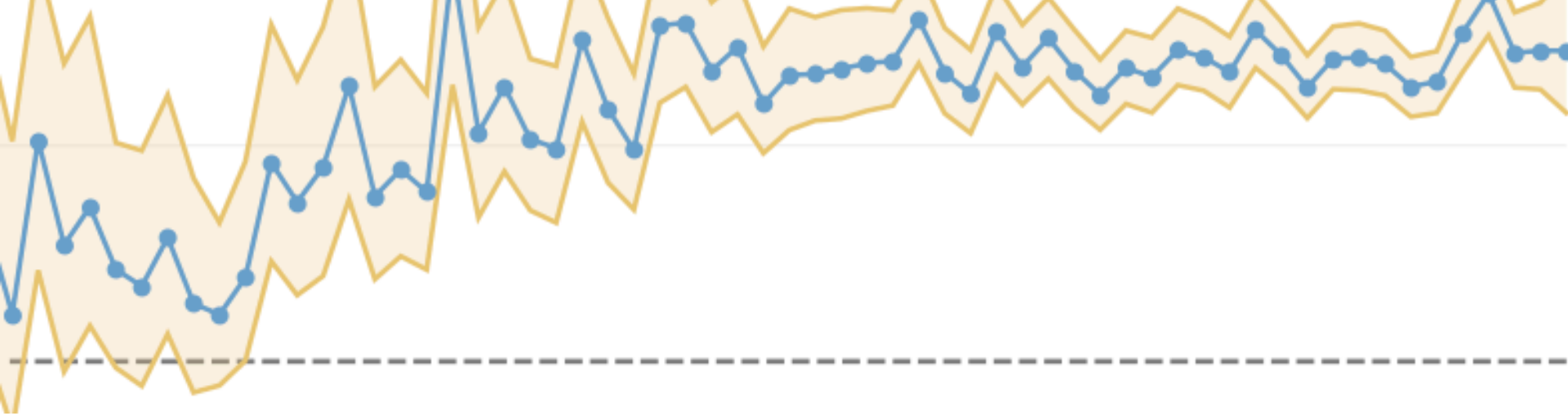


Diversity and Gender in Scholarly Publishing

Jevin West[1], Molly King[2], Carl Bergstrom[3],
Shelley Correll[2], Jennifer Jacquet[4]

[1]Information School, UW

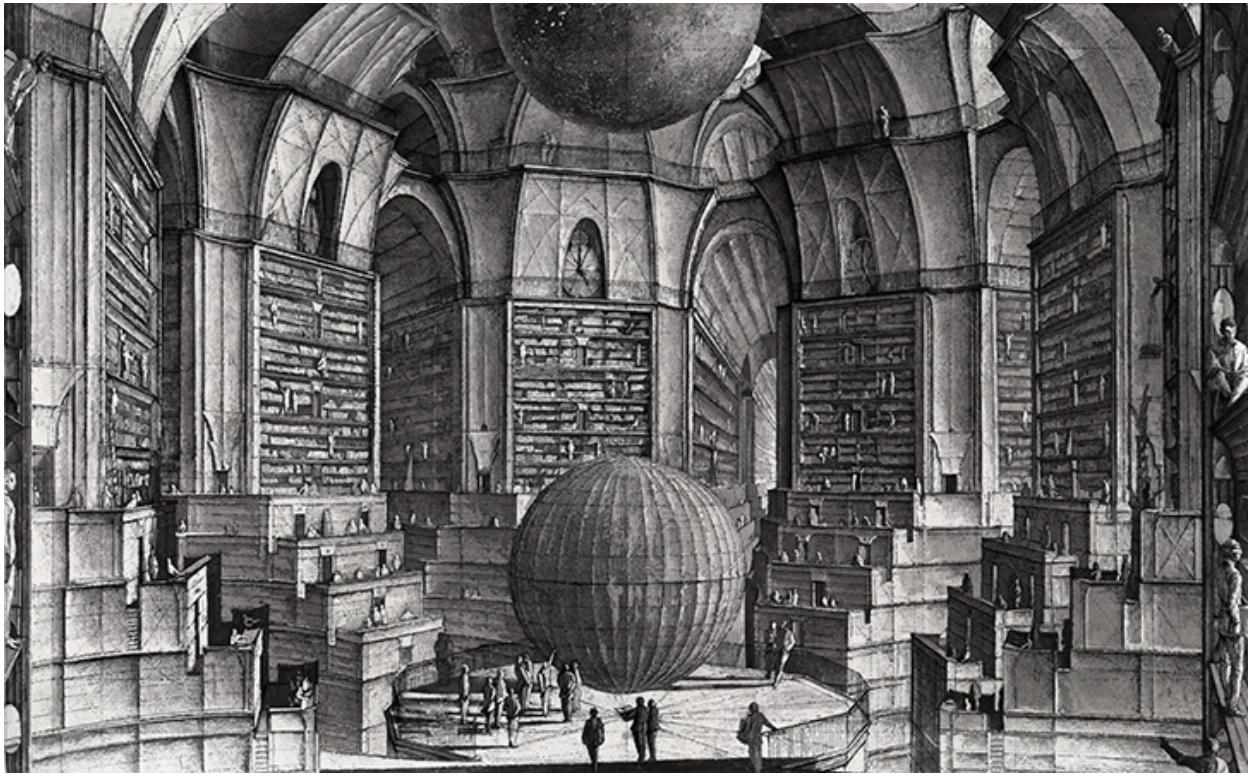
[2]Sociology, Stanford University

[3]Biology Department, UW

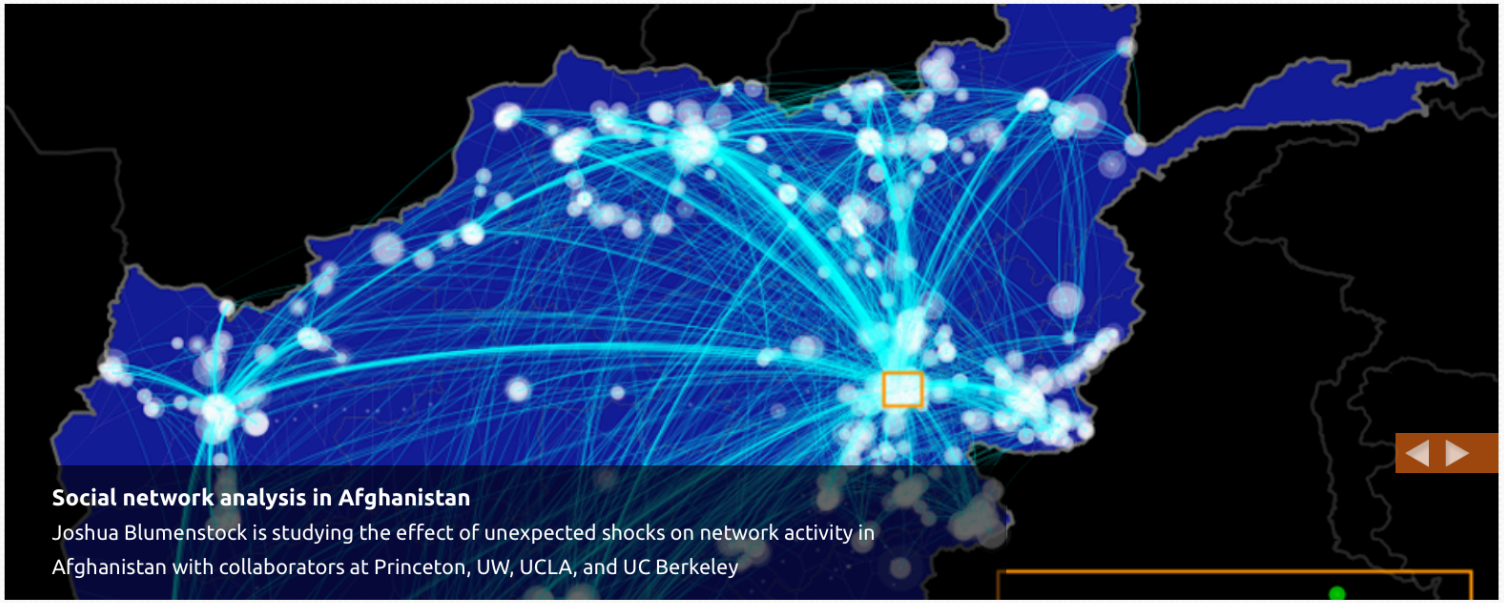
[4]Environmental Studies, NYU

Women were forbidden from seeking degrees in most universities in Europe only about a century ago.

Etzkowitz H, Kemelgor C, Uzzi B (2000) Athena unbound: The advancement of women in science and technology. Cambridge University Press.



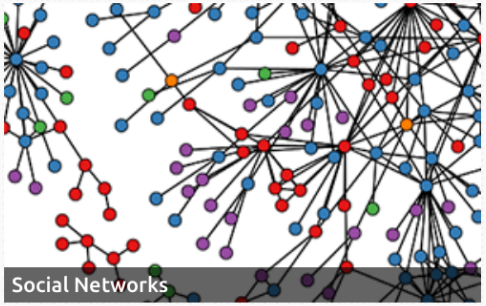
Side note: The Ohio State University, first female graduate, recognized sooner (1879)

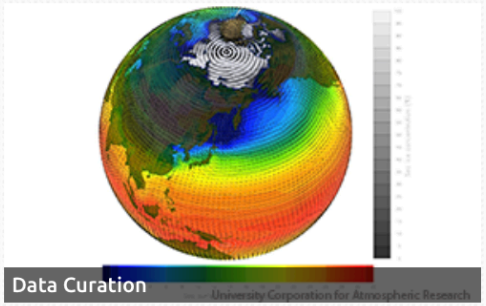


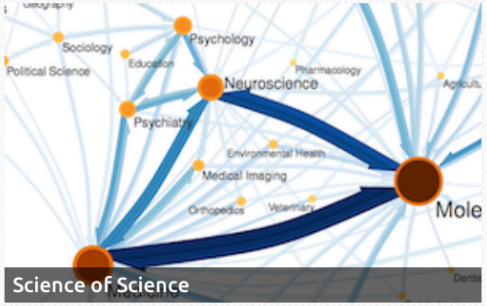
Social network analysis in Afghanistan

Joshua Blumenstock is studying the effect of unexpected shocks on network activity in Afghanistan with collaborators at Princeton, UW, UCLA, and UC Berkeley

Research Focus Areas







GORDON AND BETTY MOORE FOUNDATION

DATA-DRIVEN DISCOVERY

Data Science Environments

What We Do

Overview

Over the course of the last decade many disciplines have evolved from recording observations in laboratory notebooks to the use of instruments capable of digitally recording many gigabytes of data in a day. This abundance of data provides unprecedented opportunities for discovery. Tapping its potential requires the application of sophisticated new computational techniques operating on large scale storage, computational and network resources. Since its creation in 2008, the eScience Institute has worked to create the intellectual and physical infrastructure needed to meet this challenge.

At the core of the eScience Institute are individuals who have proven track records in developing and applying advanced computational methods and tools to real world problems. Their task is to seek out and engage researchers across disciplines where eScience approaches are likely to have the greatest impact. To ensure that researchers have access to the necessary physical infrastructure, the Institute has undertaken coordinated planning and support for advanced local and remote computational platforms. This includes developing relationships with commercial and non-commercial service providers as well as the development of shared facilities on campus. This support extends to assistance in the preparation of select proposals where we are able to focus resources, improving their chances for success.

Also in... What We Do

Appliance Gallery
Find and use the eScience Institute's virtual machines equipped with software useful for specific applications.
Campus Compute & Storage
Learn about what UW is doing to support scalable scientific computing on campus
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Projects
Explore some of our current collaborations with research scientists.
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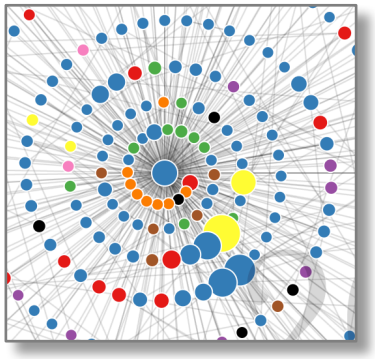
Latest eScience News

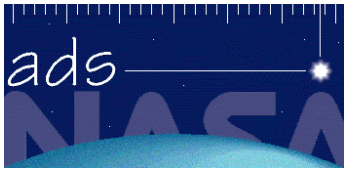
Data Science Incubation Program - Winter 2016
2 hours 4 min ago

Ben Marwick On How Computers Broke Science

Science of Science



The Scholarly Graph



The Scholarly Graph

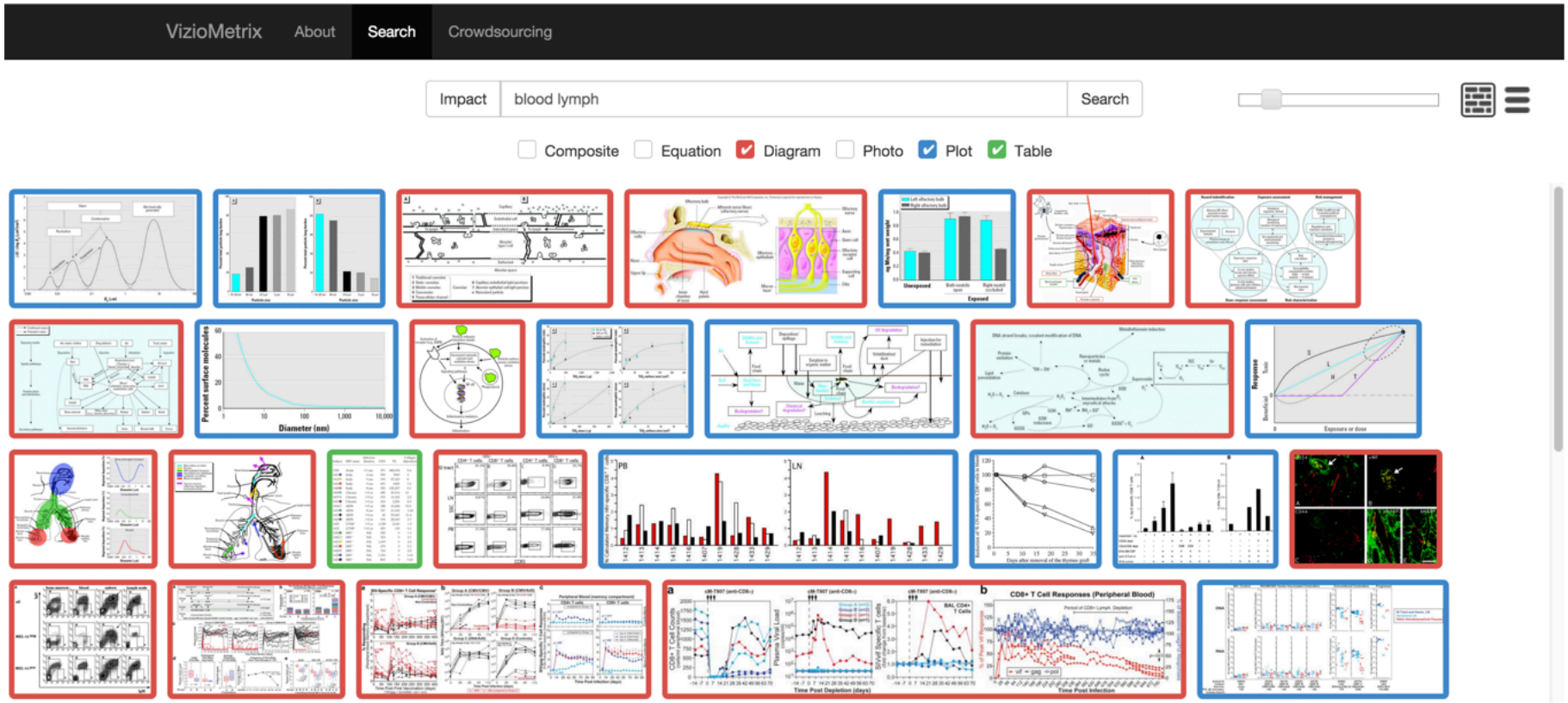
Tens of millions articles, patents, books

Billions of citation links

Years: 1600 - 2016

Figure-Centric Search Engine

viziometrics.org



Talk Outline

- Gender in Academic Authorship
- Self-citation Differences
- Patents and Inventorship
- Homophily versus Heterophily
- Recommendations

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PLOS | ONE

The Role of Gender in Scholarly Authorship

Jevin D. West[1]*, Jennifer Jacquet[2], Molly M. King[3], Shelley J. Correll[3], Carl T. Bergstrom[1,4]

1 Department of Biology, University of Washington, Seattle, Washington, United States of America, **2** Environmental Studies, New York University, New York, New York, United States of America, **3** Department of Sociology, Stanford University, Stanford, California, United States of America, **4** Santa Fe Institute, Santa Fe, New Mexico, United States of America

Abstract

Gender disparities appear to be decreasing in academia according to a number of metrics, such as grant funding, hiring, acceptance at scholarly journals, and productivity, and it might be tempting to think that gender inequity will soon be a problem of the past. However, a large-scale analysis based on over eight million papers across the natural sciences, social sciences, and humanities reveals a number of understated and persistent ways in which gender inequities remain. For instance, even where raw publication counts seem to be equal between genders, close inspection reveals that in many fields, men predominate in the prestigious first and last author positions. Moreover, women are underrepresented as authors of single-authored papers. Academics should be aware of the subtle ways disparities can occur in scholarly authorship.

