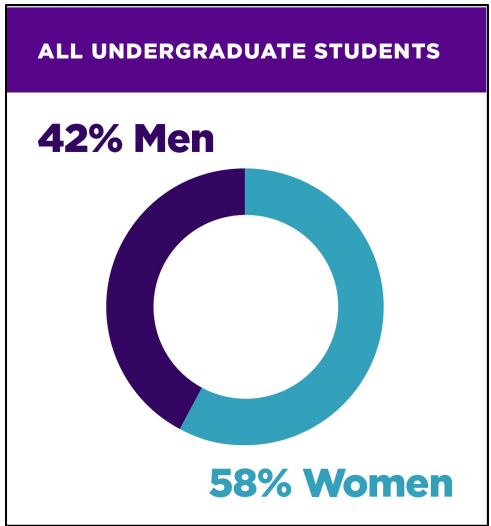


# 12. Feminism, Science, and Technology

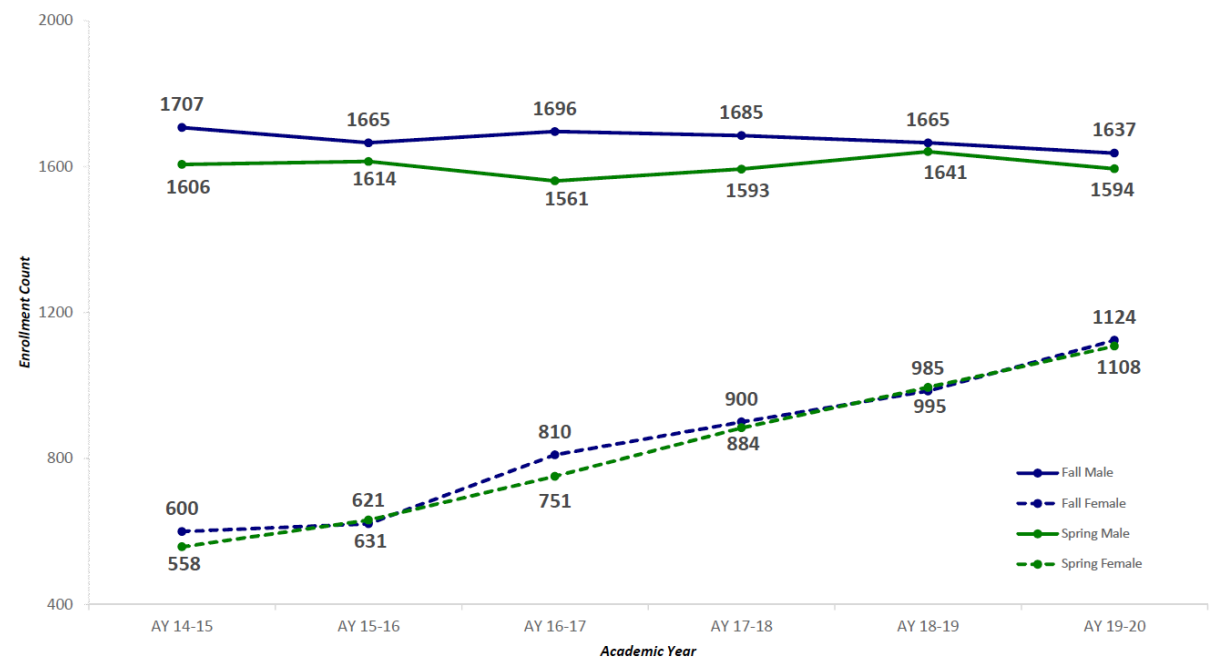
- 1. Gender and Science
- 2. Feminist Analyses of Scientific Knowledge



2018 NYU Student Data  
<https://www.nyu.edu/life/global-inclusion-and-diversity/policies-and-reporting/university-data.html>

