

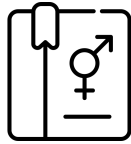
GLASS CEILING EFFECT IN SOCIAL NETWORKS

Fangchen Li, Huilin Xu
Jordie Chisam, Danielle Larson, Xiangyu Liu

AGENDA



*Paper: Homophily
and the Glass
Ceiling Effect in
Social Networks*



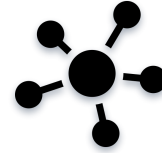
*Gender Differences
in Computer
Science
Collaboration
Networks*

*(Fangchen &
Huilin)*



*Investigating the
Glass Ceiling
Effect in Social
Networks*

*(Danielle, Jordie,
& Xiangyu)*



*Current Progress and
Anticipated Results*

Homophily and the Glass Ceiling Effect in Social Networks (Avin et al)

MOTIVATION/BACKGROUND

- Many large organizations and societies exhibit a **glass ceiling effect**
 - *A barrier that prevent minorities from moving up in professional settings regardless of qualifications or experience*
- Introduce findings that suggest ways to deal with the effect and promote equal opportunity



Homophily and the Glass Ceiling Effect in Social Networks (Avin et al)

MODEL

- Network is composed of two types of vertices and supports three social phenomena:
 - “the rich get richer”
 - minority-majority partition (social groups exhibit unequal proportions of men & women)
 - homophily (people associate with those who are similar to themselves)

APPROACH

- Analyze the glass ceiling effect in social networks using the **biased preferential attachment model**
- Examine the model as a possible mechanism for the emergence of a glass ceiling effect

Homophily and the Glass Ceiling Effect in Social Networks (Avin et al)

APPLICATION (Biased Preferential Attachment Model)

- **Propose a bi-populated preferential attachment model**
 - **Combination of classic preferential model to a bi-populated minority majority network with homophily**
 - **Resulting in the biased model**
- **After application, they found that the model produces a power inequality**
 - **Meaning that the average dress of the minority is lower than the majority, even though all members possess the same skillset.**

RESULTS

- **Under the three social phenomena on human behavior, the glass ceiling effect naturally occurs in social networks with a biased preferential attachment model**

Gender Differences in Computer Science Collaboration Networks

GENDER DISPARITY IN ACADEMIA

- Author-Reviewer Homophily in Peer Review
- Gender Barriers on Stack Overflow
- Citation Frequency based on leading authors' gender
- Glass Ceiling Effect and Homophily in CS networks

Gender Disparity in Academia

- Author-Reviewer Homophily in Peer Review
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- **Glass Ceiling Effect and Homophily in CS networks**

Investigating the Glass Ceiling Effect in Social Networks

MOTIVATION/BACKGROUND

- Same as the Avin et al paper
- Goal: replicate the results

APPROACH

- Analyze homophily, the rich get richer phenomenon, and fairness in the social network model
- In doing so, we will measure the nodes similarity in our network in order to visualize the barriers that minorities encounter in social networks.
 - Leveraging DBLP database (co-authorship network)
 - NetworkX
 - Genderize API
 - Gephi
 - PA Model

