The plan

• 20 minutes (John)

Science faculty’s subtle gender biases favor male students
Corinne A. Moss-Racusin\textsuperscript{a,b}, John F. Dovidio\textsuperscript{b}, Victoria L. Brescoll\textsuperscript{c}, Mark J. Graham\textsuperscript{a,d}, and Jo Handelsman\textsuperscript{a,1}
\textsuperscript{a}Department of Molecular, Cellular and Developmental Biology, \textsuperscript{b}Department of Psychology, \textsuperscript{c}School of Management, and \textsuperscript{d}Department of Psychiatry, Yale University, New Haven, CT 06520
Edited by Shirley Tilghman, Princeton University, Princeton, NJ, and approved August 21, 2012 (received for review July 2, 2012)
Despite efforts to recruit and retain more women, a stark gender disparity in science (9–11), and that it “is not caused

• 20 minutes (Sandro)

Quantitative evaluation of gender bias in astronomical publications from citation counts
Neven Caplar\textsuperscript{1}, Sandro Tacchella\textsuperscript{1} and Simon Birrer

Numerous studies across different research fields have shown that both male and female referees consistently give higher scores to work done by men than to identical work done by women (number of references), we have to be careful when interpreting the quoted difference in the number of citations. We attempt to separate the gender bias effect from the effect caused by some number...
Underrepresentation of women in Science and Engineering
Underrepresentation of women in Science and Engineering

Figure 5-15
Women as percentage of SEH doctorate holders with full-time employment in academia, by academic rank: Selected years, 1973–2008

Figure 3-32
Estimated differences in full-time salary between women and men with highest degree in S&E, controlling for selected employment and other characteristics, by degree level: 2008
Science faculty's subtle gender biases favor male students

Corinne A. Moss-Racusin, John F. Dovidio, Victoria L. Brescoll, Mark J. Graham, and Jo Handelsman

Department of Molecular, Cellular and Developmental Biology, Department of Psychology, School of Management, and Department of Psychiatry, Yale University, New Haven, CT 06520

Edited by Shirley Tilghman, Princeton University, Princeton, NJ, and approved August 21, 2012 (received for review July 2, 2012)

Despite efforts to recruit and retain more women, a stark gender disparity in science (9–11), and that it “is not caused


by CA Moss-Racusin - 2012 - Cited by 1112 -
Why the gender imbalance?

- “evidence [suggests] biological sex differences in inherent aptitude for math and science are small or nonexistent”

- Claims by some that “women’s preference for nonscience disciplines and their tendency to take on a disproportionate amount of child- and family-care are the primary causes of the gender disparity”, but these studies are correlational

- Moss-Racusin et al’s approach: do an experiment to directly test for gender bias
Procedure

- 3 “geographically diverse” regions in the U.S.
- 1 private & 1 public school from each
- Schools matched in size and prestige at undergrad & grad level
- Identify physics, chemistry, biology depts. (23 total)
- Select tenure-track non-emeritus faculty
- Request their participation in a [fake] study
The cover story

To study this question, we have compiled and summarized information from actual applications of students who have recently applied to be lab managers at universities across the country.
The cover story

To study this question, we have compiled and summarized information from actual applications of students who have recently applied to be lab managers at universities across the country.

Today, we will be assigning you to read the applicant profile of one randomly-selected student from the nationwide database. Please imagine that you are actually evaluating this student’s application to work in your own lab. After reading the applicant profile, you will be asked to provide your opinions of the student, and offer them feedback as they make decisions about moving forward with their career.
The identical application everyone received

Designed to “reflect slightly ambiguous competence”
Professors then answered the following

*Most of these questions are answered on a scale of 1 to 7.*

- **Student competence**
  - e.g. “How qualified do you think the applicant is?”

- **Student hireability**
  - e.g. “How likely would you be to hire the applicant?”

- **Salary Conferral**
  - “If you had to choose one of the following starting salaries for the applicant, what would it be?” $15k, $20k, $25k, $30k, $35k, $40k, $45k, $50k

- **Mentoring**
  - e.g. “If you encountered this student at your institution, how likely would you be to encourage the applicant to stay in the field if he/she were considering changing majors?”

