

# What did we learn from the project about the gender gap for the various disciplines?

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Conference on Global Approach to the Gender Gap  
in Mathematical, Computing and Natural Sciences:  
How to Measure It, How to Reduce It?

**ICTP, Trieste, Nov 2019**



# Gender Gap in **S**cience **T**echnology **E**ngineering **M**athematics



To describe accurately the  
gender gap in STEM:

→

good understanding of how the  
scientific community is  
organized in each discipline

# Gender Gap in Science Project: an interdisciplinary collaboration from professional unions



- International Science Council
- IMU through CWM
- IUPAC
- IUPAP
- IAU
- IUBS
- ICIAM
- IUHPST
- UNESCO through SAGA
- GenderInSITE
- OWSD
- ACM through ACM-W.

# Project organization

Three tasks to inform our understanding of the gender gap from different angles

1. Global survey of scientists
2. Data analysis of publication patterns
3. Database of good practices



# Project organization in regards to different disciplines



Three tasks to inform our understanding of the gender gap from different angles

1. **Global survey of scientists**
2. **Data analysis of publication patterns**
3. **Database of good practices**

# Methodology to address different disciplines



**Global survey** → respondents'  
self-disclosed information  
about fields of study

**Data analysis of publication  
patterns** → choice of  
bibliographic database to  
analyze

# Methodology to address different disciplines

**Global survey** → hold out all other variables constant and account for discipline-specific patterns

**Data analysis of publication patterns** → adapt analysis to the various data sources and formulate questions accordingly



# What have we learned about the Gender Gap for the various disciplines from the GLOBAL SURVEY



Computer Science  
Biology  
Chemistry  
Mathematics  
Physics  
Applied Mathematics  
History of Science



# Results from the global survey

*“Bivariate and multivariate analyses provide compelling evidence that women and men do not have the same experiences in STEM, and that women’s experiences are less positive than men’s.”*

Can we extract insights from the different disciplines?



# Results from the global survey



*“Bivariate and multivariate analyses provide compelling evidence that women and men do not have the same experiences in STEM, and that women’s experiences are less positive than men’s.”*

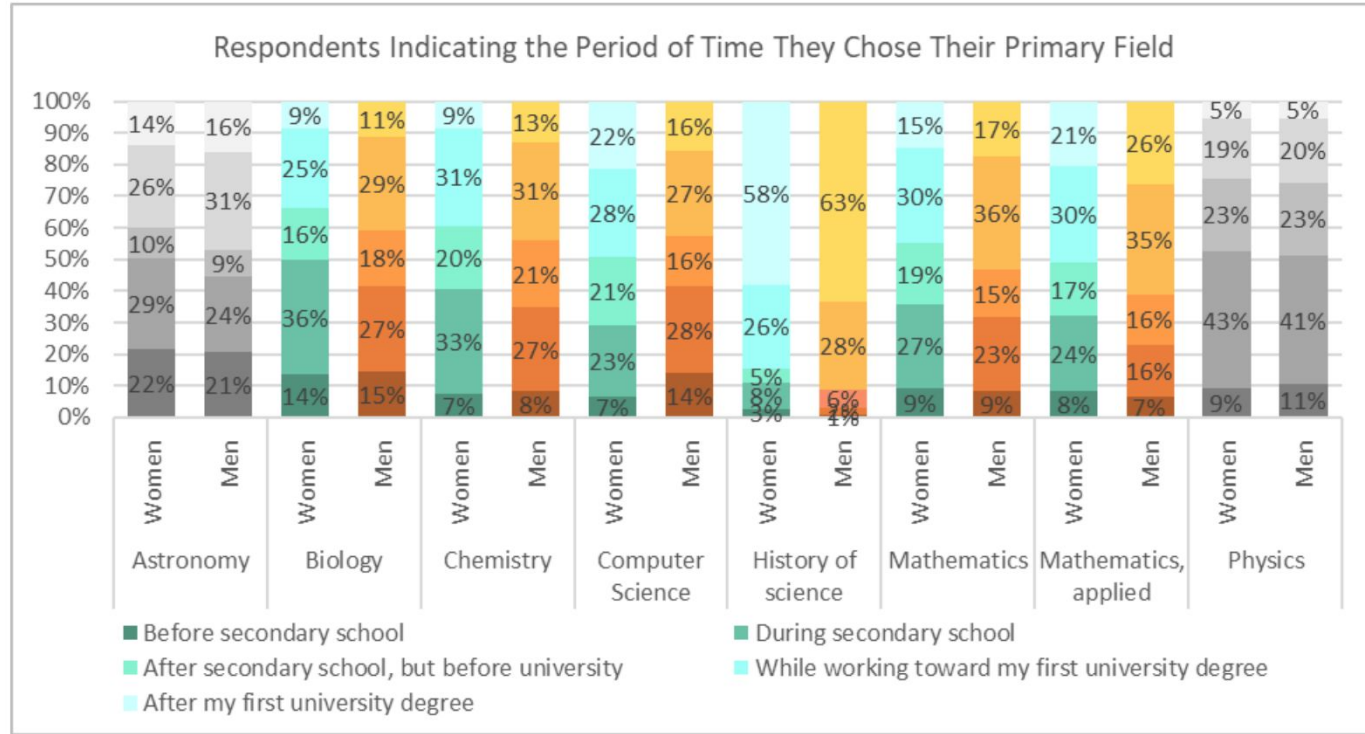
Can we extract insights from the different disciplines?

*“Bivariate analysis can also be used to explore gender differences in perceptions in three primary areas in isolation: disciplines, regions, and societal development levels.”*

## Regarding time of choice of study field:

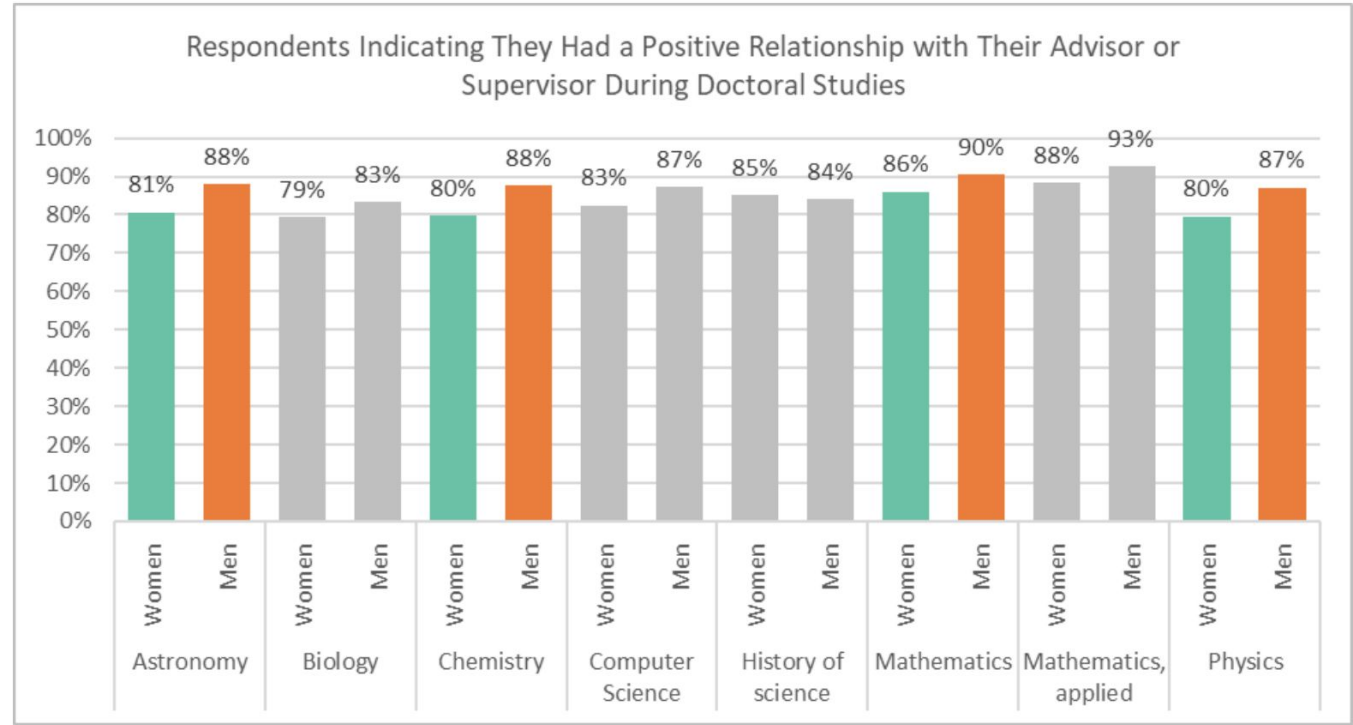
No evidence of a gender gap in Astronomy and Physics