Citation: West JD, Jacquet J, King MM, Correll SJ, Bergstrom CT (2013) The Role of Gender in Scholarly Authorship. PLoS ONE 8(7): e662 journal.pone.0066212

Editor: Lilach Hadany, Tel Aviv University, Israel

Received January 25, 2013; **Accepted** May 7, 2013; **Published** July 22, 2013

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Competing Interests: The authors have declared that no competing interests exist.

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Introduction

Gender inequities and gender biases persist in higher education. After decades of high female enrollment in most PhD fields, women represent one-quarter of full professors and earn on average 80% of the salary of men in comparable positions [1]. A recent report [2] surveyed 1800 faculty across six science and engineering disciplines and found men publish significantly more in chemistry and mathematics, while women publish more in electrical engineering (there were no significant differences found in biology, civil engineering, and physics). A recent experiment tested the role of gender in hiring by asking 127 science faculty to evaluate potential lab manager applications and found faculty gave identical applications higher scores if the applicant had a male name [3]. Another recent analysis of commissioned articles in two prestigious journals published in 2010 and 2011 showed that women scientists are underrepresented; for instance, women wrote just 3.8% of earth and environmental sciences articles for *Nature* News & Views, although they represent 20% of the scientists in this discipline [4]. With the use of alphabetical authorship listings declining over time [5], and given the complexity of evaluating intellectual contributions [6] in increasingly collaborative efforts, understanding patterns of authorship order becomes increasingly important.

Here we use the JSTOR corpus—a body of academic papers from a range of scholarly disciplines spanning five centuries—to examine trends in the gender composition of academic authorship through time. We pay particular attention to authorship order, given that first and sometimes last author publications are at least as important as raw publication counts for hiring, promotion, and tenure, particularly in scientific fields [7]. Studies of authorship in the medical literature reveal, for instance, that women have been historically underrepresented in the prestige positions of first and last author, and that while discrepancies have re
the first author position, women remain underre
authors [8,9,10,11]. To view authorship p
disciplinarily context, we use a network-ba
detection approach to categorize hierarchically
our study corpus. This yields a hierarchical cla
papers in our study and allows us to study and co
gender representation in individual fields of any

Methods

The JSTOR corpus

The JSTOR corpus [http://www.jstor.org] is a
published scholarly research that spans th
humanities from 1545 to the present day. At
analysis, the JSTOR corpus comprised 8.3 m
ranging from 1545 until early 2011, including 4.2
articles. Approximately 1.8 million of these do
which are research articles) cite or are cited by ot
the JSTOR corpus and thus are amenable to netw
call this group the "JSTOR network dataset". M
these 1.8 million articles are part of a single gia
the citation network, such that any of these article
from any other by following citation trail
backwards. We restrict our analysis to the
dataset because this is the portion of the JSTOR
can hierarchically categorize using citation infor
of the main fields available in JSTOR dataset,
gender composition of the identified authors
dataset (21.9% female) is close to that of the ide
the entire corpus (20.8% percent).

RESEARCH ARTICLE

The Academic Advantage: Gender Disparities in Patenting

Cassidy R. Sugimoto[1], Chaoqun Ni[2], Jevin D. West[3], Vincent Larivière[4,5]*

1 School of Informatics and Computing, Indiana University Bloomington, Bloomington, Indiana, United States of America, **2** School of Library and Information Science, Simmons College, Boston, Massachusetts, United States of America, **3** University of Washington Information School, Seattle, Washington, United States of America, **4** École de bibliothéconomie et des sciences de l'information, Université de Montréal, Pavillon Lionel-Groulx, Succ. Centre-ville, Montréal, Quebec, Canada, **5** Observatoire des Sciences et des Technologies (OST), Centre Interuniversitaire de Recherche sur la Science et la Technologie (CIRST), Université du Québec à Montréal, Succ. Centre-Ville, Montréal, Quebec, Canada

* vincent.lariviere@umontreal.ca

Abstract

We analyzed gender disparities in patenting by country, technological area, and type of assignee using the 4.6 million utility patents issued between 1976 and 2013 by the United States Patent and Trade Office (USPTO). Our analyses of fractionalized inventorships demonstrate that women's rate of patenting has increased from 2.7% of total patenting activity to 10.8% over the nearly 40-year period. Our results show that, in every technological area, female patenting is proportionally more likely to occur in academic institutions than in corporate or government environments. However, women's patents have a lower technological impact than that of men, and that gap is wider in the case of academic patents. vide evidence that patents to which women—and in particular academic wome ed are associated with a higher number of International Patent Classification (I and co-inventors than men. The policy implications of these disparities and aca ting advantages are discussed.

CrossMark click for updates

OPEN ACCESS

Citation: Sugimoto CR, Ni C, West JD, Larivière V (2015) The Academic Advantage: Gender Disparities in Patenting. PLoS ONE 10(5): e0128000. doi:10.1371/journal.pone.0128000

Academic Editor: Alejandro Raul Hernandez Montoya, Universidad Veracruzana, MEXICO

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Data Availability Statement: The USPTO Raw data file used in this study can be found at https://www.google.com/googlebooks/uspto-patents.html.

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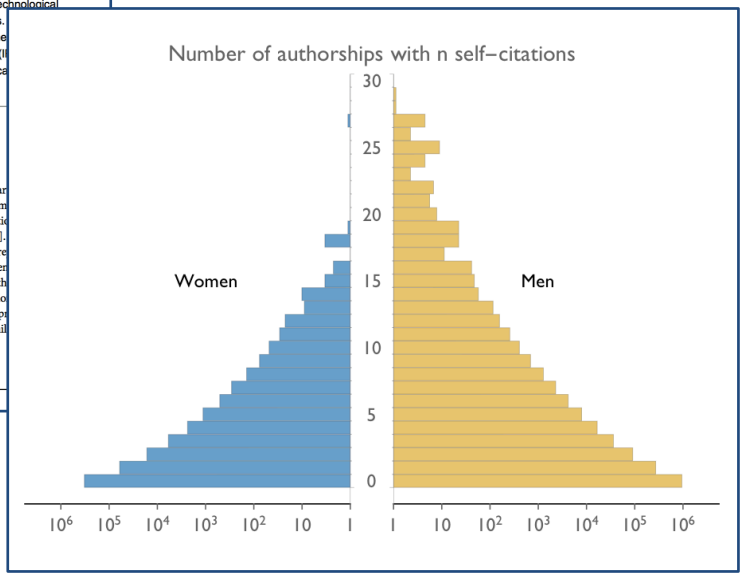
Introduction

Innovation is critical to economic development [1] and depends upon the full par
the scientific workforce [2]. Yet, the growing field of "innovation studies" [3] dem
that there are many disparities in the exploitation of human capacity for innovati
ticularly well-noted areas are the dearth of academic and female innovators [4, 5].
to this lack of innovation in the academic sector has been to stress academic entre
which encompasses the varied ways in which faculty at educational institutions en
vative and high risk activities which have the potential for financial rewards for th
or the institution with which they are affiliated [6]. This is most typically operatio
commercialization of science activities such as patenting [2], which was heavily pr
lowing the enactment of the Bayh-Dole Act in 1980 in the United States and simil
in other countries [5].



Collaborators

J. Jacquet
NYU

C. Bergstrom
UW

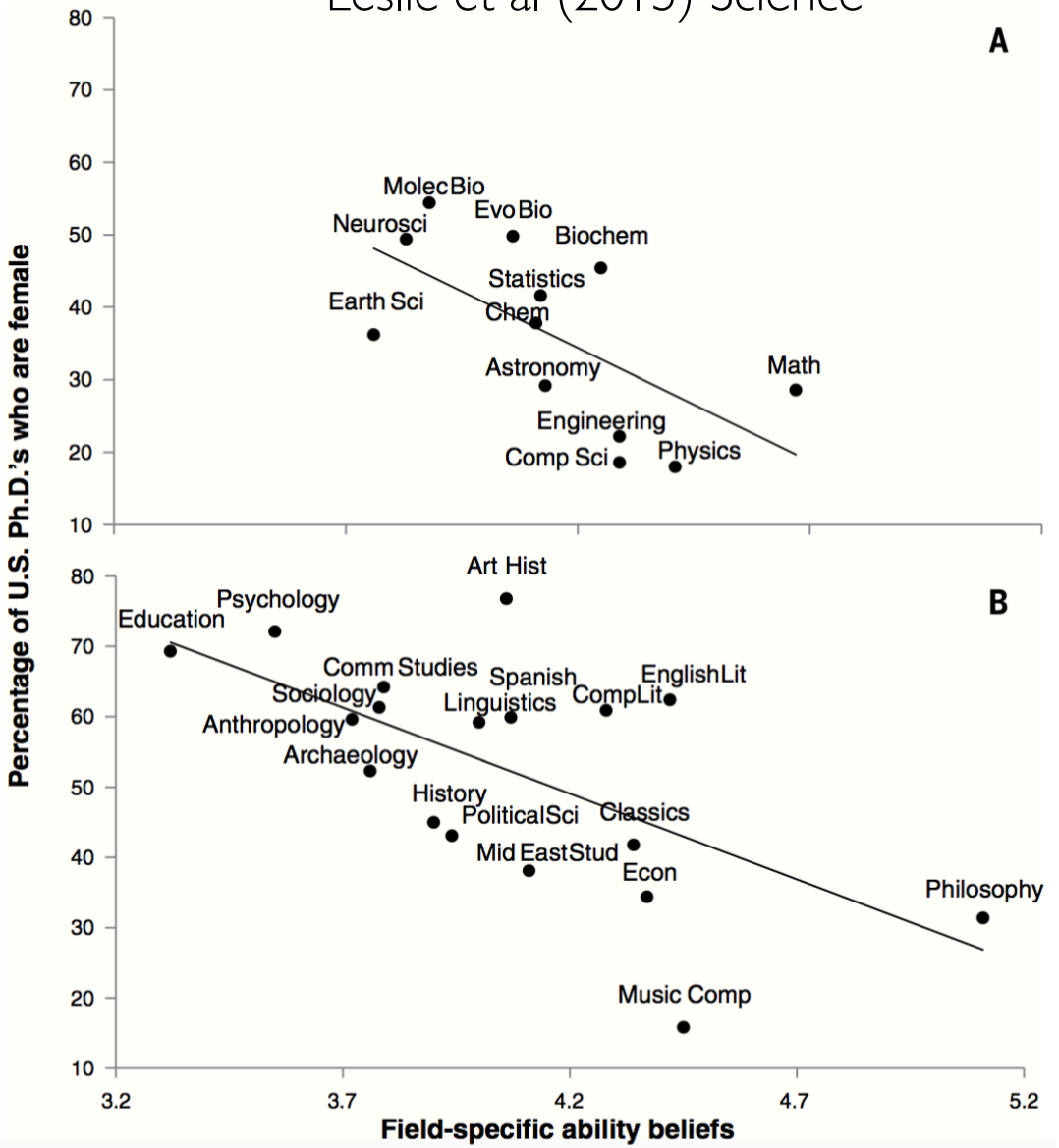
S. Correll
Stanford

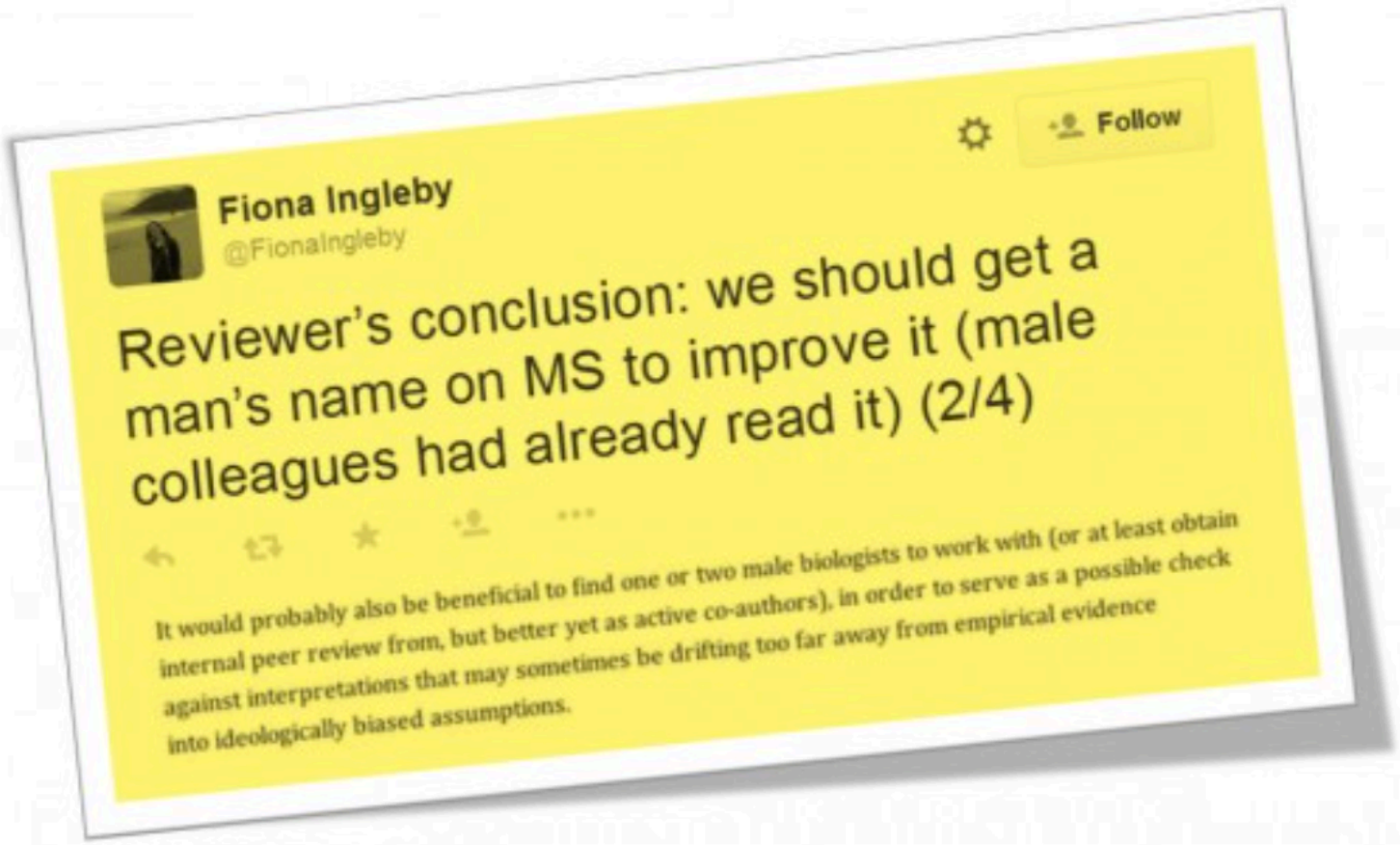
M. King
Stanford

What gender disparities still exist across academia?

