

MAKING GENDER DIVERSITY WORK FOR SCIENTIFIC DISCOVERY AND INNOVATION

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COPENHAGEN

Making gender diversity work for scientific discovery and innovation

Mathias Wullum Nielsen^{1*}, Carter Walter Bloch¹ and Londa Schiebinger²

Gender diversity has the potential to drive scientific discovery and innovation. Here, we distinguish three approaches to gender diversity: diversity in research teams, diversity in research methods and diversity in research questions. While gender diversity is commonly understood to refer only to the gender composition of research teams, fully realizing the potential of diversity for science and innovation also requires attention to the methods employed and questions raised in scientific knowledge-making. We provide a framework for understanding the best ways to support the three approaches to gender diversity across four interdependent domains — from research teams to the broader disciplines in which they are embedded to research organizations and ultimately to the different societies that shape them through specific gender norms and policies. Our analysis demonstrates that realizing the benefits of diversity for science requires careful management of these four interdependent domains.

Gender diversity is increasingly the norm in scientific work. Women and men already share laboratories, research facilities and work spaces in most disciplines, and universities and science policymakers see gender diversity as a key driver of excellence and innovation^{1–6}. Yet, gender diversity comes with both challenges and opportunities. Careful management is required to maximize the benefits of diversity for scientific discovery.

This Perspective distinguishes three approaches to gender diversity: diversity in research teams, diversity in research methods and diversity in research questions (Fig. 1). Gender diversity is commonly understood to refer to the gender composition of research teams. However, fully realizing the potential of diversity for science and innovation also requires attention to diversity in research methods and in research questions.

Importantly, gender diversity functions within larger research contexts. In the second half of this paper, we provide a framework to understand how the three approaches to gender diversity function across four interdependent domains: research teams, disciplines, research organizations and societies at large (Fig. 2). In each of the four domains, we evaluate potential drivers and barriers to gender diversity. Understanding the interplay between our three approaches to diversity and how they function within institutional frameworks will assist universities, funding agencies, industries and governments to harness the power of diversity for discovery and innovation.

This Perspective integrates insights from multiple disciplines, including social psychology, management and social studies of science and innovation (search methods are specified in the Supplementary Notes and Supplementary Tables 1 and 2).

Many organizations understand the importance of increasing women's participation in science and technology, and, increasingly, funding agencies are emphasizing the value of bringing diverse methods, such as integrating sex and gender analysis, into research design. Crucially important also is being attuned to the novel research questions newcomers to traditional disciplines might bring. This attention to diversity goes well beyond the dynamics of the research team itself and needs to be fostered by disciplines, research organizations and societies at large.

Three approaches to gender diversity

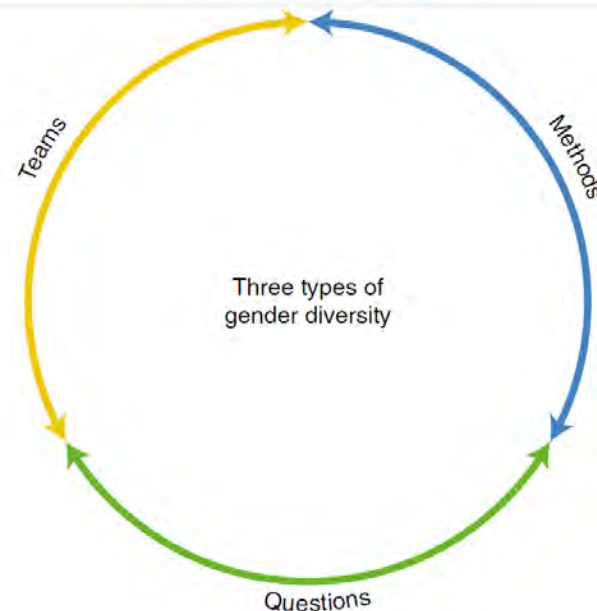
In this section, we distinguish three approaches to gender diversity: diversity in research teams, diversity in research methods and diversity in research questions.