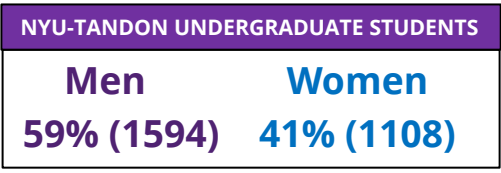
## Undergraduate Enrollment by Gender

(Official, February 17, 2020)



## Spring 2020 NYU-Tandon Student Data

<https://engineering.nyu.edu/about/assessment-and-institutional-research>



Spring 2020 NYU-Tandon Student Data

**81%**  
*increase in women undergrad enrollment since 2015*



*Women make up*  
**46%**  
*of the Class of 2023*

55% Men



45% Women

2018 NYU Faculty Data  
<https://www.nyu.edu/life/global-inclusion-and-diversity/policies-and-reporting/university-data.html>

	male		female		total		male		female		total
<b>NYU</b>						<b>CMU</b>					
Full Prof	35	85%	6	15%	41	Full Prof	75	83%	15	17%	90
Assoc Prof	18	82%	4	18%	22	Assoc Prof	16	64%	9	36%	25
Assis Prof	17	71%	7	29%	24	Assis Prof	16	55%	13	45%	29
<b>total</b>	<b>70</b>	<b>80%</b>	<b>17</b>	<b>20%</b>	<b>87</b>	<b>total</b>	<b>107</b>	<b>74%</b>	<b>37</b>	<b>26%</b>	<b>144</b>
<b>MIT</b>						<b>Stanford</b>					
Full Prof	220	85%	39	15%	259	Full Prof	127	85%	22	15%	149
Assoc Prof	52	75%	17	25%	69	Assoc Prof	43	84%	8	16%	51
Assis Prof	39	68%	18	32%	57	Assis Prof	46	77%	14	23%	60
<b>total</b>	<b>311</b>	<b>81%</b>	<b>74</b>	<b>19%</b>	<b>385</b>	<b>total</b>	<b>216</b>	<b>83%</b>	<b>44</b>	<b>17%</b>	<b>260</b>

2018 Engineering Faculty Data (ASEE College Profiles 2018)  
<https://www.asee.org/papers-and-publications/publications/college-profiles>

*The Science Gender Disparity:*

A gap between the number of women receiving PhDs in science and those hired as junior faculty.

- Number of women PhDs has increased; thus disparity can't be addressed by increasing access for women to PhD programs.
- Are "lifestyle choices" to blame?
  - Do women prefer non-science disciplines?
  - Do women take on a disproportionate amount of child- and family-care?

Moss-Racusin, *et al.* (2012) 'Science Faculty's Subtle Gender Biases Favor Male Students', *Proceedings of the National Academy of Sciences* 109, 16474-9.

- Randomized double-blind study ( $n = 127$ ) in which science faculty from research-intensive universities were asked to rate the application materials of an undergrad student, randomly assigned either a male (John) or a female (Jennifer) name, for a lab manager position.

Results:

- (i) Faculty participants rated male applicant as significantly more competent and hireable than (identical) female applicant.
- (ii) Male applicant was offered higher starting salary and given more career mentoring.
- (iii) Female student was judged more likeable.
- (iv) Gender of the faculty participants did not affect results.

DEMOGRAPHICS

Participant ID #: 149

Name: Jennifer [REDACTED]

Gender: Female

Ethnic Background: Caucasian

Age: 22

Degree: Bachelors of Science, obtained May 2011 from [REDACTED] University

BACKGROUND

GPA: 3.2

GRE score: 650 verbal, 780 quant

Awards/honors: President's Service Award, Rotary Club College Scholarship

Previous research experience: 2 years as a research assistant working with 2 different faculty mentors

Academic standing: appears from Jennifer's transcript that she was in good standing upon graduation, but withdrew from 1 class prior to final

Letters of recommendation: 3 (2 from former faculty research supervisors, 1 from an intro science course professor), all supportive