DBLP Dataset

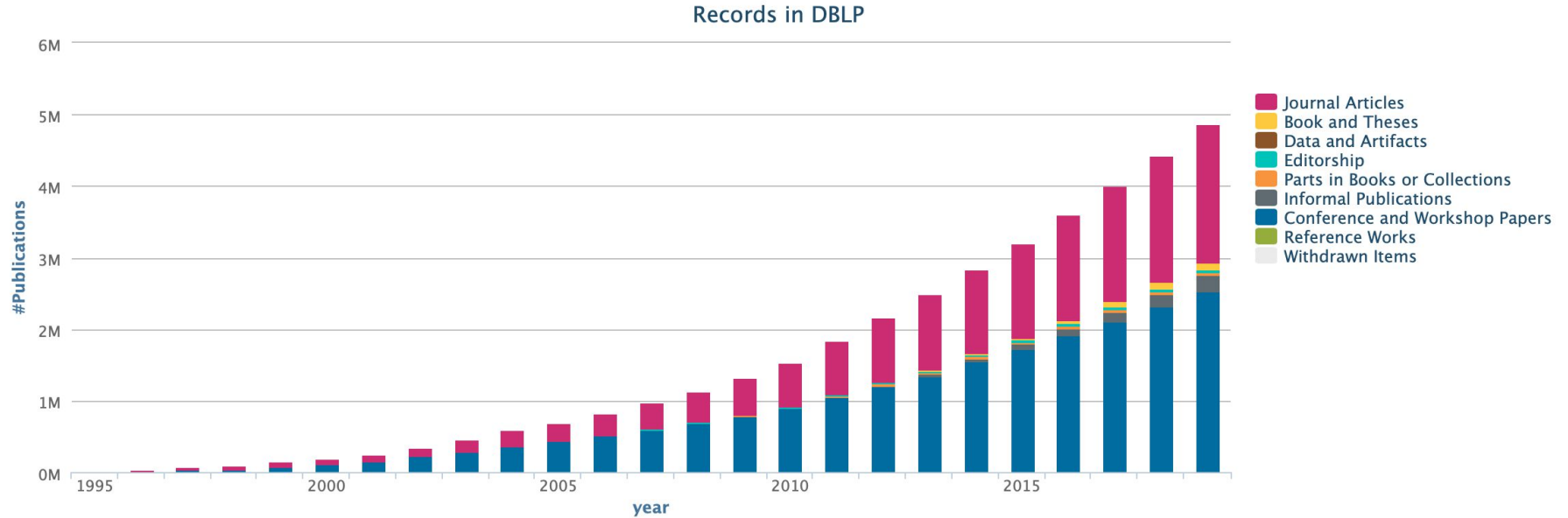
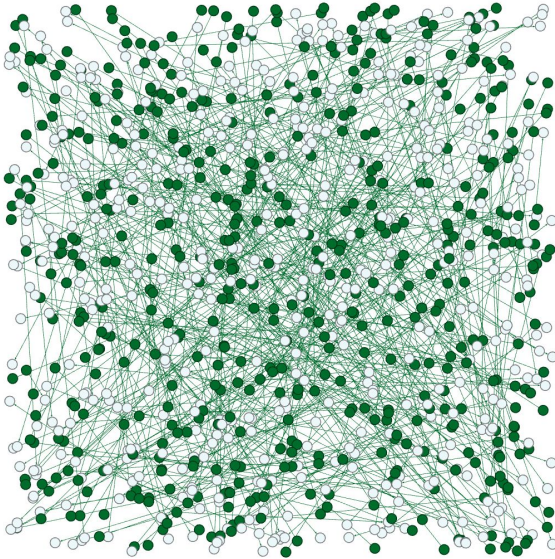
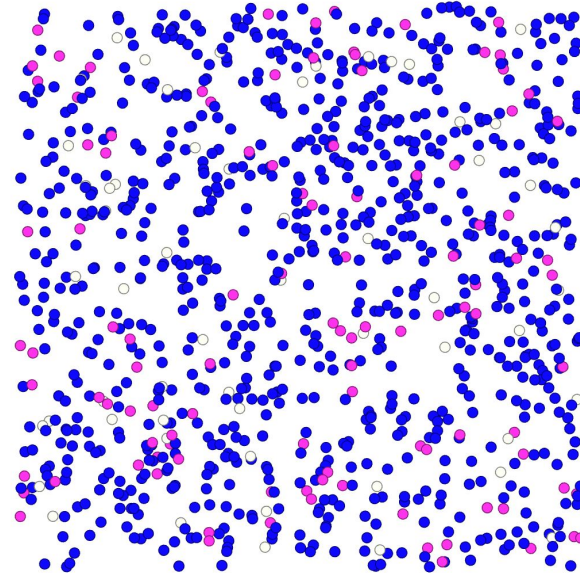
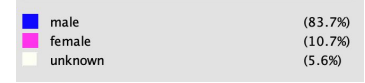


Figure from DBLP

Investigating the Glass Ceiling Effect in Social Networks



***Coauthor relationships
(colored by outdegree)***



***Gender in DBLP
(colored by gender)***



Data

Data: Pre-processing & Gender Labeling

Pre-processing

- Single author with multiple names
- Multi-authors with the same name

Gender Labeling

- API (based on first name)
- Google Search (#he vs. #she)
 - via web scraping

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Network Characteristics

- All articles (without single-author) from 1938 ~ 2019
- Initial # authors: 1,459,843
- Dropped out authors with uncertain gender (possibility < 0.8 based on API)
- Labeled # authors: 1,040,189
 - # female: 220,435
 - # male: 819,754
- # edges: 4,092,204

