https://doi.org/10.51408/issi2025_021

Gendered Collaboration Networks and Their Consequences on Conflicts between Academics

László Lőrincz[1], Brigitta Németh[2], Tamás Felföldi[3]

[1]*laszlo.lorincz@uni-corvinus.hu*
Institute of Data Analytics and Information Systems & ANETI Lab, Corvinus Institute for Advanced Studies, Corvinus University of Budapest, H-1093 Budapest, Fővám tér 8 (Hungary)
ANETI Lab, Institute for Economics, HUN-REN Centre for Economic and Regional Studies, H-1097 Budapest, Tóth Kálmán utca 4 (Hungary)

[2]*nemeth.brigitta@krtk.hu*
Doctoral School of Economics, Business and Informatics, Corvinus University of Budapest, H-1093 Budapest, Fővám tér 8 (Hungary)
ANETI Lab, Institute for Economics, HUN-REN Centre for Economic and Regional Studies, H-1097 Budapest, Tóth Kálmán utca 4 (Hungary)

[3]*tamas.felfoldi@proton.me*
Corvinus University of Budapest, H-1093 Budapest, Fővám tér 8 (Hungary)

Abstract

In academia, a major field of knowledge production, the quality of interactions among coworkers plays a critical role. Negative ties, such as conflicts or avoidance between researchers, can impede the progress of research projects, and adversely affect individual career advancement. Our study reveals that in the academic sector, these negative relations are not "gender-neutral" as they are experienced 47% more often by women. Using a large representative survey linked to official scientometric records from Hungary, we demonstrate that the conditions under which women and men experience these negative relations differ. Women experience more conflicts if they act as brokers in scientific collaborations, and fewer conflicts when they are members of cohesive groups. These factors, however, do not influence the number of conflicts for men. Thus, we can argue, that while being in a broker position holds the promise for scientific success, it comes with the price of more workplace conflicts for women. Regarding the role of gender diversity and cross-gender collaboration, we find that women report less negative relations when they collaborate with fellow women if they are a small minority, but in diverse fields, cross-gender collaboration comes with fewer conflicts.

Introduction

Employees are involved in negative relationships in workplaces, such as animosity, avoidance, or exclusion. While positive relations, such as support increase satisfaction with workplace relationships, negative ones decrease it, indirectly decreasing the attachment to the workplace too (Venkataramani et al., 2013). Similar outcomes are reported concerning performance. Employees who are more central in advice networks tend to be more efficient, while centrality in hindrance networks is inversely related to performance. The extent of hindrance relationships also harms performance on the group level (Sparrowe et al., 2001). Moreover, there is evidence that negative relations are more influential than positive ones in one's network (Kane & Labianca, 2006).

In academia, as a major field of knowledge production, the quality of interactions among coworkers plays a critical role, from collaboration to talent recruitment. Negative ties, such as conflicts or avoidance between coworkers, can hinder the progress of research projects, and may negatively influence individual career progression.

What is more interesting, however, is that in academia, negative relations do not seem to be "gender-neutral", that is they are unproportionally more often experienced by women. In the qualitative study of (Gersick et al., 2000) women reported negative aspects of their relationships more than four times higher than men. In light that in non-academic contexts (business organizations) the number of negative ties was found non-different between genders (Merluzzi, 2017), if such an excess number of difficult relationships are experienced by women in academia, it can be a significant liability for female researchers, a factor contributing to the observed higher dropout rate of female scientist (Lietz et al., 2024).

If such gender differences exist, it is also interesting that under what conditions women (and men) experience them. A potential argument is that the gender differences in negative tie formation are influenced by gender norms that convey gender-specific behaviors and expectations in organizations (Ridgeway, 2009, 2001; Elsesser & Lever, 2011; Eagly & Karau, 2002; Heilman & Okimoto, 2007). Furthermore, the effect of proportions, or the relative number of socially, culturally, or biologically different people in a group, has been also observed to be significant in shaping these role expectations (Benan & Olca, 2020; Holgersson & Romani, 2020; Kanter, 1977; Zimmer, 1988). Thus, highlighting the amplifying effect of (low) diversity in a work environment is crucial to understand the gender differences in conflict-type relationships.

Given the intertwined nature of diversity and role expectations, we aim to explore the effect of field diversity on the relationship between conflicts, social capital, and the role of male or female weight in the collaboration network. Our goal is to enrich the gender-focused literature on negative ties in the professional networks of the scientific workforce by exploring the association between gender role incongruent social capital and conflicts in balanced and male-dominated fields.

For the analysis, we use survey data linked to administrative scientometric data from Hungary. In this country, the gender ratio of scholars in different disciplines varies between a very low share of females, 12.6% in Engineering, to almost perfectly balanced (52,4%) in Literature and Linguistics, which makes the Hungarian scientific sector a good setting to explore the consequences of low diversity and tokenism regarding conflict type relationships.

Our results reveal that there is indeed a significant difference between male and female academics in the number of negative relations; women report 47% more negative relations, and the difference remains significant after controlling for individual attributes. We also find that the factors predicting the number of negative relations are different for men and women. Women experience more conflicts if they act as brokers in scientific collaborations, and less if they are members of cohesive groups. These factors however do not influence the number of conflicts for men. Thus, we can argue, that while being in a broker position has the promise of scientific

success (Guan et al., 2017; Jadidi et al., 2018), this comes with the price of more workplace conflicts for women. About the moderating role of gender diversity in the field, we find that in comparison to male-dominated fields, in more balanced fields men report more conflicts and women report less. Interestingly, however, women experience more conflicts if they collaborate with other women in balanced fields.

Theory and hypotheses

In every organization, but in academia particularly, success depends on collaboration. Positions in the networks of social relations represent specific advantages and at the same time, different characteristics are attributed to the holders by the others. Social capital as cohesion, for instance, is about strong ties: close relationships characterized by trust, cooperation, mutual support, or solidarity (Coleman, 1988, 1990) and means that everyone knows each other in one's network. In academia, these strong ties can manifest as long-lasting research collaborations (Dahlander & McFarland, 2013), and more cohesive networks of scientists are found to be more productive, but only in already well-established fields (Jansen et al., 2010). Social capital as brokerage is captured in networks with sparsely connected parties by brokers, who bridge these gaps (structural holes), which allow movement in versatile social circles with access to non-redundant information through these weak ties (Burt, 1992; Barthauer et al., 2016). Therefore, weak ties were shown to contribute to success in different fields (Fronczak et al., 2022; Rajkumar et al., 2022), and it has also shown that access to more unique information is a key mechanism beyond this success in organizations (Aral & Dhillon, 2023; Gonzalez-Brambila, 2014). In academia, being in a broker position also tends to have a positive influence on scientific success (Guan et al., 2017), especially for junior scholars (Patel et al., 2019). Moreover, the positive influence of brokerage on academic success was not found to be moderated by gender (Jadidi et al., 2018).