Diversity in research teams. The best-understood approach to gender diversity concerns the composition of research teams. Diversity refers here to the different ideas, beliefs and perspectives that women, men and gender-diverse people bring to the team. The possible benefits of gender diversity are linked to cognitive diversity, conceptualized here as the different ways in which “people represent problems and go about solving them in team work”⁷. Research suggests that cognitive diversity can heighten creativity and encourage the search for novel solutions^{8,9}. Experiments indicate that teams comprised of diverse problem-solvers can outperform teams that prioritize best-performing individuals⁷.

Gender-diverse teams may, however, encounter higher levels of conflict than more homogeneous teams¹⁰. Careful team management is therefore imperative to reap the possible benefits of diversity (we return to this in the discussion of the four interdependent domains for scientific discovery and innovation).

The impact of gender diversity on team performance has been analysed extensively in laboratory studies and in corporate and public organizations, but not in science^{11–13}. The few existing studies focusing on gender diversity in scientific teams typically evaluate research outcomes based on citation rates, publication productivity and patents. Surveying research from 2006 to 2015, we found eleven studies on team performance in research and innovation. Six studies examined research in for-profit research and development (R&D) firms^{14–19} (Table 1), and, of these, five found possible benefits of team gender diversity for innovation and technological performance (measured by patents). Five of the original eleven studies focused on academic science^{20–24}, and two of these found possible benefits of gender diversity — one with respect to citation impact; another with respect to publication productivity. The remaining studies showed no notable effects of gender diversity.

Yet, gender diversity in teams may influence research outcomes in important ways not captured using traditional, bibliometric



	Teams	Methods	Questions
Focus	Gender composition of research teams	Integration of GSA into research design	Changes in research questions and priorities
Evaluation	Assess the numbers of citations, publications, patents, and so on	Analyse the proportion and quality of GSA in funding proposals and publications	Map large-scale patterns in the topics addressed and questions raised in research
Future research	How does team diversity contribute to the social impact of research?	What is the value of GSA to society in terms of human well-being and economic impact?	Will increasing the numbers of women change research questions, or will changing questions increase the numbers of women in research?

Fig. 1 | Three approaches to gender diversity. Each approach to diversity — diversity in research teams, diversity in research methods and diversity in research questions — has a distinct focus, modes of evaluation and opportunities for future research. The double-ended arrows indicate that these three approaches mutually influence one another; improvements in one likely lead to improvements in the others.

DIVERSITY IN TEAMS

Gender-Heterogeneous Working Groups Produce Higher Quality Science

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Abstract

Here we present the first empirical evidence to support the hypothesis that a gender-heterogeneous problem-solving team generally produced journal articles perceived to be higher quality by peers than a team comprised of highly-performing individuals of the same gender. Although women were historically underrepresented as principal investigators of working groups, their frequency as PIs at the National Center for Ecological Analysis and Synthesis is now comparable to the national frequencies in biology and they are now equally qualified, in terms of their impact on the accumulation of ecological knowledge (as measured by the h-index). While women continue to be underrepresented as working group participants, peer-reviewed publications with gender-heterogeneous authorship teams received 34% more citations than publications produced by gender-uniform authorship teams. This suggests that peers citing these publications perceive publications that also happen to have gender-heterogeneous authorship teams as higher quality than publications with gender uniform authorship teams. Promoting diversity not only promotes representation and fairness but may lead to higher quality science.



JOHNSON
Cornell University

By Whom and When Is Women's Expertise Recognized? The Interactive Effects of Gender and Education in Science and Engineering Teams

Aparna Joshi¹

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R&D MANAGEMENT

How diversity contributes to academic research teams performance

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Inmaculada Aguiar-Díaz³ and
José Luis Ballesteros-Rodríguez⁴

The objective of this paper is to analyse how the job-related diversity in academic research teams influences their scientific performance. To achieve that objective, an empirical study of a university's research teams was carried out during the years 2006–2009. The results reflect a non-significant effect of functional diversity on research teams' performance, whereas status diversity affects in a positive and significant way. However, educational diversity has a significant negative impact when a certain threshold is exceeded. The effect of institutional diversity presents an inverted U-shaped relation with the number of published articles by the research teams. The results reveal that the relationship between diversity and research performance may not be a simple and direct one because its effect could depend on the organisational context and the type of diversity attributes.