For those, about 50% respondents made the choice before or during secondary school



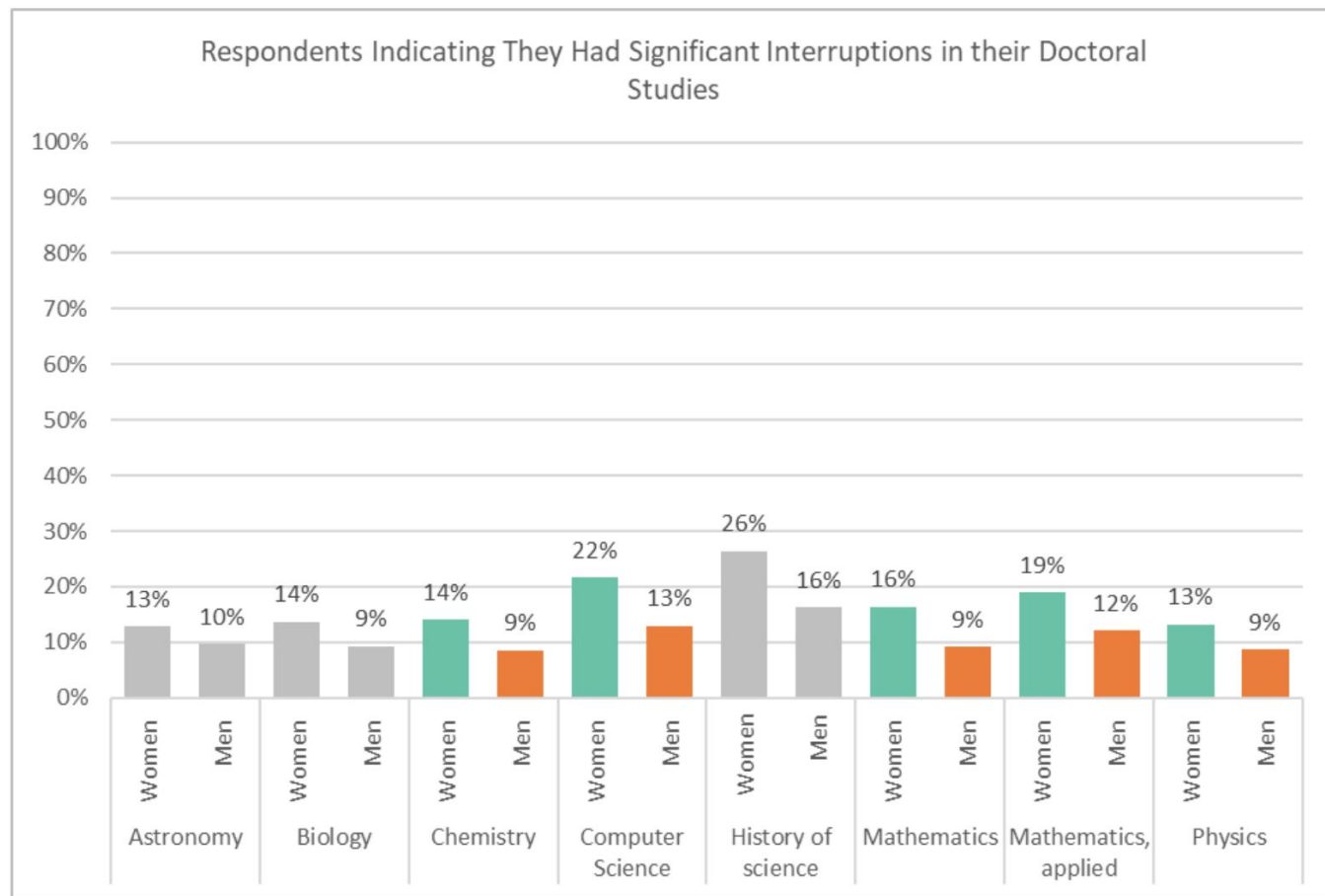
**Regarding  
quality of  
relationship with  
advisor:**

No evidence of a  
gender gap in  
Biology,  
Computer  
Science, History  
of Science,  
Applied  
Mathematics



**Regarding  
interruptions  
during doctoral  
studies:**

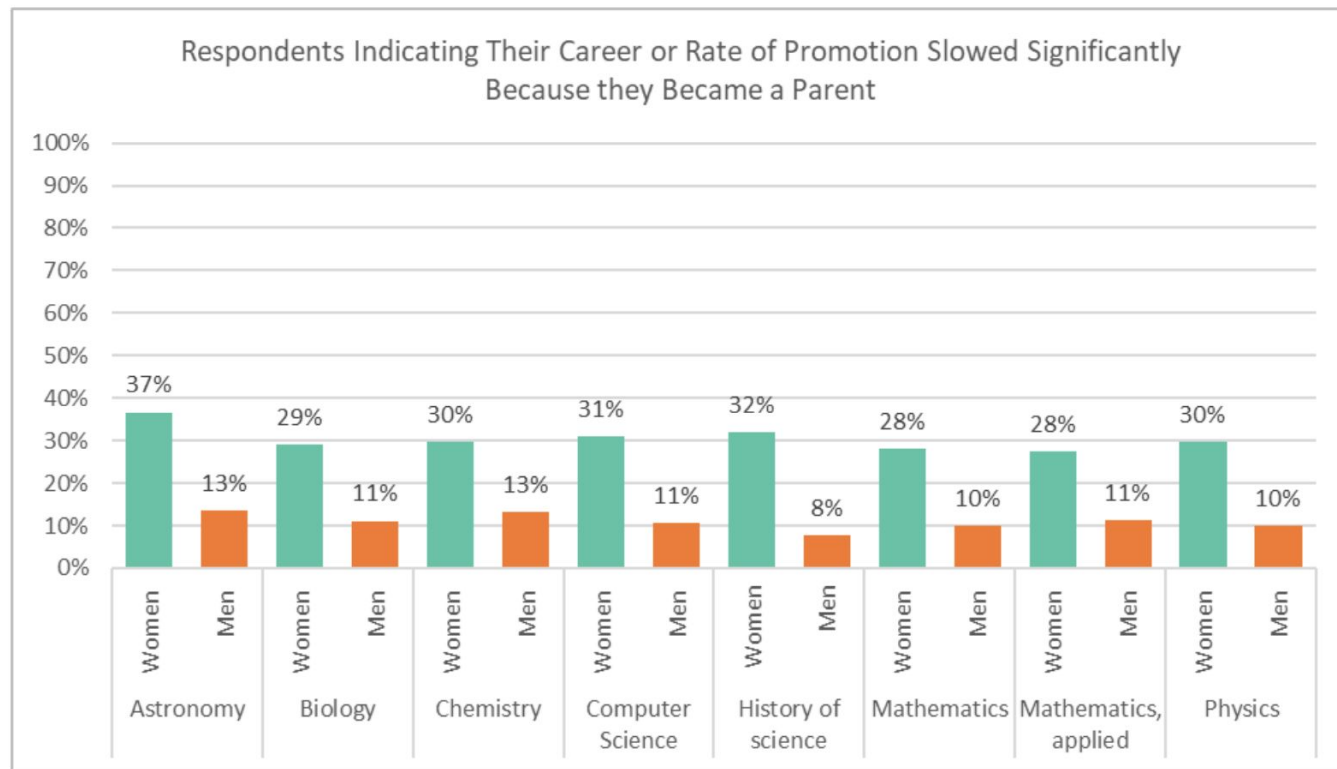
**No evidence of a  
gender gap in  
Astronomy,  
Biology, History  
of Science**