Interaction dynamics in organizations is also driven by gender norms (Ridgeway, 2001, 2009; Elsesser & Lever, 2011; Eagly & Karau, 2002; Heilman & Okimoto, 2007). Ridgeway (2009) argues that gender is a primary cultural frame for coordinating behavior and organizing social relations; thus, it shapes organizational structures as well. The stereotypical female gender roles are communal roles, including nurturing, caring, and sensitivity. Male roles are more agentic, like ambitious, assertive, and direct (Elsesser & Lever, 2011). Eagly and Karau (2002) propose that acting incongruent with these stereotypical roles leads to being evaluated negatively. Heilman and Okimoto (2007) confirm that women indeed face penalties for success in traditionally male domains if they lack nurturing and socially sensitive communal attributes. At the same time, the control benefits and relative independence associated with a broker's position are congruent with gender role expectations for men, they are not congruent with gender role expectations for women (Eagly, 1987).

About gender differences in navigating organizational networks, Burt (1998) finds that women benefit from different network strategies than their male coworkers to achieve success. While successful men are more likely to be brokers in networks with more structural holes, successful women are involved in networks characterized

by few structural holes and higher cohesion since they have less legitimacy in a work setting. Contrary to this, Ibarra (1997) finds that high-performing women are more likely to have connections outside their organizational units. The results of Lutter (2015) analyzing the film industry align with this, showing that women suffer a career penalty if they work in cohesive groups. Carboni and Gilman (2012) however add that women are more likely to experience social stress when they occupy brokerage positions and so attempt to address often conflicting expectations of the relationship partners from disconnected social groups. Jadidi et al. (2018) confirm that women are more likely to embed into networks with higher cohesion and to have lower brokerage than men in academia as well. An opposite tendency, that women have more brokerage was reported by Barthauer et al. (2016). Note that they consider mentorship networks, while Jadidi et al. (2018) considered scientific collaboration networks.

Based on the arguments that communal roles are typically associated with females and agentic roles with males, and the observation that women tend to occupy more cohesive and less bridging positions in organization networks, we expect that:

H1: Being in bridging positions in the scientific collaboration network will be positively associated with conflict relationships for women, however, we expect no such association for men, reflecting gender role expectations.

Structural constraints however interact with role expectations, and they were found to jointly determine these gender specificities regarding social capital (Eagly & Karau, 2002; Rudman & Glick, 2001; Carboni, 2023). The concept of "tokenism" has been widely used to explain women's experiences, such as role entrapment, as they enter traditionally male occupations and represent a clear minority in an organization. 15% is the estimated critical ratio of the minority group to apply the category (Benan & Olca, 2020; Holgersson & Romani, 2020; Kanter, 1977; Zimmer, 1988). Schoen et al. (2018) emphasize the altering effect of diversity in this context; when women are in token situations, they benefit from networks with few structural holes, and their male colleagues benefit from networks with many structural holes. While in non-token situations, i.e., when the proportion of women exceeds 15%, men and women benefit from the same network structures.

We therefore expect that being in a token situation contributes to lower acceptance by peers if not following the gender-specific role expectations thus engaging in bridging collaborations.

H2: We propose that women with high brokerage experience fewer conflicts in diverse fields.

Concerning gender in organizations, homophily is also an important driver of network relations. McPherson et al. (2001) define it as "the principle that contact between similar people occurs at a higher rate than among dissimilar people". In academia, homophily in the collaboration patterns was analyzed by Kwiek and Roszka (2021). They found gender homophily to apply to male scientists—but not to females. The majority of male scientists collaborate solely with males, while all-female collaboration was found to be marginal. Yap and Harrigan (2015) highlight the significance of homophily in understanding negative tie formation, noting that

men and women tend to direct negative ties towards the opposite gender rather than their own.

At the same time, the effect of proportions, or the relative number of socially and culturally different people in a group, has been observed to be significant in shaping social networks as well (Kanter, 1977). Experiments by Szell and Thurner (2013) have shown that in a male-dominated context, men discount women as legitimate competitors, which would reduce the odds of work conflict with women initiated by men. They observe male competitiveness exclusively among themselves, with fewer cooperative links between them and a reluctance to reciprocate hostile actions from females. On the contrary, females exhibit stronger homophily and network closure among themselves in their collaboration networks in the analyzed online gaming environment. Ely (1994) finds that the principal mechanism through which the representation of women influences their relationships is social identity. Women were less likely to experience gender as a positive basis for identification in organizations with few senior women and less likely to perceive senior women as role models with legitimate authority. When being in a small minority, women are more likely to perceive competition in female peers instead of finding support in these relationships (Duguid, 2011), and apply masculine self-descriptions themselves (Derks et al., 2011). Merluzzi (2017) adds that even though men and women were equally likely to cite a negative work relationship, women were more inclined than men to cite a negative relationship with another woman if they had no female social support in the workplace network. Being a minority in categories such as race, gender, and age can generate conflict according to Pelled (1996) as well. Being different from other group members may negatively shape a person's perspective on group interactions but it is also possible that having a demographically distinct group member truly fosters conflict.

These mechanisms lead to different hypotheses regarding the relationship between the number of women in the field and the number of conflicts by gender. For men, the increased number of women may contribute to more conflicts based on homophily theory; while men do not see women as competitors in token situations, if the female ratio increases, this would change.

H3: We expect the number of conflicts to be positively related to the ratio of the other gender in the scientific field for men.

On the other hand, for women:

H4: The number of conflicts will be negatively related to their ratio in the scientific field for women, indicating the influence of positive social identification and so the lower level of competitiveness.

Besides, we are investigating whether there is an interaction between the gender ratio of individuals' collaboration networks and the gender ratio of the scientific field. We consider that while the gender makeup of the field is something external, academics in minority positions might opt to collaborate with others in similar situations to mitigate their position and seek support. This implies that collaborating with co-authors isn't just a strategic career move, but also a way to find support through connections with people of the same gender.

H5: If women collaborate more with other women in male-dominated fields, (or men collaborate with fellow men in female-dominated fields) they experience fewer conflicts.

Data

For our analysis, we use survey data linked to administrative scientometric data on the individual level. The survey was initiated by the Hungarian Young Academy about working conditions, income, satisfaction, international mobility, and professional relations of Hungarian researchers under the age of 45. Its special feature was that respondents were asked if they consented to link their scientometric data in the Hungarian scientometric system (MTMT) to the survey and to provide their IDs for the linking.

The survey was conducted online. Invitations were sent by the Hungarian Academy of Sciences to all members of the Academy's public body under the age of 45, and to all researchers who have defended their Ph.D. after 1992 and gave active consent to receive science-related news. In addition, a Facebook campaign supported the recruitment of respondents. The data was collected in September–October 2021.

The number of completed responses was 1,219, of which we were able to analyze the responses of 1,135 respondents after data cleaning. Linking the data was possible for 1,009 individuals. The linked database was deposited and only accessible at the Data Bank of the Centre for Economic and Regional Studies, providing a secure on-site environment for analysis.

Measures

For the measurement of conflicts, we used the following name-generator question from the survey: "Do you have someone with whom you have a difficult or burdensome relationship, perhaps even conflict from time to time?" Respondents could provide a list of up to ten names or pseudonyms in the form. We consider the number of names provided as the number of conflict (or adversary) relationships. We use these terms as synonyms in the analysis.

As for the independent variables, we used self-reported survey data on gender, academic rank, and discipline. Academic rank was measured using four categories corresponding to the Hungarian standards: (1) Ph.D. Student or assistant lecturer (2) Assistant professor or research fellow (3) Associate professor or senior research fellow (4) Full professor. Discipline was measured according to the eleven-class classification of the Hungarian Academy (see Figure 2B).

