Do the social roles that women and men occupy in science allow equal access to publication?

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Anyone who thinks that science is on a glide path to gender equality should read the study by Huang et al. (1) showing a publication gender gap favoring men that has increased over time as more women have entered science fields. Although the lesser publishing by women has also emerged in several other studies, this current PNAS article provides more extensive evidence by showing that the women's publication deficit extends across science, technology, engineering, and mathematics (STEM) disciplines and nations (1). These findings may seem puzzling but less so if considered in the context of women's positioning within science.

Why is it that women are not gradually attaining status equal to that of men as contributors to scientific knowledge? Huang et al. (1) provide some guidance concerning possible causes of their perplexing findings. They show that women and men publish a similar number of articles per year of their publishing careers and have the same impact for the same number of publications. They further demonstrate that the overall sex difference in productivity is explained largely by women's higher rates of dropping out of publishing, producing women's shorter publishing careers. Therefore, a search for causes should focus on these shorter publishing histories.

Although not testable within the limits of the bibliometric data of Huang et al. (1), likely explanations reside in the social roles that women and men occupy in science and the responsibilities that they undertake in these roles. Although this commentary addresses these considerations only in the context of available US data, they warrant investigation in all nations.

Consider that entry to science takes place in the roles of graduate student and postdoctoral researcher in which beginning scientists typically achieve one or more usually coauthored publications, enabling their names first to appear in the research literature. Among students, from the bachelor's degree to the PhD, currently there is no greater loss of women than men (2). However, do women subsequently leak from the STEM pipeline? That outcome depends on their subsequent employment. In fact, some young scientists, more women than men, disappear entirely from further employment, perhaps temporarily, after their graduate education. Among the 2014 to 2015 doctorate recipients in science and engineering, more women (4.0%) than men (1.4%) were not employed and not seeking work in 2017 (3).

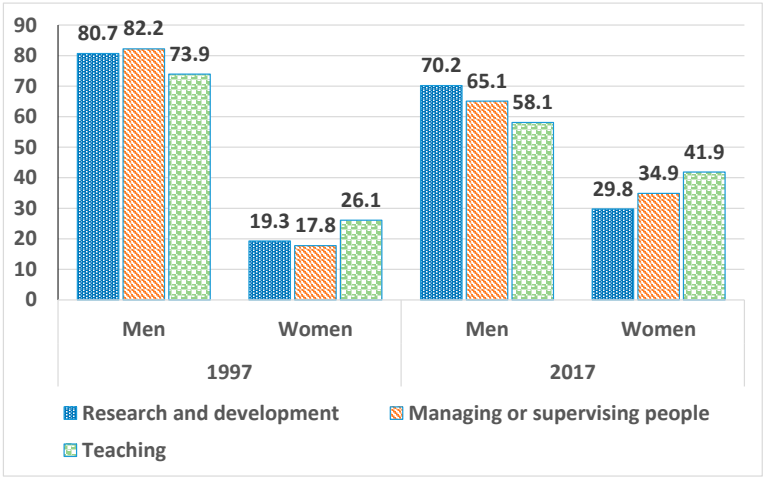

Fig. 1. Percentages of men and women among respondents reporting as primary work activities: research and development, managing or supervising people, or teaching. Respondents are US-trained science, engineering, and health doctorate holders residing in the United States in 1997 and 2017. Data from ref. 7.

Given that most science publication comes from individuals employed by universities, it is important to examine the roles that women and men occupy in these institutions. In STEM and other fields and across all types of institutions, women are relatively more common than men in teaching-intensive positions, such as lecturer and instructor, as well as in part-time positions. For example, in doctoral institutions with very high research activity, which produce a large portion of all publication, 21.7% of female faculty were in instructor and lecturer positions in 2017 to 2018 compared with 11.6% of male faculty (4).

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Among STEM doctorate holders employed in academia in science and engineering fields in 2017 (5), 72.0% of the men and 62.8% of the women held full-time tenured and tenure track positions as assistant, associate, or full professors, positions that are usually more conducive to research than other university positions. Also, 22.5% of these female doctorate holders were in nontenurable full-time positions (e.g., lecturer, instructor) compared with 17.9% of the men. Finally, 6.8% of the women and 5.9% of the men held adjunct positions as temporary faculty hired to teach one or more courses as need arises (6). In such teaching-intensive positions not in the tenure system, faculty members are evaluated primarily by the quality of their teaching and not by other contributions, such as research. With little reward for publication and little or no access to resources for producing research, these contingent faculty members usually drop out of publishing.