- **Subtle Gender Bias**
  - e.g. on a scale of 1-7, how strongly do you agree “Discrimination against women is no longer a problem in the United States”

- **Likability**
  - e.g. “Would the applicant fit in well with other lab members?”
Results: I

Fig. 1. Competence, hireability, and mentoring by student gender condition (collapsed across faculty gender). All student gender differences are significant.
Results: II

Fig. 2. Salary conferral by student gender condition (collapsed across faculty gender). The student gender difference is significant ($P < 0.01$). The scale
Results: III

Gender → relative Competence

relative Competence → relative Hireability
Results: III

Gender \rightarrow \text{relative Competence} \rightarrow \text{relative Hireability}
Results: III

- Gender
  - relative Competence
  - relative Hireability

- Subtle Gender Bias
  - Competence of women
  - Hireability of women
  - Mentorship of women
Results: III

Gender → relative Competence → relative Hireability

Subtle Gender Bias → Competence of women → Hireability of women → Mentorship of women → but not men
Results: III

Gender

relative Competence

relative Hireability

Subtle Gender Bias

Competence of women

Hireability of women

Mentorship of women

Gender

Likability

women seen as more likable

but not men
The story

• Profs considered female students less **hirable**

• … because they considered the female students less **competent**

• … because of **subtle gender bias**

• Female and male profs were equally subject to this bias
Suggestions for action

• “Our results suggest that academic policies and mentoring interventions targeting undergraduate advisors could contribute to reducing the gender disparity”

• “educating faculty and students about the existence and impact of bias within academia”

• “establishing objective, transparent student evaluation and admissions criteria”
Quantitative Evaluation of Gender Bias in Astronomical Publications from Citation Counts

Neven Caplar, Sandro Tacchella & Simon Birrer
Women in Science – Why so Few?

Meg Urry
Department of Physics, Yale University
Gender difference in astronomy

Davenport+14: women ask less questions at conferences

Reid+14: women are less likely to get telescope time (seems even more so for older women)

Is there a difference between men and women in citations counts?
Method

• gathering data
  – all the information gathered in single effort in June 2016
  – if paper is available on arXiv, also record the subfield of the paper and download the source *.tex file

• adding paper information
  – *.tex file used to establish length of papers
  – subfield determined from abstract for papers where subfield is not recorded
Method

• adding information about authors
  – Country of origin from affiliation
  – Seniority = time since the first paper in our database
  – Gender
    • We run the name through 3 different databases
      ✴ SexMachine (40,000 names, done by native speakers)
      ✴ Data from USA Social Security Administration and UK Office of National Statistics (highly complete but geographically limited)
      ✴ Gender API (commercial service)
    • Agreement between databases around 98.5%
### Table 1A
Example of the data available (first 8 columns)

<table>
<thead>
<tr>
<th>Bibcode</th>
<th>First Author$^1$</th>
<th>First name</th>
<th>Gender</th>
<th>first publication year$^2$</th>
<th># citations</th>
<th># references</th>
<th># authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990MNRAS.246..565A</td>
<td>Aspin, C.</td>
<td>Colin</td>
<td>male</td>
<td>1981</td>
<td>19</td>
<td>26</td>
<td>4</td>
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<tr>
<td>1990Natur.345..49T</td>
<td>Torbett, Michael V.</td>
<td>Michael</td>
<td>male</td>
<td>1980</td>
<td>48</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>1993A&amp;A...277..677M</td>
<td>Meier, R.</td>
<td>Roland</td>
<td>male</td>
<td>1993</td>
<td>97</td>
<td>77</td>
<td>4</td>
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<tr>
<td>1996A&amp;A...309..171S</td>
<td>Shibanov, Y. A.</td>
<td>Yuriii</td>
<td>male</td>
<td>1992</td>
<td>42</td>
<td>18</td>
<td>2</td>
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<tr>
<td>1997A&amp;A...324L..5C</td>
<td>Cambresy, L.</td>
<td>Laurent</td>
<td>male</td>
<td>1997</td>
<td>58</td>
<td>12</td>
<td>8</td>
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<tr>
<td>2002A&amp;A...381L..25M</td>
<td>Meynet, G.</td>
<td>Georges</td>
<td>male</td>
<td>1985</td>
<td>82</td>
<td>31</td>
<td>2</td>
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<tr>
<td>2010ApJ...711.1310K</td>
<td>Khati, Rishi</td>
<td>Rishi</td>
<td>male</td>
<td>2010</td>
<td>3</td>
<td>37</td>
<td>2</td>
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<tr>
<td>2014ApJ...780..111H</td>
<td>Heitmann, Katrin</td>
<td>Katrin</td>
<td>female</td>
<td>2006</td>
<td>63</td>
<td>57</td>
<td>5</td>
</tr>
</tbody>
</table>