RESEARCH

Adequate statistical power in clinical trials is associated with the combination of a male first author and a female last author

Abstract Clinical trials have a vital role in ensuring the safety and efficacy of new treatments and interventions in medicine. A key characteristic of a clinical trial is its statistical power. Here we investigate whether the statistical power of a trial is related to the gender of first and last authors on the paper reporting the results of the trial. Based on an analysis of 31,873 clinical trials published between 1974 and 2017, we find that adequate statistical power was most often present in clinical trials with a male first author and a female last author (20.6%, 95% confidence interval 19.4-21.8%), and that this figure was significantly higher than the percentage for other gender combinations (12.5-13.5%; $P < 0.0001$). The absolute number of female authors in clinical trials gradually increased over time, with the percentage of female last authors rising from 20.7% (1975-85) to 28.5% (after 2005). Our results demonstrate the importance of gender diversity in research collaborations and emphasize the need to increase the number of women in senior positions in medicine.

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**WILLEM M OTTE, JOERI K TIJDINK, PAUL L WEERHEIM, HERM J LAMBERINK
AND CHRISTIAAN H VINKERS***

DIVERSITY IN RESEARCH METHODS

Gendered Innovations

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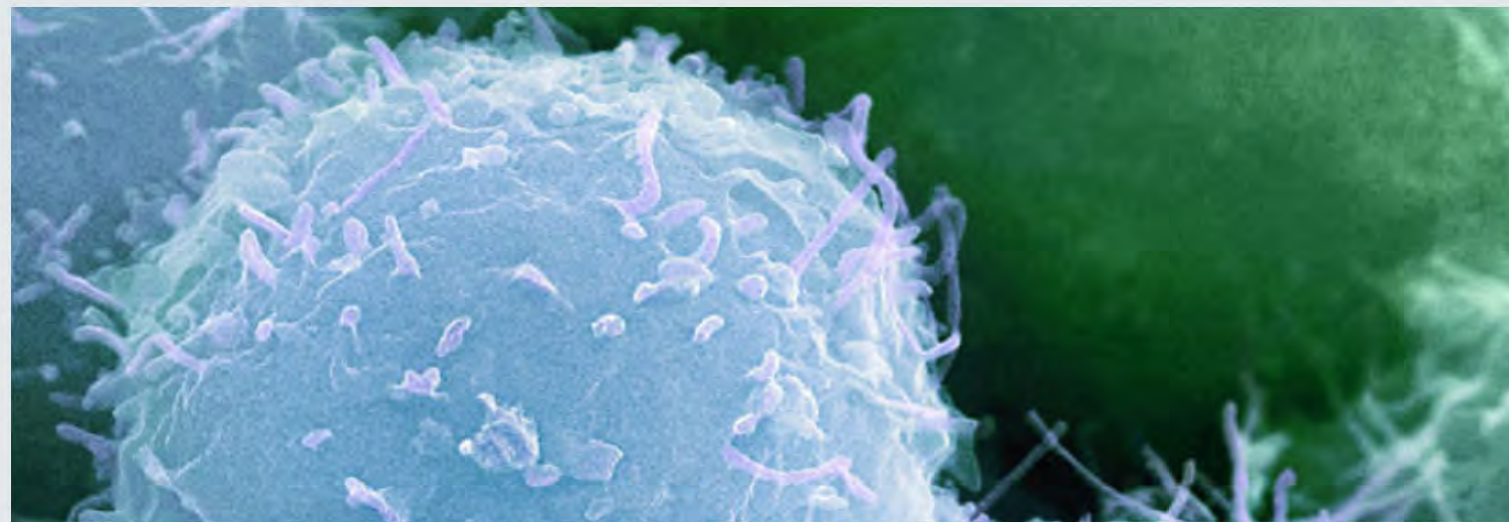
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SCIENCE

Sex and Gender Methods for Research

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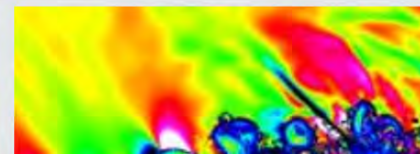
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Why Gendered Innovations?