We measured the gender ratio of the specific fields using the directories of the Academy's public body. Membership lists by disciplines were retrieved from its official website[1] in 2023, and genders were identified by matching with the list of registerable surnames in Hungary[2], and by using the 'gender' R package of Mullen (2021)[3] for non-Hungarian surnames. The share of female scientists varied

[1] https://mta.hu/koztestuleti_tagok, N=17,428
[2] https://nytud.hu/en/oldal/utonevjegyzek
[3] https://cran.r-project.org/web/packages/gender/readme/README.html

significantly by field, from 13% in Engineering to 52% in Language and Literature (Figure 1B).

Another group of measures was calculated from the scientometric data. Considering citations, we used citation values standardized by academic age (time since the first publication) and discipline.

To measure collaboration characteristics, we first created a weighted collaboration network between scientists. We defined weights between two scientists taking into account that co-authorship on a paper with many authors indicates a weaker collaboration than co-authorship on a paper with only two authors, following (Newman, 2001):

$$w_{ij} = \sum_k \frac{\delta_i^k \delta_j^k}{n_k - 1}$$

where δ_i^k is the indicator that person *i* is the author on paper *k* and n_k is the number of authors of paper *k*. Having the weighted collaboration network, we calculated the following measures. *(Strength of) Collaboration with women* is calculated as:

$$Collab\ w.women_i = \frac{\sum_j w_{ij \mid gender(j) = female}}{\sum_j w_{ij}}$$

Burt's constraint measure (Burt, 1992) measures the redundancy of ties and, thus is used as an inverse measure for bridging position in the network:

$$C_i = \sum\nolimits_{j \in V_{i, i \neq j}} \left(\sum\nolimits_{q \in V_{i, q \neq i, j}} p_{ij} + p_{iq} p_{qj} \right)^2$$

where p_{ij} are proportional tie strengths, defined as

$$p_{ij} = \frac{w_{ij} + w_{ji}}{\sum_{q \in V_{i, q \neq i}} (w_{iq} + w_{qi})}$$

and V_i is the ego-network of person *i*.

The weighted clustering coefficient. In general, local clustering measures the intensity of closed triangles around the individual that indicate structural embeddedness (Nahapiet & Ghoshal, 1998). We use its implementation applied for weighted networks, as suggested by (Onnela et al., 2005):

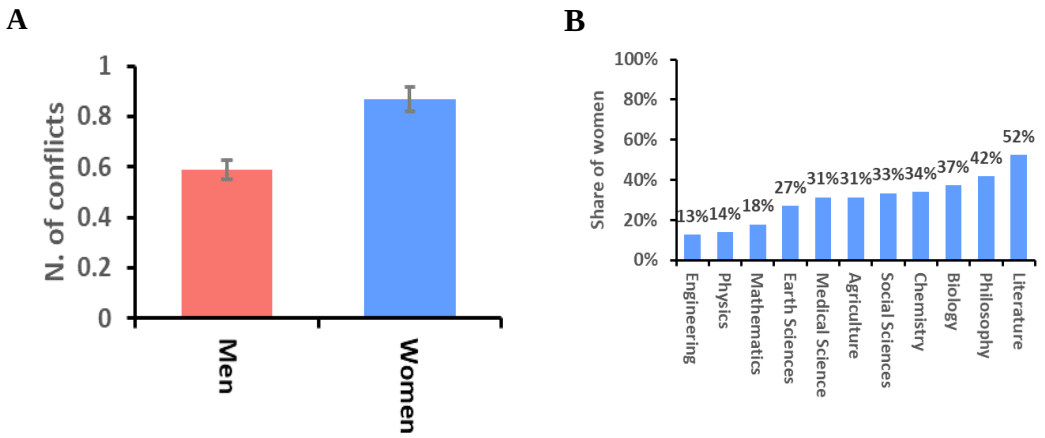
$$\tilde{C}_i = \frac{2}{k_i(k_i - 1)} \sum_{j,k} \sqrt[3]{\tilde{w}_{ij} \tilde{w}_{jk} \tilde{w}_{ki}}$$

where

$$\tilde{w}_{ij} = \frac{w_{ij}}{\max(w_{ij})}$$

Descriptive results

Figure 1A indicates that on average, women report significantly, about 40% more conflict relations. If we do not control for any other differences, men are more likely to be highly cited than women (Figure 1C), a result that is congruent with large scientometric studies (Huang et al., 2020; Larivière et al., 2013; Meho, 2022). In terms of scientific collaboration patterns, we see a substantive tendency of homophily, that women are more likely to collaborate with women than men do, therefore women have higher average strength of collaboration with women (Figure 1D). By visualizing it by scientific field (Figure 1E), we see that this is largely due to induced homophily because women collaborate with other women more often in fields where the ratio of female researchers is higher. However, we can observe choice homophily too, indicated by that women are more likely to collaborate with women than men are in every scientific field. Being involved in closed communities (measured by clustering), versus creating bridges in the collaboration networks (measured by constraint), is not different by gender (Figure 1F-G), similar to what Schoen et al. (2018) reports. Thus we neither observe that female researchers would have more brokerage capital than men do (in contrast to Barthauer et al., 2016), nor that they would have less (in contrast to Jadidi et al., 2018). In this aspect of the number of coauthors (degree), we do not observe gender differences either (Figure 3H), similar to Bozeman & Gaughan (2011) and Zeng et al. (2016).