Future plans: apply to doctoral programs

Extracurricular activities: student government, college learning center tutor

Position sought: Lab Manager

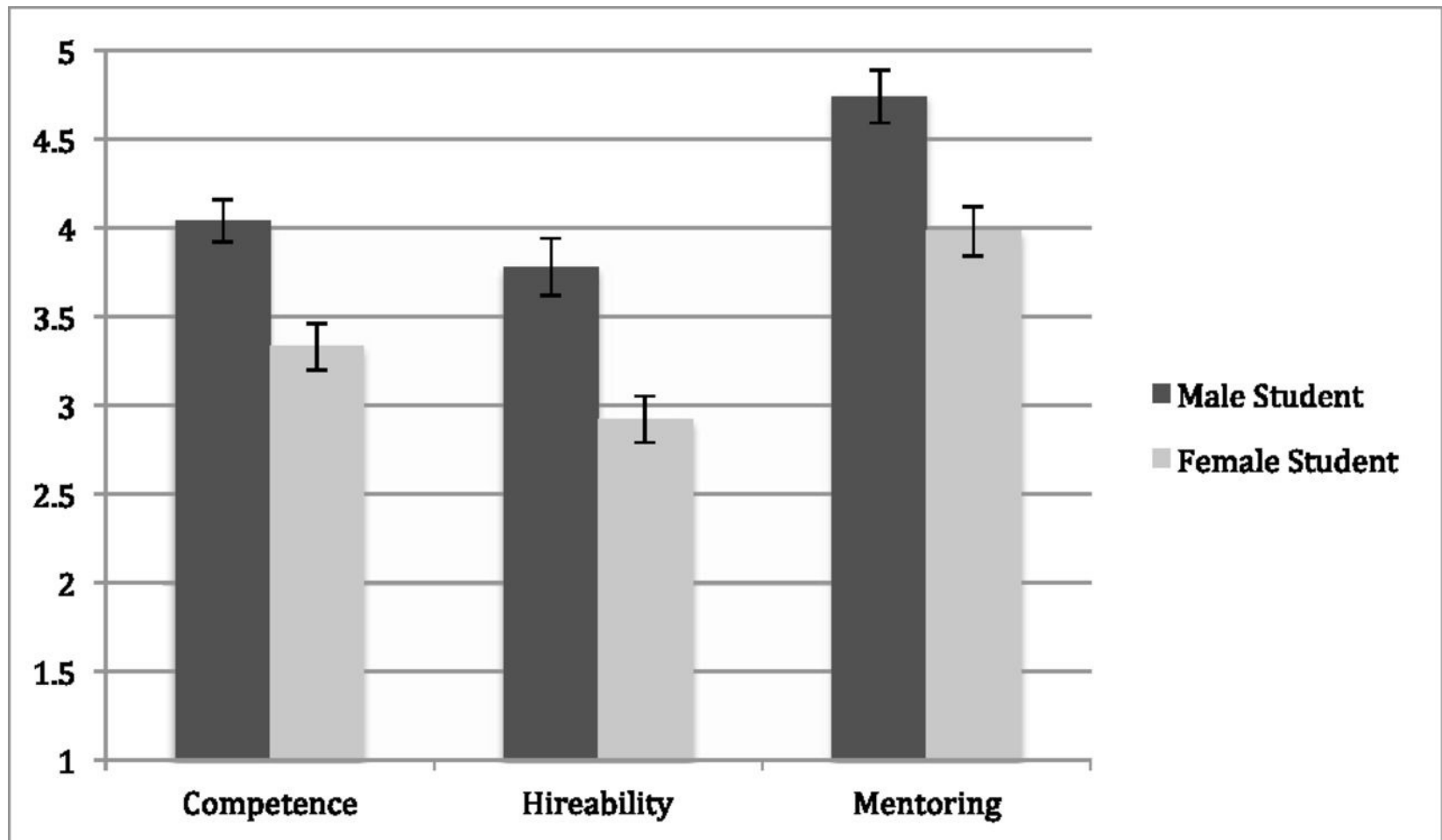
Position duration: 2 years, with possibility of renewal pending satisfactory performance