The *'Brilliance'* Effect

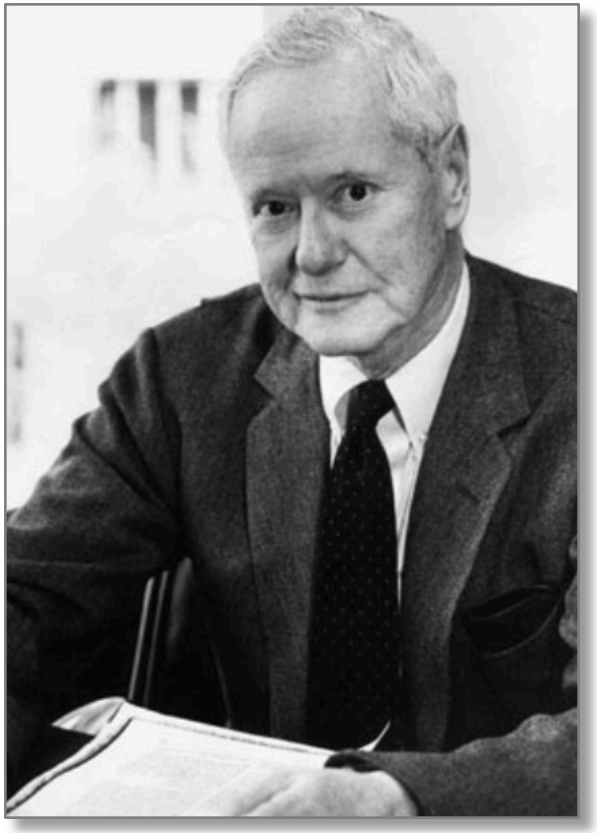
Leslie et al (2015) Science



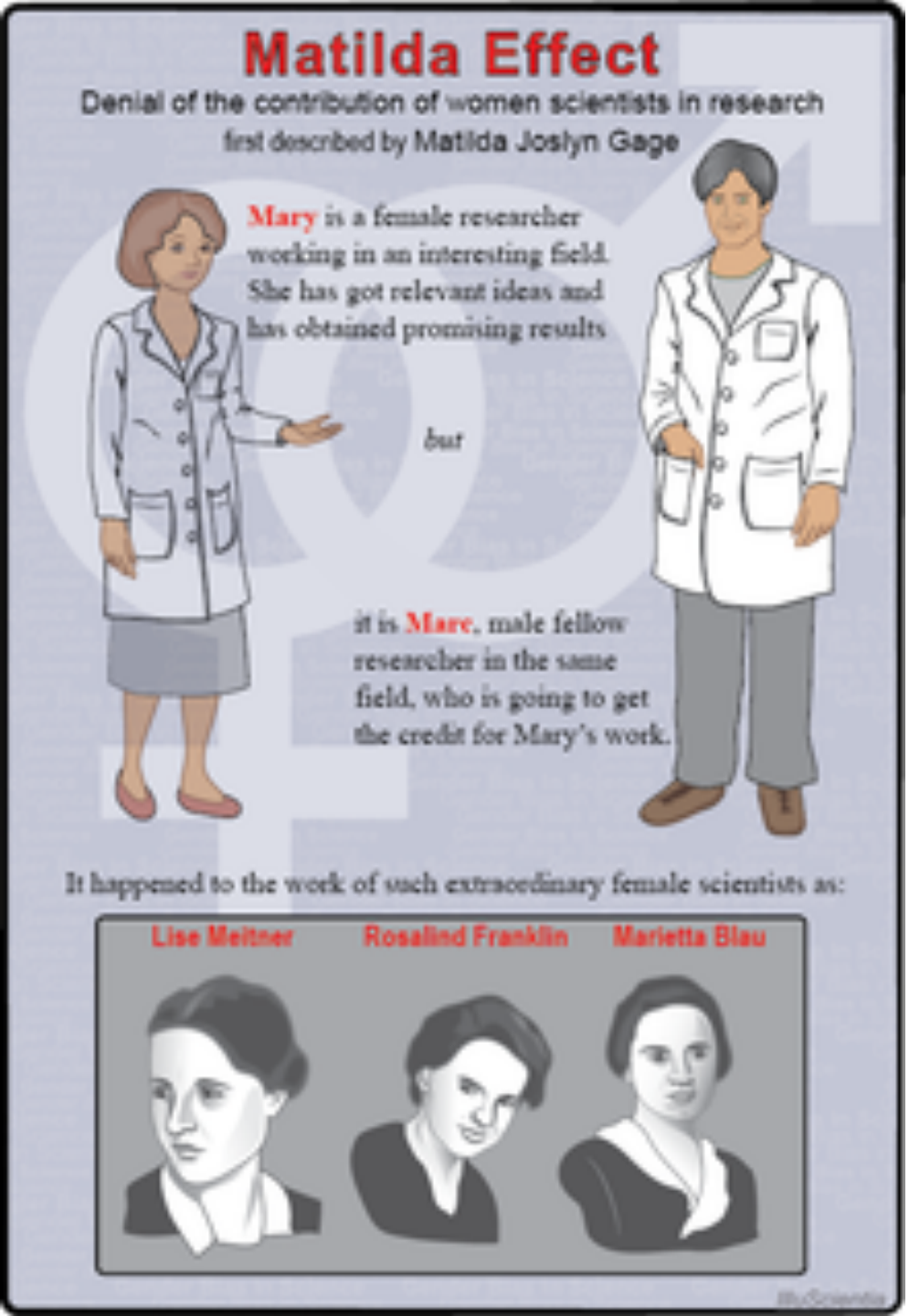


Science magazine: DOI: 10.1126/science.aab2568

Mathew Effect



Robert Merton



Harriet Zuckerman

Margaret Rossiter (1993)

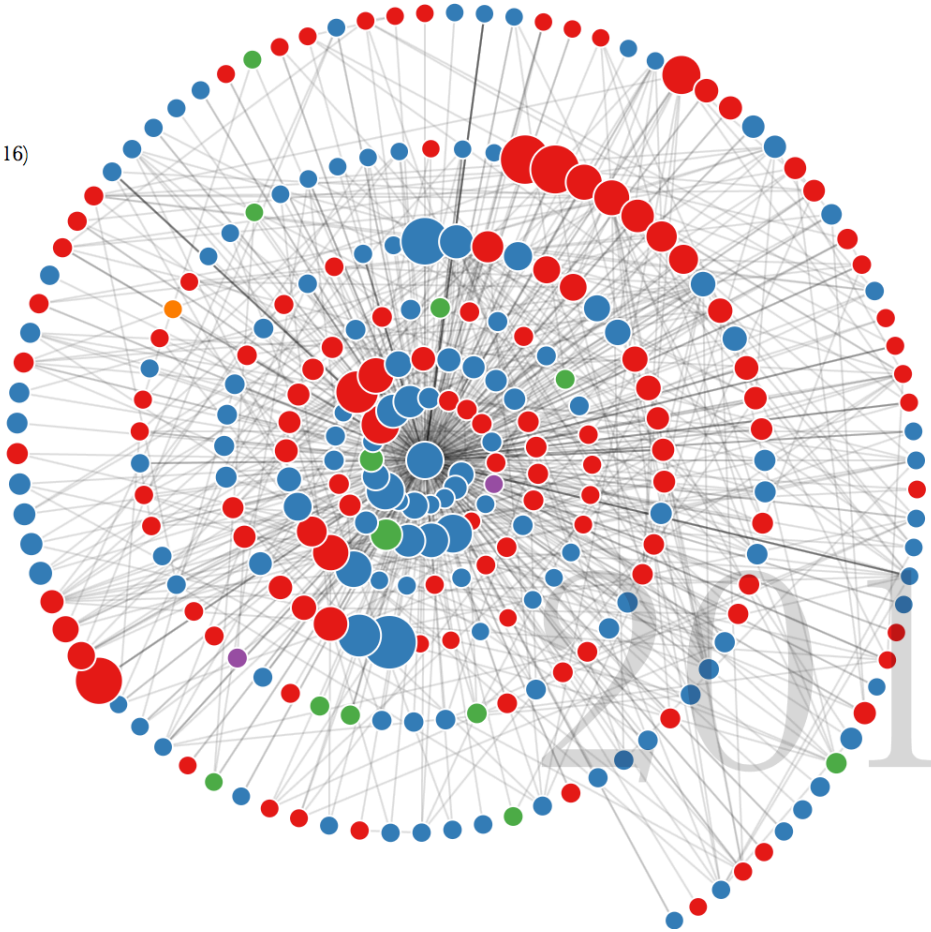
Visualizing Scholarly Influence Over Time

Influence of Pew Scholars

Roberta A. Gottlieb

Learn More

- Papers in category "Medicine" (domain 6)
- Papers in category "Biology" (domain 4)
- Papers in category "Chemistry" (domain 5)
- Papers in category "Unknown" (domain 0)
- Papers in category "Agriculture Science" (domain 16)



Roberta A. Gottlieb

Pew Scholar
1997

2012

	1960s	1970s	1980s	1990s	2000s
% PhDs overall	7–9	9–22	23–30	29–37	38–40
Computer sciences	n/a	n/a	9–18	14–19	16–21
Engineering	0–1	1–3	4–8	9–15	16–20
Life Sciences	8–14	13–25	26–39	38–46	47–52
Mathematics	5–7	6–16	13–18	18–24	25–30
Physical Sciences	3–5	5–11	11–19	19–24	25–29
Psychology	18–24	24–41	42–56	58–67	67–71
Social Sciences	8–12	11–26	27–35	33–42	43–46
% Tenure track faculty	n/a	n/a	10–15	16–22	24–28
Full Professors	n/a	5	5–8	9–14	16–19

Burrelli J (2008) Thirty-three years of women in S&E faculty positions. Infobrief, Science Resources Statistics NSF 08-308, National Science Foundation.

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Psychology	18–24	24–41	42–56	58–67	67–71
Social Sciences	8–12	11–26	27–35	33–42	43–46
% Tenure track faculty	n/a	n/a	10–15	16–22	24–28
Full Professors	n/a	5	5–8	9–14	16–19
% Authors overall	10.6	14.2	20.1	25.3	29.2
Single author	8.7	12.5	18.7	24.5	28.5
1st author	9.2	12.9	19.3	25.3	30.9
2nd author	14.8	16.2	20.8	25.0	28.8
Last author	15.0	15.2	17.6	20.1	22.8

West et al (2013) PLoS One

What gender disparities still exist across academia?