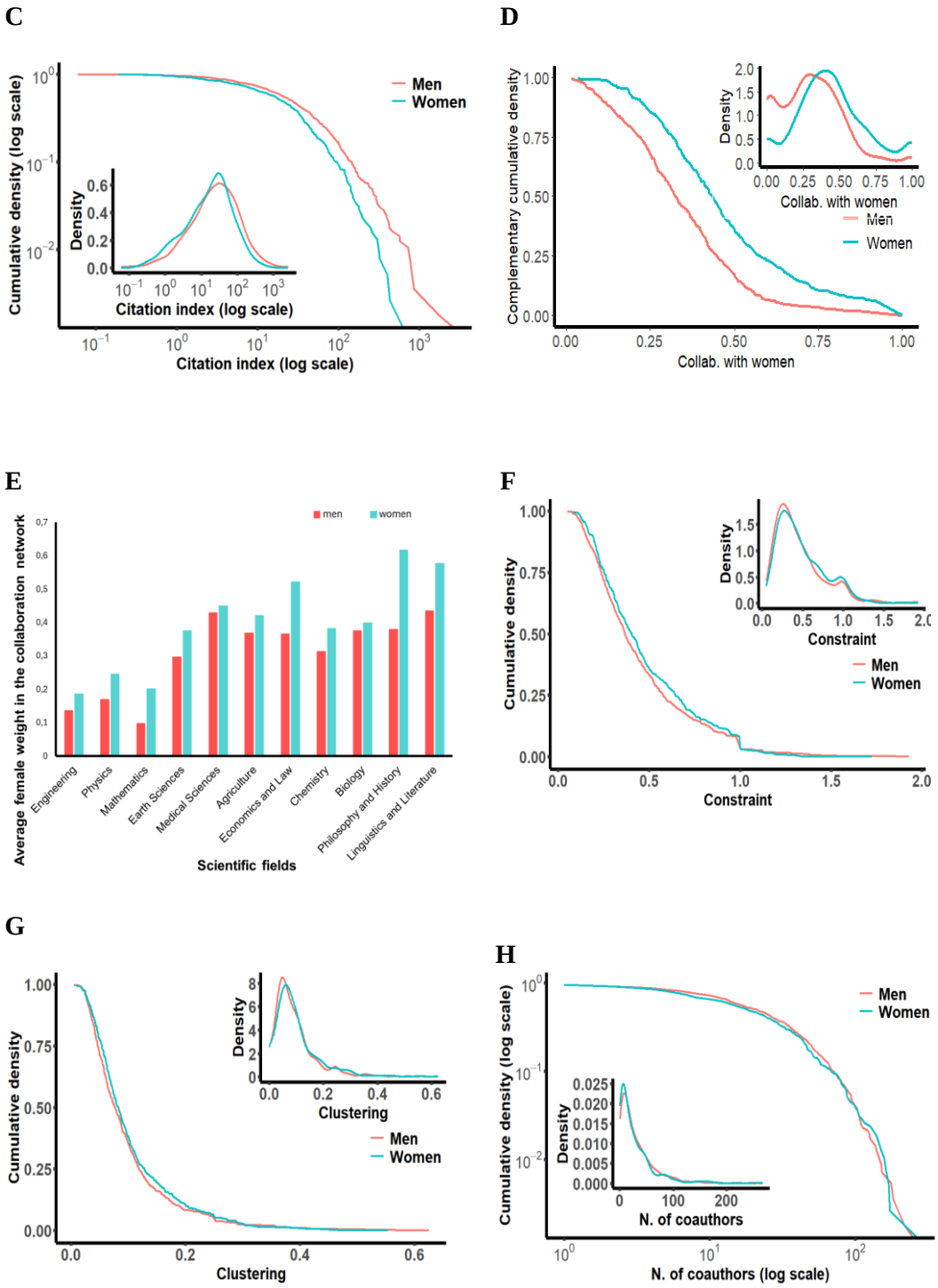


Figure 1. Descriptive statistics. A. Number of conflicts reported by gender (mean and SEM). B. Share of women in scientific fields. C. Normalized citation by gender. D. Collaboration strength with women by gender. E. Collaboration strength with women by academic field and gender. F. Burt's constraint by gender. G. Weighted clustering coefficient by gender. H. Number of coauthors by gender.

Results for statistical tests of hypotheses

We start the presentation with the statistical analysis of the relationship between ego-network position and the number of conflict relations. As the number of conflicts is a count variable, we model it using a Poisson regression. Our key independent variables corresponding to Hypothesis 1 are those describing whether ego-networks are structurally cohesive (that we measure by weighted clustering), or the individual is in a broker position (that we measure by the inverse of constraint). As these variables are highly correlated (Figure 2), we examine them in separate models. Important control variables in the regression are indicators of academic rank, citations, and the number of co-authors. The number of coauthors is important because clustering and constraint measures are empirically correlated with degree in most social networks (Marsden, 1990; Newman, 2003). Academic rank and citations are important cofounders, as they tend to be different by gender, and they are also correlated with the structural position of the researcher (more successful and senior researchers have more publications and more open network positions compared to beginners) (Figure 2).

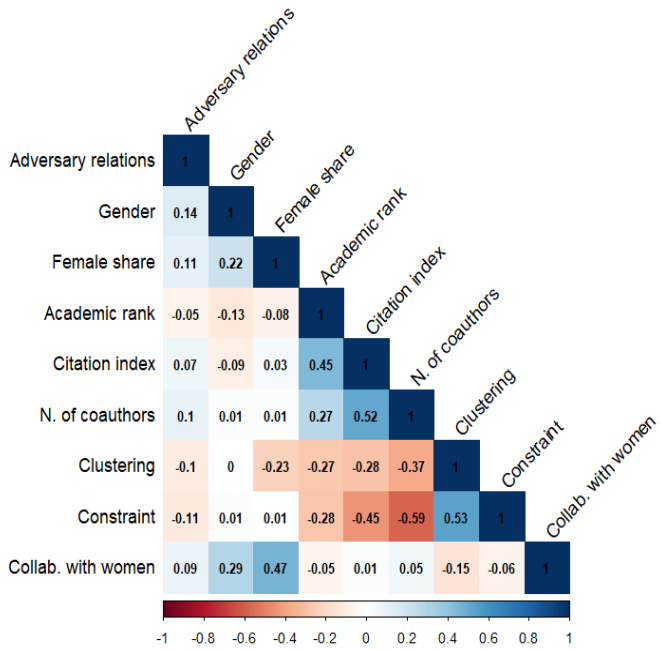


Figure 2. Correlation matrix of the variables used in our models.

Figure 3 displays the coefficients of Poisson regressions with the number of adversary relations as the dependent variable. When we consider men and women together (Figure 3A), we see that the most important predictor of the number of conflicts is gender; women have more conflicts. In addition, academic rank and clustering are also significant, indicating that more senior researchers and those who are more embedded in the coauthor network (higher clustering) have somewhat fewer conflicts. The coefficients of the scientific field dummies are not significant.

If we consider men and women separately (Figure 3B), we see that the factors predicting the number of conflicts are largely gender dependent. Men have more conflicts if they have more coauthors and if they are cited more, thus, we might say that their conflicts are related to their success in publications. These factors are in turn not significant for women. They have more conflicts if they are less embedded in co-author networks and if they have more junior ranks. These factors however are not significant for men. In Figure 3C we replace the clustering measure with Burt's constraint measure, which captures the inverse of bridging positions in networks. We see that the results are consistent with the previous panel. Women have more conflicts if their constraint is low (when they are in bridging positions), while the constraint is not significant for men. Taken together, we see that if women occupy bridging positions in co-author networks, connecting people who are otherwise unconnected, they experience more conflicts. However, if they are in closed networks, where everyone works with everyone else, it prevents them from conflicts. For men, however, clustering and constraint are not significant. This is what we expected in Hypothesis 1.

In Hypothesis 2 we put forward that being in a broker position creates more conflicts for women, especially if they are in token positions. Thus, to test this hypothesis, we replace the field dummies with the share of women in the corresponding scientific field and add its interaction term with the constraint measure. Because the data on the share of women is an aggregate by scientific fields, and the other variables are observed for the individuals, we use a multilevel (random intercept) specification of the Poisson regressions in this case. The coefficients of these models are displayed in Figure 3D. It is visible that although the coefficient of the "Female share x Constraint" interaction is positive, as expected in H2, it is not significant. Therefore, we could not justify that women in broker positions (having lower constraint) would have less conflict relationships in more balanced fields (if the share of women increases).