**Regarding effect  
of becoming a  
parent on career  
progression:**

**Evidence of a  
gender gap in all  
surveyed  
disciplines**

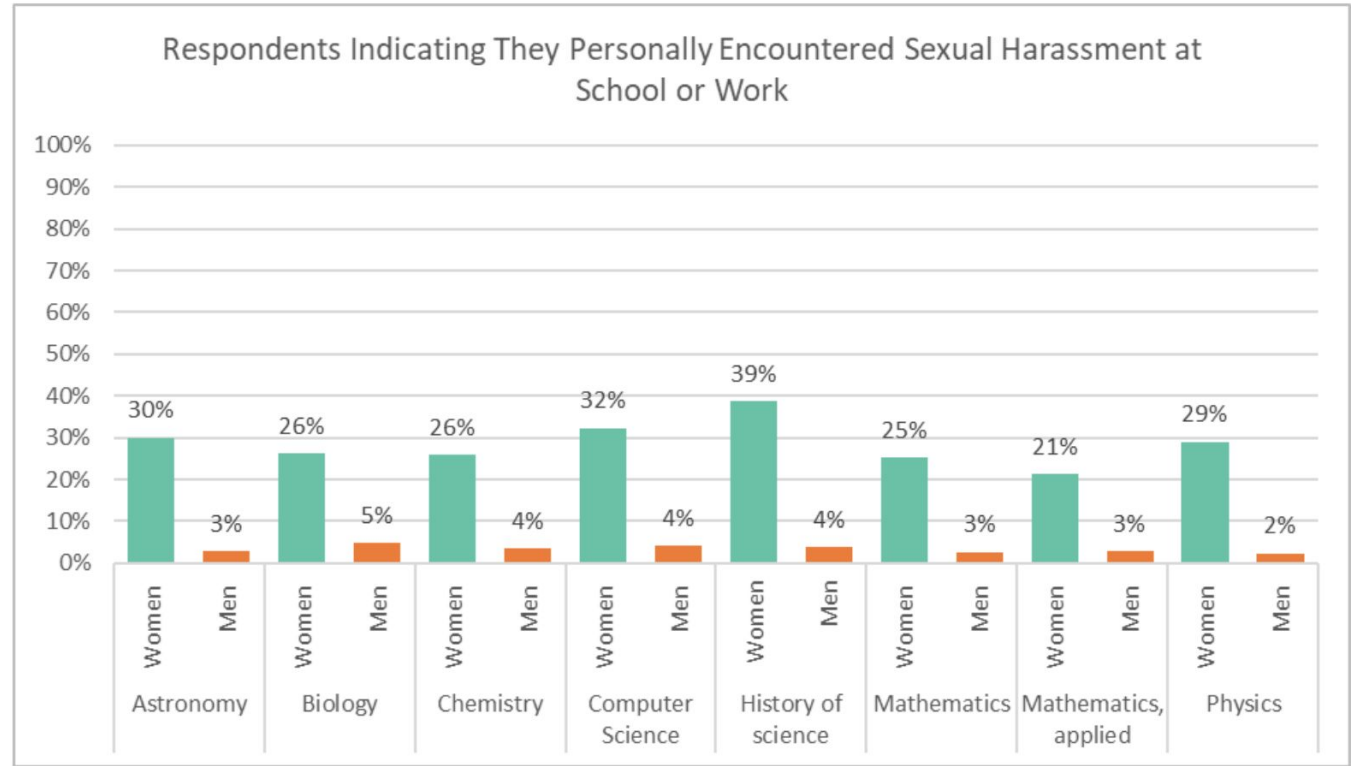
**Worse field:  
Astronomy**



**Regarding  
personal  
encounters with  
sexual  
harassment:**

**Evidence of a  
gender gap in all  
surveyed  
disciplines**

**Worst field:  
History of  
Science**



# Survey responses regarding submission to top journals

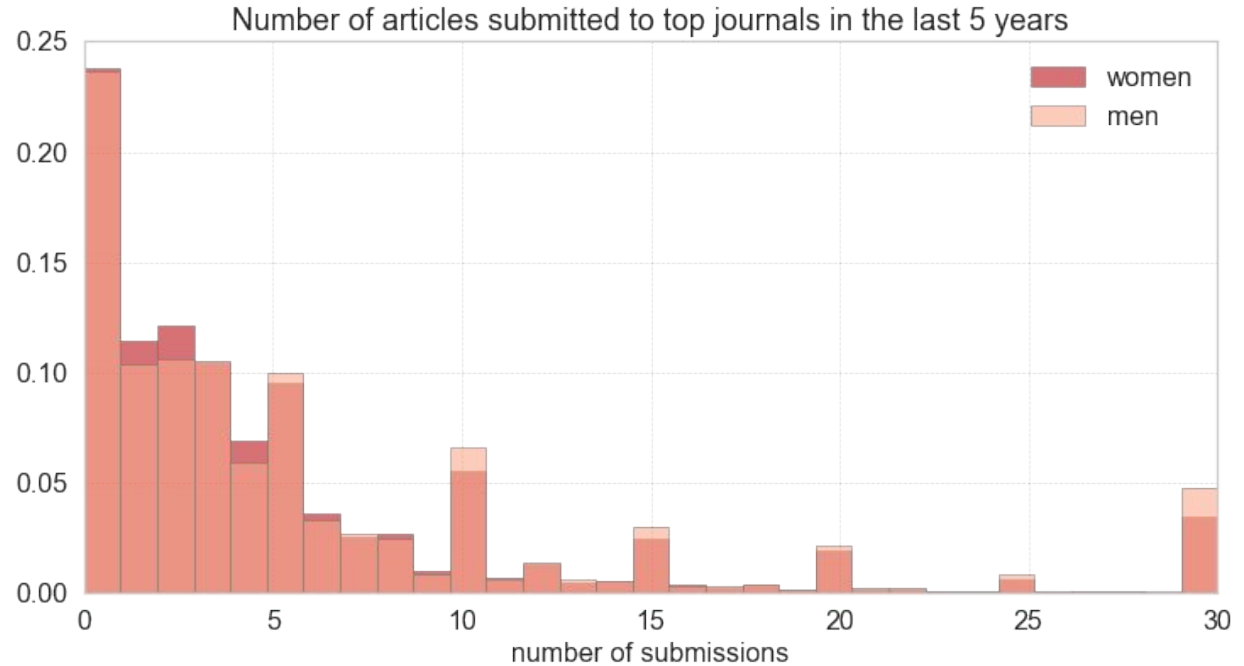
Women reported submitting fewer journal articles to top-ranked journals (5.7), compared to men (6.3), in the last 5 years.