Network Characteristics

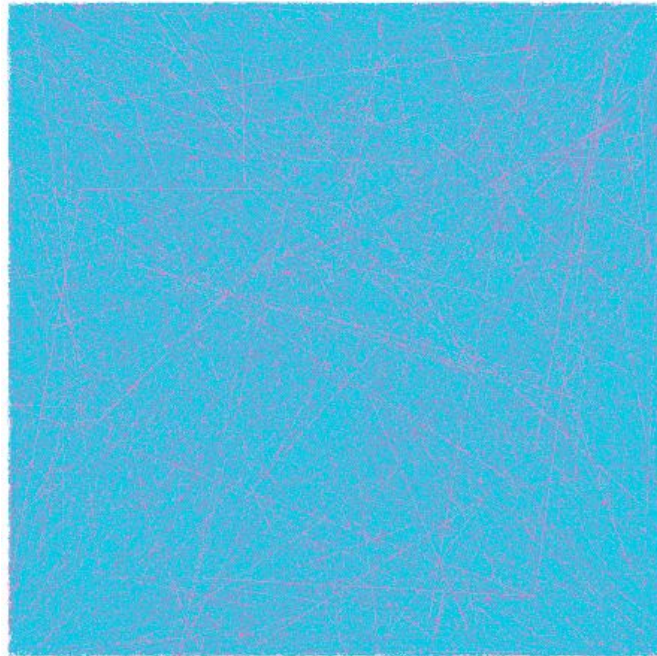
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Avin et al (2015):

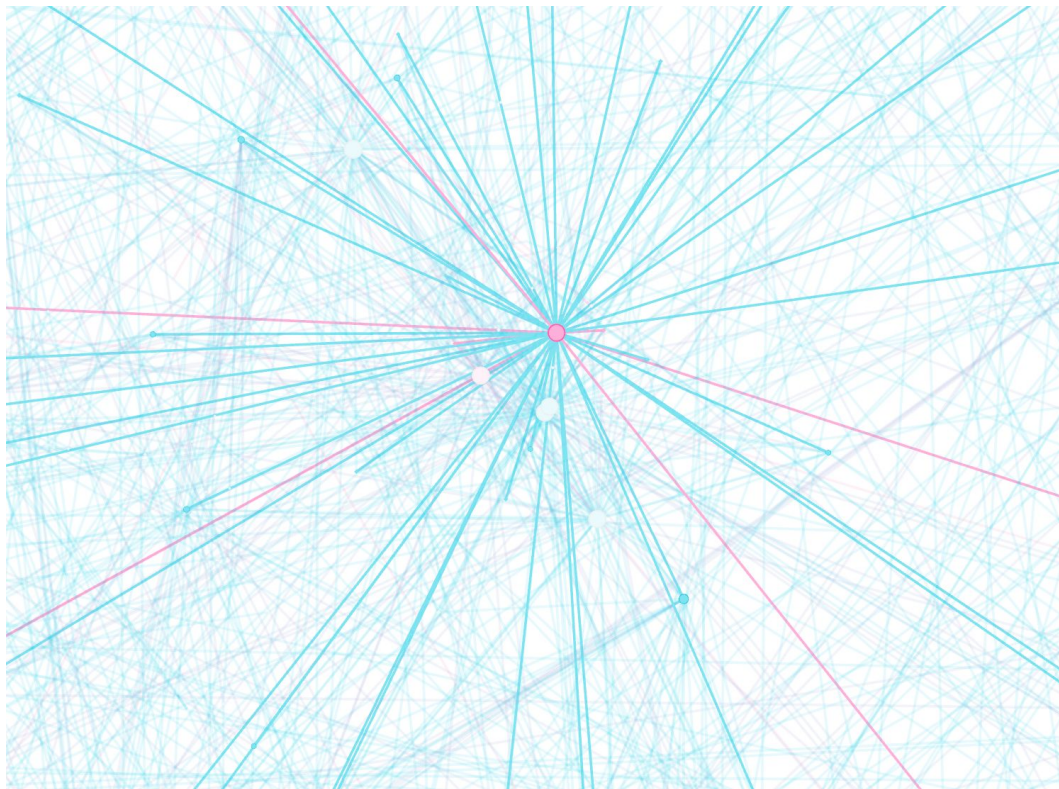
- spans over 30 years
- 434,232 authors
- 389,296 edges