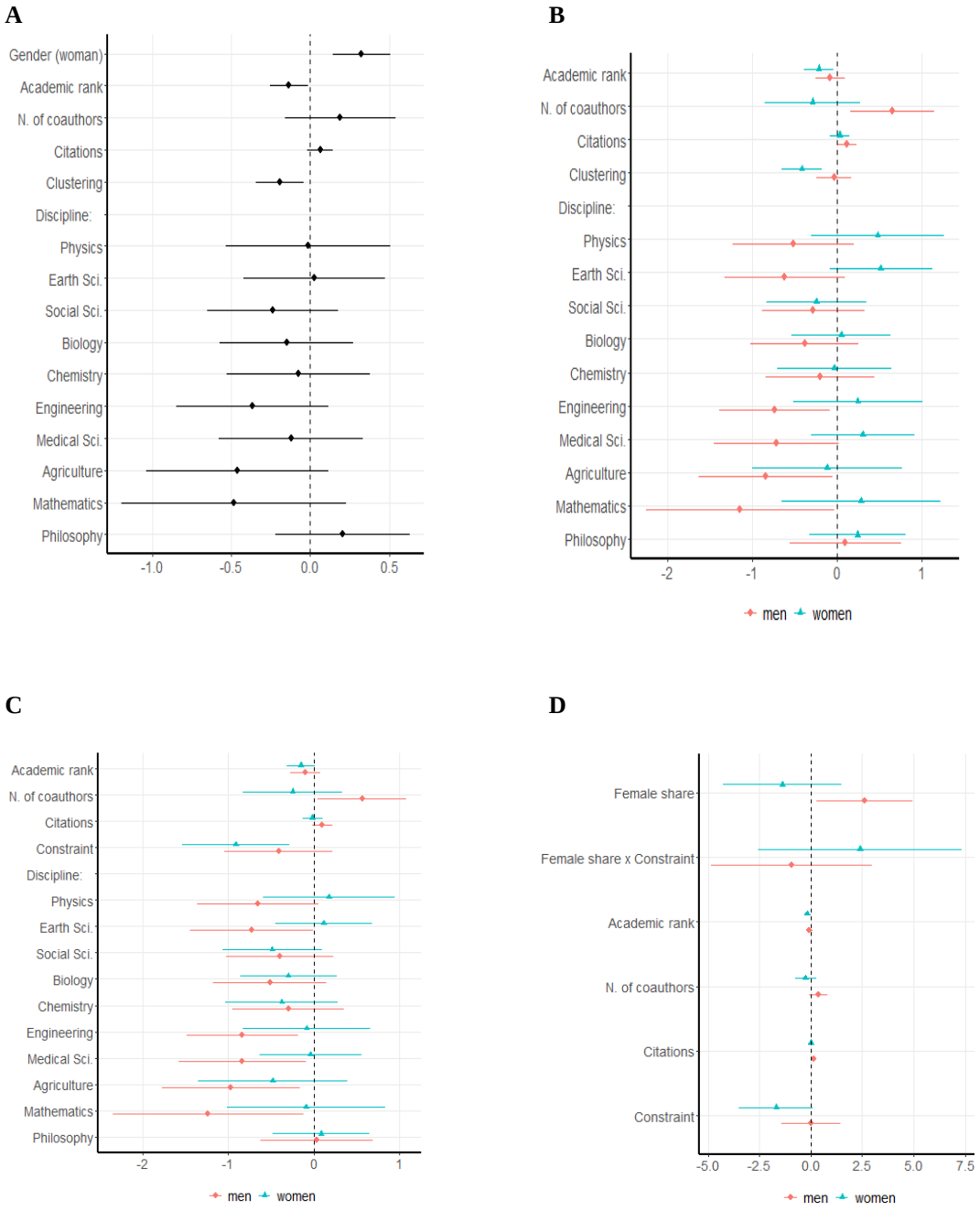
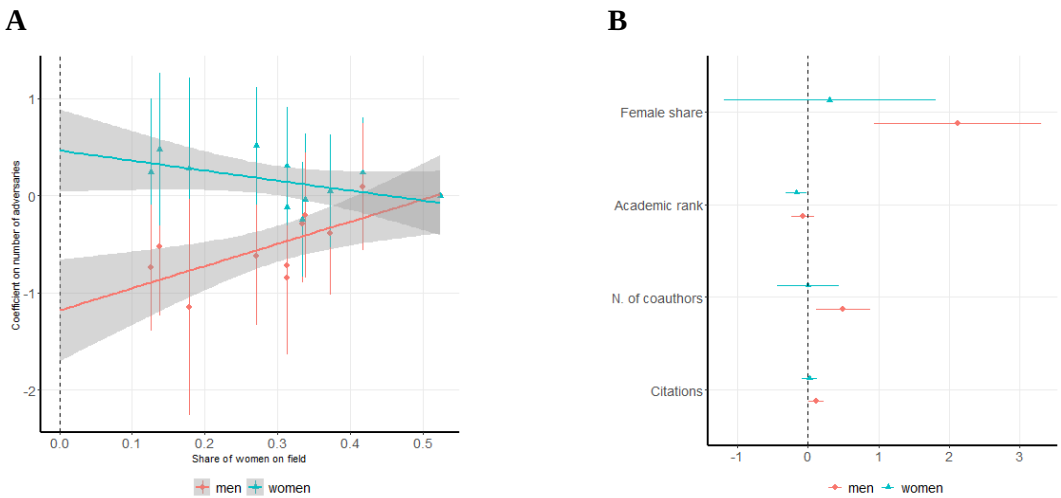


Figure 3. Results of Poisson regressions on the number of conflict relations (coefficients and confidence intervals). A. Both genders together B. Separate models by gender C. Separate models by genders, using Burt's constraint instead of clustering. D. Separate models by gender, using the share of women on the field and its interaction. Notes. N= 422 men + 301 women. Scale of variables: N. of coauthors (100), Clustering (0.1).

In Figure 4 we focus on the impact of gender composition on the number of conflicts. In Figure 4A we order the coefficients of scientific fields according to the share of women on the fields on the *x-axis* from the model presented in Figure 3C. We can observe a tendency that men have fewer conflicts in male-dominated fields, while they experience conflicts in fields with more balanced gender compositions. However, women tend to have more conflicts if they are in a token position, in contrast to more balanced fields. We test this tendency statistically in Figure 4B, where we replace the field dummies with the share of women in the corresponding scientific field. Because the data on the share of women is an aggregate by scientific fields, and the other variables are observed for the individuals, we use a multilevel (random intercept) specification. The coefficient plot shows that the share of women significantly increases the number of conflicts for men, corresponding to Hypothesis 3, but the tendency that women have fewer conflicts if they are not in token position (corresponding to Hypothesis 4) is not significant.

Figure 4C adds the interaction term of the collaboration with women and the share of women on the field, which is significant for women but not for men. The first conclusion is that men experience fewer conflicts, if they work in a male-dominated field, and it is not related to their collaboration patterns with men or women. Second, women experience more conflicts, if they collaborate with men in a male-dominated field, or if they collaborate with women in a more balanced field, which supports Hypothesis 5. From the point of view of the female scientists, our results suggest that both collaborating between females if they are a small minority or collaborating with men in gender-diverse fields can reduce conflicts. This tendency is visualized in Panel D in terms of the predicted change in the number of adversaries for the lowest and the highest observed female ratios as an example. For males, however, we cannot verify Hypothesis 5, as we only have balanced and male-dominated fields in the data, thus do not have ones, where men would be in minority position.