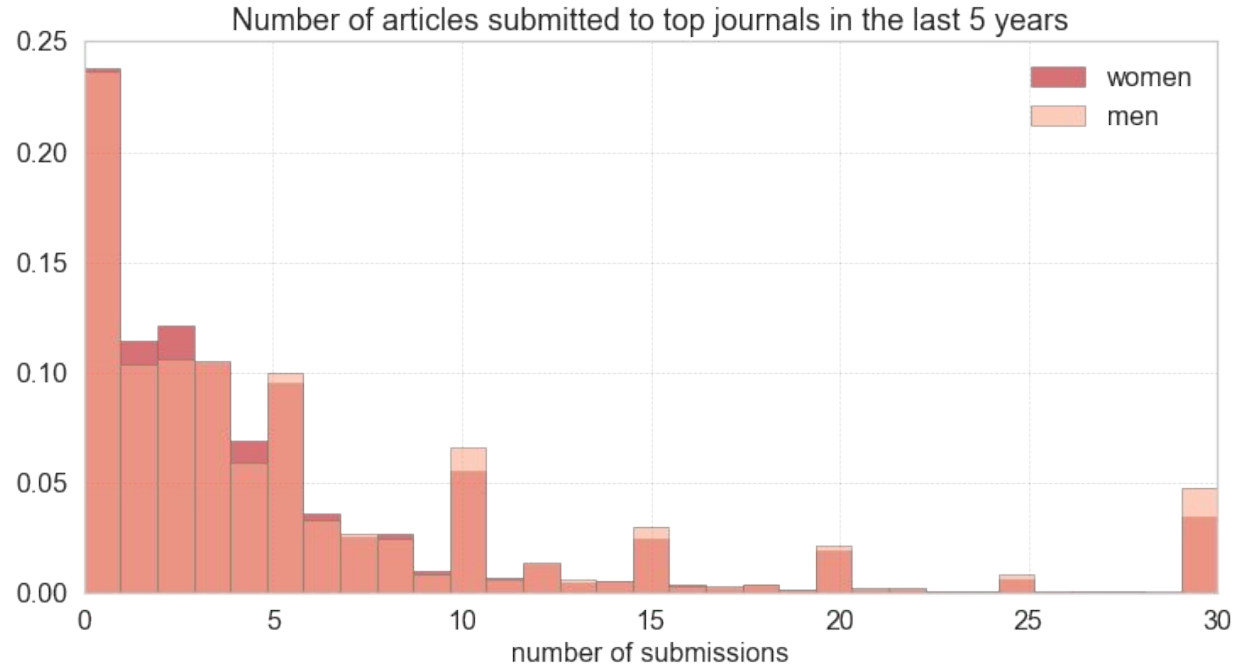
We have computed test statistics to test the null hypothesis that there is no statistical difference between the self-reported submission rates of women and men.

Tests show that the **difference is statistically significant** but the **effect size is small**, and noteworthy only for certain disciplines and regions



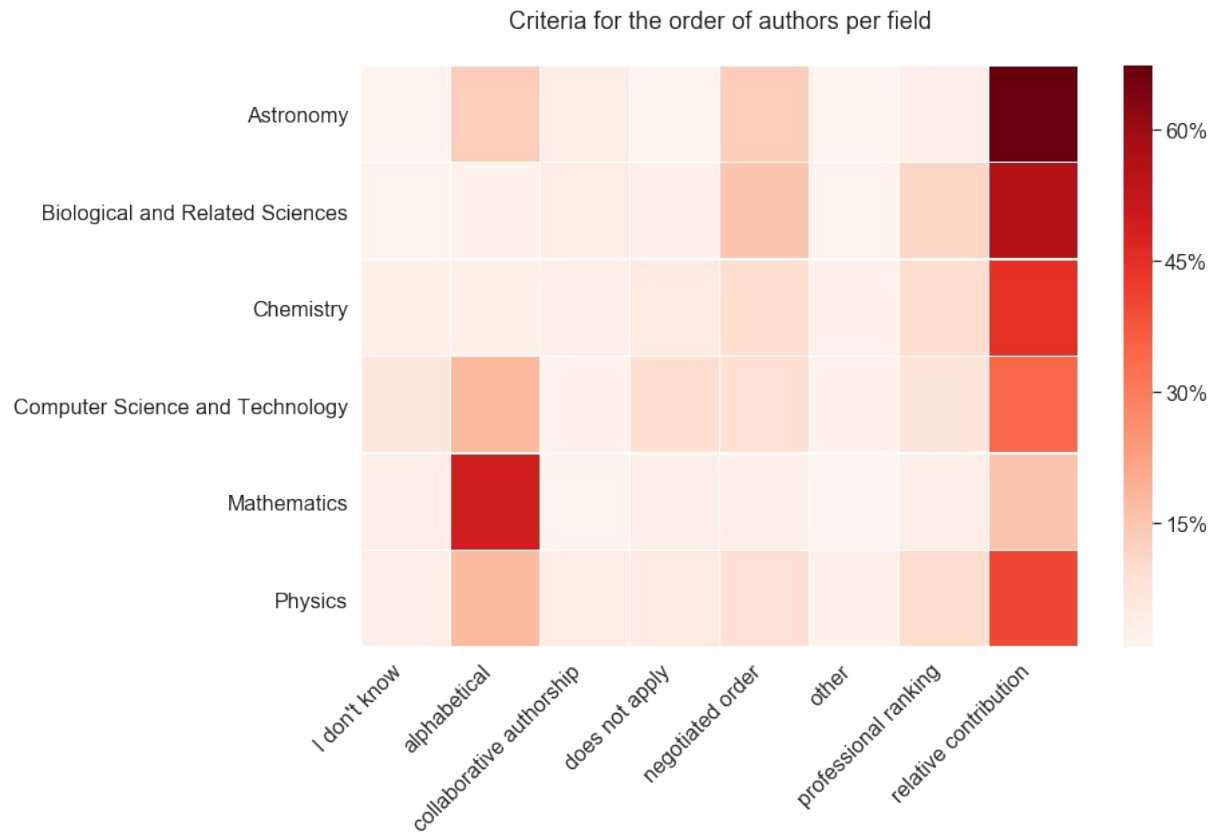
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1. Perceptions
2. Top journal (?)

# Discipline-specific publication practices



What have we  
learned about the  
Gender Gap for the  
various disciplines  
from the ANALYSIS  
OF PUBLICATIONS



*Chemistry*  
*Astronomy and Astrophysics*  
*Mathematics*  
*Theoretical Physics*

# Analysis of publication patterns: why

- Successful academic careers are tied to a prolific scholarly record
- Decisions on tenure and promotion depend (partly) on publication metrics
- Relevant for academic institutions, science policy makers and researchers