Snapshot of 2019 Data

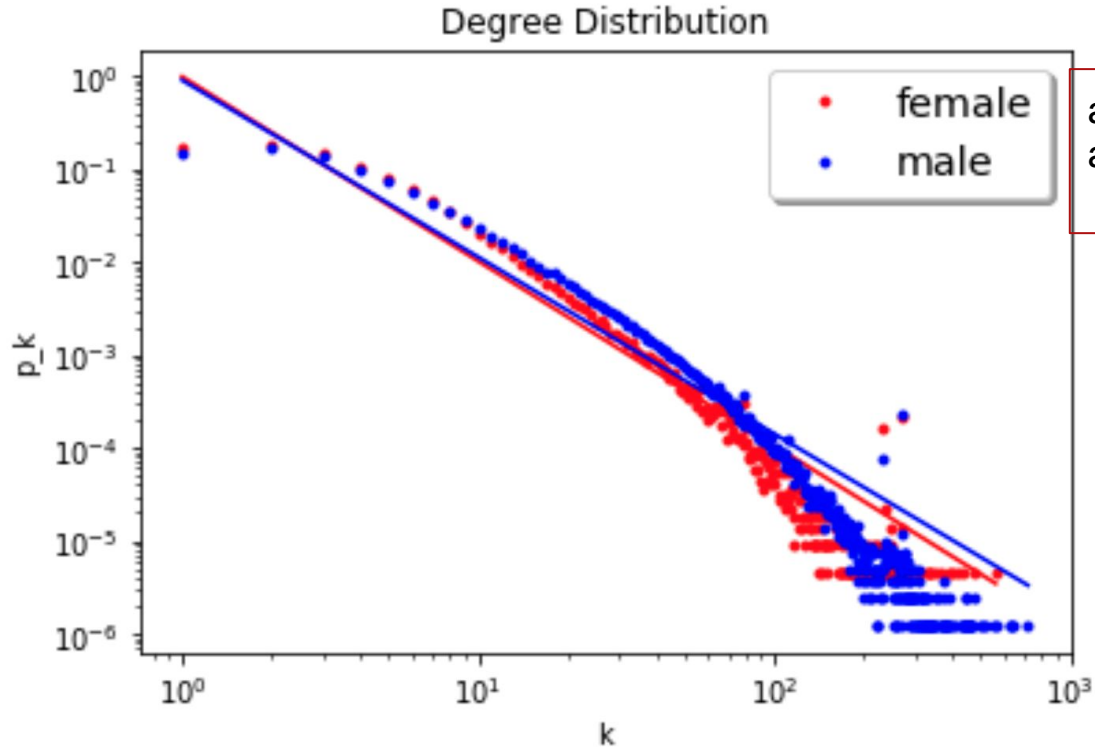
male	(81.45%)
female	(18.55%)