STATEMENTS/LETTERS

**Excerpt from student statement:** "I am a motivated student and would make the most of the opportunity to serve as your lab manager. After spending a semester working in Dr. [REDACTED]'s lab and another year doing research with Dr. [REDACTED], I have gained valuable technical skills, co-authored a journal article, and am now committed to an academic research career...as someone focused on improving my standing and enhancing my research experience, this lab manager position would provide the perfect opportunity to hone the necessary skills to make me competitive for graduate school applications... additionally, the fascinating research taking place in your lab is directly in line with my interests and experiences...in short, I am focused, motivated, organized and dedicated to improving my research skills. I am enthusiastic about the opportunity to fill the lab manager position and collaborate with you on future research."

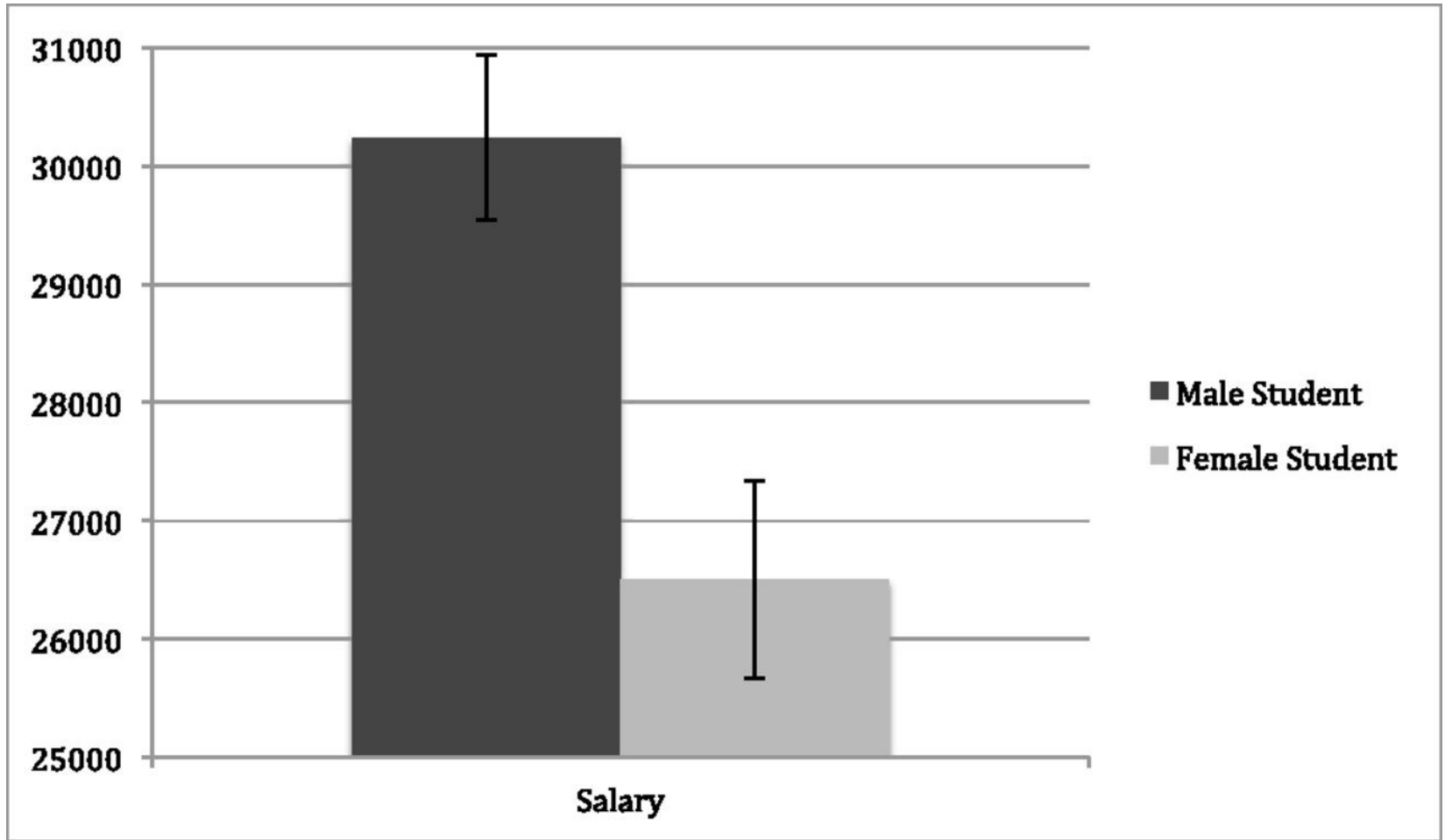
**Excerpt from faculty recommendation letter:** "...although Jennifer admittedly took a bit longer than some students to get serious about her studies early in college, she has impressed me by improving over the last two years of her science coursework and has made every effort to make up for lost ground...she has been a strong research assistant in my lab, and I know she is capable of serving as a dedicated lab manager."