Full text for

8.2 million articles over

345 Years

Names from over

300 million boys and girls

from 1880 - 2010

West, JD *et al.* (2013) *PLoS One*

Data: "authorship" =

a person

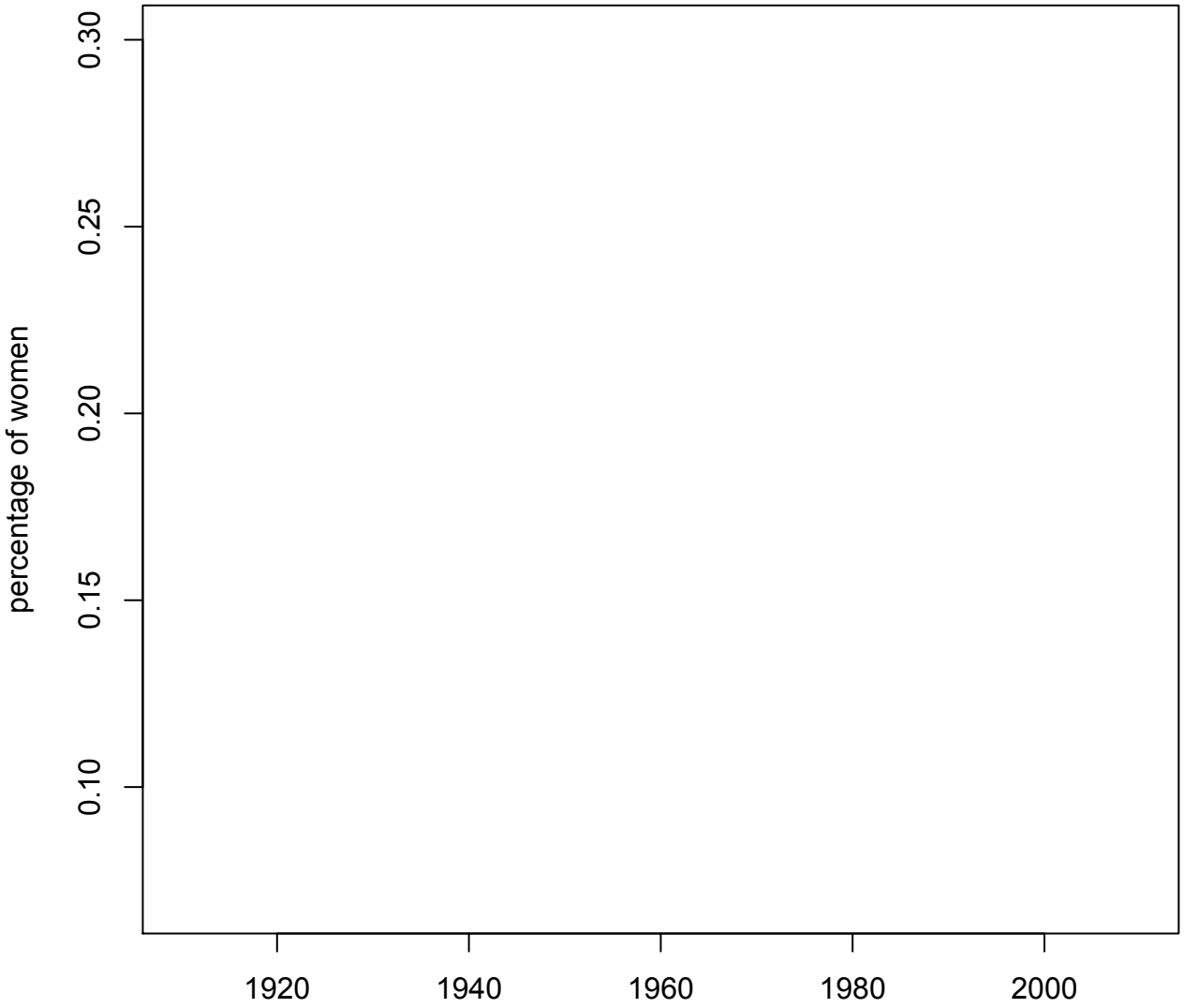
+

a paper for which the person is designated as a sole or co-author

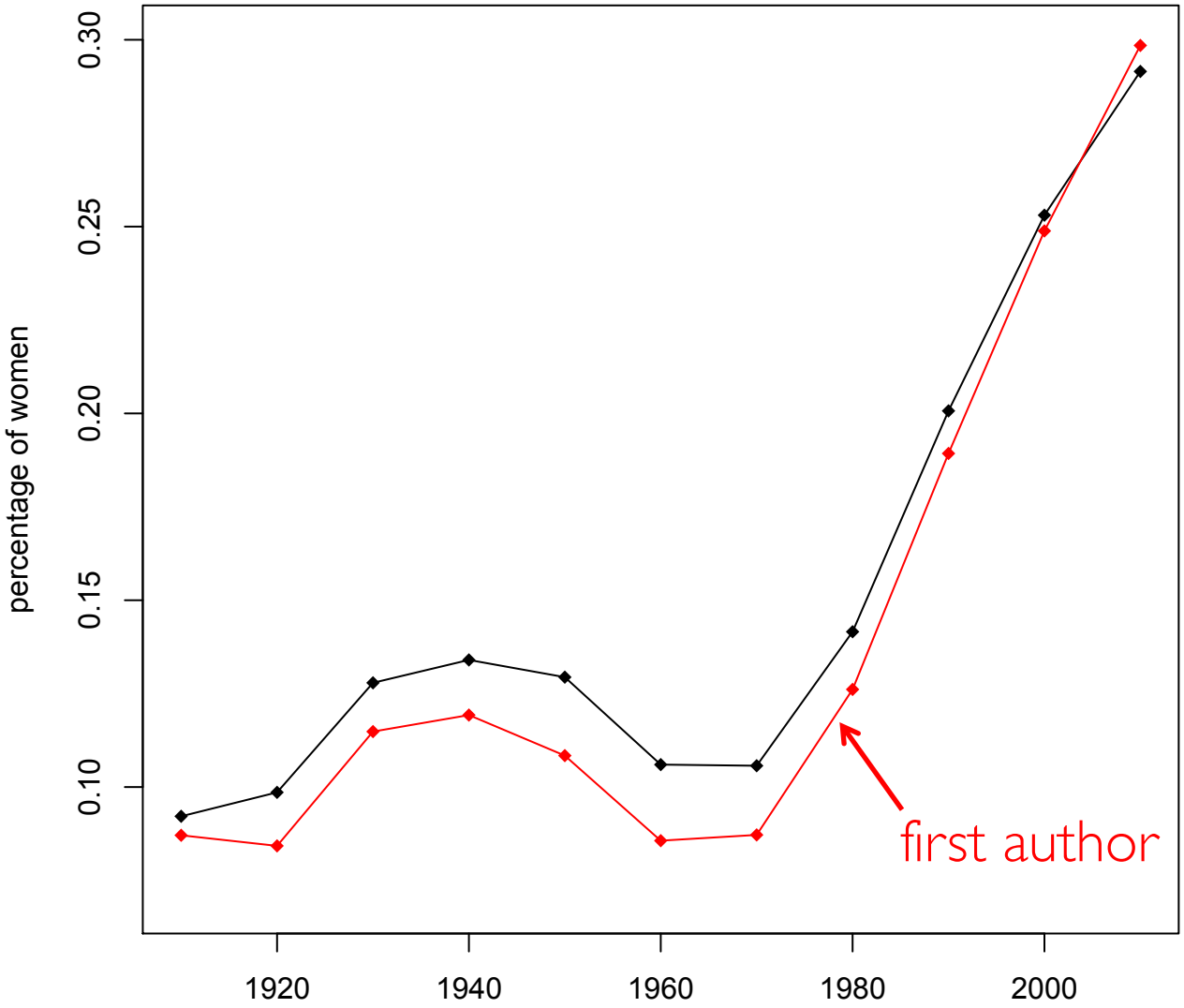
3.6 million authorships

Field	% female	authorships
Mathematics	10.64	6134
Philosophy	12.04	12190
Economics	13.68	69142
Probability and Statistics	18.11	28324
Political science - international	19.07	14908
Political science-US domestic	19.09	15705
Ecology and evolution	22.76	279012
Law	24.21	18503
Organizational and marketing	25.44	32119
Physical anthropology	27.05	16296
Radiation damage	27.69	7825
Classical studies	28.88	6372
Molecular & Cell biology	29.25	277032
History	30.47	15585
Veterinary medicine	31.81	10960
Cognitive science	32.12	12786
Anthropology	36.46	19900
Pollution and occupational health	37.57	32108
Sociology	41.41	44895
Demography	41.90	7600
Education	46.35	28635

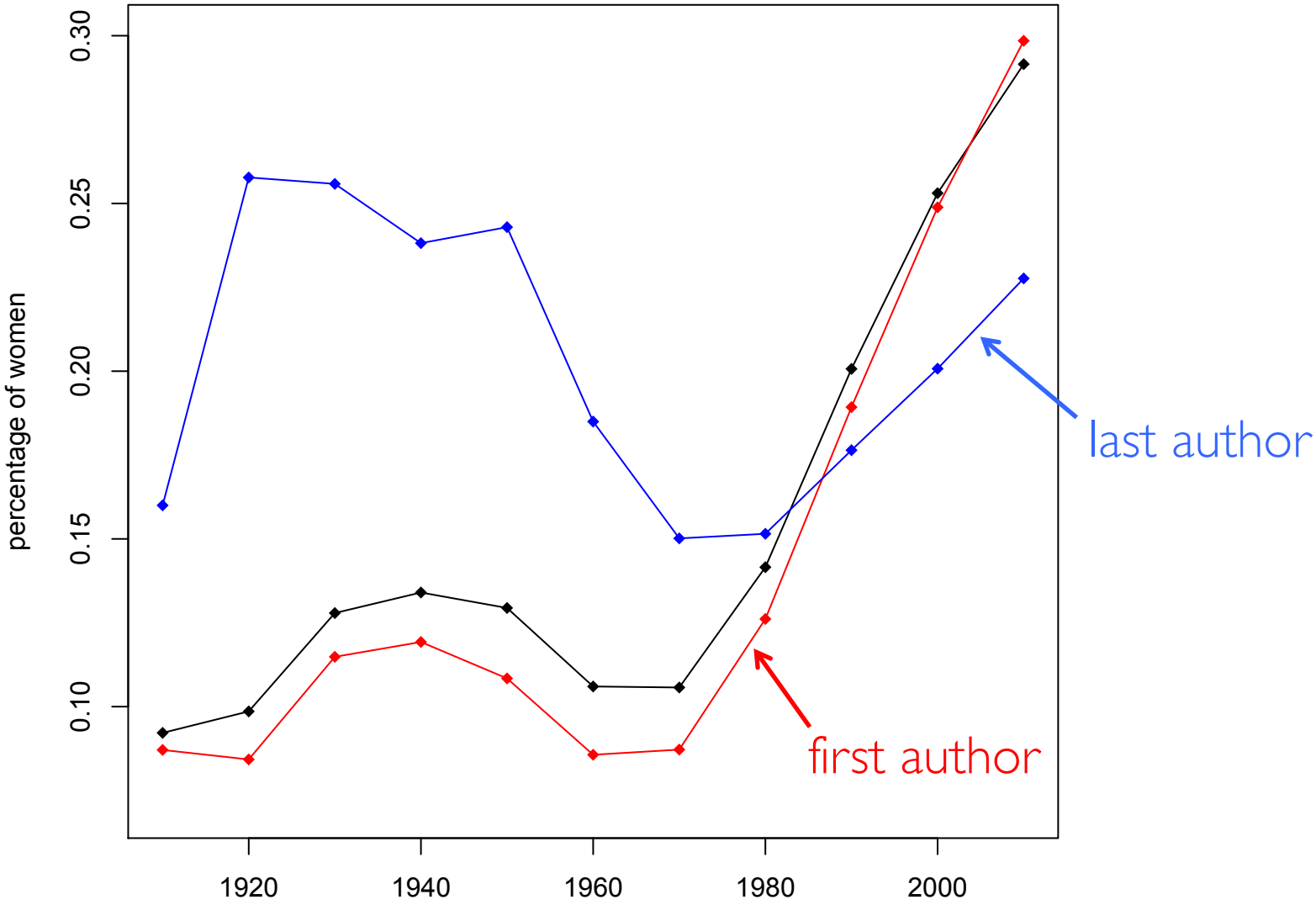
What gender disparities still exist across academia?

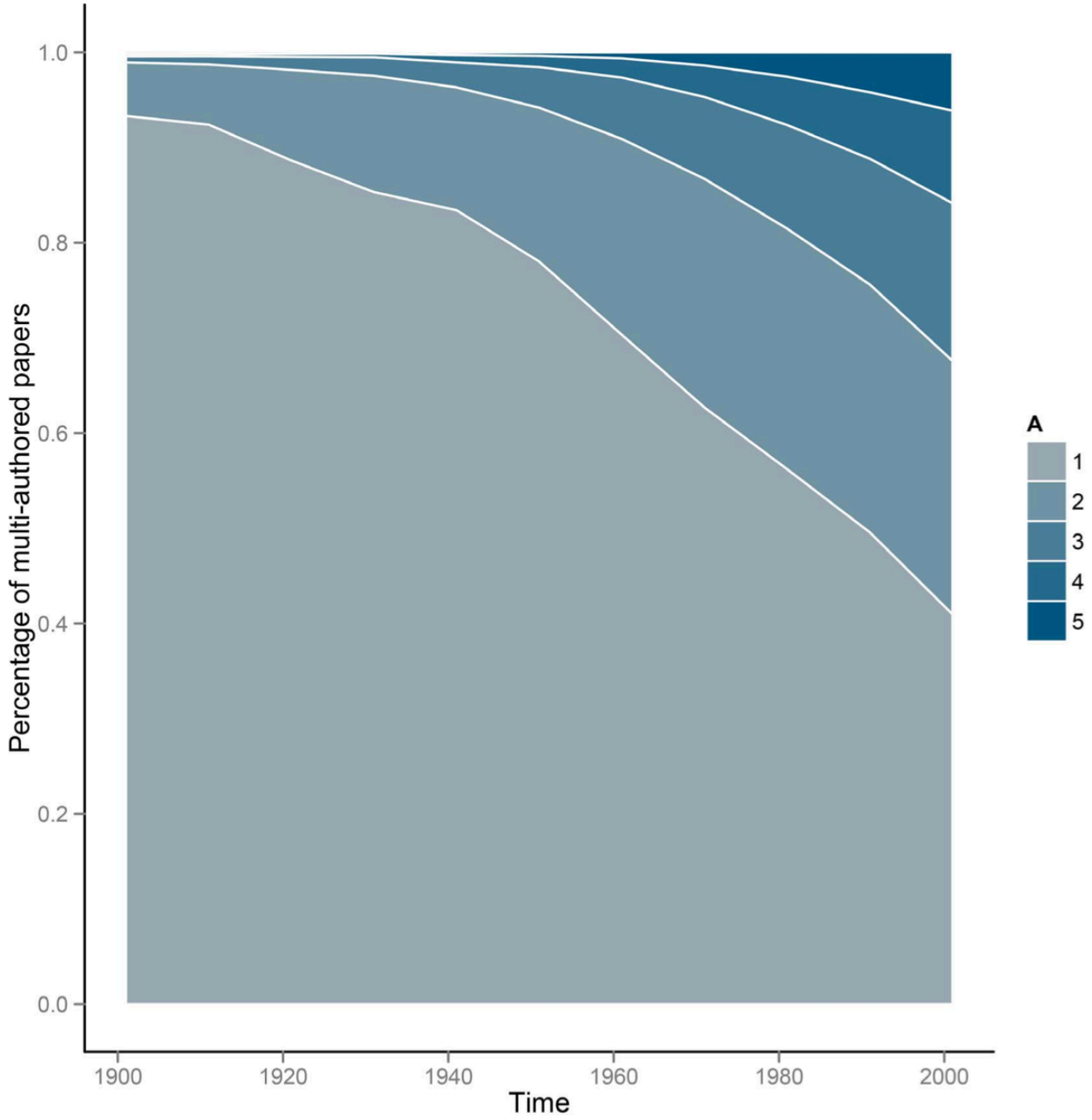


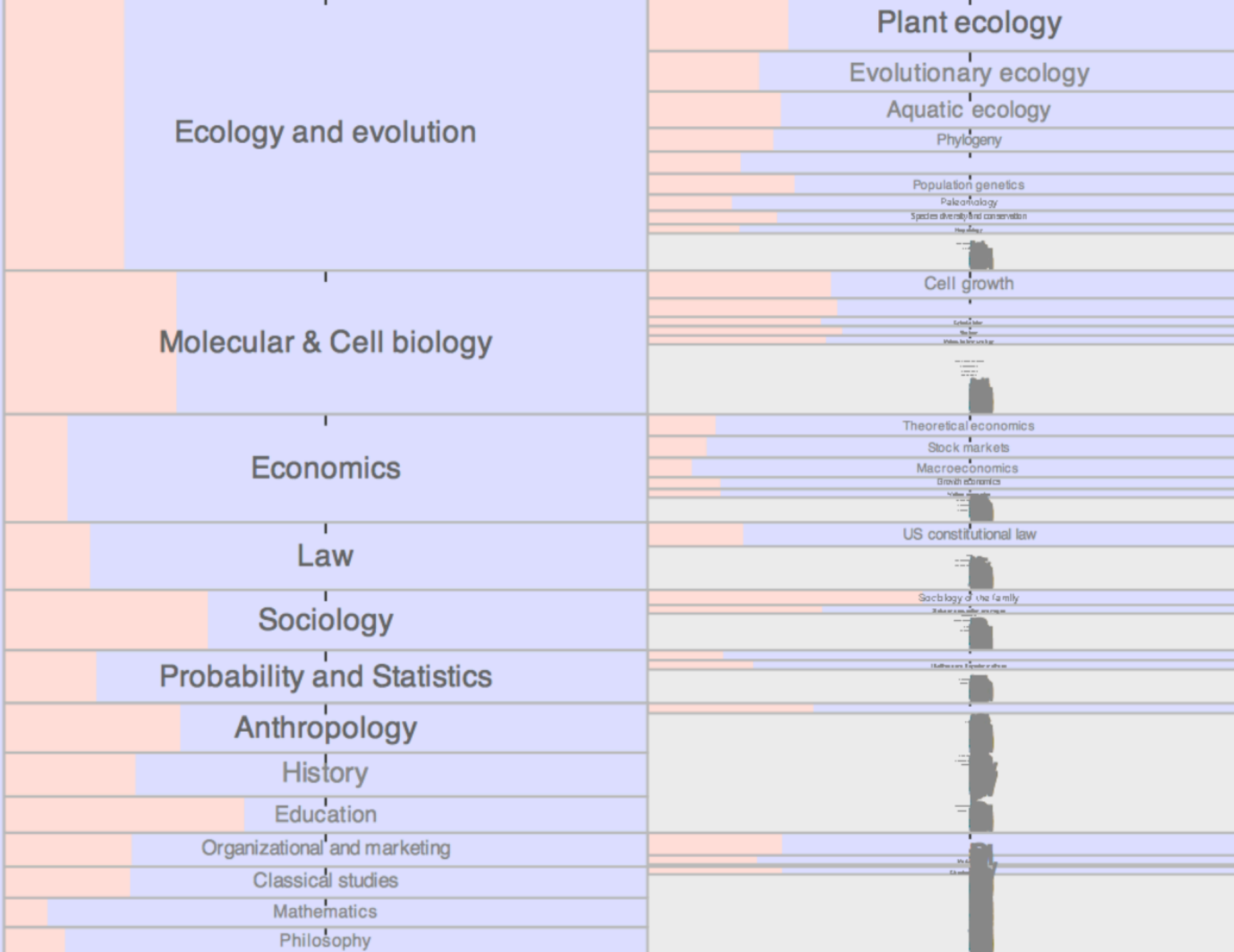
What gender disparities still exist across academia?



What gender disparities still exist across academia?




