Gender in STEM: Trends, Paradoxes, and Job Talks
April 12, 2019

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Outline

• Surprising patterns in women’s participation in CS & STEM
  • Time
  • Different countries
  • Socioeconomic levels

• My gender-STEM projects
  • Job talks: interruptions & introductions
  • Career assessment tools, faculty hiring, book project...

• Suggestions for what individuals can do
Women’s Under-representation in STEM

BIOLOGICAL FACTORS
- Strength
- Height
- Psychological factors
- Reproductive needs...

SOCIAL FACTORS
- Parental Influence
-Advertisements
- Societal Expectations
- Discrimination
- Role models...

Aptitudes
Preferences

Job Choice
Law & Medical degrees: % women, 1971-2010

Change over decade

+23

+14

+23

+10

+10

+7

+3

+5
STEM B.S. degrees: % women, 1967-2017

Bachelor's Degrees Earned by Women

- All Bachelor's
- Biology
- Chemistry
- Math & Stats
- Earth Sciences
- Engineering
- Physics

Source: IPEDS and APS
Female Share of Bachelor's Degrees in Computer Science, 1970-2016

What happened?

Going up again

Source: US Department of Education

Carpe Diem
Why? Hypothesis 1. Personal computers arrived in the home... went to sons not daughters

Clive Thompson, “The Secret History of Women in Coding,”
New York Times Magazine, February 2019

Boy gets pre-college experience with coding, better prepared for intro CS course

Girl worries about relative lack of preparation? Course moves at a faster pace?

Girl leaves CS
Why? Hypothesis 2. Women react more strongly to downturns

Stuart Reges, “Why Women Don’t Code,” Quillette, June 2018

Proportion of entering students who plan to major in CS, by gender, 1971 - 2015

Recession: Nov 1982
unemployment = 10.8%

Dot-com crash

Source: Cooperative Institutional Research Program Freshman Survey, Higher Education Research Institute, UCLA
### Why? Hypothesis 3. Hollywood

<table>
<thead>
<tr>
<th>Movie</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tron</td>
<td>1982</td>
</tr>
<tr>
<td>WarGames</td>
<td>1983</td>
</tr>
<tr>
<td>Revenge of the Nerds</td>
<td>1984</td>
</tr>
<tr>
<td>Weird Science</td>
<td>1985</td>
</tr>
<tr>
<td>Back to the Future</td>
<td>1985</td>
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</table>

From 1980 onward, there were powerful social and economic changes that led to many sociocultural effects. These effects include:

- **BIOLOGICAL FACTORS**
  - Strength
  - Height
  - Psychological factors
  - Reproductive needs

- **SOCIAL FACTORS**
  - Parental Influence
  - Societal Expectations
  - Advertisements
  - Discrimination
  - Role models

**Science Education in Other Countries**

In more than 20 countries, women earn the majority of STEM bachelor’s degrees.
Iran
Oman
Saudi Arabia
UAE
Romania
Algeria
Bulgaria
Malaysia
Kyrgyzstan
Italy
Uzbekistan
Georgia
Panama
Lebanon
Argentina...

Why do wealthy countries have fewer women in STEM?


1. Personal economic security & national development
   more central concerns in developing societies
   – Affluent people can study subjects that don’t lead to secure or
     high-paying jobs.

2. College viewed as identity construction and self-realization:
   – Expressing your essential male/female selves, rather than
     career preparation, economic betterment

3. More high school choices:
   – Art, drama, languages... Girls can opt out of STEM

4. More college choices created for girls:
   – Home economics, early childhood education, gender studies
5. Consumerism:

– Sell more toys if boys/girls play with different stuff
Why do wealthy countries have fewer women in STEM?

6. “Follow your passion”
   - Many 18-year-olds don’t know their passion
   - *What does society expect me to be passionate about?*
   - Becomes a stereotypical gendered choice

7. Self-reinforcing:
   - Fewer opportunities to socialize with other girls in STEM clubs
   - Believing in difference can produce difference (e.g., stereotype threat)
Why do many conservative Muslim countries have more women in STEM?

1. **Single-sex education:**
   - More girls enjoy STEM when no pressure to appear feminine
   - No need to “dumb down”

2. **Military, religious, political jobs:**
   - Only for men in some countries, leaving more STEM jobs for women

3. **Appropriate environments for women:**
   - Chemistry lab vs. courtroom
Two counter-intuitive patterns so far...