**Competence, hireability, and mentoring by student gender condition (collapsed across faculty gender).**



Moss-Racusin C A et al. PNAS 2012;109:16474-16479

**Salary conferral by student gender condition (collapsed across faculty gender).**



Moss-Racusin C A et al. PNAS 2012;109:16474-16479

## Are faculty biases intentional?

"Past studies indicate that people's behavior is shaped by implicit or unintended biases, stemming from repeated exposure to pervasive cultural stereotypes that portray women as less competent but simultaneously emphasize their warmth and likeability compared with men."

"...research demonstrates that people who value their objectivity and fairness are paradoxically particularly likely to fall prey to biases, in part because they are not on guard against subtle bias."

- Conclusions:

"These findings underscore the point that faculty participants did not exhibit outright hostility or dislike toward the female students, but were instead affected by pervasive gender stereotypes, unintentionally downgrading the competence, hireability, salary, and mentoring of a female student compared with an identical male."

"Our results suggest that academic policies and mentoring interventions targeting undergraduate advisors could contribute to reducing the gender disparity."

"Importance of objective, transparent student evaluation and admissions criteria to guard against observers' tendency to unintentionally use different standards when assessing women relative to men."

# 1. Gender and Science

- Is gender biological or socially constructed?
- Is science gendered?

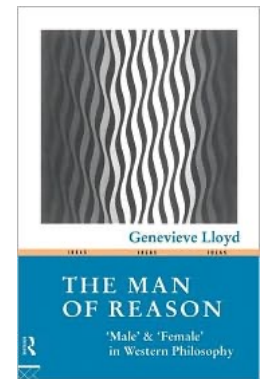
Claim: Cultural assumptions are embedded in the language of science.

Example 1. Francis Bacon, 17th cent.

- Leading figure in articulating a new "experimental method" in transition from Renaissance to early modern period.
  - *nature = wife*
  - *mind (controller) = husband*
  - *characteristics of a "good husband" (scientist)*:
    - *respectful, firm, in charge*
    - "Nature betrays her secrets more fully when in the grip and under the pressure of art [artiface] than when in enjoyment of her natural liberty."
- Does the use of such metaphors have an effect on how science is practiced?
- Do contemporary popular images of science have an effect on who is encouraged to practice it?



Francis Bacon  
(1561-1626)