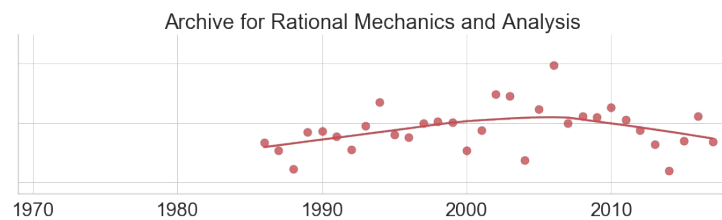
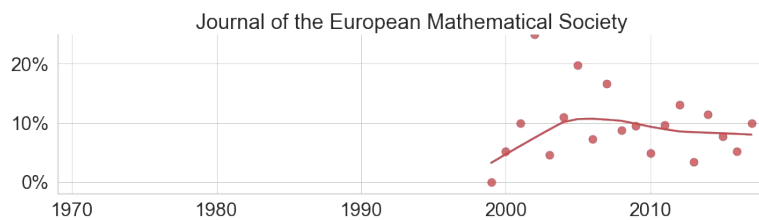
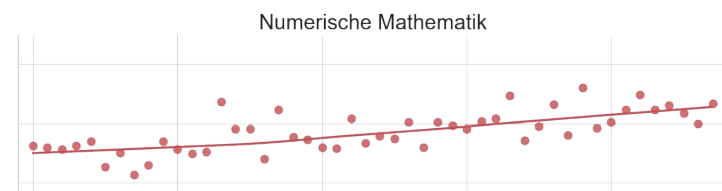
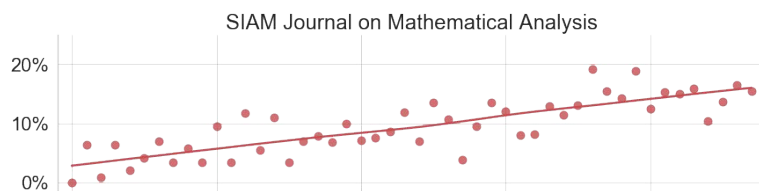
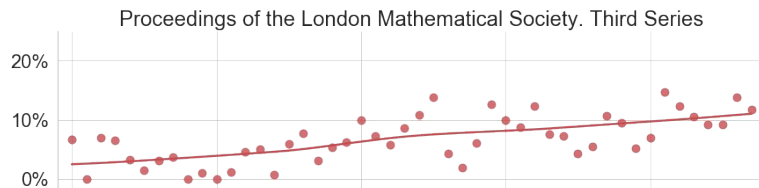
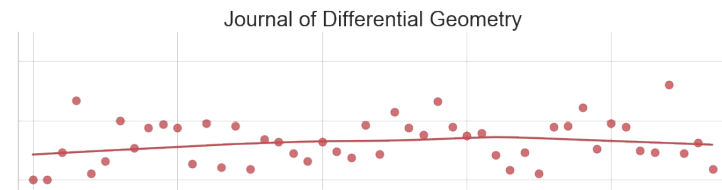
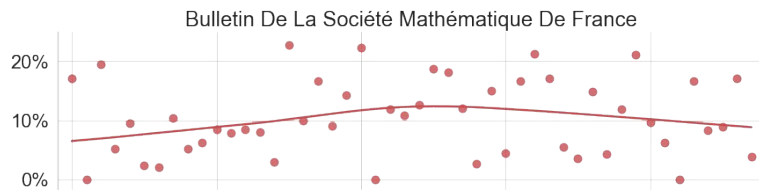
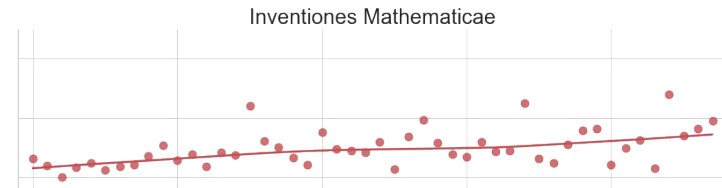
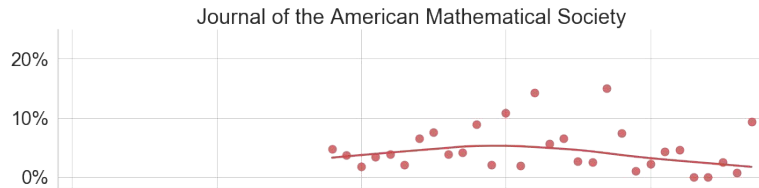


# Bibliographic data sources per discipline

- Mathematics → zbMATH
- Astrophysics → ADS
- Theoretical Physics → arXiv
- Chemistry → 6 renowned journals

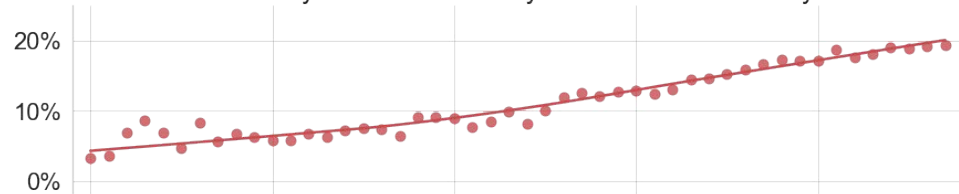


# Math

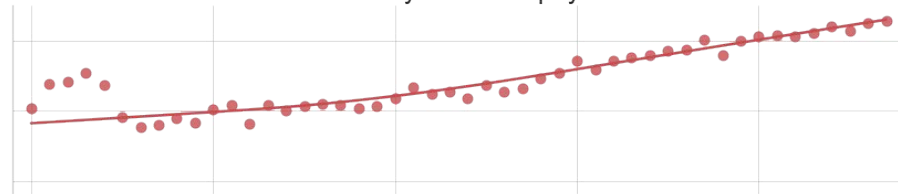


# Astronomy and Astrophysics

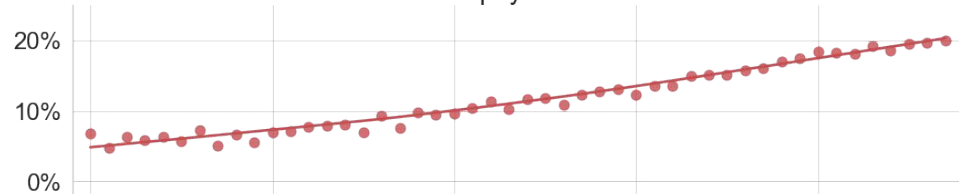
Monthly Notices of the Royal Astronomical Society