---

1. Name of the first author as specified in the paper.
2. Year in which the leading author of the paper in question published their first paper.

### Table 1B
Example of the data available (continued, last 9 columns)

<table>
<thead>
<tr>
<th>Region</th>
<th>Year</th>
<th>Journal</th>
<th># field$^3$</th>
<th># floats$^4,5$</th>
<th># equations</th>
<th># math inline</th>
<th># words</th>
<th># Bibcode of first publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAMERICA</td>
<td>2010</td>
<td>APJ</td>
<td>3</td>
<td>8</td>
<td>10</td>
<td>160</td>
<td>2709</td>
<td>2010ApJ...711.1310K</td>
</tr>
<tr>
<td>NAMERICA</td>
<td>2014</td>
<td>APJ</td>
<td>3</td>
<td>17</td>
<td>14</td>
<td>502</td>
<td>11456</td>
<td>2006ApJ...642L..85H</td>
</tr>
</tbody>
</table>

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4. $^4$floats include both figures and tables
5. $^5$with -99 we denote that there is no data available for this quantity
Method

• Total: 208,577 entries
• Final dataset: 149,741 entries
• Cleaning data
  – entries with zero citations or zero references (4,417 ADS entries);
  – authors that have only published in Science and/or Nature (5,484 ADS entries);
  – entries with no authors specified (491 ADS entries);
  – entries with no first name for the first author (e.g. collaboration articles; 7,713 ADS entries);
  – entries for which first author only used initials for all publications available in the dataset (42,448 ADS entries)
  – entries for which the gender of the first name of first author could not be determined (2,260 ADS entries)
Properties of the sample

Slow increase of the fraction of the papers written by women.
Properties of the sample

(a) 

(b) 

(c)
Gender difference: ratio of mean number of citation for papers written by men over mean number of citations for papers written by women

Constant fit to data since 1985: Men receive ~6% more citations
How to control for difference in the properties of the sample?

idea:
train random forest algorithm on the sample of papers written by men and use it on the sample of papers written by women

non-gender-specific parameters:
• seniority of the first author
• number of references
• total number of authors
• year of publication
• journal of publication
• field of study
• geographical region of the first author’s institution

assumption:
men and women should receive the same number of citations for papers that have the same non-gender-specific properties
⇒ any difference in the citation counts between papers led by men and women with matched non-gender properties is labeled as “gender bias”
Gender bias: measured over predicted number of citations for papers authored by women

Constant fit to data since 1985: Women receive 10.4±0.9% less citations
Summary

- analysis of over 200,000 publications from astronomy
- gender difference of 6%
- but samples differ in their properties: we find that women receive $10.4 \pm 0.9\%$ less citations than expected given the parameters of their papers, i.e., we expect that if there was no bias men should receive 4\% fewer citations in the sample
- Most important parameters (Gini importance): 1. number of references, 2. year of publication, 3. journal
Suggested questions for discussion

1. Why is there a gender bias in the number of citation a paper gets?
2. What kind of numbers / studies would you like to see in order to address gender bias better?
3. What institutional procedures can we adopt at the CfA to help us avoid subtle gender bias? Are transparent hiring standards feasible?
4. What day-to-day practices can we adopt among ourselves to help us avoid subtle gender bias?
• Do women leave astronomy more often than men?
• We find no difference in fraction of authors who have left the field

• Women publish less than men in our sample