Given evidence that women are more likely than men to occupy teaching-intensive positions, why would the publication gap have increased over time? One consideration is the large increase over recent decades in the proportion of positions that are not in the tenure system. For example, among doctorate holders in science, engineering, and health employed in academia, the percentage in full-time positions not in the tenure system increased among men from 6.1% in 1973 to 17.9% in 2017 and slightly more among women: from 10.3% in 1973 to 22.5% in 2017 (5).

Although academic job titles signal faculty members' responsibilities, these titles provide only rough guidance concerning the type of work that they do in their jobs. Even tenured professors differ greatly in the allocation of their time to research, teaching, and administration. Moreover, research and publishing of course also occur outside of university settings. Therefore, it is informative to compare all female and male scientists over past years in terms of how they allocate their work time and effort. This comparison is allowed by data from the NSF Survey of Doctorate Recipients in science, engineering, and health pertaining to their primary work activities (Fig. 1). Among those reporting three activities—research and development, managing or supervising people, or teaching—as a primary work activity in 1997 or 2017, the percentages of women increased in all three areas as more women entered science careers. This increase was most notable in teaching, and in managing or supervising people (7).

Aside from women's engagement in teaching likely lessening their research productivity, women can disappear from publishing more often than men do if they reduce their efforts during crucial years of parenting, in some cases leaving tenured or tenurable positions for part-time positions or no employment at all. Given the pressures of research-intensive positions, childbearing considerations can lower women's (but rarely, men's) aspirations for these careers as well as their success in them when their children are young (8, 9). Nevertheless, some research has shown women in academic science moving up through the professor ranks at the same pace as men (10).

In terms of broader societal considerations, gender norms discouraging female agency may disadvantage women in gaining status in departmental and disciplinary networks, especially in male-dominated ones, and in garnering resources, such as internal and external funding and laboratory space (11, 12). Similar to other high-status, male-dominated occupations, such as lawyer and corporate executive, the stereotype of scientist conflicts with the female gender stereotype of relatively high communion and lower agency (13–15). To the extent that such cultural incongruities are present, they can contribute to prejudice against female scientists and discourage the aspirations that enable long-term scientific productivity. Yet, in the harsher environments that women faced in much earlier decades, the few women who then became productive research scientists no doubt had to be extremely tenacious, perhaps thereby producing their lesser dropout from publication than the women who followed them.

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Claims by sociologists about a stalling of progress toward gender equality place the findings of Huang et al. (1) in a larger societal context (16). Although occupational segregation of the US labor force declined considerably from 1970 to about 2000, the pace of integration has stalled at a quite high level of segregation (17). Moreover, the decline of overall segregation coincided with considerable resegregation internal to the once male-dominated occupations that women entered (18). For example, whereas women are now 40.0% of all managers, they are 74.7% of human resources managers and 71.4% of public relations and fundraising managers (19). Similarly, whereas women are 35.2% of active physicians, they are 63.3% of pediatricians and 57.0% of those in obstetrics and gynecology (20). Thus, in other male-dominated fields as in science, the women who enter have become partially segregated into specializations that offer greater congruence with social expectations for women. Teaching and to some extent, also administrative roles may provide these more female-friendly locations within science and technology.

Proponents of gender equality in science should look to the allocation of positions within universities and other research-producing organizations. There is in fact some evidence of the affirmative hiring of women faculty in science fields (21, 22). However, hiring is only a first step. Also crucial are the definitions of academic jobs in terms of teaching, research, and other obligations and the allocation of on-the-job activities among those scientists who hold the same positions. These considerations are more subtle than outright employment discrimination and are likely more important to contemporary women's publication careers. The gendered arrangements that can prevail are embedded in the social structures of organizations and in the ambitions and preferences of individual scientists. With these considerations of roles and role behaviors in mind, researchers should probe the causal pathways by which gender affects publication in ways that contribute to women's lesser scientific productivity.

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