1.0
0.8
0.6
0.4
0.2
0.0
Percentage of multi-authored papers
1900
1920
1940
1960
1980
2000
Time
A
1
2
3
4
5

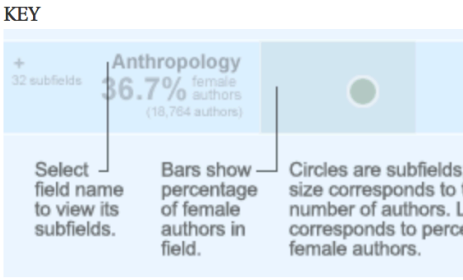

Ecology and evolution
Plant ecology
Evolutionary ecology
Aquatic ecology
Phylogeny
Population genetics
Paleontology
Species diversity and conservation
Molecular & Cell biology
Cell growth
Economics
Theoretical economics
Stock markets
Macroeconomics
Growth economics
Law
US constitutional law
Sociology
Sociology of the family
Probability and Statistics
Anthropology
History
Education
Organizational and marketing
Classical studies
Mathematics
Philosophy

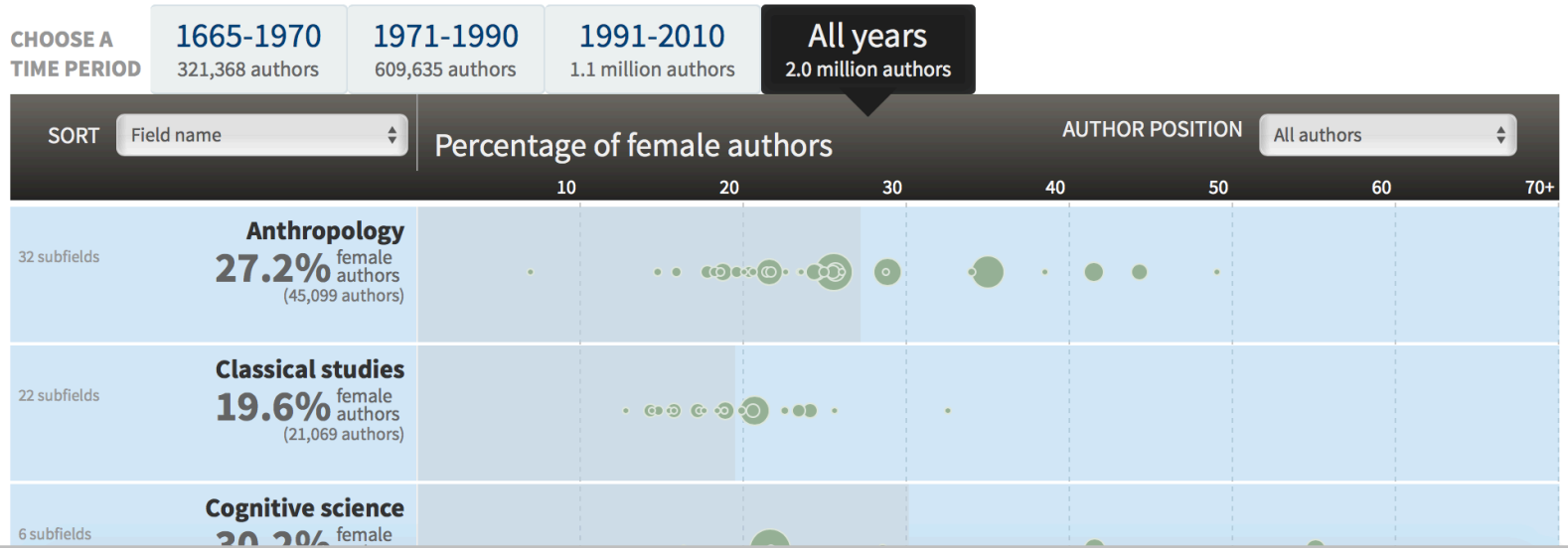
DATA

Women as Academic Authors 1665-2010

Women's presence in higher education has increased, but as authors of scholarly papers—keys to career success—their publishing patterns differ from those of men. Explore nearly 1,800 fields and subfields, across four centuries, to see which areas have the most female authors and which have the fewest, in this exclusive *Chronicle* report. See how overall percentages differ from the important first-author position and—in two major bioscience fields—from the prestigious last-author position. See "About these data" for details.

Source: Gender analysis led by Jevin West and Jennifer Jacquet at the University of Washington's Eigenfactor Project.





http://www.chronicle.com/interactives/gender-gap

Talk Outline

- Gender in Academic Authorship
- Self-citation Differences
- Patents and Inventorship
- Homophily versus Heterophily
- Recommendations

Motivation: Why Study Self-Citation?

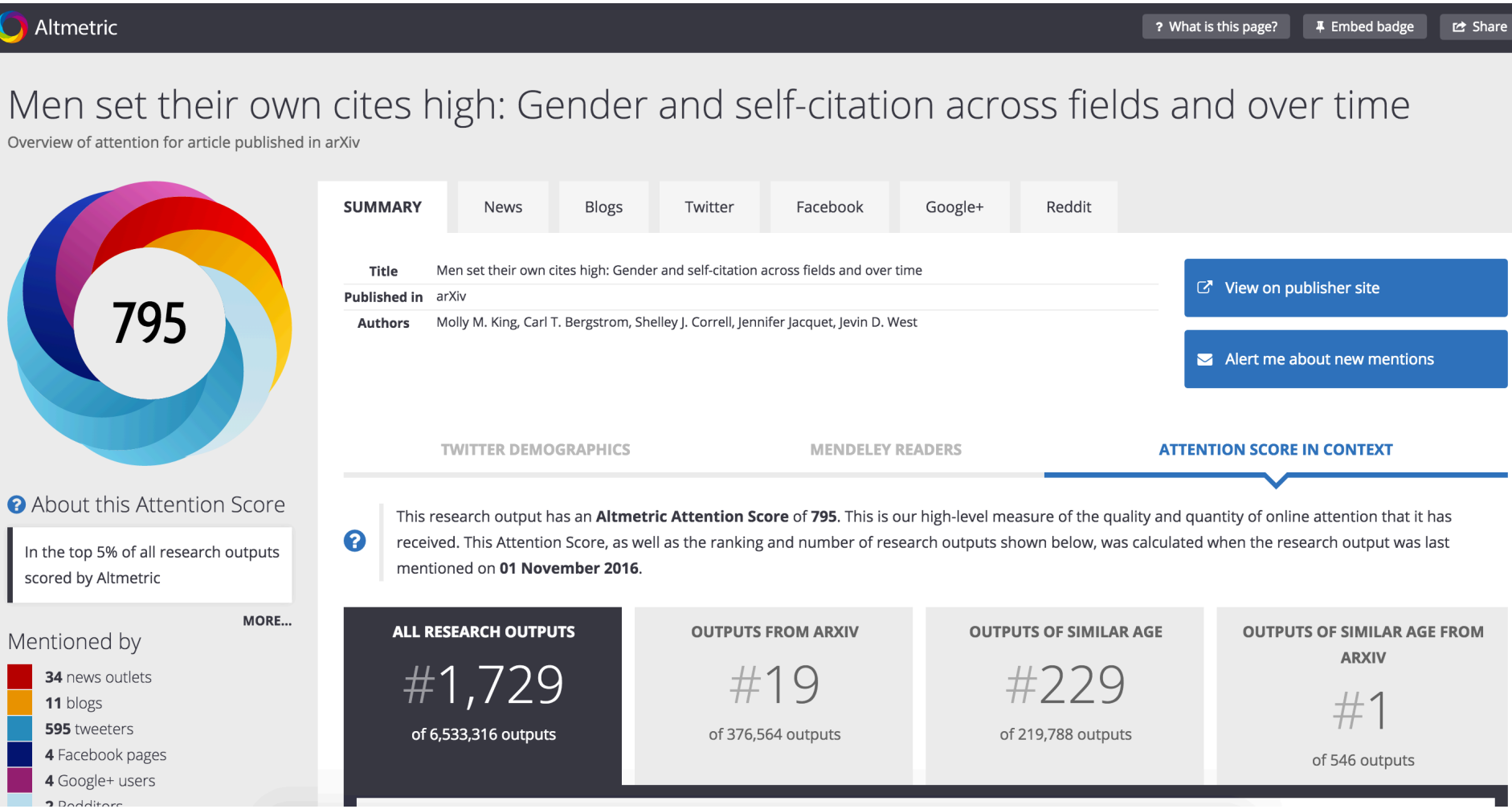
- Women authors: fewer cites
- Could be due partly to self-cites
  - +1 self-cite ➔ +3 cites from others over 5 years (Fowler & Aksnes 2007)
- Case of workplace self-promotion

Men set their own cites high: Gender and self-citation across fields and over time

nature

VICE

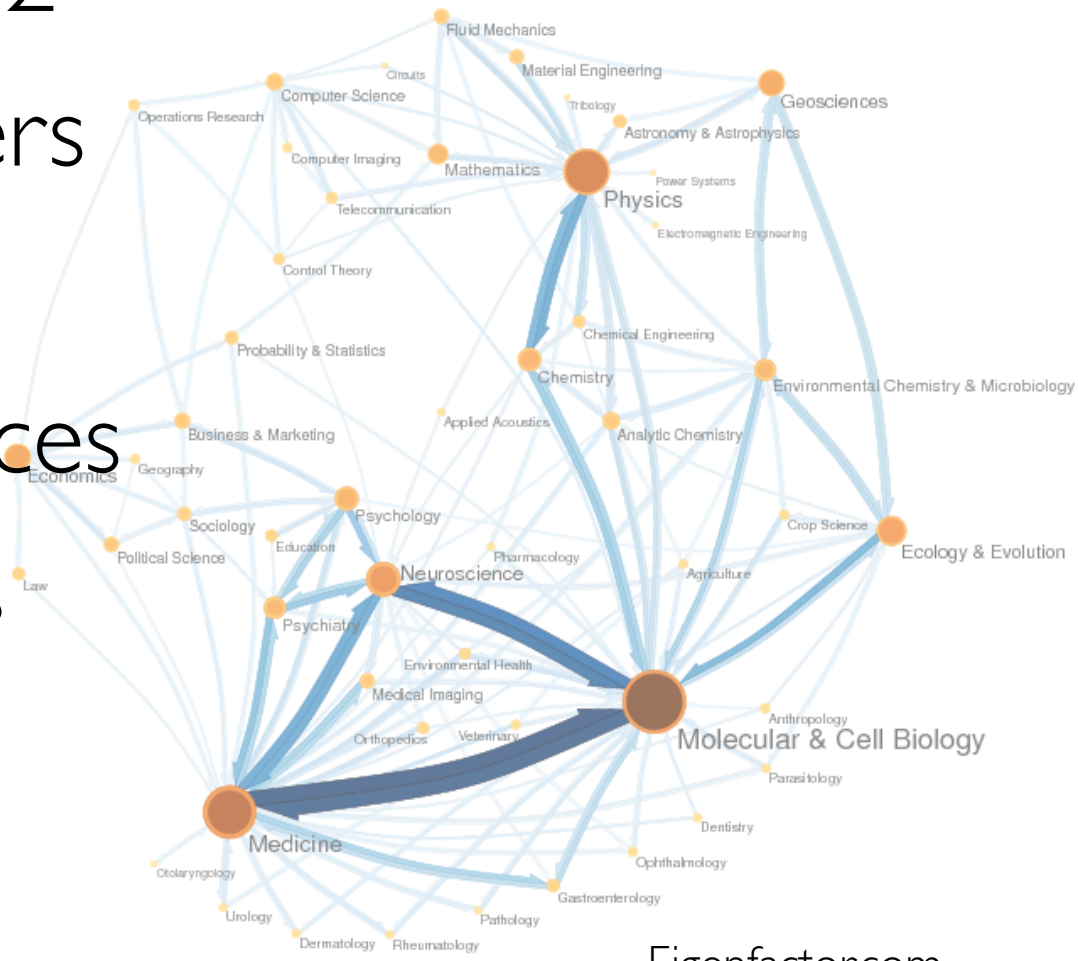
MEDIA



https://www.altmetric.com/details/923143?src=bookmarklet#score

Data: JSTOR "Network Dataset"

- Years 1950-2012
- 1.6 million papers
- 9.4% of references are self-citations



Eigenfactor.com

Methods: authorship-to-authorship citations

Pooja Gupta, Colin Jones, and John Williams (2010)

cites the paper

Rita Paulson, Colin Jones, and Sarah Erikson (2008)

9 authorship-to-authorship citations 39.4M

1 self-citations: Colin Jones to Colin Jones 1M

Self-citation rates

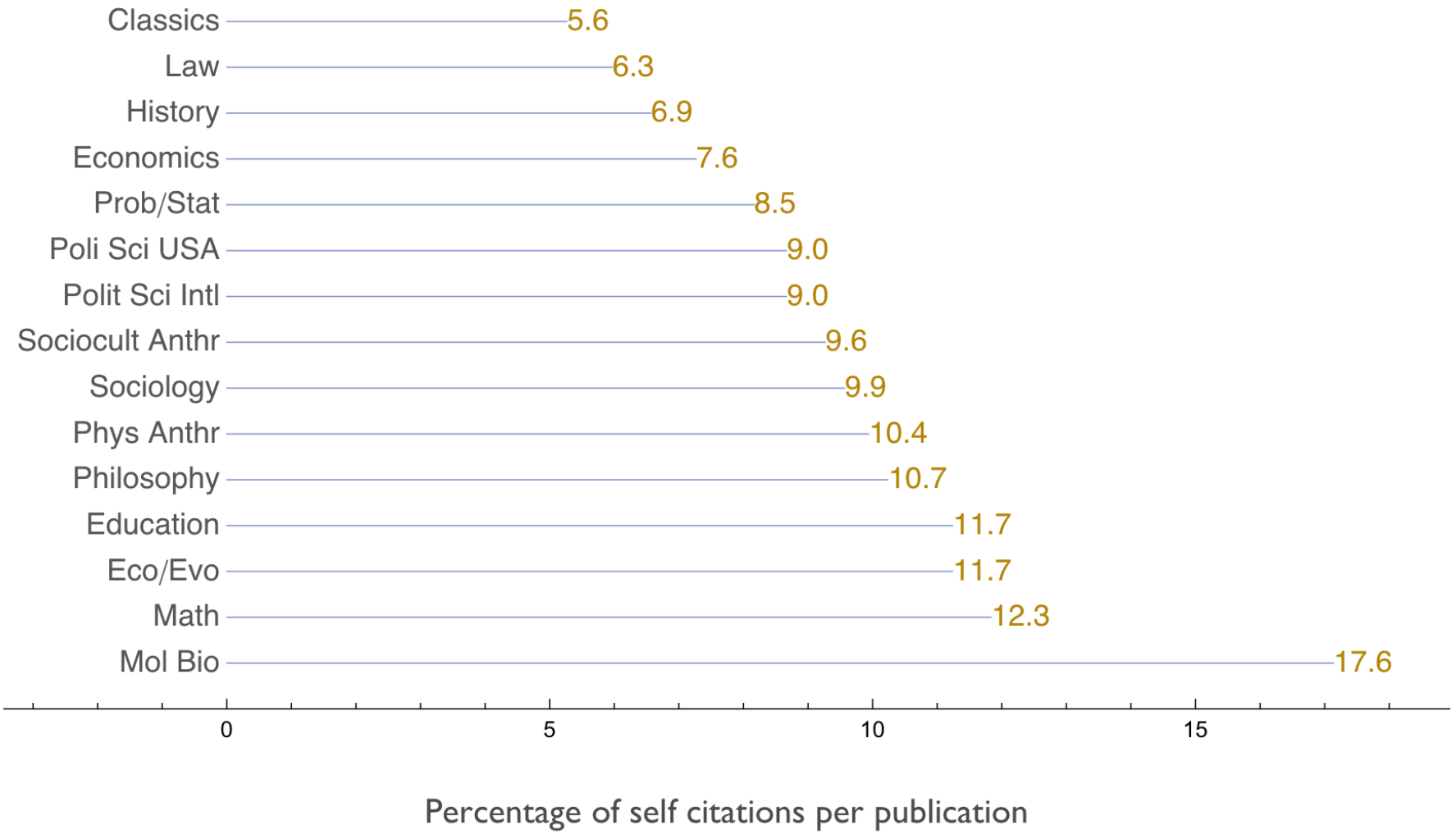
678,768 author self citations that are male-to-male
121,923 author self citations that are female-to-female
216,671 author self citations that I cannot tell the gender

Men self-citations represent 84.8% of the population
Women self-citations represent 15.2% of the population.