“Gendered Innovations”
employs methods of

DIVERSITY IN RESEARCH QUESTIONS

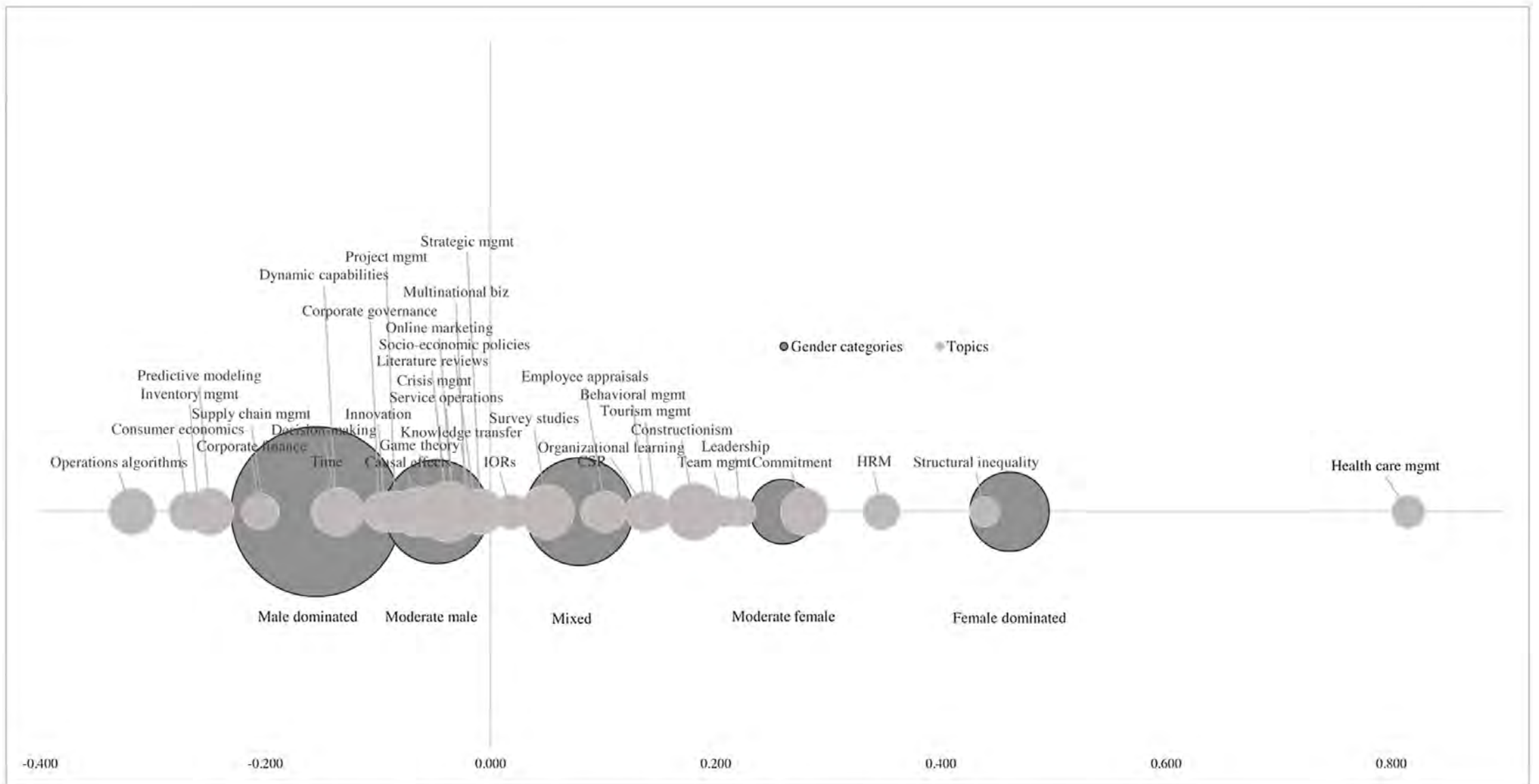
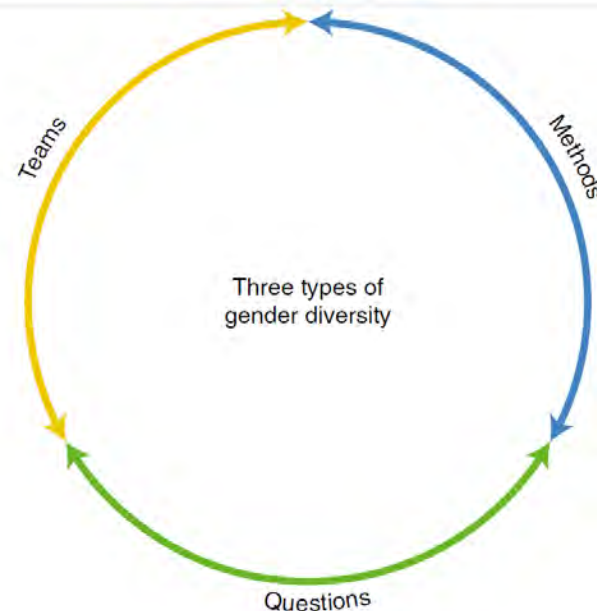