Lloyd, G. (1984) *The Man of Reason*



## Example 2. Primatology and behavioral ecology.

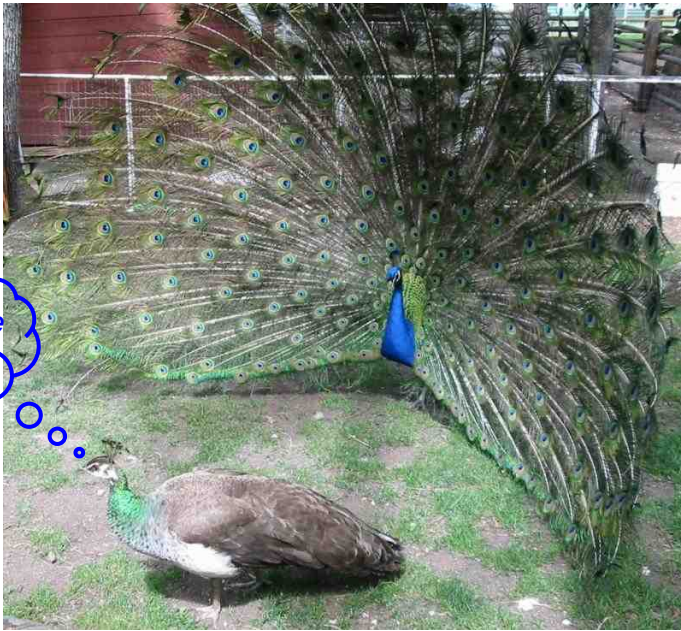
- *Observation:* Male primates exhibit greater variation in reproductive success than females.
  - *A few males have many mates, most of the others don't; whereas females tend to have the same number of mates.*
- *Early explanation (Dominant Alpha Male):*
  - Males control social life and are active in attempting to gain reproductive success.
  - Natural selection sorts the fittest males from the rest.
  - Female roles are passive.





- *Current explanation (Dominant Females):*

- Females play active roles in reproductive success of males.
- Females select physical and behavioral characteristics that distinguish dominant males from submissive males.



*Peafowl: "Drab" peahens select peacocks with the largest, brightest tail displays.*



*Bowerbirds: Drab females select drab males with the greatest building expertise.*

*Claim*: Early views in primatology were due to implicit sexism. Once more women became primatologists, more nuanced (and accurate) analyses of behavior became available.

## **2. Feminist Analyses of Scientific Knowledge**

- (a) Spontaneous Feminist Empiricism
- (b) Philosophical Feminist Empiricism
- (c) Radical Feminist Epistemology
  - (i) Standpoint Epistemology
  - (ii) Difference Feminism
  - (iii) Feminist Postmodernism

# 2. Feminist Analyses of Scientific Knowledge

## (a) Spontaneous Feminist Empiricism

Empiricist Claim: Science should and can be value-neutral.

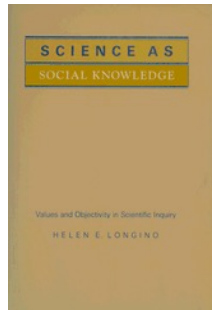
- Thus: Sexism detracts from science and should be avoided.

## (b) Philosophical Feminist Empiricism

Claim: Science *cannot* be entirely value-neutral.

- Empiricism: Belief in an objective, external world.
- Duhem-Quine modifiication: The methods used to investigate the external world are not as objective as traditional empiricists claim.
- But: Commitment to *rational critical discourse* is essential to its normative social structure.
- And: Such a norm requires the input of a diversity of points of view.

Longino's social knowledge



(1990) *Science as Social Knowledge*



Helen Longino

## (c) Radical Feminist Epistemology

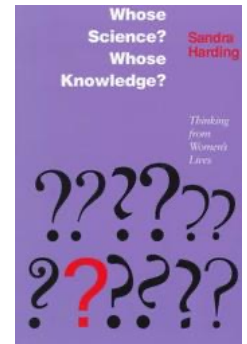
Claim: If scientific facts are socially constructed, and society discriminates against women, then scientific facts inherently discriminate against women.

### Three versions:

#### (i) Standpoint Epistemology

Claim: The viewpoints of oppressed people (women, minorities, disenfranchised social groups) are privileged when it comes to obtaining knowledge about the world.

- There is *no* value-neutrality in science: political and social interests cannot be avoided.
- The oppression of women (and other disenfranchised groups) makes them less dogmatic and more open to change than the views of those in power.
  - *All views distort knowledge of the world; oppressed views distort it the least.*



(1991) *Whose Science?  
Whose Knowledge?*



Sandra Harding

## (ii) Difference Feminism

Claim: There are masculine and feminine perspectives and styles of knowing.