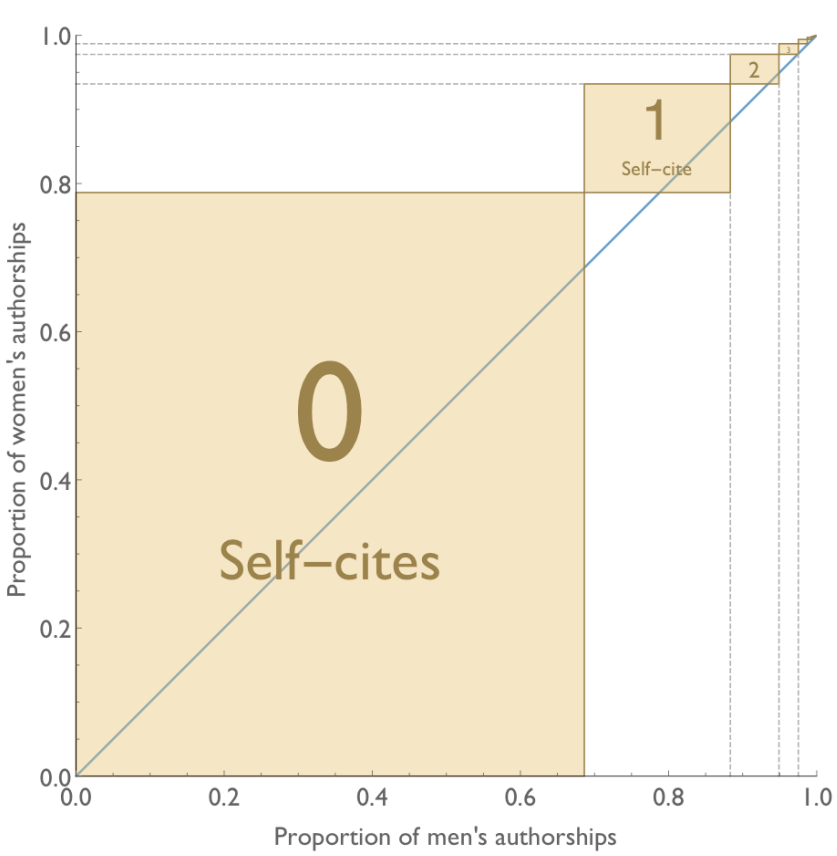
448,389 women
1,596,125 men

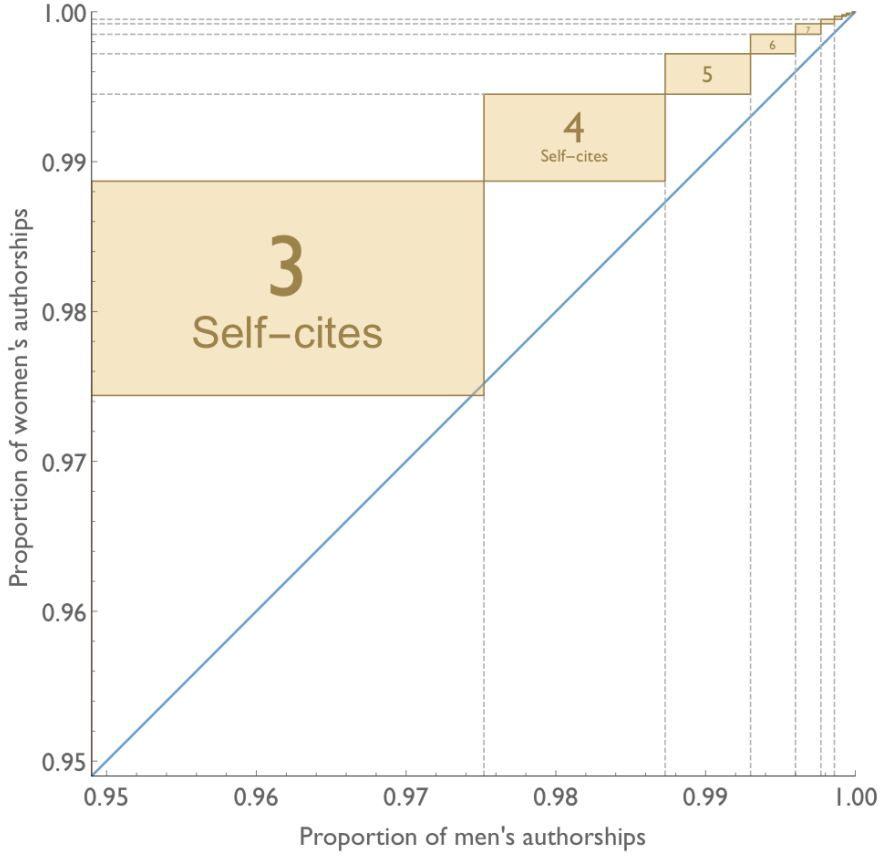
Men represent 78.1% of the population.
Women represent 21.9% of the population.