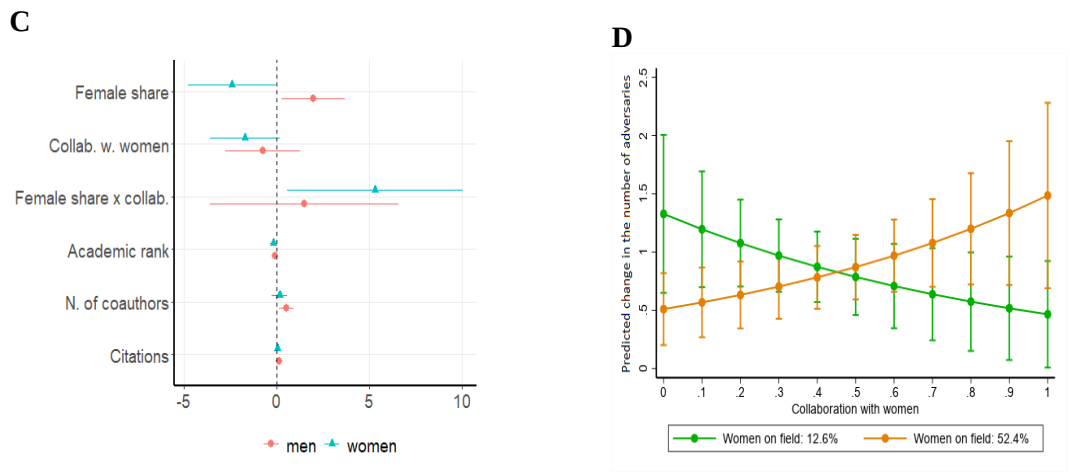


Figure 4. A. Coefficients of scientific fields from the model presented in Figure 3C (with confidence intervals) arranged by the share of women on fields, and two regression lines fitted on the coefficients. B. Results of Poisson regressions (random intercept models) by genders on the number of adversaries considering the share of female academics on the field (coefficients and confidence intervals) C. Results of Poisson regressions (random intercept models) by genders on the number of adversaries considering the share of female academics, the collaboration with women and their interactions. D. Predicted change in the number of adversaries for women by the share of women on the field (lowest and highest observed values) and the individual's collaboration strength with women. Notes. N= 422 men + 301 women. Scale of variables: N. of coauthors (100), Clustering (0.1).

Discussion

The research and pursuit of gender equality now has a strong and colorful tradition (Clavero & Galligan, 2021; Nielsen, 2014; Squires, 2007). In academia, despite all efforts, however, we still observe a huge gender gap. It can be illustrated by the fact, for example, that only 15% of highly cited researchers are women, while 33% of all authors are female (Meho, 2022). Moreover, this gap did not improve at all during the last decade (Lietz et al., 2024; Meho, 2022). While the presence of the gap is evident, research on the mechanisms behind this can easily provoke heated discussions over statistical methodology and on the conclusions one can draw from the analysis - recent examples include e.g. Strumia (2021) or AlShebli et al., (2020). This sensitivity of the question is related to its high policy relevance. While neglecting extant inequalities can be harmful on the one hand, exaggerating difficulties may contribute to stereotypes that can be a force of deterrence for young talents (Ball et al., 2021). Still, several tendencies can be taken as evident. One is the higher dropout rate of women over the career that creates a "leaky pipeline" in their representation over the different ranks (Dubois-Shaik & Fusulier, 2015), and second, the Matthew-effect that success early in the career determines later success versus dropout (Guan et al., 2017).

We attempt to enrich this literature by highlighting a new element, the role of negative ties. Using survey data, we demonstrate that young female academics experience more conflicts than young male scientists do - by large. Furthermore, our results suggest that these conflict relations may create an obstacle in the career of young female scientists in brokering roles between different communities, that are more promising in terms of scientific success (Guan et al., 2017; Jadidi et al., 2018), because in these situations they face more conflicts. Seeing that in our data junior women are more likely to report negative relations than seniors, we may speculate that the gender differences in conflict relations may contribute to the higher dropout rate of young female scientists. Thus, although the same collaboration patterns were found useful for scientists regardless of gender (Dorantes-Gilardi et al., 2023; Jadidi et al., 2018), it seems that the community expects different behavior from men and women Additionally, we do not see that diversity (gender balance of the field) would significantly alter this situation. However, we must also note, that scientific success is not without conflicts for men either; we see that men who are more successful in science (in terms of citations) also report more conflict relations.

What is also interesting is how gender diversity of the field adds to this picture. In this aspect, we see that men working in male-dominated fields report fewer conflicts than men in balanced fields. For women, however, we see interesting interactions. They report more conflicts if they work with men in male-dominated fields, and if they work with women in balanced fields. Given that homophily in collaboration leads to information disadvantage for minority groups (Karimi et al., 2018), this again creates a trade-off for women working in male-dominated fields; they either work with men and risk conflicts or work with each other that may create a lock-in that is less fruitful on the long term. This, however, underlines the importance of initiatives that increase visibility and promote cooperation between women in fields, where they traditionally have low representation; for instance, Women in Data Science, the Society of Women Engineers, and Women in Aviation International. In more diverse fields this trade-off does not exist, as working in gender-integrated teams tends to be both more productive (Vedres & Vásárhelyi, 2023) and also less exposed to conflicts. In this regard, Merluzzi finds that women are more inclined than men to cite a negative relationship with another woman if they lack female social support in the workplace network. Our results align with the assumption that co-authorship is not only a strategic collaboration aiming at career advancement but also a means of finding support in gender-homophile contacts and working together with potential role models (Ely, 1994; Duguid, 2011).

At this point we need to point out a limitation of our study, that is we consider these scientific fields uniform and do not take into account gender segregation within them, across sub-fields (Bandelj, 2019; Strumia, 2021). Considering this, for example, one can imagine a cohesive and gender-homophile female collaboration network in a seemingly male-dominated field too).

References

AlShebli, B., Makovi, K., & Rahwan, T. (2020). RETRACTED ARTICLE: The association between early career informal mentorship in academic collaborations and junior author performance. *Nature Communications*, *11*(1), 1–8.

Aral, S., & Dhillon, P. S. (2023). What (Exactly) Is Novelty in Networks? Unpacking the Vision Advantages of Brokers, Bridges, and Weak Ties. *Management Science*, *69*(2), 1092–1115. https://doi.org/10.1287/mnsc.2022.4377

Ball, P., Britton, T. B., Hengel, E., Moriarty, P., Oliver, R. A., Rippon, G., Saini, A., & Wade, J. (2021). Gender issues in fundamental physics: Strumia's bibliometric analysis fails to account for key confounders and confuses correlation with causation. *Quantitative Science Studies*, *2*(1), 263–272. https://doi.org/10.1162/qss_a_00117

Bandelj, N. (2019). Academic Familism, Spillover Prestige and Gender Segregation in Sociology Subfields: The Trajectory of Economic Sociology. *The American Sociologist*, *50*(4), 488–508. https://doi.org/10.1007/s12108-019-09421-4

Barthauer, L., Spurk, D., & Kauffeld, S. (2016). Women's Social Capital in Academia: A Personal Network Analysis. *International Review of Social Research*, *6*(4), 195–205. https://doi.org/10.1515/irsr-2016-0022