Snapshot of 2019 Data



Power law distribution for female and male authors



avg_k_female = 6.604
avg_k_male = 8.208

Power law distribution for female and male authors

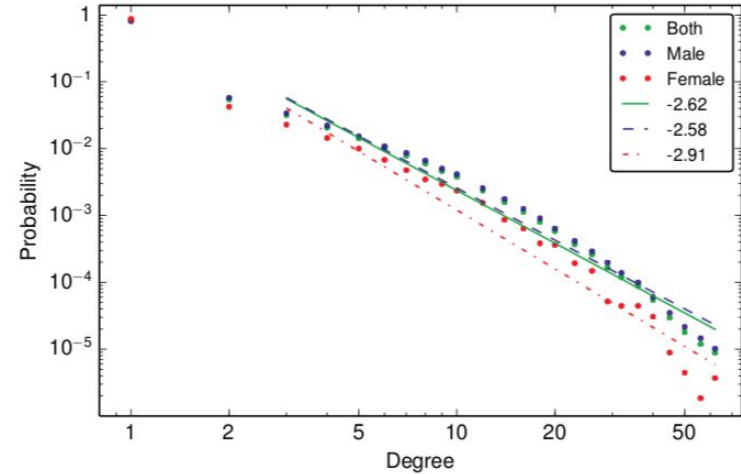
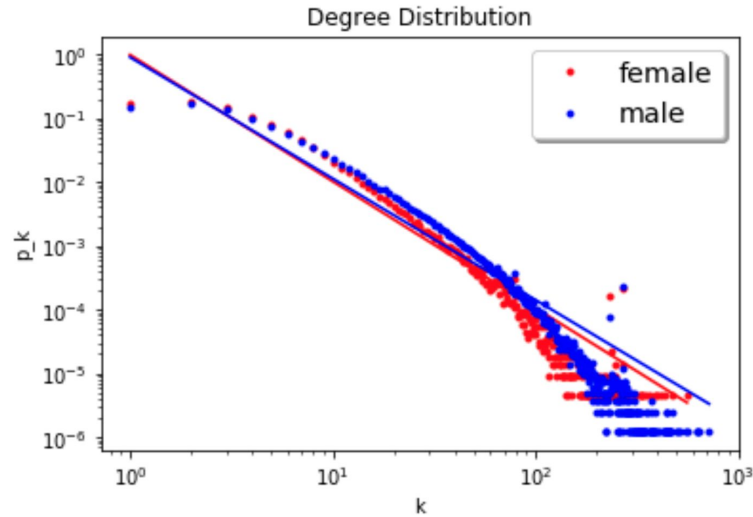
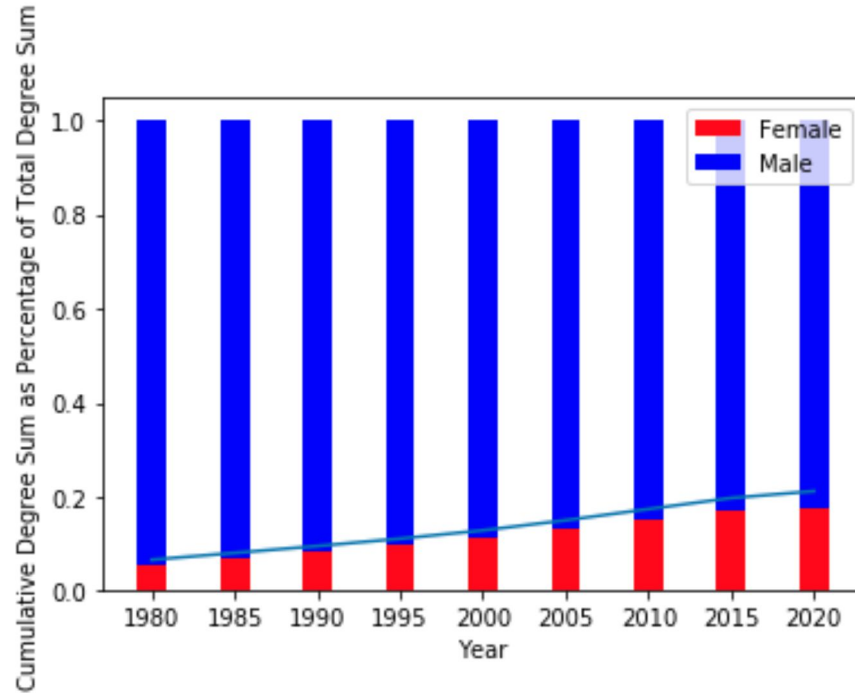