Fig. 1. Topic dimension of management studies (Correspondence analysis).

Nielsen, M. W., & Börjeson, L. (2019). Gender diversity in the management field: Does it matter for research outcomes?. *Research Policy*, 48(7), 1617-1632.



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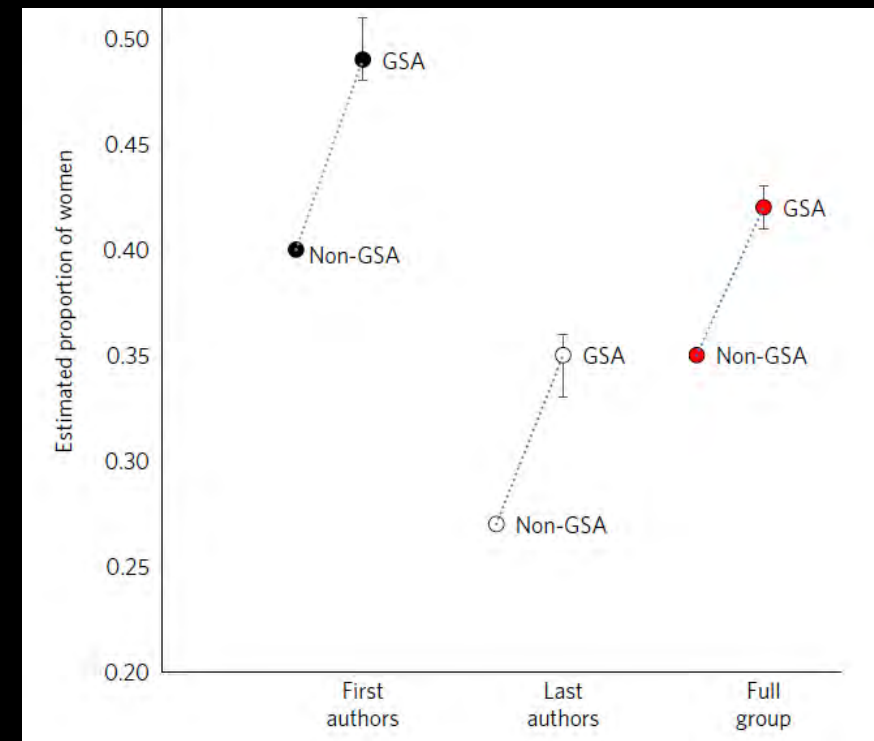
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nature human behaviour

One and a half million medical papers
reveal a link between author gender and
attention to gender and sex analysis

Mathias Wullum Nielsen ✉, Jens Peter Andersen, Londa Schiebinger & Jesper W. Schneider

Fig. 2 | Plot of estimated marginal means. The estimated marginal means for f_first , f_last and fw in models 1, 2 and 3 are shown. Error bars represent 95% CI (for estimate specifications, see Supplementary Table 5). The plots visualize the participation of women (relative to men) as first authors, last authors and overall representation in the byline for studies that do and do not involve GSA. The figure shows that women's estimated share of authorships is higher in GSA studies than in non-GSA studies for all three author variables.