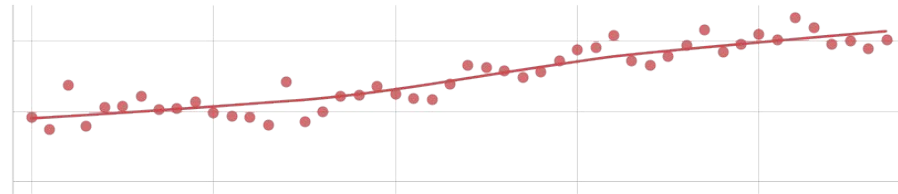
Astronomy and Astrophysics



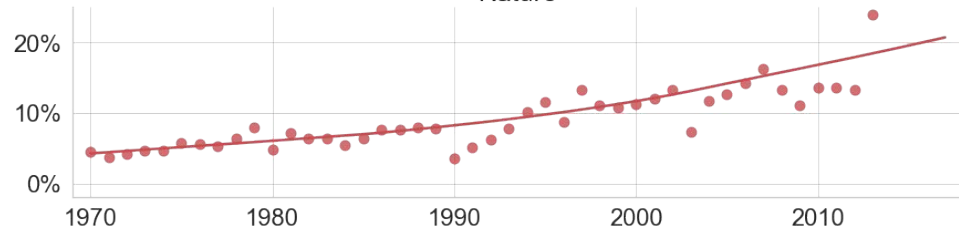
The Astrophysical Journal



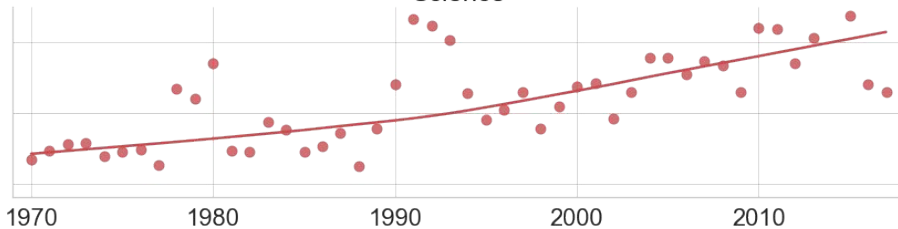
The Astronomical Journal



Nature

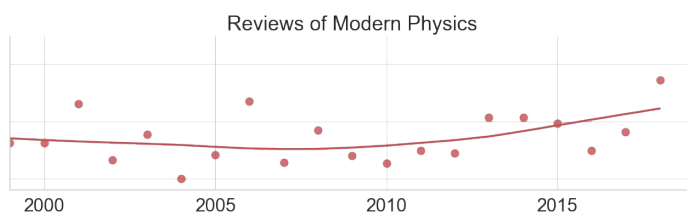
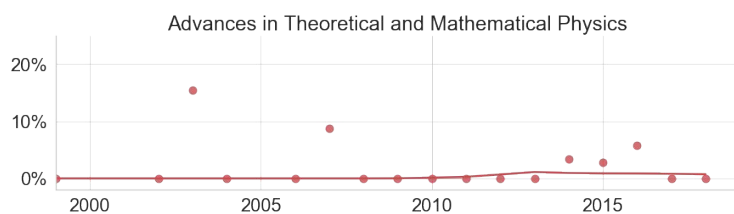
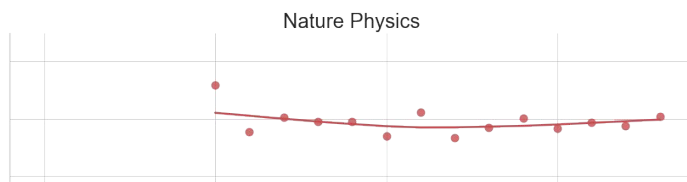
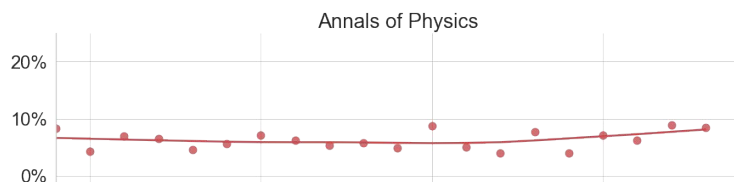
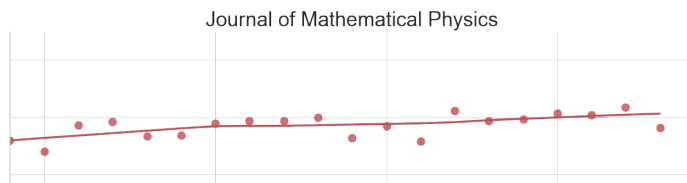
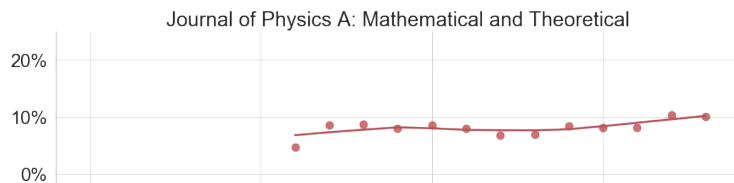
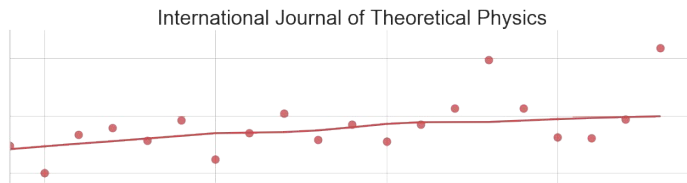
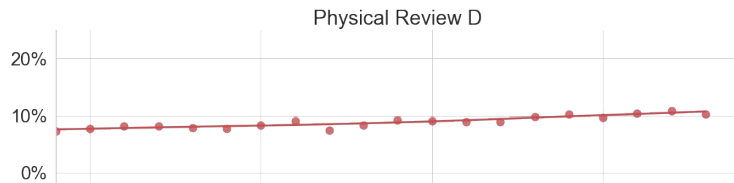
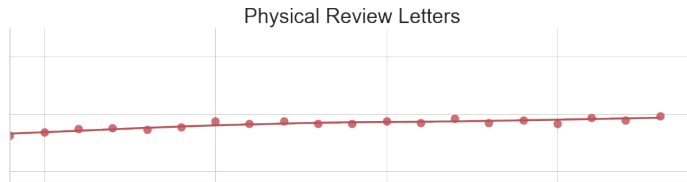
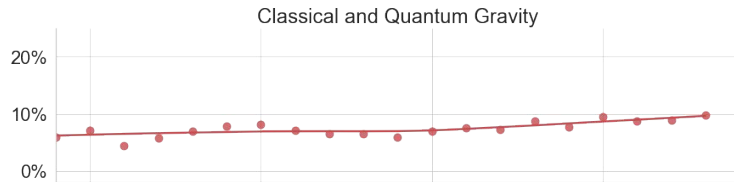


Science

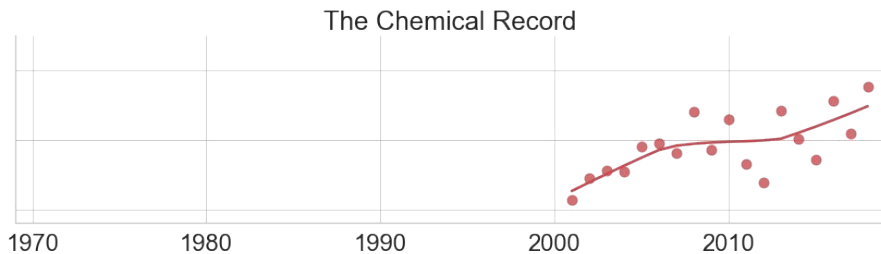
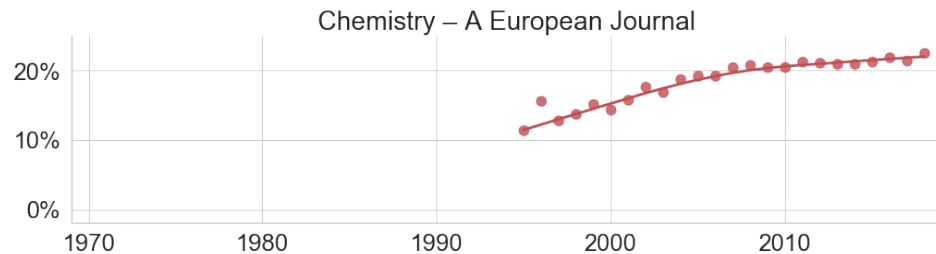
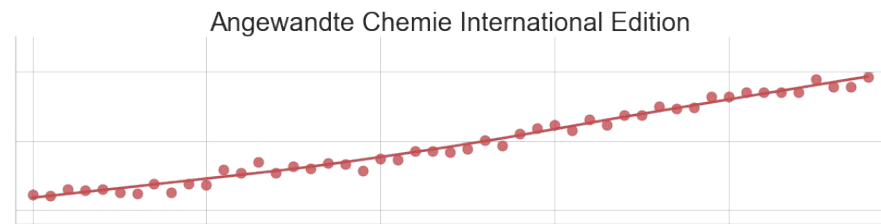
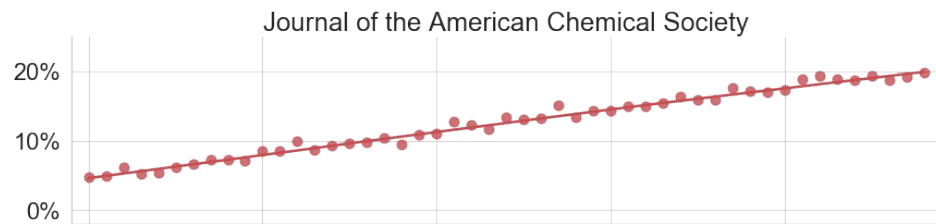
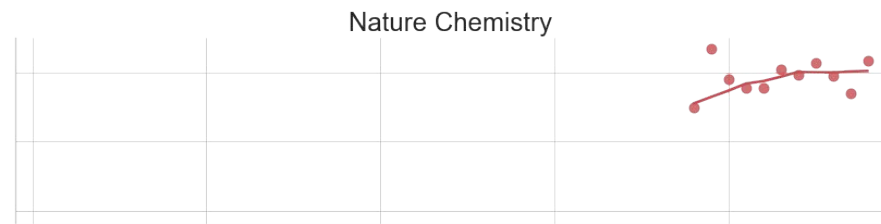
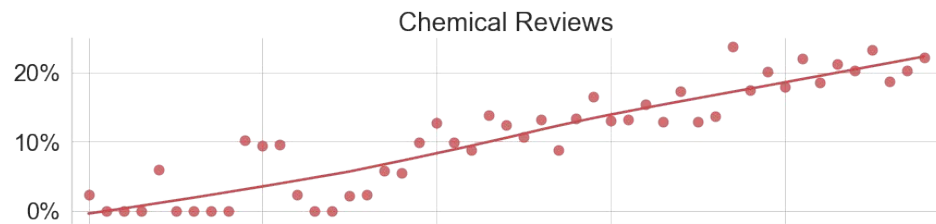