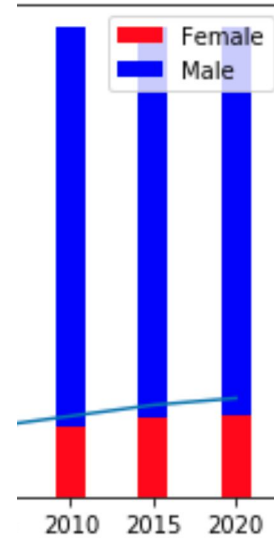
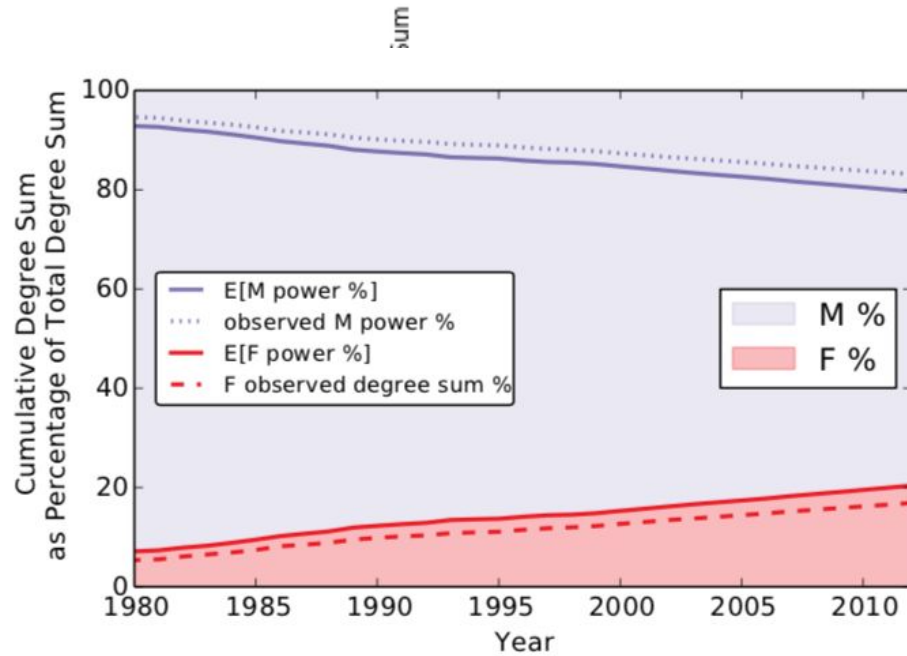
Figure from Avin et al

