but are not rule bound, flows of non-redundant "freer" info (Powell 1990).

  Life sciences example: **biotechnology** firms dedicated to human therapeutics

  Question for women in science—do old boy networks flourish in the absence of rules?

- Hierarchies:

  Employment in formal authority structure patterns interaction, rules govern relations, resources (including info) distributed according to rank, mass production of reliable products of a given quality.

  Life sciences examples: multinational pharmaceutical corporations, universities

  Question for women in science—does bureaucratic procedure combat discrimination, or hide biased informal organization?

Data sources

- US life scientists' holding leadership roles in different organizational settings by gender: Smith-Doerr (2004).
- USPTO patenting by organizational setting and gender: Whittington and Smith-Doerr (2008).
- Massachusetts biotechnology firm founders by gender and immigrant status: Monti, Smith-Doerr and McQuaid (forthcoming).

Dependent variable—leadership role in life sciences

TABLE 2

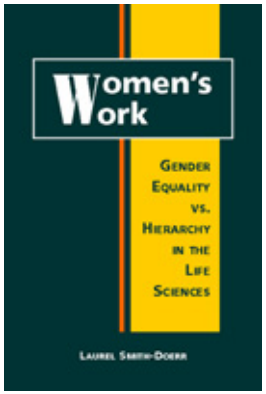
PhD Positions and Supervisory Level

Academic Position	*Industry Position*	*Supervisory Level*
Student in another discipline, RA		0
	Assistant, technician	0
Postdoctoral fellow		0
	Scientist	0
	Team director	1
Assistant professor		1
Associate professor		1
	Department/section head	1
Full professor		1
	Upper research administration	1
Dean/administration		1
	Board of directors, CEO	1

Source: Smith-Doerr (2004, *Soc Perspectives*)

Likelihood of scientists moving into supervisory positions, Network v. Hierarchical settings

	Change in Odds of Supervising in **Network firms**	Change in Odds of Supervising in **Hierarchies**
Men	*No difference*	*No difference*
Women	*7.9 times more likely*	*60% decrease in odds*



Source: Smith-Doerr (2004, *Women's Work*), based on logistic regression analysis controlling for years since PhD, prestige of PhD program; N=2,062

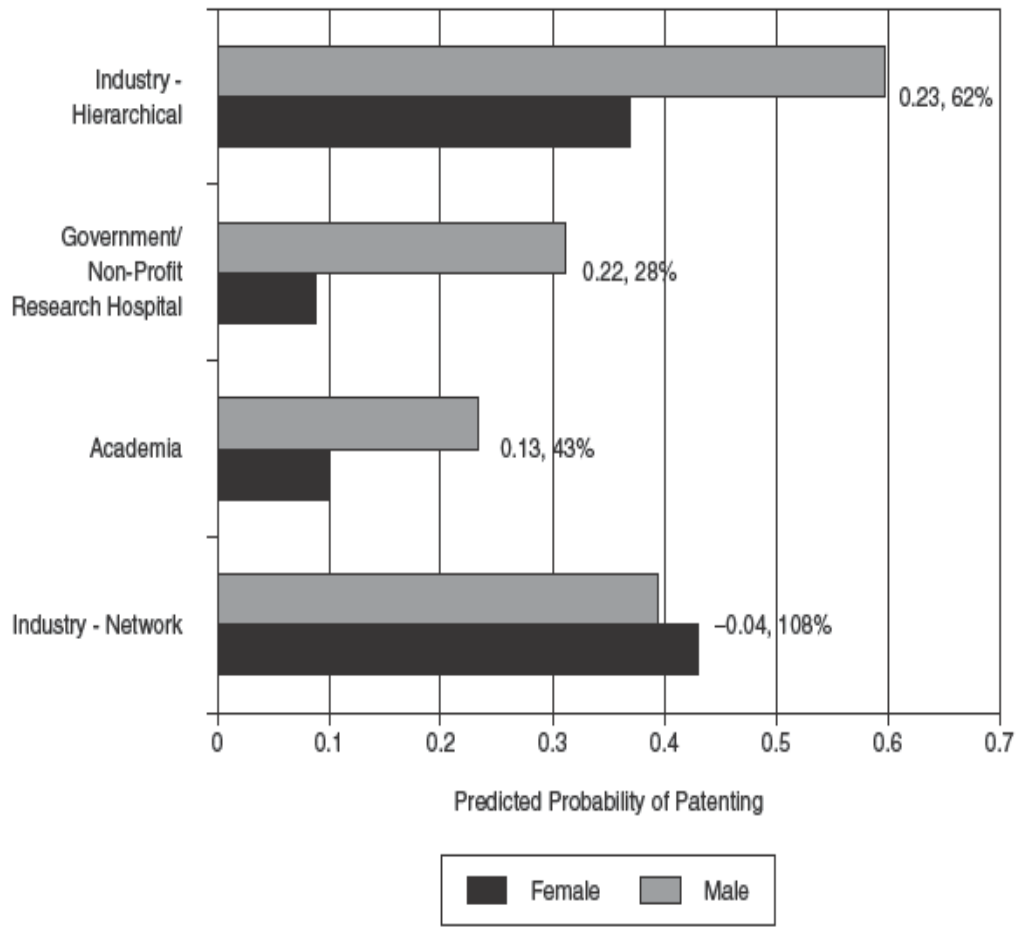
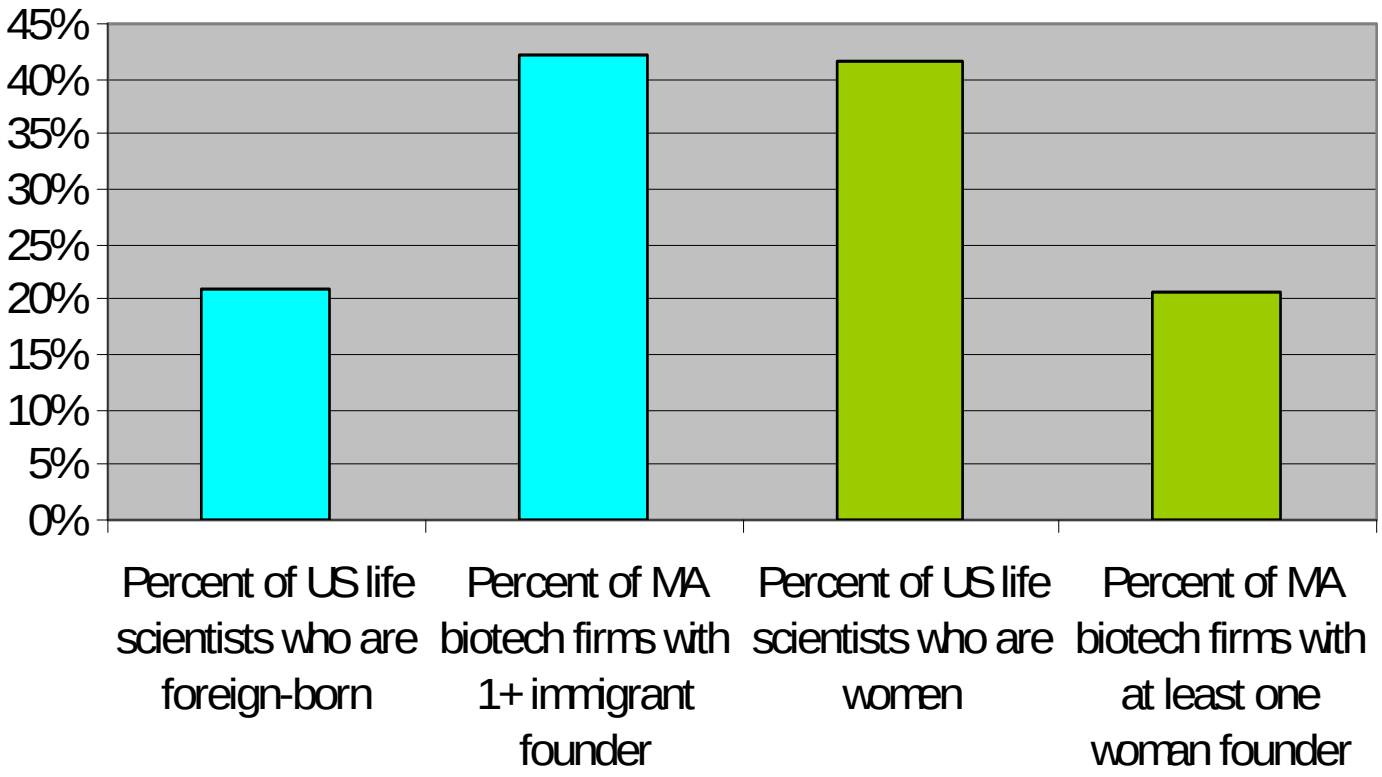