1. CS has a different trend from math, engineering fields, everything else...

2. Developing countries and, in particular, conservative Muslim countries, have more women in STEM
U.S. Math/ELA patterns by socioeconomic level

260 million standardized test scores
Roughly 10,000 U.S. school districts
Grades 3-8

Reardon, Fahle, Kalogrides, Podolsky, Zarate, Stanford Center for Education Policy Analysis, CEPA Working Paper No. 18-13
Why? Hypothesis 1. Parents invest time/money resources in their children in gendered ways

Parents have gender stereotypes

Leading children to develop

Gendered interests

Broad social norms

Lead children to develop

Gendered interests

Parents respond & reinforce

Either way, greater investments from affluent families can lead to greater gender differences in children’s interests, identities, and skills
Why? Hypothesis 2. Different returns on educational investments

Wealthy families: Men earn more than women

Leading to

Higher expected return on education for boys

Lower SES conditions (especially single-mom families)

Higher expected return on education for girls

- Sons of high-status fathers tend to achieve higher educational attainment than daughters
- Among low SES families, boys have lower academic & economic outcomes than girls
Extraordinarily complex set of causes:

- Social/cultural/economic/religious/etc

We can do something about many of these
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  • Different countries
  • Socioeconomic levels

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• Suggestions for what individuals can do
My roles & projects

• **Co-Director, Center for Research on Gender in STEMM**
  • [http://crg-stemm.ucsd.edu](http://crg-stemm.ucsd.edu)
  • Research on engineering job talks
  • Research on career assessment tools

• **Faculty Equity Advisor, Jacobs School of Engineering (7 years)**
  • Faculty search committee training
  • Mentoring

• **Community involvement**
  • Book project, talks at schools
  • Volunteer with Girl Scouts
  • Many presentations in the community
Gender Gap in Engineering Faculty: Many Causes

Not much studied: The Interview Day

• 1-hour research seminar open to faculty, students
  • Questions & interruptions
  • Introductions

• Many contexts studied: Corporations, press briefings, parent-child, fictional TV, supreme court,...
How would you define an Interruption?

• Simultaneous speech more than two syllables before the end of someone’s sentence
• Interrupting in midst of incomplete grammatical unit
  – It’s raining outside so I am going to leave.
  – It’s raining outside ...
  – It’s...

Didn’t raise your hand; didn’t get acknowledged by the speaker
Definitions of Interruptions

Presenter is Presenting:

- Raise hand, get acknowledged
  - ACKNOWLEDGED QUESTION

- Otherwise
  - INTERRUPTION

Presenter is Answering a Question:

- Wait until presenter finishes answer, ask another question without raising hand
  - FOLLOW-UP QUESTION

- Otherwise (speech overlap)
  - INTERRUPTION
First Data Set: Video recordings of job talks

- 140 videos
- 91 men, 49 women
- Range of seniority:
  - PhD students: 44
  - 1-2 years out: 26
  - 3-6 years out: 40
  - 7-21 years out: 30
- 2 large public R1 schools
- Multiple departments
  - EE, CS, ME, BioEng
- Data analysis from pre-Q&A portion

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
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<tbody>
<tr>
<td>Presenting</td>
<td>10:03</td>
</tr>
<tr>
<td>Question (Acknowledged)</td>
<td>00:07</td>
</tr>
<tr>
<td>Answer</td>
<td>00:12</td>
</tr>
<tr>
<td>Presenting</td>
<td>03:53</td>
</tr>
<tr>
<td>Question ( Interruption)</td>
<td>00:03</td>
</tr>
<tr>
<td>Answer</td>
<td>00:06</td>
</tr>
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</table>
Number of Questions vs. Length of Talk

Blair-Loy, Rogers, Glaser, Wong, Abraham, Cosman, "Gender in Engineering Departments: Are there Gender Differences in Interruptions of Academic Job Talks?," Social Science, 2017
## Results (excluding Bioengineering)