Benan, K. Y., & Olca, S. D. (2020). Cinsiyete Dayalı Tokenizm: Kadın Egemen ve Erkek Egemen Meslekler Üzerinde Nitel Bir Araştırma. *Istanbul Management Journal*, 85–125. https://doi.org/10.26650/imj.2020.88.0004

Bozeman, B., & Gaughan, M. (2011). How do men and women differ in research collaborations? An analysis of the collaborative motives and strategies of academic researchers. *Research Policy*, *40*(10), 1393–1402. https://doi.org/10.1016/j.respol.2011.07.002

Burt, R. S. (1992). *Structural Holes: The Social Structure of Competition*. Harvard University Press. https://www.jstor.org/stable/j.ctv1kz4h78

Burt, R. S. (1998). THE GENDER OF SOCIAL CAPITAL. *Rationality and Society*, *10*(1), 5–46. https://doi.org/10.1177/104346398010001001

Carboni, I. (2023). Women Alone in the Middle: Gender Differences in the Occupation and Leverage of Social Network Brokerage Roles. In A. Gerbasi, C. Emery, & A. Parker (Eds.), *Understanding Workplace Relationships* (pp. 101–134). Springer International Publishing. https://doi.org/10.1007/978-3-031-16640-2_4

Carboni, I., & Gilman, R. (2012). Brokers at risk: Gender differences in the effects of structural position on social stress and life satisfaction. *Group Dynamics: Theory, Research, and Practice*, *16*(3), 218–230. https://doi.org/10.1037/a0028753

Clavero, S., & Galligan, Y. (2021). Delivering gender justice in academia through gender equality plans? Normative and practical challenges. *Gender, Work & Organization*, *28*(3), 1115–1132. https://doi.org/10.1111/gwao.12658

Coleman, J. S. (1988). Social capital in the creation of human capital. *American Journal of Sociology*, *94*, S95–S120.

Coleman, J. S. (1990). *Foundations of social theory*. Belknap Press of Harvard Univ. Press.

Dahlander, L., & McFarland, D. A. (2013). Ties That Last: Tie Formation and Persistence in Research Collaborations over Time. *Administrative Science Quarterly*, *58*(1), 69–110. https://doi.org/10.1177/0001839212474272

Derks, B., Ellemers, N., Van Laar, C., & De Groot, K. (2011). Do sexist organizational cultures create the Queen Bee? *British Journal of Social Psychology*, *50*(3), 519–535. https://doi.org/10.1348/014466610X525280

Dorantes-Gilardi, R., Ramírez-Álvarez, A. A., & Terrazas-Santamaría, D. (2023). Is there a differentiated gender effect of collaboration with super-cited authors? Evidence from junior researchers in economics. *Scientometrics*, *128*(4), 2317–2336. https://doi.org/10.1007/s11192-023-04656-y

Dubois-Shaik, F., & Fusulier, B. (2015). *Academic Careers and Gender Inequality: Leaky Pipeline and Interrelated Phenomena in Seven European Countries*. https://eige.europa.eu/sites/default/files/garcia_working_paper_5_academic_careers_gender_inequality.pdf

Duguid, M. (2011). Female tokens in high-prestige work groups: Catalysts or inhibitors of group diversification? *Organizational Behavior and Human Decision Processes*, *116*(1), 104–115. https://doi.org/10.1016/j.obhdp.2011.05.009

Eagly, A. H. (1987). *Sex differences in social behavior: A social-role interpretation* (pp. xii, 178). Lawrence Erlbaum Associates, Inc.

Eagly, A. H., & Karau, S. J. (2002). Role congruity theory of prejudice toward female leaders. *Psychological Review*, *109*(3), 573–598. https://doi.org/10.1037/0033-295X.109.3.573

Elsesser, K. M., & Lever, J. (2011). Does gender bias against female leaders persist? Quantitative and qualitative data from a large-scale survey. *Human Relations*, *64*(12), 1555–1578. https://doi.org/10.1177/0018726711424323

Ely, R. J. (1994). The Effects of Organizational Demographics and Social Identity on Relationships among Professional Women. *Administrative Science Quarterly*, *39*(2), 203. https://doi.org/10.2307/2393234

Fronczak, A., Mrowinski, M. J., & Fronczak, P. (2022). Scientific success from the perspective of the strength of weak ties. *Scientific Reports*, *12*(1), 5074. https://doi.org/10.1038/s41598-022-09118-8

Gersick, C. J. G., Dutton, J. E., & Bartunek, J. M. (2000). LEARNING FROM ACADEMIA: THE IMPORTANCE OF RELATIONSHIPS IN PROFESSIONAL LIFE. *Academy of Management Journal*, *43*(6), 1026–1044. https://doi.org/10.2307/1556333

Gonzalez-Brambila, C. N. (2014). Social capital in academia. *Scientometrics*, *101*(3), 1609–1625. https://doi.org/10.1007/s11192-014-1424-2

Guan, J., Yan, Y., & Zhang, J. J. (2017). The impact of collaboration and knowledge networks on citations. *Journal of Informetrics*, *11*(2), 407–422. https://doi.org/10.1016/j.joi.2017.02.007

Heilman, M. E., & Okimoto, T. G. (2007). Why are women penalized for success at male tasks?: The implied communality deficit. *Journal of Applied Psychology*, *92*(1), 81–92. https://doi.org/10.1037/0021-9010.92.1.81

Holgersson, C., & Romani, L. (2020). Tokenism Revisited: When Organizational Culture Challenges Masculine Norms, the Experience of Token Is Transformed. *European Management Review*, *17*(3), 649–661. https://doi.org/10.1111/emre.12385

Huang, J., Gates, A. J., Sinatra, R., & Barabási, A.-L. (2020). Historical comparison of gender inequality in scientific careers across countries and disciplines. *Proceedings of the National Academy of Sciences*, *117*(9), 4609–4616. https://doi.org/10.1073/pnas.1914221117

Ibarra, H. (1997). Paving an Alternative Route: Gender Differences in Managerial Networks. *Social Psychology Quarterly*, *60*(1), 91. https://doi.org/10.2307/2787014

Jadidi, M., Karimi, F., Lietz, H., & Wagner, C. (2018). GENDER DISPARITIES IN SCIENCE? DROPOUT, PRODUCTIVITY, COLLABORATIONS AND SUCCESS OF MALE AND FEMALE COMPUTER SCIENTISTS. *Advances in Complex Systems*, *21*(03n04), 1750011. https://doi.org/10.1142/S0219525917500114

Jansen, D., Von Görtz, R., & Heidler, R. (2010). Knowledge production and the structure of collaboration networks in two scientific fields. *Scientometrics*, *83*(1), 219–241. https://doi.org/10.1007/s11192-009-0022-1

Kane, G., & Labianca, G. (2006). *Accounting for clergy's social ledgers: Mixed blessings associated with direct and indirect negative ties in a religious organization*.