Self-citation by Field

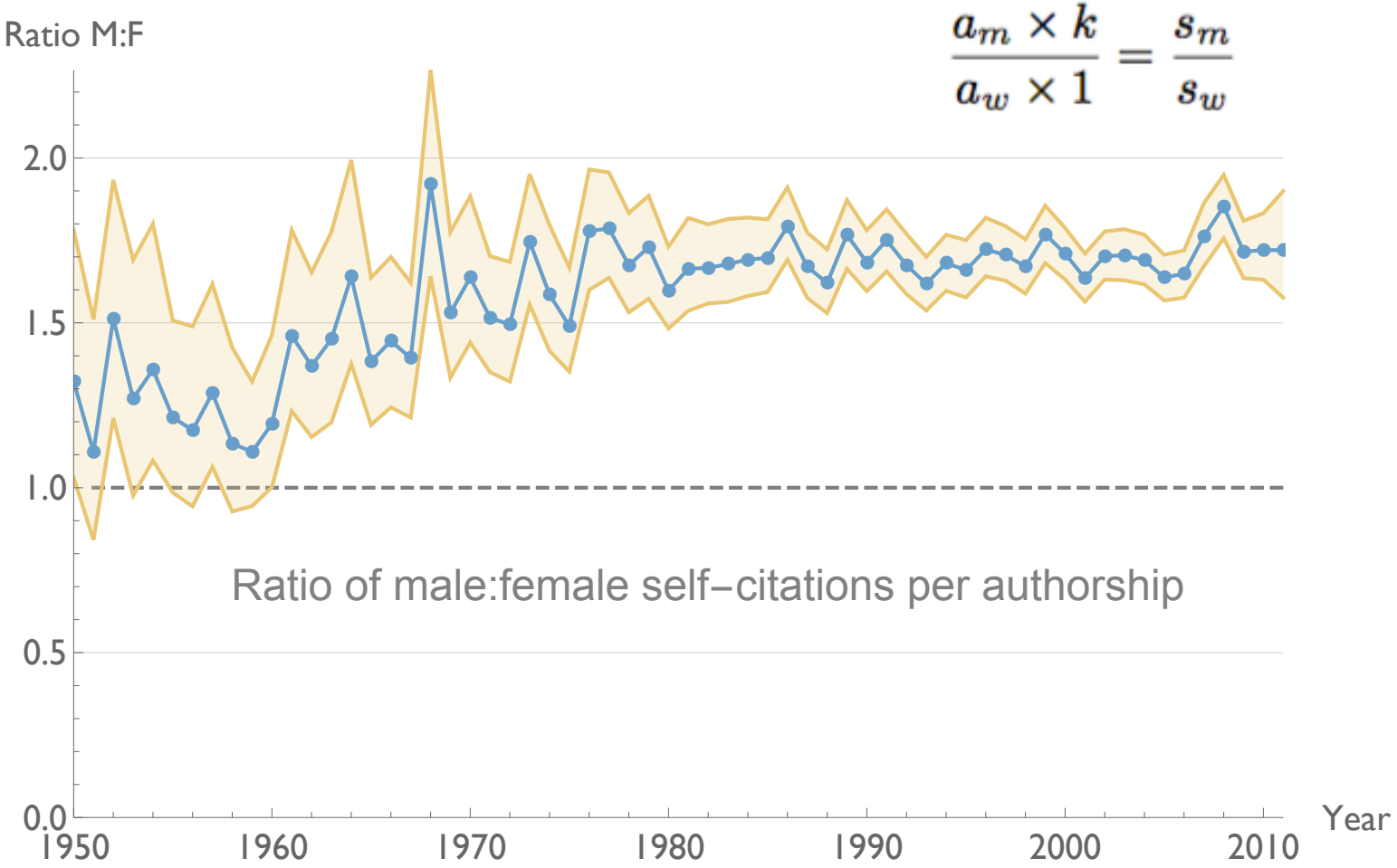


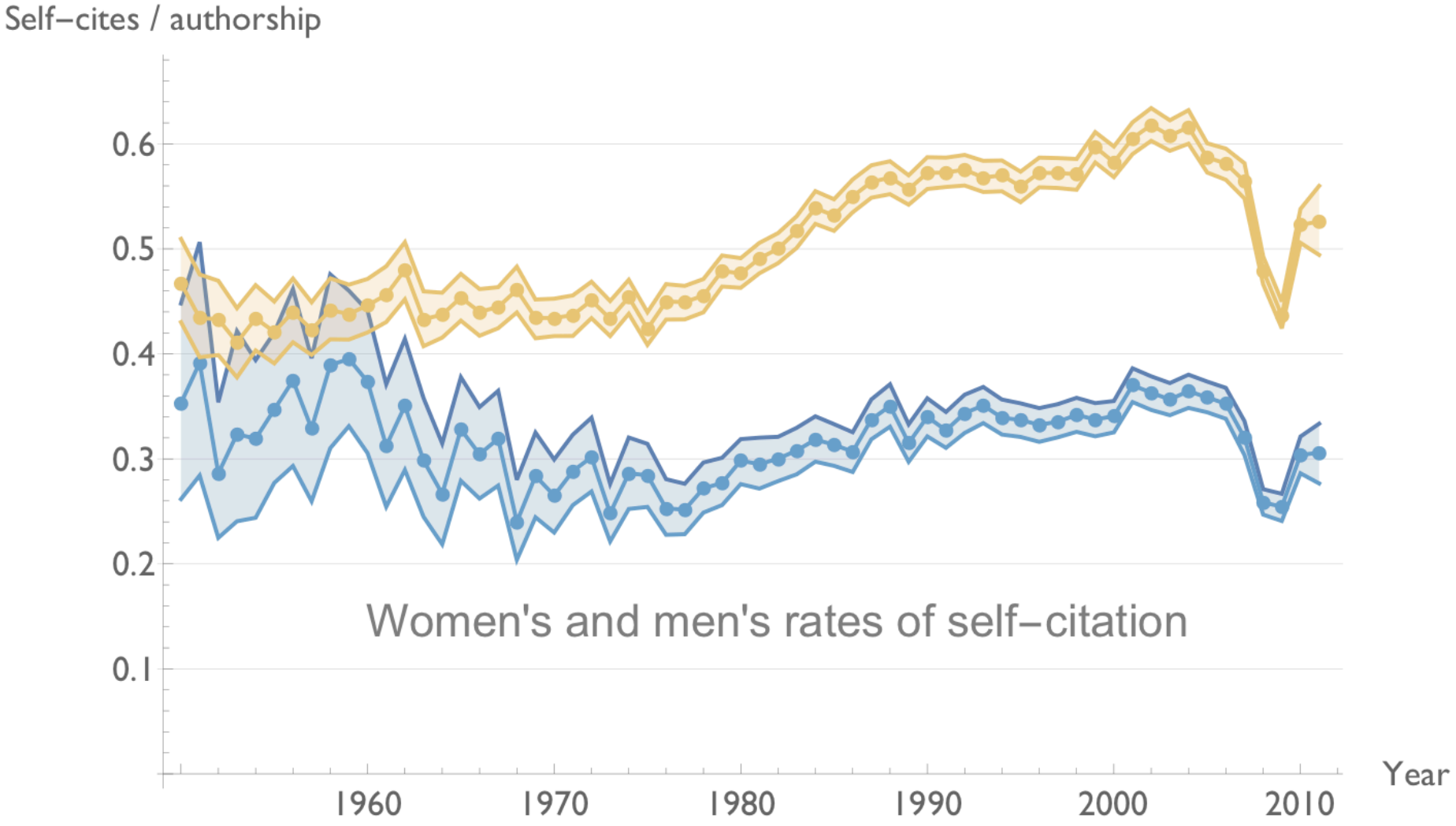
Number of Self-citation by Gender



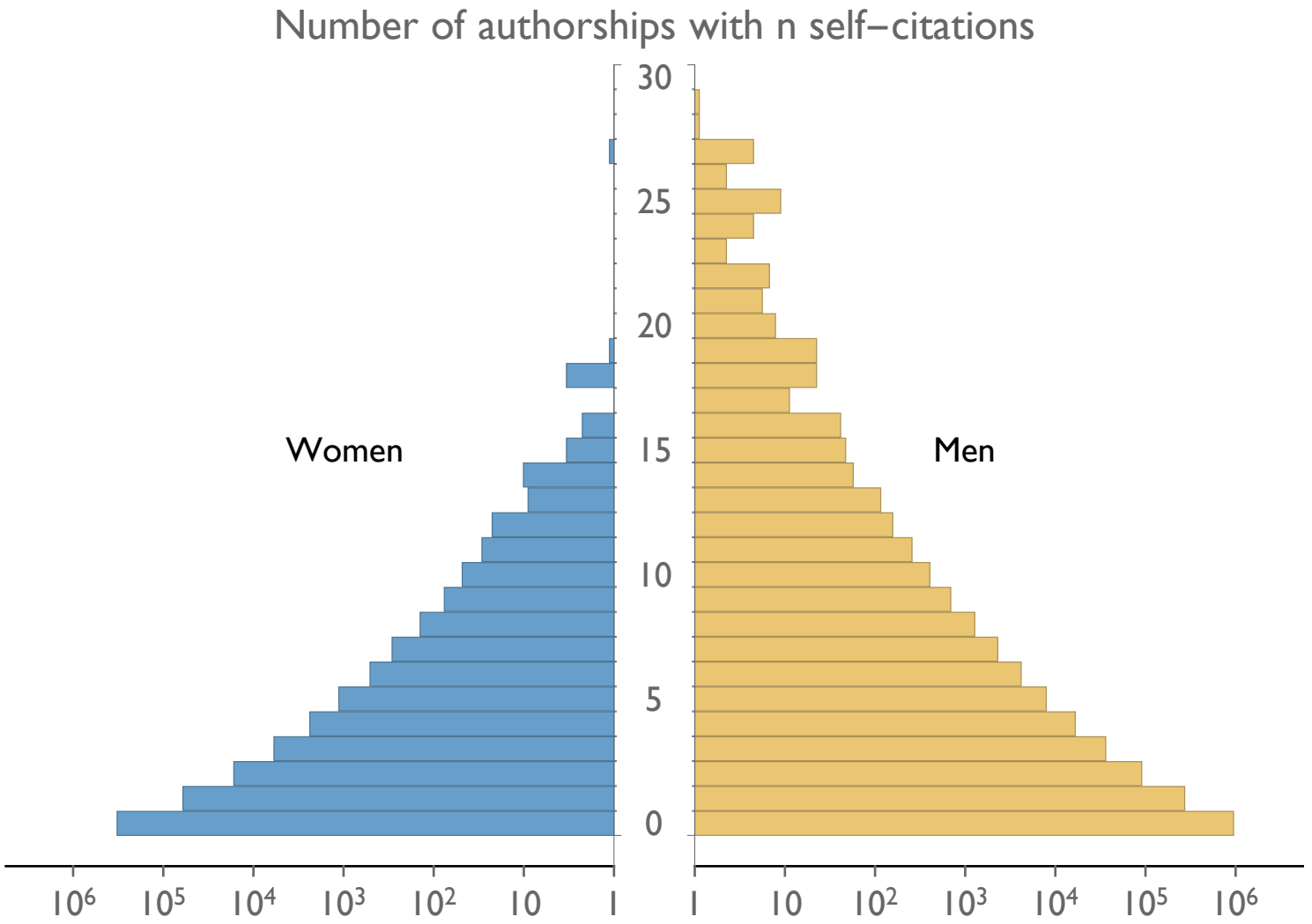


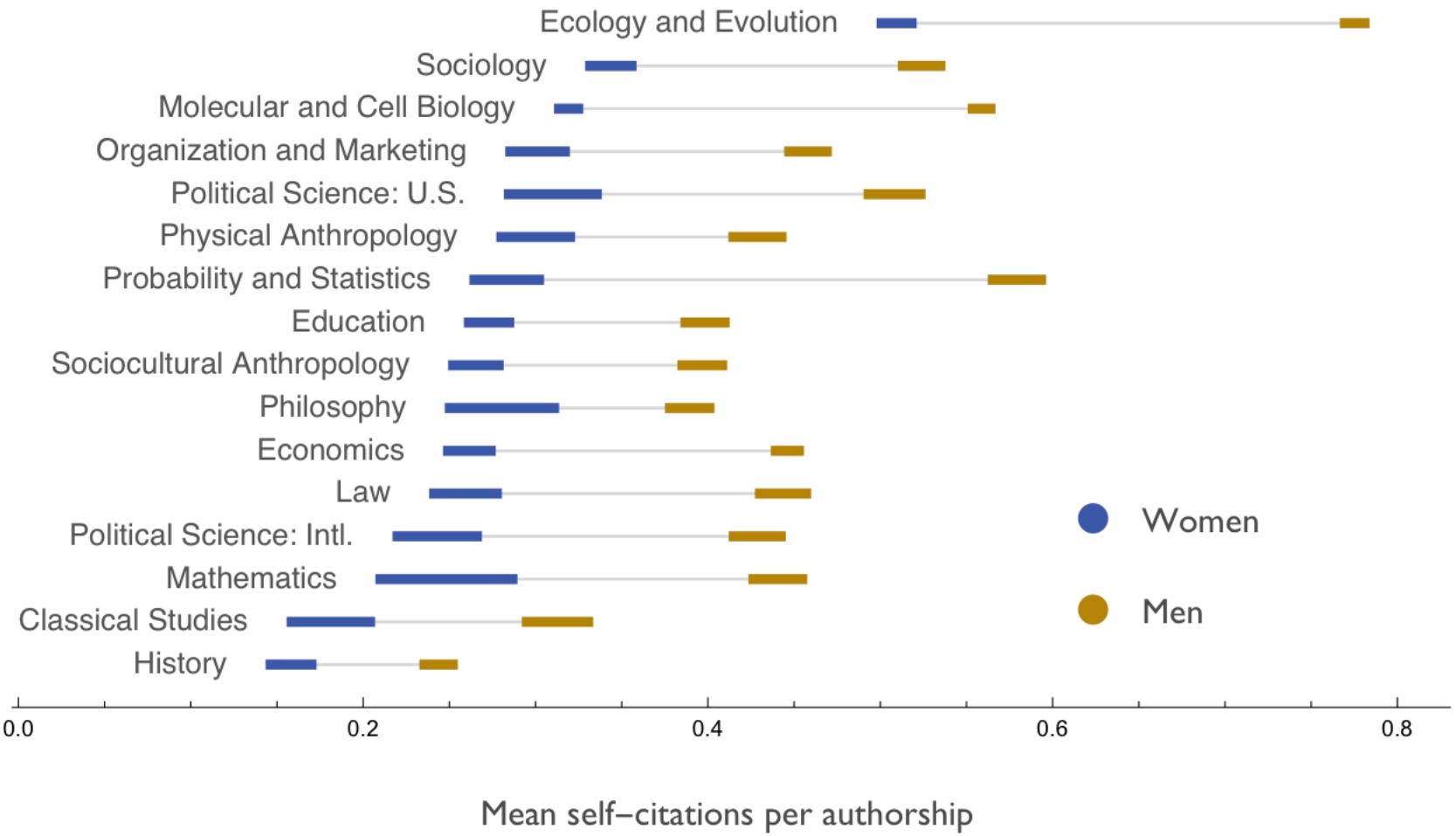
Self-citation over time

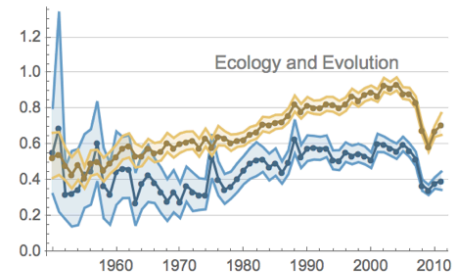



Self−cites / authorship
0.6
0.5
0.4
0.3
0.2
0.1
Women's and men's rates of self−citation
1960
1970
1980
1990
2000
2010
Year

Excessive Self Citation




Ecology and Evolution
Sociology
Molecular and Cell Biology
Organization and Marketing
Political Science: U.S.
Physical Anthropology
Probability and Statistics
Education
Sociocultural Anthropology
Philosophy
Economics
Law
Political Science: Intl.
Mathematics
Classical Studies
History
Women
Men
0.0
0.2
0.4
0.6
0.8
Mean self−citations per authorship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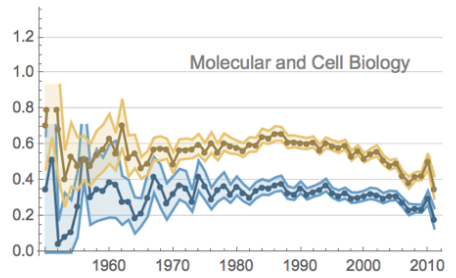
1.0
1.2
1960
1970
1980
1990
2000
2010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1.0
1.2
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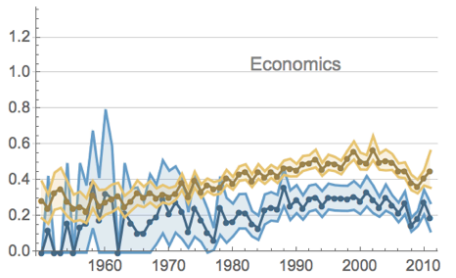
2010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0.8
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1.2
1960
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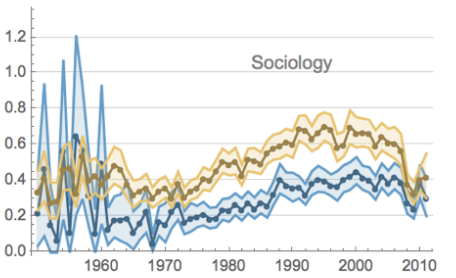
2010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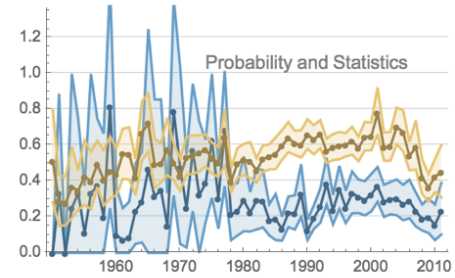
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1960
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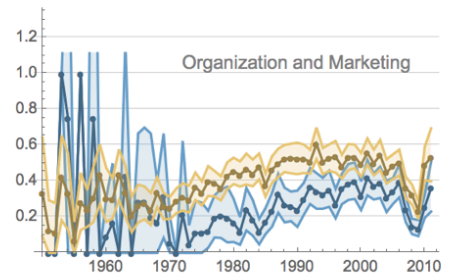
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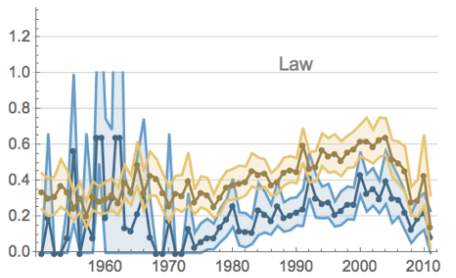
2010


Law
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1960
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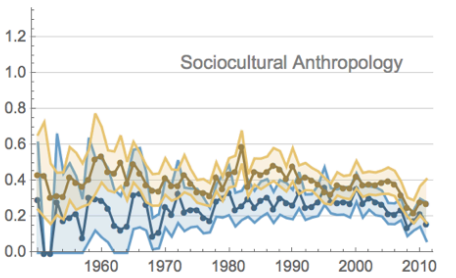
2010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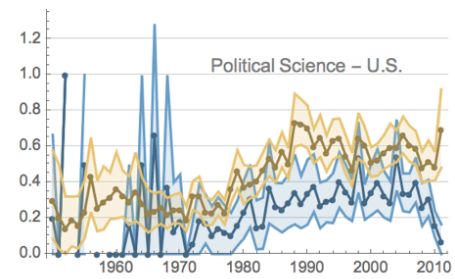
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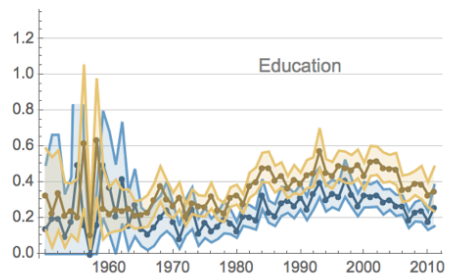
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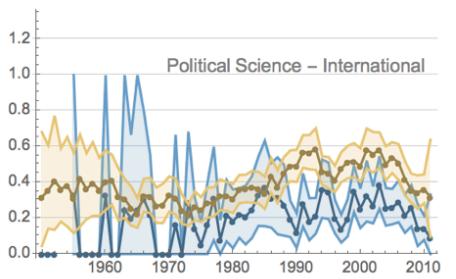
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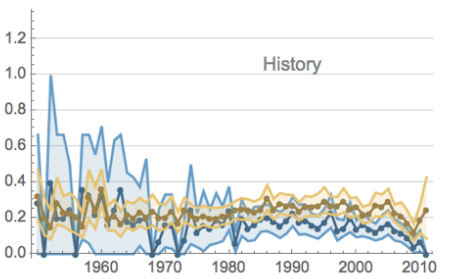
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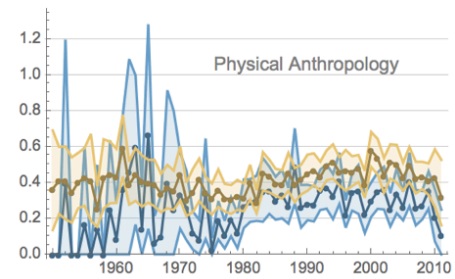
Physical Anthropology
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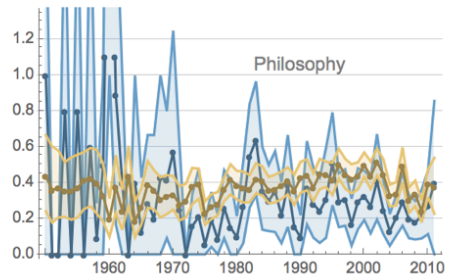
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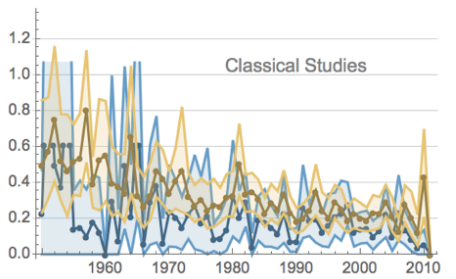
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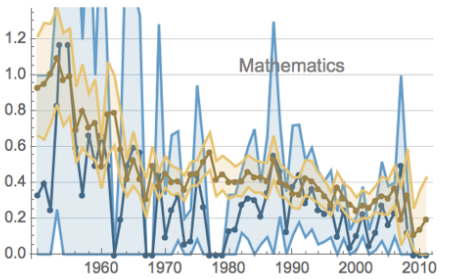
Mathematics
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1960
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1980
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2000
2010

Potential Mechanisms

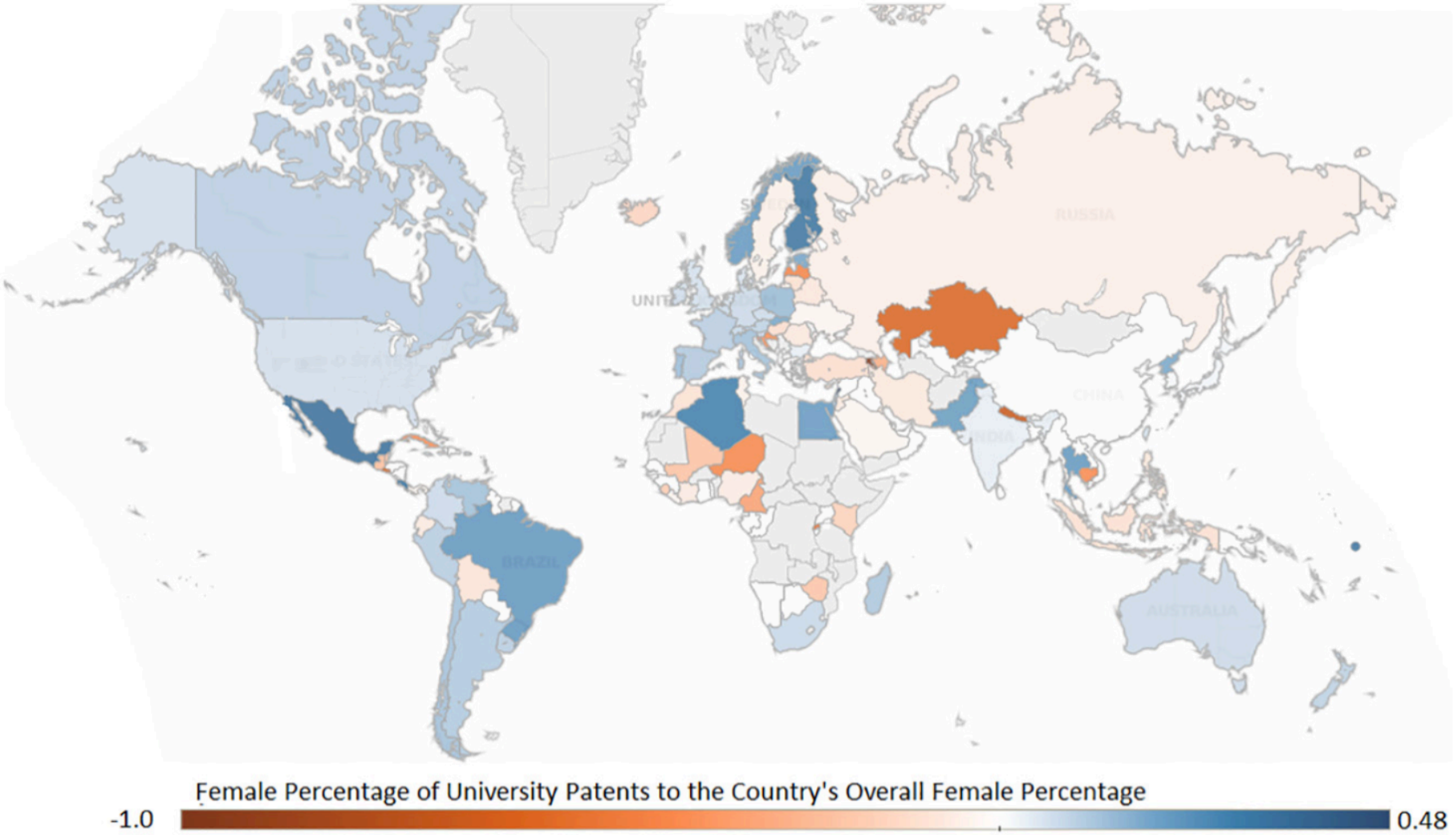
- Men may self-cite more because they evaluate their abilities more positively than women
- Men face fewer social penalties for self-promotion.
- Men specialize more in academic subfields, and specialization may encourage more self-citation
- Men publish more papers, particularly earlier in their careers, and therefore have more work to cite
- Men publish different types of papers; namely, the types of papers an academic may be more likely to self-cite
- Women switch fields more often so reduce their need for self-citation
- What else?