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Men</th>
<th>Women</th>
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<tbody>
<tr>
<td>Interruptions</td>
<td>3.77</td>
<td>4.95</td>
</tr>
<tr>
<td>Ack. Questions</td>
<td>5.49</td>
<td>5.39</td>
</tr>
<tr>
<td>Follow-ups</td>
<td>4.83</td>
<td>6.66</td>
</tr>
<tr>
<td>Total Questions</td>
<td>14.1</td>
<td>17</td>
</tr>
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- **Gender effect:**
  - Women get 3 more questions, on average
  - Women experience more talks with zero questions
  - Conditioned on getting any questions, women get 6 more questions than men, on average

- **Seniority effect**

- **Department effect:** Some depts much more aggressive (Bioengineering is very different, almost no questions)
Is it Bad to get More Questions?

• Could be a sign of audience interest
• No outcome information (offers, hires)
• More questions correlated with speaker having to rush:
  – “There’s not much time left; I will rush through this”
  – “I’m going to skip to the end”
Preliminary research: Analyses of Introductions

• 85 Introductions transcribed
• No difference in first/last name use
• Research awards:

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<tr>
<th></th>
<th>Listed in CV</th>
<th>Mentioned in Intro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>78%</td>
<td>52%</td>
</tr>
<tr>
<td>Women</td>
<td>73%</td>
<td>27%</td>
</tr>
</tbody>
</table>

• Counting irrelevant statements in intro:
  – Things that wouldn’t be found in the CV
  – Women: 41 %
  – Men: 14 %
My Own Story of an Irrelevance…

- Stanford Biostatistics Colloquium, mid-90’s
- But going back some years earlier… when I was a senior at Caltech, I was one of Glamour Magazine’s Top Ten College Women 1987.
Introduction: “The only speaker at our biostatistics colloquium who has had a swimsuit photo in Glamour Magazine!”
Suggestions for Engineering Departments

• Standardize strongly positive introductions for all faculty candidates

• If questions get out of hand:
  – Ask audience to hold remaining questions for the end
  – Most natural for introducer to say this
  – But any faculty member in audience can step in

• Engineering should have a less aggressive culture!
Career Assessment Tools (CATs)

- CATs are questionnaires that attempt to ascertain a person’s interests and aptitudes, and that suggest possible careers.
- Taken by 3000+ undergrads at UCSD each year
Do CATs suggest engineering as a career to women as much as they do to men?

- 121 engineering students
  - 53% women, 18% underrepresented minorities (URM)

<table>
<thead>
<tr>
<th>O*Net</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least one engineering occupation</td>
<td>66%</td>
<td>40%</td>
</tr>
<tr>
<td>occupation recommended</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median rank 1st engr occupation</td>
<td>7</td>
<td>&gt;20</td>
</tr>
<tr>
<td>recommended (top=1)</td>
<td></td>
<td></td>
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- After controlling for GPA & satisfaction with major: O*Net less likely to recommend Eng major to women
Outreach Projects

• Girl Scouts, Splash, school talks

• Children’s book (ages 9-11) that teaches a little about Electrical Engineering (error correction coding) through fiction

• *My attempt at social engineering*: Both lead characters = girls

• *Publisher’s idea of social reality*: Don’t even think about it.

“Girls are willing to read about boys but boys are not willing to read about girls”

Delancey ➔ Daniel
Some Assorted Recommendations

1. Do not say “Follow your passion”
   • Instead say “Nurture an interest”

2. Women: Never say “I hated math... I could never understand it”
   • Even if it’s true, don’t say it
   • Believing in difference can actually produce difference
   • Find something else to be self-deprecatory about

3. Men: Suggest item #2 to the women in your life

4. Encourage children to:
   • Draw
   • Work with their hands
   • Play games that involve fitting things into places
   • Play with construction toys
More Assorted Recommendations

5. Teach children that intellectual skills can be acquired
   • Praise children for effort not innate brilliance
   • Talented and gifted programs should send the message that they value growth and learning

6. Portray challenges, effort and mistakes as highly valued

7. Expose girls to successful role models

8. Encourage girls to join robotics clubs, Girls Who Code, math clubs, etc.

9. Pre-screen media regarding portrayals of women scientists
The “Gender of Science” is a cultural construct that varies across
- time
- nations
- socioeconomic levels

When talking to scientists and engineers about sociology, data is important

U.S. needs more computer scientists!

Many things individuals can do to help