Female Fraction over Year



expected:
$$= \frac{\# \text{ female}}{\# \text{ total}}$$

Female Fraction over Year

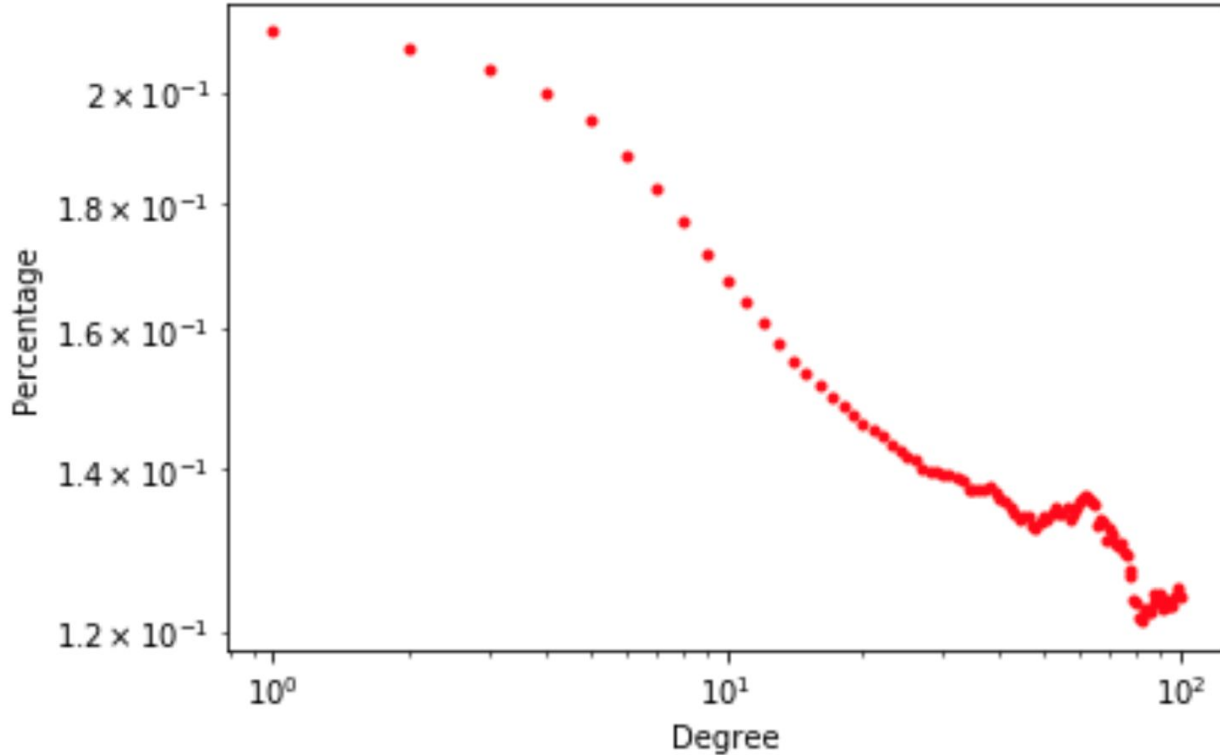


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Figure from Avin et al

% Female among All Authors with Degree at least x



% Female among All Authors with Degree at least x

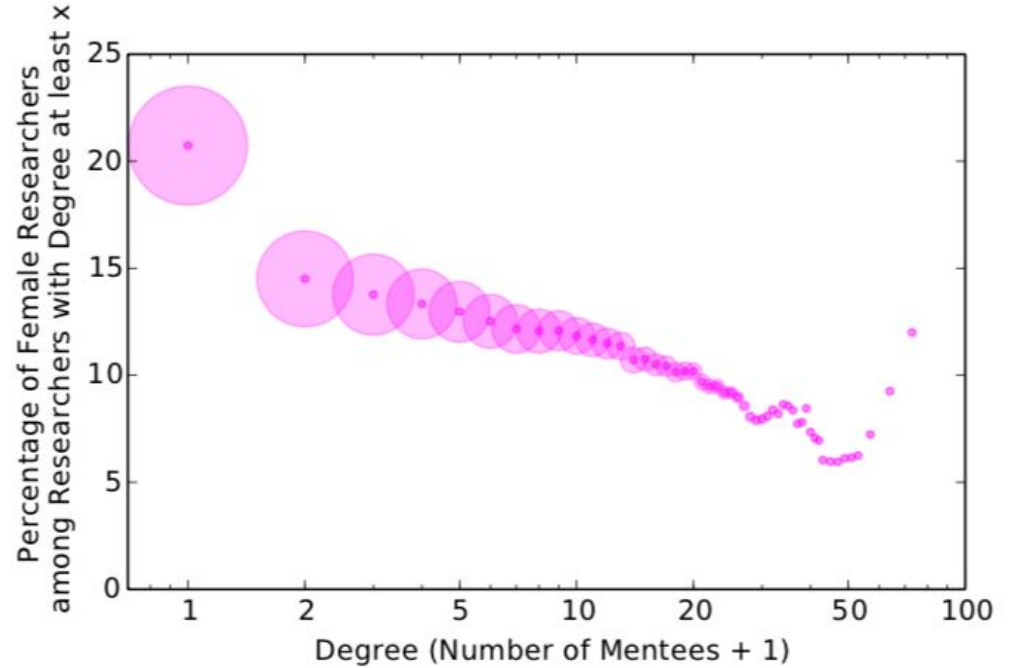
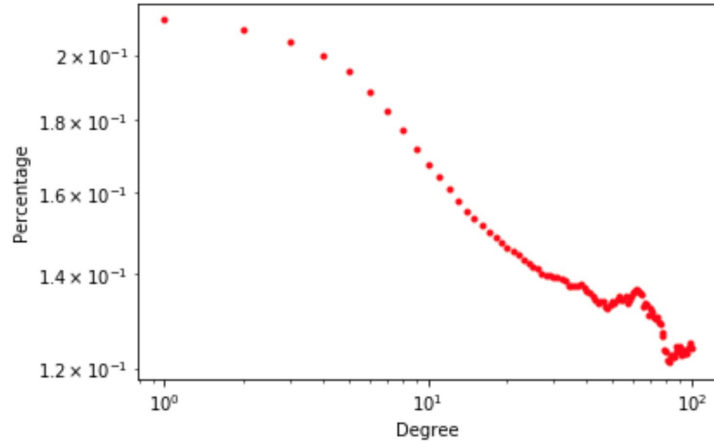
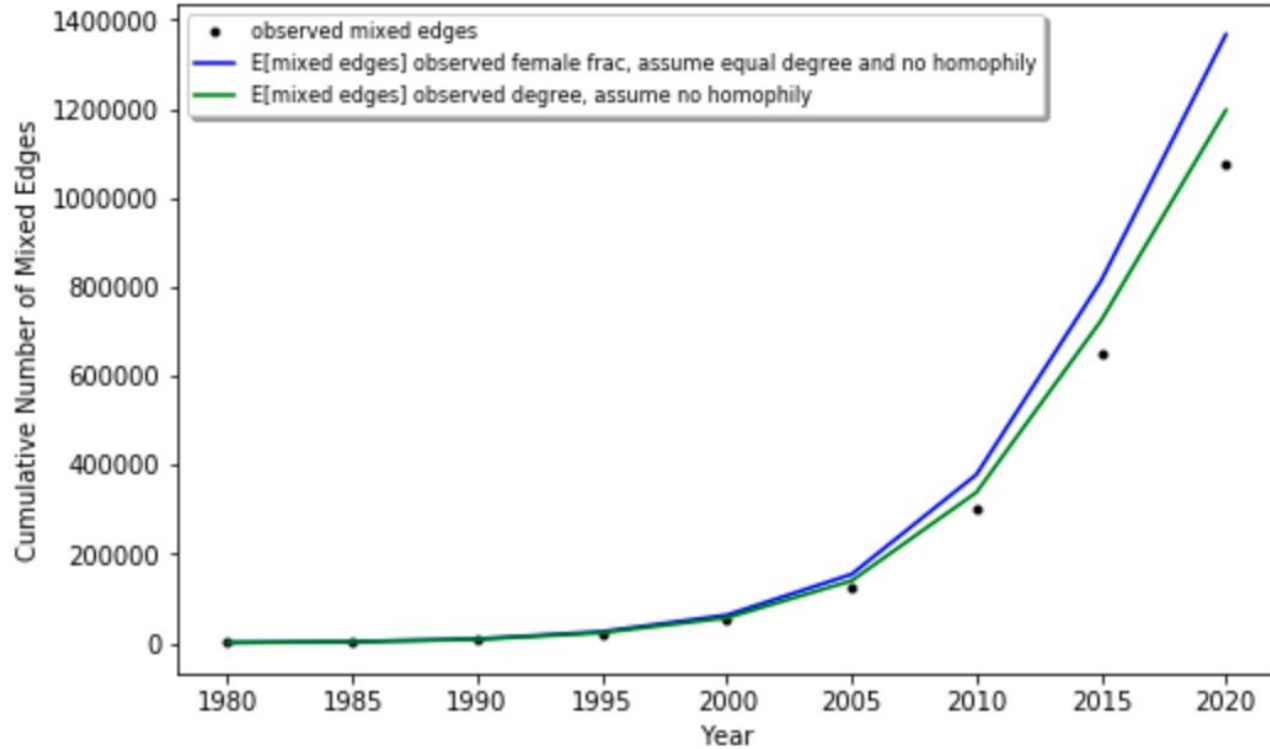


Figure from Avin et al

Recall: Homophily

- People associate with those who are similar to themselves.
- Mixed edge: edge between female and male
- Homophily Test:
 - Fraction of mixed edges $< 2 * (f) * (1 - f)$
- Normalized Homophily Test:
 - Fraction of mixed edges $< 2 * (d(F) / 2m) * (1 - d(F) / 2m)$
 - where f : percentage of female
 - $d(f)$: sum of degrees of female nodes
 - m : num of total edges

Homophily?



Conclusion

- Female are still minority in CS community
- Some evidence for glass ceiling effect
- Some degree of homophily

Future Directions

- Better processed data
 - alias
 - gender
 - student vs. mentor
- Divide by fields, countries...

Questions?

SOURCES

Avin, Chen, et al. "Homophily and the glass ceiling effect in social networks." *Proceedings of the 2015 conference on innovations in theoretical computer science*. ACM, 2015. ([Paper](#))

Stoica, Ana-Andreea, Christopher Riederer, and Augustin Chaintreau. "Algorithmic Glass Ceiling in Social Networks: The effects of social recommendations on network diversity." *Proceedings of the 2018 World Wide Web Conference*. International World Wide Web Conferences Steering Committee, 2018. ([Paper](#))