Kanter, R. M. (1977). Some Effects of Proportions on Group Life: Skewed Sex Ratios and Responses to Token Women. *American Journal of Sociology*, *82*(5), 965–990. https://doi.org/10.1086/226425

Karimi, F., Génois, M., Wagner, C., Singer, P., & Strohmaier, M. (2018). Homophily influences ranking of minorities in social networks. *Scientific Reports*, *8*(1), 11077. https://doi.org/10.1038/s41598-018-29405-7

Kwiek, M., & Roszka, W. (2021). Gender-based homophily in research: A large-scale study of man-woman collaboration. *Journal of Informetrics*, *15*(3), 101171. https://doi.org/10.1016/j.joi.2021.101171

Larivière, V., Ni, C., Gingras, Y., Cronin, B., & Sugimoto, C. R. (2013). Bibliometrics: Global gender disparities in science. *Nature*, *504*(7479), 211–213. https://doi.org/10.1038/504211a

Lietz, H., Jadidi, M., Kostic, D., Tsvetkova, M., & Wagner, C. (2024a). Individual and gender inequality in computer science: A career study of cohorts from 1970 to 2000. *Quantitative Science Studies*, *5*(1), 128–152. https://doi.org/10.1162/qss_a_00283

Lietz, H., Jadidi, M., Kostic, D., Tsvetkova, M., & Wagner, C. (2024b). Individual and gender inequality in computer science: A career study of cohorts from 1970 to 2000. *Quantitative Science Studies*, *5*(1), 128–152. https://doi.org/10.1162/qss_a_00283

Lutter, M. (2015). Do Women Suffer from Network Closure? The Moderating Effect of Social Capital on Gender Inequality in a Project-Based Labor Market, 1929 to 2010. *American Sociological Review*, *80*(2), 329–358. https://doi.org/10.1177/0003122414568788

Marsden, P. V. (1990). Network Data and Measurement. *Annual Review of Sociology*, *16*(1), 435–463. https://doi.org/10.1146/annurev.so.16.080190.002251

McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a Feather: Homophily in Social Networks. *Annual Review of Sociology*, *27*(1), 415–444. https://doi.org/10.1146/annurev.soc.27.1.415

Meho, L. I. (2022). Gender gap among highly cited researchers, 2014–2021. *Quantitative Science Studies*, *3*(4), 1003–1023. https://doi.org/10.1162/qss_a_00218

Merluzzi, J. (2017). Gender and Negative Network Ties: Exploring Difficult Work Relationships Within and Across Gender. *Organization Science*, *28*(4), 636–652. https://doi.org/10.1287/orsc.2017.1137

Nahapiet, J., & Ghoshal, S. (1998). Social Capital, Intellectual Capital, and the Organizational Advantage. *The Academy of Management Review*, *23*(2), 242. https://doi.org/10.2307/259373

Newman, M. E. J. (2001). Scientific collaboration networks. II. Shortest paths, weighted networks, and centrality. *Physical Review E*, *64*(1), 016132. https://doi.org/10.1103/PhysRevE.64.016132

Newman, M. E. J. (2003). The Structure and Function of Complex Networks. *SIAM Review*, *45*(2), 167–256. https://doi.org/10.1137/S003614450342480

Nielsen, M. W. (2014). Justifications of Gender Equality in Academia: Comparing Gender Equality Policies of Six Scandinavian Universities. *NORA - Nordic Journal of Feminist and Gender Research*, *22*(3), 187–203. https://doi.org/10.1080/08038740.2014.905490

Onnela, J.-P., Saramäki, J., Kertész, J., & Kaski, K. (2005). Intensity and coherence of motifs in weighted complex networks. *Physical Review E*, *71*(6), 065103. https://doi.org/10.1103/PhysRevE.71.065103

Patel, V. M., Panzarasa, P., Ashrafian, H., Evans, T. S., Kirresh, A., Sevdalis, N., Darzi, A., & Athanasiou, T. (2019). Collaborative patterns, authorship practices and scientific success in biomedical research: A network analysis. *Journal of the Royal Society of Medicine*, *112*(6), 245–257. https://doi.org/10.1177/0141076819851666

Pelled, L. H. (1996). RELATIONAL DEMOGRAPHY AND PERCEPTIONS OF GROUP CONFLICT AND PERFORMANCE: A FIELD INVESTIGATION. *International Journal of Conflict Management*, *7*(3), 230–246. https://doi.org/10.1108/eb022783

Rajkumar, K., Saint-Jacques, G., Bojinov, I., Brynjolfsson, E., & Aral, S. (2022). A causal test of the strength of weak ties. *Science*, *377*(6612), 1304–1310. https://doi.org/10.1126/science.abl4476

Ridgeway, C. L. (2001). Gender, Status, and Leadership. *Journal of Social Issues*, *57*(4), 637–655. https://doi.org/10.1111/0022-4537.00233

Ridgeway, C. L. (2009). Framed Before We Know It: How Gender Shapes Social Relations. *Gender & Society*, *23*(2), 145–160. https://doi.org/10.1177/0891243208330313

Rudman, L. A., & Glick, P. (2001). Prescriptive Gender Stereotypes and Backlash Toward Agentic Women. *Journal of Social Issues*, *57*(4), 743–762. https://doi.org/10.1111/0022-4537.00239

Schoen, C., Rost, K., & Seidl, D. (2018). The influence of gender ratios on academic careers: Combining social networks with tokenism. *PLOS ONE*, *13*(11), e0207337. https://doi.org/10.1371/journal.pone.0207337

Sparrowe, R. T., Liden, R. C., Wayne, S. J., & Kraimer, M. L. (2001). SOCIAL NETWORKS AND THE PERFORMANCE OF INDIVIDUALS AND GROUPS. *Academy of Management Journal*, *44*(2), 316–325. https://doi.org/10.2307/3069458

Squires, J. (2007). *The New Politics of Gender Equality*. Bloomsbury Publishing.

Strumia, A. (2021). Gender issues in fundamental physics: A bibliometric analysis. *Quantitative Science Studies*, *2*(1), 225–253. https://doi.org/10.1162/qss_a_00114

Szell, M., & Thurner, S. (2013). How women organize social networks different from men. *Scientific Reports*, *3*(1), 1214. https://doi.org/10.1038/srep01214

Vedres, B., & Vásárhelyi, O. (2023). Inclusion unlocks the creative potential of gender diversity in teams. *Scientific Reports*, *13*(1), 13757. https://doi.org/10.1038/s41598-023-39922-9

Venkataramani, V., Labianca, G. (Joe), & Grosser, T. (2013). Positive and negative workplace relationships, social satisfaction, and organizational attachment. *Journal of Applied Psychology*, *98*(6), 1028–1039. https://doi.org/10.1037/a0034090

YAP, J., & HARRIGAN, N. (2015). Why does Everybody Hate me? Balance, Status, and Homophily: The Triumvirate of Signed Tie Formation. *Social Networks*, *40*, 103–122. https://doi.org/10.1016/j.socnet.2014.08.002

Zeng, X. H. T., Duch, J., Sales-Pardo, M., Moreira, J. A. G., Radicchi, F., Ribeiro, H. V., Woodruff, T. K., & Amaral, L. A. N. (2016). Differences in Collaboration Patterns across Discipline, Career Stage, and Gender. *PLOS Biology*, *14*(11), e1002573. https://doi.org/10.1371/journal.pbio.1002573

Zimmer, L. (1988). Tokenism and Women in the Workplace: The Limits of Gender-Neutral Theory. *Social Problems*, *35*(1), 64–77. https://doi.org/10.2307/800667