Factors affecting sex-related reporting in medical research: a cross-disciplinary bibliometric analysis

Cassidy R Sugimoto, Yong-Yeol Ahn, Elise Smith, Benoit Macaluso, Vincent Larivière

Summary

Background Clinical and preclinical studies have shown that there are sex-based differences at the genetic, cellular, biochemical, and physiological levels. Despite this, numerous studies have shown poor levels of inclusion of female populations into medical research. These disparities in sex inclusion in research are further complicated by the absence of sufficient reporting and analysis by sex of study populations. Disparities in the inclusion of the sexes in medical research substantially reduce the utility of the results of such research for the entire population. The absence of sex-related reporting are problematical for the translation of research from the preclinical to clinical and applied health settings. Large-scale studies are needed to identify the extent of sex-related reporting and where disparities are more prevalent. In addition, while several studies have shown the dearth of female researchers in science, few have evaluated whether a scarcity of women in science might be related to disparities in sex inclusion and reporting. We aimed to do a cross-disciplinary analysis of the degree of sex-related reporting across the health sciences—from biomedical, to clinical, and public health research—and the role of author gender in sex-related reporting.

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See [Comment](#) page 497

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Association of Author Gender With Sex Bias in Surgical Research

Nicholas Xiao, BSc¹; Neel A. Mansukhani, MD¹; Diego F. Mendes de Oliveira, PhD²; [et al](#)

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MAKING GENDER DIVERSITY WORK