# Theoretical Physics



# Chemistry



# What we learned about the gender gap through the analysis of TOP JOURNALS by discipline



- Astrophysics and Chemistry show the largest improvement in women representation
- Mathematics and Physics stagnate or decline instead
- Applied fields seem to have larger female representation

**But mostly**

- Submission, acceptance/rejection rates still very intransparent part of the publication process. **Biases are unknown / immeasurable**

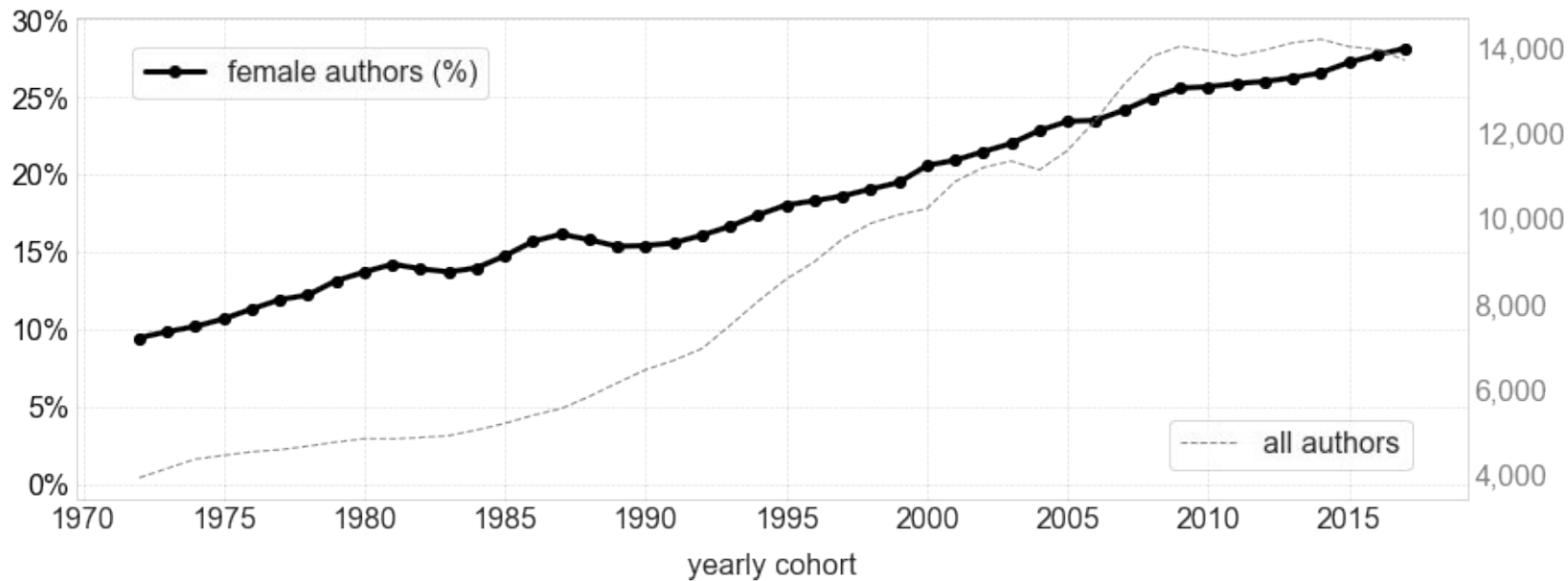
# Insights from the analysis of the COMPLETE BIBLIOGRAPHIC DATA SOURCES



*Chemistry*  
*Astronomy and Astrophysics*  
*Mathematics*  
*Theoretical Physics*