Figure 1: Predicted Probabilities of Patenting, by Sex and Sector

NOTE: Numbers in boxes refer to the difference in probabilities between men and women (M-F) and the F/M predicted probability ratio (multiplied by 100).

Note: All other variables are held at mean.
Source: Whittington and Smith-Doerr (2008). N=961.

A Comparison of US data to Massachusetts and New England biotech founders



US data in 2002 from CPST;
MA data in 2006 from Monti, Smith-Doerr & McQuaid

Why greater equity in biotech firms?

Clues from interviews (Smith-Doerr 2004, N=47).

- **1. Flexibility in collaboration**
  - About a woman scientist friend: "left a tenured position at [an elite university] to go to [a biotechnology firm]…said the university department under [Chairman] was an autocracy…could do science there [at firm]—working with who they wanted to rather than dealing with [Chairman]."
- **2. Transparency**
  - "From my experience at [academic setting] I could tell you many a true story about political infighting…[at biotech firm] we are not compartmentalized—and get to work with many good scientists both here and outside the firm. And we choose who to work with based on non-financial considerations, like how good they are in their field."
- **3. Collective rewards**
  - "While I was on maternity leave here [biotech firm] I could keep in touch with my colleagues who kept it moving forward…when I was a postdoc at [prestigious academic institute], people collaborated somewhat, on the fringes of their work, but still had their main turf which they guarded carefully."

Beyond equity in biotech industry—does network form work elsewhere?

- Kalev (2009): Generalizable to other for-profit organizational settings, and for race equity
- Ridgeway (2009): cultural gender frames work for equity in biological sciences, but not engineering because of masculinity bias

Concluding thoughts

- Importance of investigating variation in employment contexts for women (and men!) in science for innovation as well as equity.
- When do rules help? When do bureaucratic procedures help hide bias?
- Stratification processes vary by gender and race/ethnicity. Need further study of foreign-born women scientists, women of color, and entrepreneurship.

Moving forward

- Global problems require global leadership.
- Interdisciplinary research is crucial for solving problems and innovation
  - Women drawn to interdisciplinarity (Rhoten and Pfirman 2007).
- Need to understand (and change) legitimacy of multiple career paths for PhDs.

Thank you!

Your further thoughts are welcome:

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