### Masculine

Reductionism

Distanced objectivity

Goal: technical control

### Feminine

Relational

Intimacy between observer and observed

Goal: holistic understanding



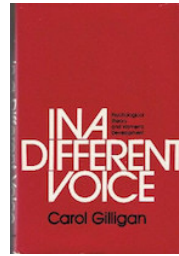
Evelyn Fox Keller  
(1936-2023)



(1983) *A Feeling for the Organism*



Carol Gilligan



(1982) *In a Different Voice*

### • Are engineering virtues gendered?

- *concrete, hands-on tinkering*
- *technical mastery*
- *emotional detachment*
- *social responsibility*

### • Are there distinct engineering subcultures with distinct gendered virtues?

*Civil Engineering*

*Mechanical Engineering*

*Computer Engineering*

*Electrical Engineering*

*Bioengineering*

*Engineering Management*

*Engineering Physics*

*Environmental Engineering*

*etc.*

### (iii) Feminist Postmodernism

Claim #1 (anti-essentialism): There are no essential, foundational characteristics of knowledge.

• Thus (epistemological relativism): No viewpoints should be given privileged epistemological status.

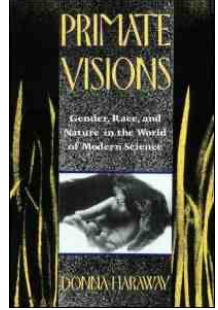
- women
- minorities
- socioeconomic classes
- science

} *Different ways of describing the world, none of which should be privileged over the others.*

Claim #2: Languages have no fixed, definite meaning.

• Thus: Literary, narrative analyses of relations among science, technology, and society are applicable.

- Example (Haraway): Primatology is a "creation myth" of contemporary science (myth of origins) analogous to Christian creation myths and infused with Christian motifs and values.



(1990) Primate Visions



Donna Haraway





Emily Martin

Example. Martin, E. (1991) 'The Egg and the Sperm: How Science has Constructed a Romance Based on Stereotypical Male-Female Roles' *Signs: Journal of Women in culture and Society* 16, 485-501.

Claim: Cultural assumptions are embedded in the language of science.

Particular Claim: "The picture of egg and sperm drawn in popular as well as scientific accounts of reproductive biology relies on stereotypes central to our cultural definitions of male and female."

### Egg characteristics

- large and passive.
- "is transported", "is swept", "drifts".
- Religious overtones: has "vestments" and a "corona, is accompanied by "attendant cells".
- The queen to the sperm's king.
- "a dormant bride awaiting her mate's magic kiss, which instills the spirit that brings her to life".

### Sperm characteristics

- small, "streamlined", active.
- "deliver" genes to the egg.
- "activate the developmental program of the egg".
- have a "velocity", "energy", "fuel".
- tails are "strong" and efficiently powered.
- carry out a "perilous journey" into the "warm darkness" where some fall away "exhausted".



- But: Research suggests egg's role is more active.
- Baltz, Katz, Cone (1988) 'The Mechanics of the Sperm-Egg Interaction at the Zona Pellucida', *Biophysical Journal* 54, 643-54.
  - *Forward thrust of sperm is too weak to penetrate inner layer of egg (zona).*
  - *Sperm motion (side-to-side) suggests escape from egg rather than penetration.*
  - *Adhesive molecules on egg trap sperm.*

"The innermost vestment, the *zona pellucida*, is a glyco-protein shell, which captures and tethers the sperm before they penetrate it... The sperm is captured at the initial contact between the sperm tip and the *zona*... Since the thrust [of the sperm] is much smaller than the force needed to break a single affinity bond, the first bond made upon the tip-first meeting of the sperm and *zona* can result in the capture of the sperm." (Baltz, *et al.*, pp. 643, 650.)

- But: This revisionist account still involves another cultural stereotype: Woman as a dangerous and aggressive threat.
  - *Active egg "captures and tethers" sperm (like a spider lying in wait in her web).*
  - *Egg's nucleus "interrupts" the sperm's dive and "clasps the sperm and guides its nucleus to the center".*

"New data did not lead scientists to eliminate gender stereotypes in their descriptions of egg and sperm. Instead, scientists simply began to describe egg and sperm in different, but no less damaging, terms." (Martin, pg. 498.)