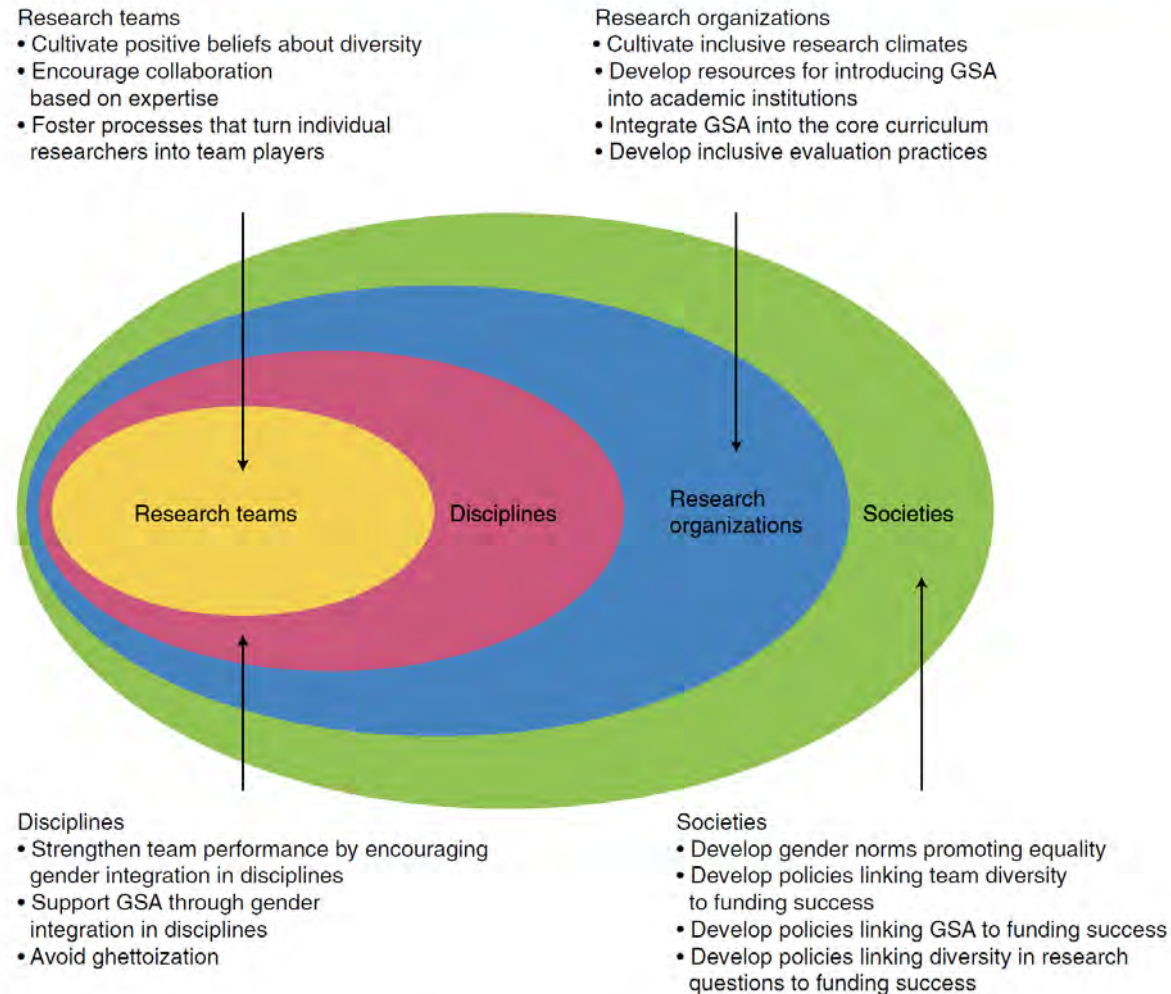


Fig. 2 | Four interdependent domains. Specific management techniques in each domain — research teams, disciplines, research organizations and societies at large — are crucial to foster the benefits associated with gender diversity in research teams, in research methods and in research questions.

Making GD Work: Research teams

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Bridging Faultlines by Valuing Diversity: Diversity Beliefs, Information Elaboration, and Performance in Diverse Work Groups

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Although there are numerous potential benefits to diversity in work groups, converging dimensions of diversity often prevent groups from exploiting this potential. In a study of heterogeneous decision-making groups, the authors examined whether the disruptive effects of diversity faultlines can be overcome by convincing groups of the value of diversity. Groups were persuaded either of the value of diversity or the value of similarity for group performance, and they were provided with either homogeneous or heterogeneous information. As expected, informationally diverse groups performed better when they held pro-diversity rather than pro-similarity beliefs, whereas the performance of informationally homogeneous groups was unaffected by diversity beliefs. This effect was mediated by group-level information elaboration. Implications for diversity management in organizations are discussed.

Keywords: diversity, faultlines, diversity beliefs, information elaboration, team performance

EMR European Management Review
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Original Article |  Full Access

The Performance of Gender Diverse Teams: What Is the Relation between Diversity Attitudes and Degree of Diversity?

Jakob Luring, Florence Villesèche 

Making GD Work: Research organizations

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THE BENEFITS OF CLIMATE FOR INCLUSION FOR GENDER-DIVERSE GROUPS

LISA H. NISHII
Cornell University

I introduce the construct of climate for inclusion, which involves eliminating relational sources of bias by ensuring that identity group status is unrelated to access to resources, creating expectations and opportunities for heterogeneous individuals to establish personalized cross-cutting ties, and integrating ideas across boundaries in joint problem solving. I show that within inclusive climates, interpersonal bias is reduced in such a way that gender diversity is associated with lower levels of conflict. In turn, the negative effect that group conflict typically has on unit-level satisfaction disappears. This has important implications, as unit-level satisfaction is negatively associated with turnover in groups.

BRIEF COMMUNICATION

<https://doi.org/10.1038/s41559-019-0911-5>

nature
ecology & evolution

Underrepresented faculty play a disproportionate role in advancing diversity and inclusion

Miguel F. Jimenez^{1,4}, Theresa M. Laverty^{2,4*}, Sara P. Bombaci¹, Kate Wilkins¹, Drew E. Bennett³ and Liba Pejchar²

A diverse and inclusive scientific community is more productive, innovative and impactful, yet ecology and evolutionary biology continues to be dominated by white male faculty. We quantify faculty engagement in activities related to diversity and inclusion and identify factors that either facilitate or hinder participation. Through a nationwide survey, we show that faculty with underrepresented identities disproportionately engage in diversity and inclusion activities, yet such engagement was not considered important for tenure. Faculty perceived time and funding as major limitations, which suggests that institutions should reallocate resources and reconsider how faculty are evaluated to promote shared responsibility in advancing diversity and inclusion.

To overcome current disparities and ensure that science reflects and is relevant to society, it is critical to understand what factors contribute to or inhibit faculty engagement in diversity and inclusion activities. To achieve this objective, we ask: (1) how do ecology and evolutionary biology faculty value and participate in activities related to diversity and inclusion? (2) What characteristics of faculty are associated with engagement in these activities? (3) What do faculty perceive as the key motivations and barriers for participation? (4) What resources or approaches are most likely to reduce these barriers and enhance faculty engagement in diversity and inclusion?

To address these questions, we conducted an online survey of faculty associated with ecology and evolutionary biology doctoral

Making GD Work: Societies



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The influence of cultural context on the relationship between gender diversity and team performance: a meta-analysis

Matthias Schneid, Rodrigo Isidor, Chengguang Li & Rüdiger Kabst

