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Scientific Eminence: Where Are the Women?

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Abstract

Women are sparsely represented among psychologists honored for scientific eminence. However, most currently eminent psychologists started their careers when far fewer women pursued training in psychological science. Now that women earn the majority of psychology Ph.D.'s, will they predominate in the next generation's cadre of eminent psychologists? Comparing currently active female and male psychology professors on publication metrics such as the *h* index provides clues for answering this question. Men outperform women on the *h* index and its two components: scientific productivity and citations of contributions. To interpret these gender gaps, we first evaluate whether publication metrics are affected by gender bias in obtaining grant support, publishing papers, or gaining citations of published papers. We also consider whether women's chances of attaining eminence are compromised by two intertwined sets of influences: (a) gender bias stemming from social norms pertaining to gender and to science and (b) the choices that individual psychologists make in pursuing their careers.

Keywords

scientific eminence, publication metrics, careers, gender bias

In hierarchies of power, prestige, and wealth, women typically become rarer at higher levels. However, women have made inroads over time into positions that were once predominantly male domains. Psychology provides an extreme example of such trends. For instance, in the United States, women earned only 18% of psychology Ph.D.'s in 1958 but 71% of them in 2014 (Burrelli, 2008; National Science Foundation, 2015). Nevertheless, men still predominate at the highest level of scientific eminence in psychology (Diener, Oishi, & Park, 2014). This phenomenon may be a vestige of the earlier era of female exclusion. However, women's scientific contributions in psychology even now may not be as numerous or influential as those of men, portending continuing female disadvantage in fame and eminence. In this article, we probe these questions.

What is the magnitude of the current eminence gender gap? The most recent ranking of psychologists took into account citation metrics, textbook page coverage, and major awards. The resulting list of the top 100 "extremely eminent psychologists" included 14 women (Diener et al., 2014). Earlier surveys yielded (a) 6 women among the 100 most eminent psychologists of the 20th century (Haggbloom et al., 2002); (b) 3 women among 69 eminent U.S. psychologists, 1879 to 1967 (Simonton, 1992); and (c) 0 women among the 103 most important psychologists, 1600–1966 (Annin, Boring, & Watson, 1968). Illustrating the profound scarcity of women deemed eminent even in the mid-20th century is a photo from the 1964 meeting of the Society of Experimental Psychologists, one of psychology's honorific organizations (see Fig. 1). Eleanor Gibson is prominent in a sea of dark-suited men.

Most currently eminent psychologists started their careers several decades ago when fewer women pursued psychology. Diener et al.'s (2014) list, for example, contains historical figures such as Edward Tolman, Jean Piaget, B. F. Skinner, and Gordon Allport. In fact, the Ph.D. years of these 100 psychologists range from 1915 to 1990, with a mean of 1957. Women's modest inroads into this list of eminent psychologists therefore deserve respect, given this long lag between obtaining a doctorate and attaining eminence as well as the formidable barriers that women once faced in pursuing scientific careers.

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Fig. 1. 1964 meeting of the Society of Experimental Social Psychologists in Berkeley, California. Reprinted by permission of the Society of Experimental Psychologists.

To understand whether this eminence gap is likely to disappear in future years, the rest of this article focuses on the status of women among contemporary psychological scientists.

Psychologists judge eminence by observing signs such as memberships in selective societies, career scientific achievement awards, and honorary degrees. These distinctions, in turn, are imperfect indicators of scientists' underlying accomplishments—namely, journal articles and books published and their impact on other scientists. Various metrics quantify scientists' publications and their impact (Ruscio, 2016, this issue).

In many scientific fields, including psychology, women on average have lower scores than men on such metrics, including the widely used *h* index, which defines *h* as the number of a researcher's publications that have been cited at least *h* times (Hirsch, 2005). For instance, in a random sample of 140 tenured associate and full professors from the top 100 U.S. psychology departments (Geraci, Balsis, & Busch, 2015), men scored higher than women on the *h* index ($d = 0.44$) even after statistically controlling for year of first publication ($d = 0.32$). Also, in a study of 611 core faculty from 97 U.S. and Canadian social psychology graduate programs (Nosek et al., 2010), men scored higher than women on a composite index of cumulative scientific impact ($d = 0.41$) and on a composite index of career-stage impact that controlled for men's longer average career span ($d = 0.25$).

An initial question about such findings is whether men exceed women on both the quantity and impact of their publications, which are the two underlying components of the *h* index. A second question is whether these metrics are tainted by unfair bias against women. A third question reaches beyond gender bias in metrics to identify potential sociocultural and individual causes of the eminence gap. In answering these questions, we favor the most recent, large-scale, and nationally representative data, as well as data specific to psychology, when available.