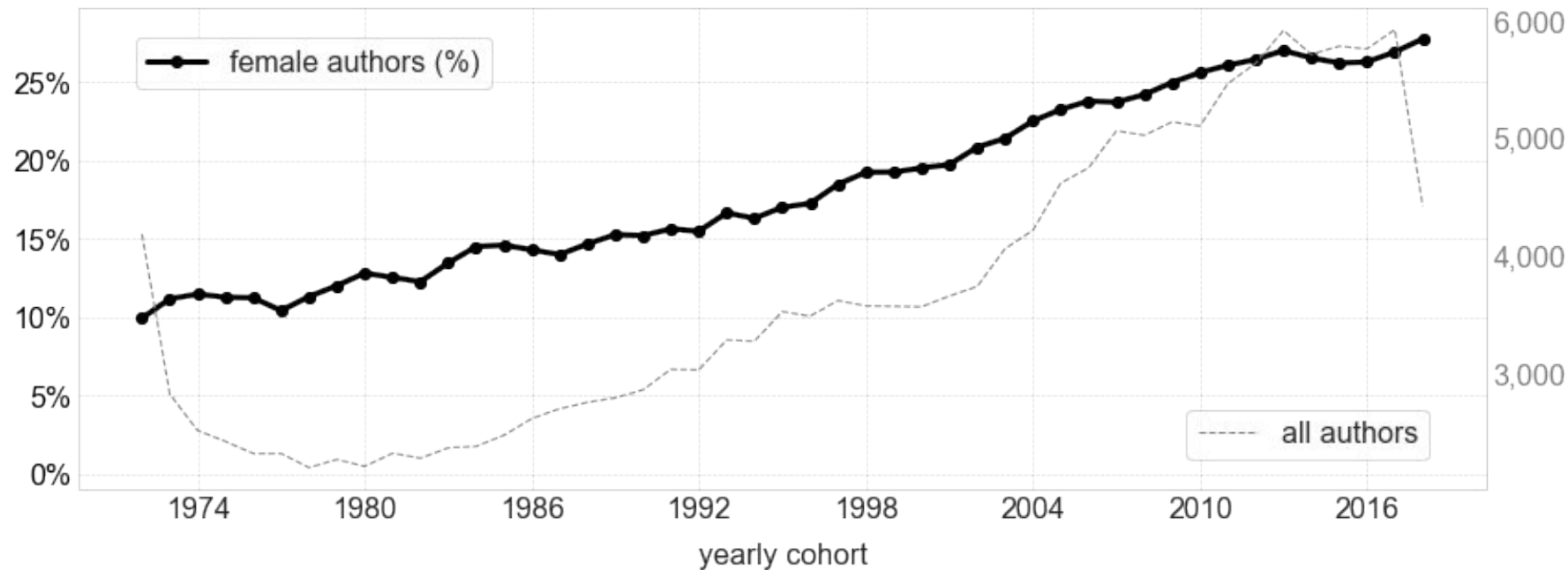
# Mathematics

Number of authors per yearly cohort in mathematics



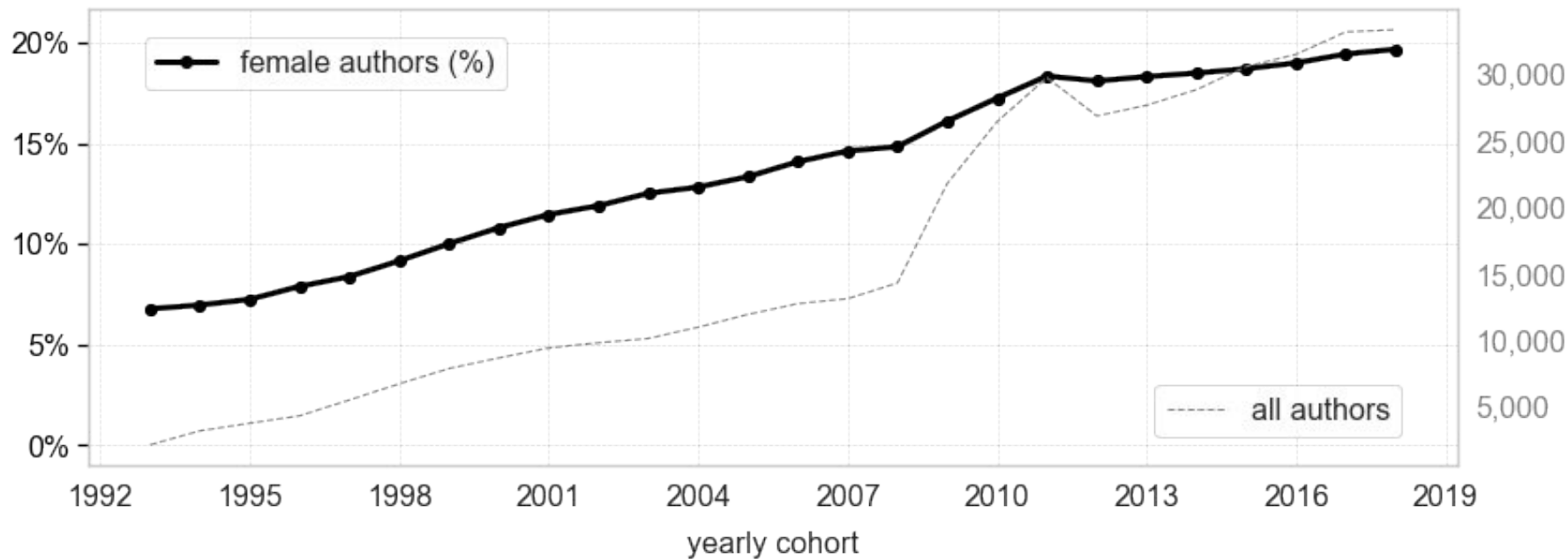
# Astronomy and Astrophysics

Number of authors per yearly cohort in astronomy and astrophysics



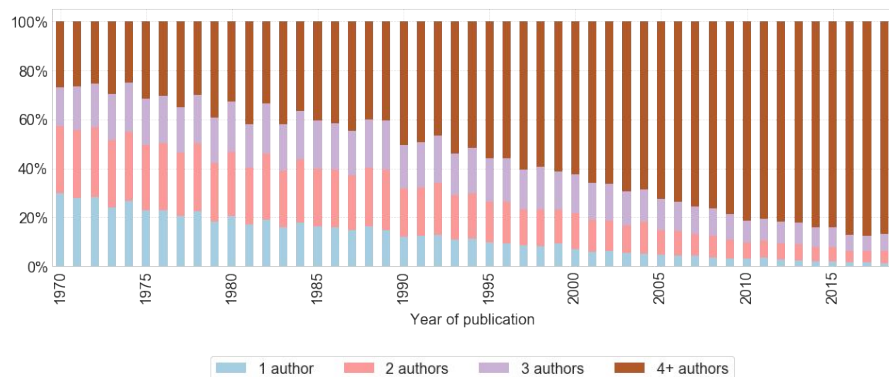
# Theoretical Physics

Number of authors per yearly cohort in arxiv physics

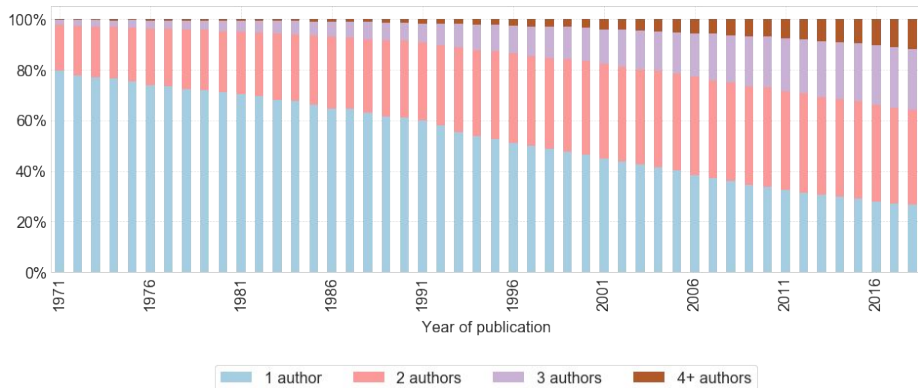


# Big-team vs small-team disciplines

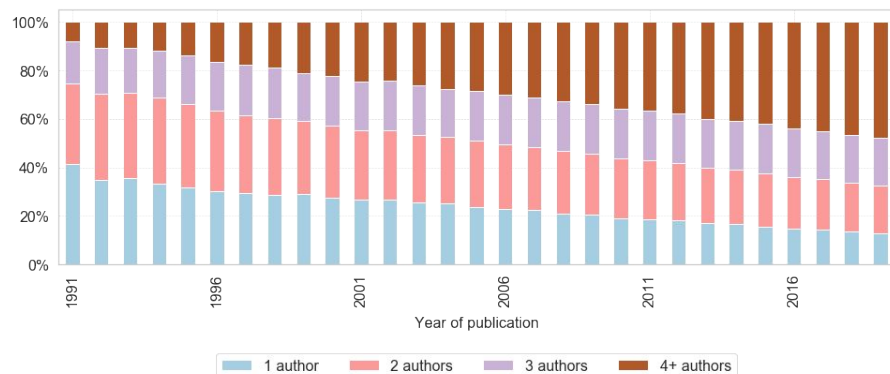
Evolution of the number of authors per paper in astronomy and astrophysics



Evolution of the number of authors per paper in mathematics



Evolution of the number of authors per paper in theoretical physics





# Summary

- Consistent answers and trends from the project as a whole difficult to reconcile
- From the survey:
  - No perception of inequity across fields regarding submission to top journals
- From the analysis of publications:
  - Mismatch between the % of total female authors and female authors in top journals



# Summary

- Differences in perceptions that were extracted from the survey do not necessarily align with the results from the publication analysis
- From the point of view of scientific output, Astronomy and Astrophysics present the smallest gender gap of all 3 analyzed sources
- Collaborative character of disciplines seem to play an important role



# Thank you

Questions

Comments

Feedback