Talk Outline

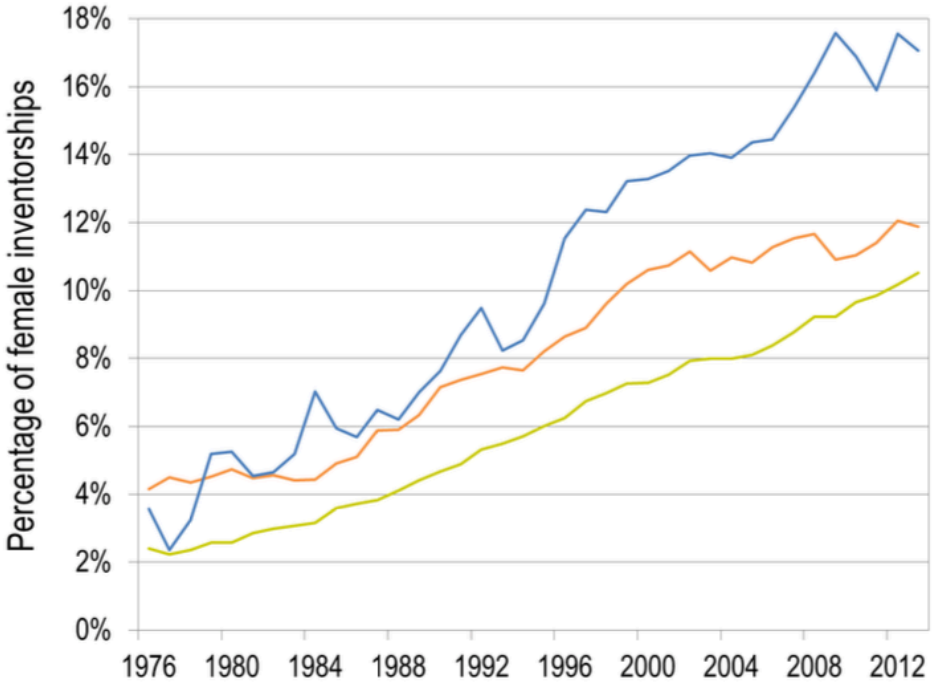
- Gender in Academic Authorship
- Self-citation Differences
- Patents and Inventorship
- Homophily versus Heterophily
- Recommendations

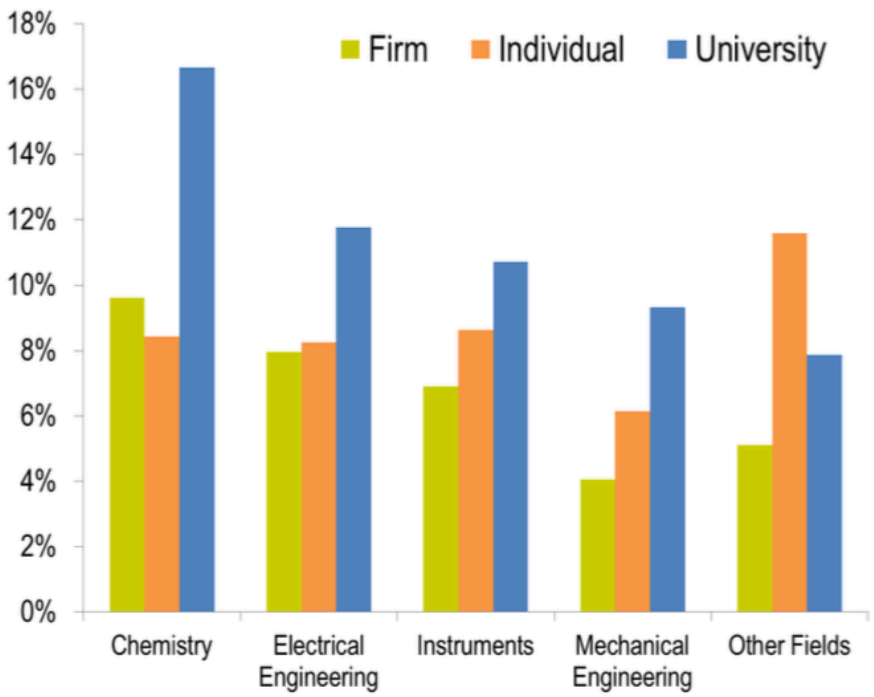
University Tech Transfer

Gender Disparities in Patents

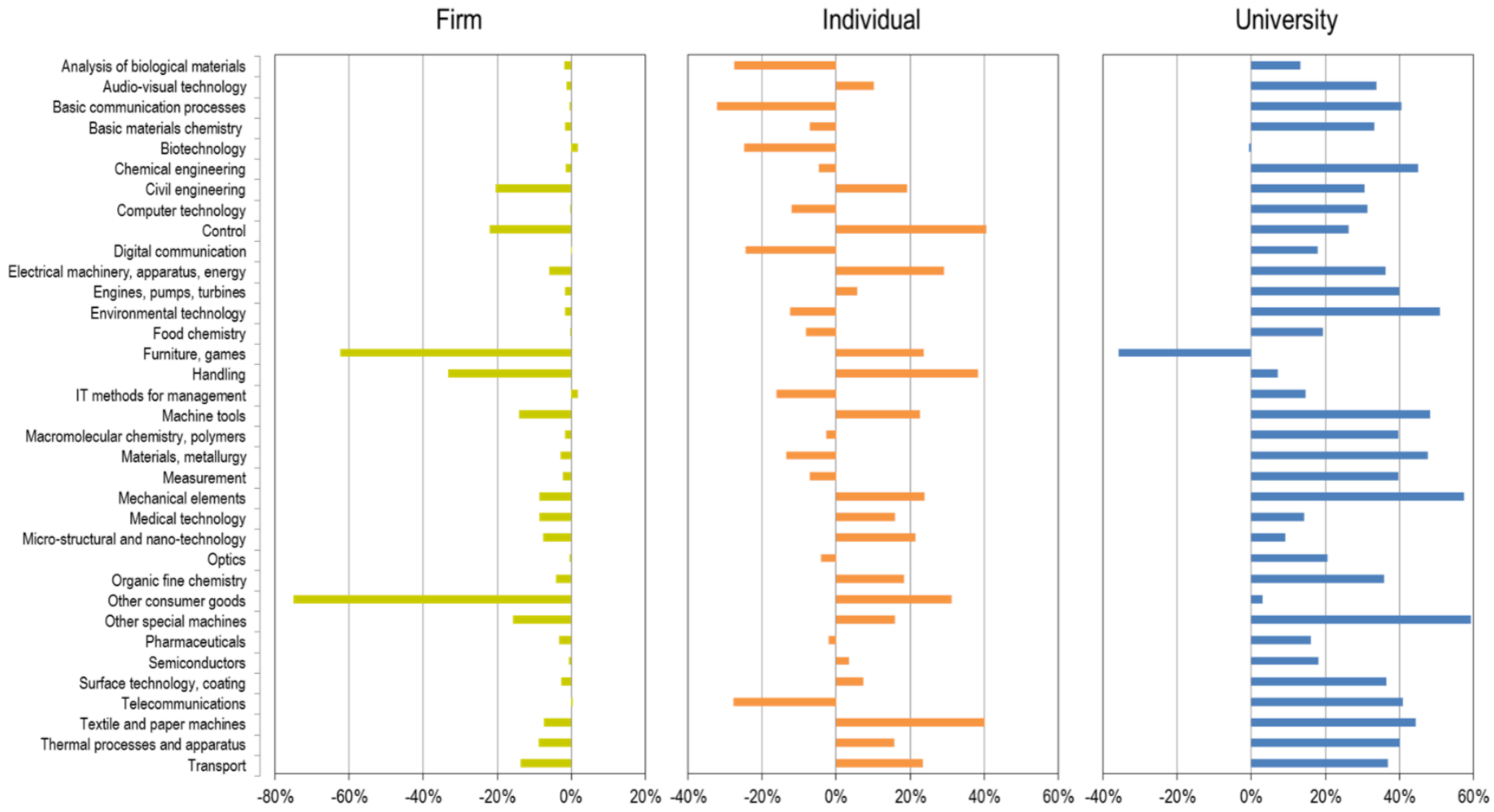


University Patent Environments

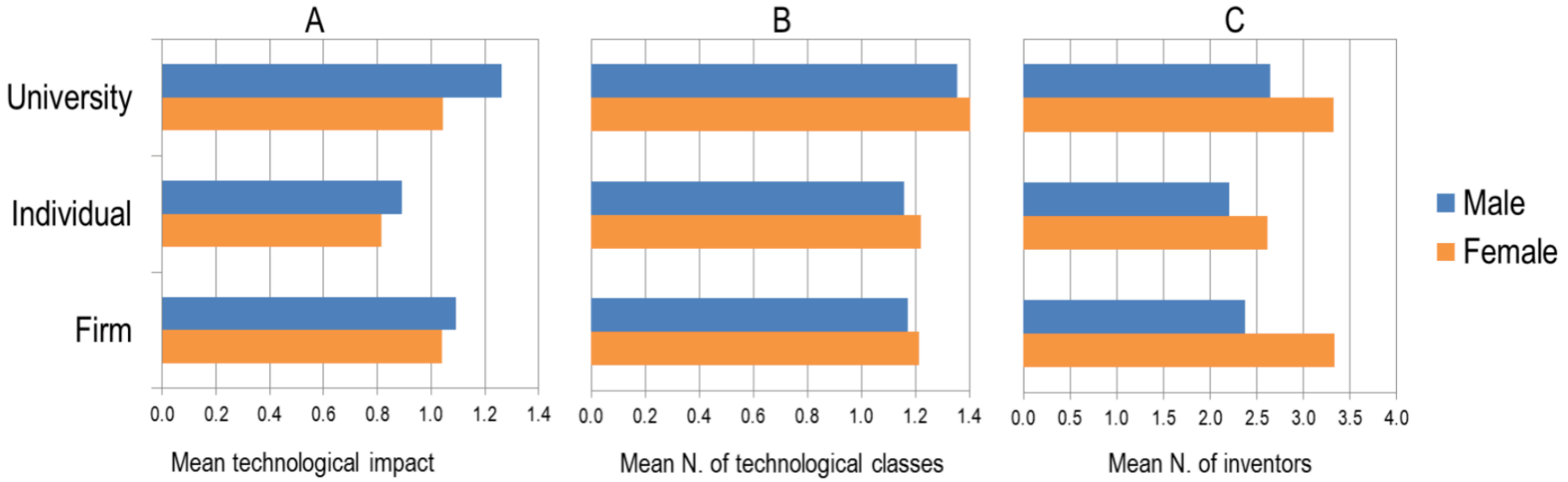




Gender Differences by Industry



‘Impact’ differences by gender



Gender differences

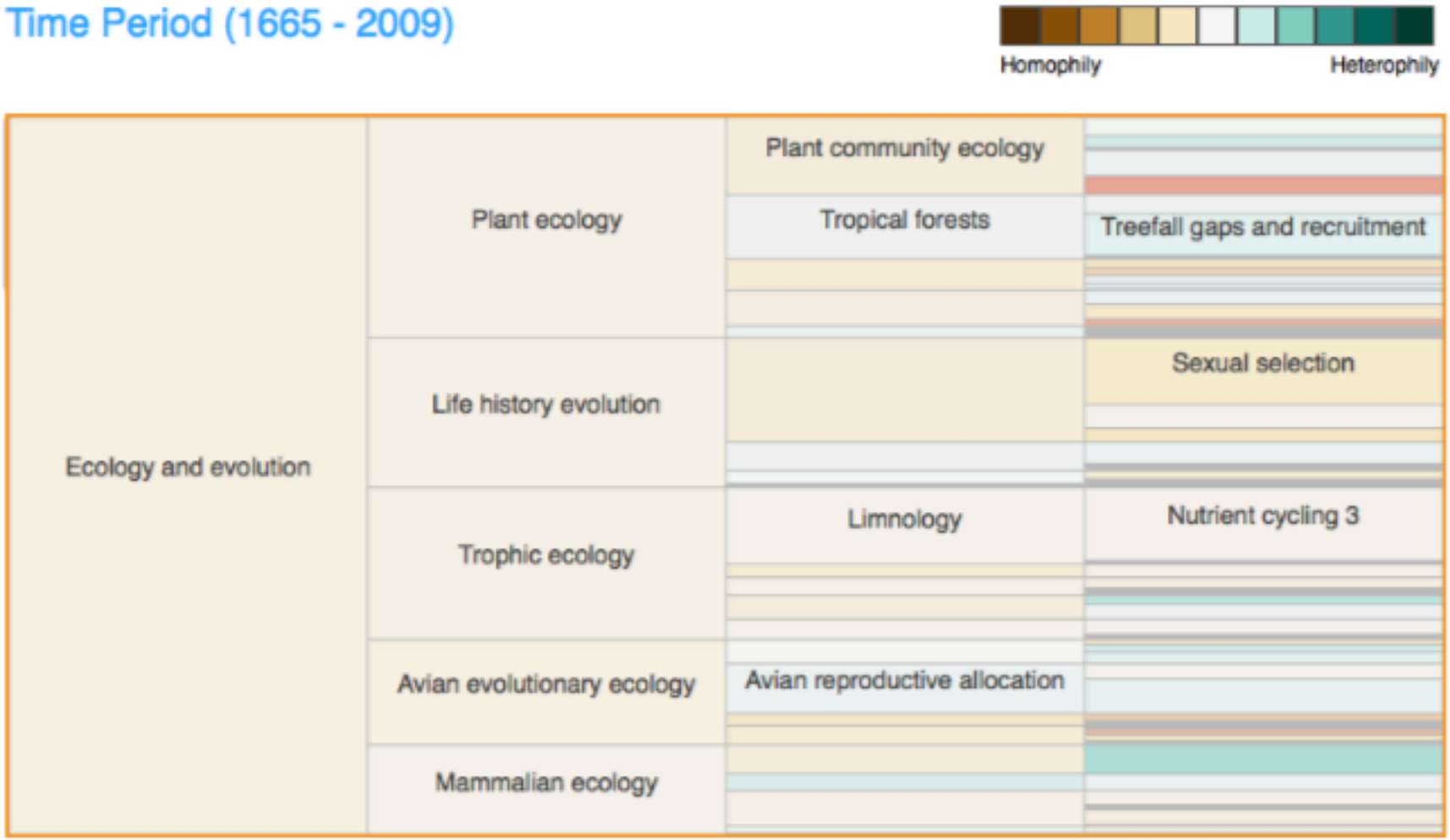
Authorship

Inventorship

Self-citation

Assortativity

Homophily vs Heterophily



Future Directions

- Full disambiguated author data set
- Paper and journal status effects
- Homophily versus Heterophily
- Patent acceptance rates
- What else?

What to do?

Avoiding gender bias in reference writing

Got a great student? Planning to write a super letter of reference?
Don't fall into these common traps based on unconscious gender bias.

Mention research & publications

Letters of reference for men are 4x more likely to mention publications and twice as likely to have multiple references to research. Make sure you put these critical accomplishments in every letter!

Don't stop now!

On average, letters for men are 16% longer than letters for women and letters for women are 2.5x as likely to make a minimal assurance ('she can do the job') rather than a ringing endorsement ('she is the best for the job').

Emphasize accomplishments, not effort

Letters for reference for men are more likely to emphasize accomplishments ('his research', 'his skills', or 'his career') while letters for women are 50% more likely to include 'grindstone' adjectives that describe effort. 'Hard-working' associates with effort, but not ability.

We all share bias

It is important to remember that unconscious gender bias isn't a male problem. Research shows that women are just a susceptible to these common pitfalls as men.
This is a problem for all of us - let's solve it together!

Keep it professional

Letters of reference for women are 7x more likely to mention personal life - something that is almost always irrelevant for the application. Also make sure you use formal titles and surnames for both men and women.

Stay away from stereotypes

Although they describe positive traits, adjectives like 'caring', 'compassionate', and 'helpful' are used more frequently in letters for women and can evoke gender stereotypes which can hurt a candidate. And be careful not to invoke these stereotypes directly ('she is not emotional').

Be careful raising doubt

We all want to write honest letters, but negative or irrelevant comments, such as 'challenging personality' or 'I have confidence that she will become better than average' are twice as common in letters for female applicants. Don't add doubt unless it is strictly necessary!

Adjectives to avoid:	Adjectives to include:
caring	successful
compassionate	excellent
hard-working	accomplished
conscientious	outstanding
dependable	skilled
diligent	knowlegeable
dedicated	insightful
tactful	resourceful
interpersonal	confident
warm	ambitious
helpful	independent
	intellectual

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THE UNIVERSITY OF ARIZONA
Commission on the Status of Women

Research from Trix, F & Psenka, C. Exploring the color of glass: Letters of recommendation for female and male medical faculty. Discourse & Society, 2003; and Madera, JM, Hebl, MR, & Martin, RC. Gender and letters of Recommendation for Academia: Agentic and Communal Differences. Journal of Applied Psychology, 2009.

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For an electronic copy of this graphic, see:
www.csw.arizona.edu/LORbias

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Ted Bergstrom, Department of Economics, USCB

Carole Lee, Department of Philosophy, UW

Elena Erosheva, Department of Statistics, UW