Quantity and Impact of Publications

On quantity, surveys of science publications show that in most fields, including psychology, women publish less than men (see review by Ceci, Ginther, Kahn, & Williams, 2014). Yet, because the gradual increase of women in psychology means that on average they have fewer years of scientific productivity than men, productivity statistics should be examined within ranks. Providing such a report, Ceci et al. (2014, Fig. 14) analyzed publication data from the U.S. National Science Foundation's nationally representative 2008 Survey of Doctorate Recipients (http://www.nsf.gov/statistics/nsf13302/). In psychology during the previous 5 years, female assistant professors published 34% fewer articles than male assistant professors, and female full professors published 27% fewer articles than male full professors—there was no difference between men and women among associate professors.

On impact, women's publications are cited less per article than men's, according to a study of 5.5 million articles published between 2008 and 2012 (Larivière, Ni, Gingras, Cronin, & Sugimoto, 2013). Before this massive

project, studies of citation gender gaps were more limited in scope and produced contradictory results (Ceci et al., 2014, p. 112). In contrast, Larivière et al.'s study was global and inclusive of all fields indexed by Thomas Reuters Web of Science. Averaging across fields, publications with a woman as a lead author received approximately 10% fewer citations than comparable publications for men. However, this gap was larger in psychology, based on our own subsequent analysis of this same dataset (for methodological details and data, see Open Science Framework: http://osf.io/gyw82). Specifically, women received roughly 20% fewer citations in psychology, and this gap varied some across subfields such as child development (13%), cognitive psychology (14%), educational psychology (29%), and social psychology (21%).

The gender gap on the *h* index and similar metrics therefore has two sources: In general, (a) women publish less than men, and (b) their articles receive fewer citations. These effects could result from gender biased metrics or other causes.

Gender Bias in Publication Metrics

The metrics that assess scientific eminence may be tainted by prejudicial bias against female scientists in obtaining grant support, publishing papers, or gaining citations of published papers. Gender bias, here defined as differently evaluating otherwise identical scientific documents based on author sex, may unfairly contribute to the gender gap in publication metrics. For instance, women would publish less than men if peer reviewers were biased against manuscripts with female authors. Any such reviewer biases should be diminished in recent decades given that most journals have implemented blind review. Nevertheless, some journals do not offer blind review, editors know authors' sex, and knowledgeable reviewers often can make good guesses about authors' identities.

Most observational studies have found little to no gender gap in funding agencies' evaluations of grant applications (e.g., see meta-analysis of international data by Marsh, Bornmann, Mutz, Daniel, & O'Mara, 2009; also United States Government Accountability Office, 2015), as reviewers of relevant research have also suggested for journals' acceptance of articles (e.g., Ceci et al., 2014; Lee, Sugimoto, Zhang, & Cronin, 2013). However, to rigorously test for gender biases, researchers need experiments that hold constant the content of the evaluated materials and assign participants randomly to male or female author conditions. Consistent with some bias, a meta-analysis of 123 such experiments that presented a variety of ability-relevant stimulus materials (e.g., students' essays, job applications) found a very small overall bias against women (*d*s = .05 to .08) that was larger in masculine or neutral than feminine contexts (*d*s = 0.10 to 0.25 in masculine contexts; Swim, Borgida, Maruyama, & Myers, 1989). However, the evaluated stimuli were not scientific articles; most participants were undergraduates, not expert raters; and the meta-analysis is more than 25 years old.

More relevant to potential gender bias in contemporary science are recent experiments that have come closer to simulating journal reviews. In an experiment in which 243 communication graduate students rated conference abstracts, bias favoring male authors was found, but only if the research topic was male-typed ($d = 0.25$; e.g., in politics; Knobloch-Westerwick, Glynn, & Huge, 2013). In two other experiments, each presenting a single article on a research topic that was presumably not male-typed, evaluations were unaffected by author sex: (a) Borsuk et al.'s (2009) experiment in which 854 undergraduates, 102 graduate students, and 33 postdocs in biology evaluated an article on zebra mussels, and (b) Handley, Brown, Moss-Racusin, and Smith's (2015) experiments in which 205 general-public participants and 205 university faculty members evaluated an abstract of an article reporting gender bias in science. Therefore, if female psychological scientists are disadvantaged in publishing their work, this bias may be confined to culturally masculine topics or male-dominated research areas. Such topics and areas are no doubt becoming rarer in psychology, given that women now receive the majority of U.S. doctorates in all subfields of psychology cataloged by the National Science Foundation (2015).

Authors' citations could be unfairly biased if a female author lowered chances of citation, holding content constant. Although experiments specifically pertaining to citations have not been conducted, observational research has examined rates of self-citation. Men's greater overall citations might thus reflect their higher rate of self-citation. In an analysis of 12.7 million articles in the Web of Science database that were published between 2008 and 2014, the average female first author self-cited 37% less often than the average male first author (Ghiasi, Larivière, & Sugimoto, 2016); this effect would in part reflect men's somewhat larger corpus of their own citable papers. Notably, psychology had a 44% gender gap on this index of self-citation, the highest among the disciplines, with the lowest gaps found in the male-dominated fields of physics and engineering.