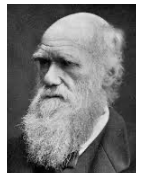
- A less stereotypical view: the cybernetic model.
  - feedback loops
  - flexible adaptation to change
  - coordination of the parts within the whole
  - evolution over time
  - changing response to the environment
- 19th century interaction between social and natural sciences:
  - *Malthus on population control of poor, Spenser on economic "survival of the fittest"...*
  - *...influenced Darwin's concept of natural selection in Origin of Species...*
  - *...which, in turn, was used to justify Malthusianism and social Darwinism.*



Thomas Malthus  
(1766-1834)



Herbert Spencer  
(1820-1903)



Charles Darwin  
(1809-1882)

"What we are seeing now is similar: the importation of cultural ideas about passive females and heroic males into the 'personalities' of gametes. This amounts to the 'implanting of social imagery on representations of nature so as to lay a firm basis for reimporting exactly that same imagery as natural explanations of social phenomena'." (Martin, pg. 500.)



Rene Almeling

*Follow-up.* Almeling, R. (2023) 'What Biological Stories are Americans Telling About the Egg and the Sperm? A Study Inspired by Emily Martin 30 Years Later', *Gender and Society* 37, 750-773.

- Interviews with  $n = 47$  individuals.
  - Metaphor #1: Active Sperm/Passive Egg
  - Metaphor #2: Sperm and Egg as Equal Parts

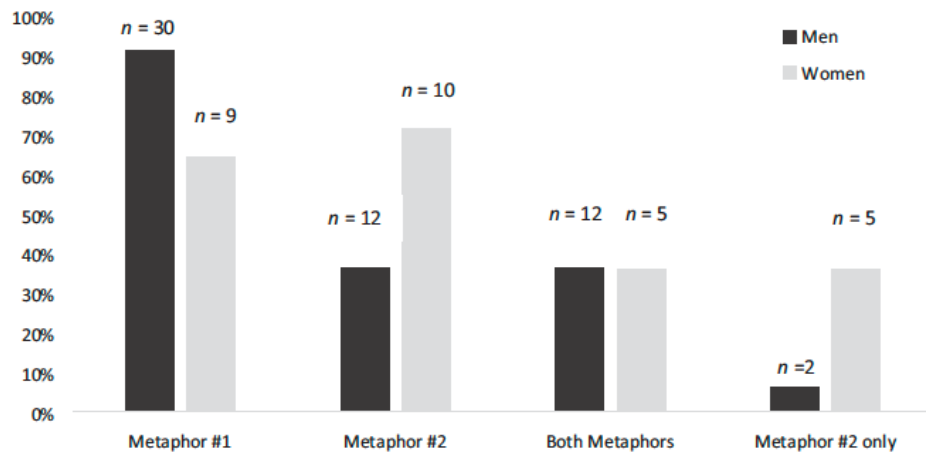


FIGURE 1: Percentage and Number of People Using Metaphors, by Gender

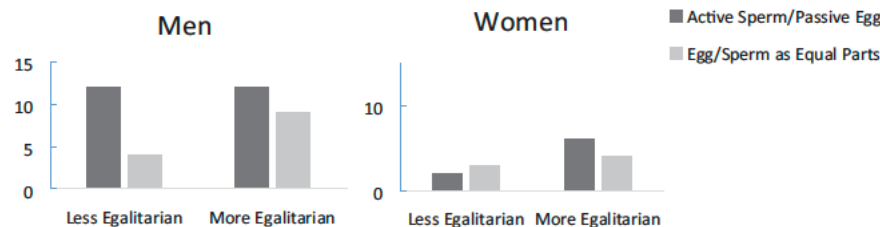


FIGURE 2: Number of People Using Metaphors, by Gender and Egalitarianism