In summary, the available evidence on prejudicial gender bias in journal publication and article citations is limited and presents considerable ambiguity, given that most studies were correlational rather than experimental. Moreover, very little is known about possible gender bias in awards for scientific eminence such as science prizes and honorary degrees, which are imperfect indicators of the importance of scientists' contributions (Simonton,

2016, this issue). In psychology, awards have gone more often to men than women but with an increasing representation of women (Eagly & Riger, 2014). In a study of U.S. awards in life science, mathematics, and physical science, women were underrepresented in awards for research excellence and overrepresented in awards for service and teaching, relative to women's representation in the applicant pools (Lincoln, Pincus, Koster, & Leboy, 2012). Further research should clarify the relations between gender, awards, and metrics of scientific eminence.

Beyond Possible Bias in Eminence Indicators

Female scientists' lesser rates of publication and citation no doubt reflect causes other than bias in the indicators of eminence. In particular, social scientists have long debated whether such sex differences follow from individualistic, meritocratic factors, which are often labeled as *choice*, as opposed to social and cultural influences, which are often labeled as *gender bias*. Transcending disagreements between the advocates of choice versus bias explanations of career gender gaps (e.g., Conner et al., 2014), we argue that these two sets of considerations are linked. Broader sociocultural factors shape individual identities and motivations. In particular, nature and nurture interactively influence role occupancies so that men and women are differently distributed into social roles. Gender roles, or stereotypes, arise because people infer group members' traits from observations of their behaviors in their typical occupational and family roles (Koenig & Eagly, 2014). These gender roles typically include expectations for women to excel in communal qualities of warmth and concern for others and for men to excel in agentic qualities of assertiveness and mastery. The social norms and personal identities that reflect gender roles enable the normative and self-regulatory processes that underlie phenomena such as conformity, stereotype threat, and backlash against female agency, which in turn can affect success as a scientist (Eagly & Wood, 2012; Wood & Eagly, 2012).

This perspective illuminates varied effects that may underlie the eminence gender gap. For instance, consistent with gender roles, women in the U.S. tend to be less single-mindedly devoted to their own professional advancement (e.g., Gino, Wilmuth, & Brooks, 2015). Women in academic careers also spend relatively less time than men on research and more on teaching and service (see review by Ceci et al., 2014), a pattern that to some extent mirrors their preferences (Winslow, 2010). Consistent with these trends, across U.S. academic fields, women are overrepresented in less research-intensive institutions of higher education and in more teaching-intensive ranks such as lecturer and instructor, as well as in contingent and part-time positions (American Association of University Professors, 2015; American Psychological Association, 2014). Also consistent with gender roles, the general public in the U.S. disapproves of demanding careers for mothers of young children (Parker, 2015). Given the rigors of academic careers in research-intensive institutions, child-bearing considerations can unsurprisingly lower women's (but not men's) aspirations for these careers as well as their success in them when their children are young (e.g., Ginther & Kahn, 2014; Mason, Wolfinger, & Goulden, 2013). Nevertheless, findings reported by Ceci et al. (2014, pp. 109–110) for psychology suggest that female assistant professors publish less than male assistant professors, regardless of childbearing. In addition, gender norms discouraging female agency may disadvantage women in gaining status in departmental and disciplinary networks, especially male-dominated ones (e.g., Fox, 2010), and in garnering resources such as internal and external funding and laboratory space (e.g., Duch et al., 2012). All of these factors could influence women's scientific productivity.

A related matter is that the cultural context of science is not gender-neutral. Instead, people associate science more with men than women (Miller, Eagly, & Linn, 2015; Smyth & Nosek, 2015). Also tempering women's aspiration may be cultural beliefs that scientific eminence requires intellectual brilliance, which is accorded more to men than women (e.g., Meyer, Cimpian, & Leslie, 2015). Such stereotypes may erode women's confidence in their ability to become highly successful scientists.

The Future of the Eminence Gap

The eminence gender gap in psychology and other sciences will likely shrink further over time as new cohorts of scientists advance in their careers. One consideration is that women's representation among Ph.D. earners has increased dramatically over the recent decades. Moreover, observational data from actual hiring at 89 U.S. research-intensive institutions for recent cohorts has shown that in the sciences in general, women who apply for positions have a better chance of being interviewed and receiving offers than do male job candidates (National Research Council, 2010)—a finding that is also suggested by recent experimental simulations of hiring (Williams & Ceci, 2015). Furthermore, after securing a tenure-track position, female and male psychologists in recent U.S. cohorts have progressed at similar rates from assistant to associate to full professor, according to nationally representative data (Box-Steffensmeier et al., 2015; Ginther & Kahn, 2014). The resulting shifts of women into science would likely encourage young women's interest in science careers (Stout, Dasgupta, Hunsinger, & McManus, 2011) and would have even broader impact by instilling

the female stereotype with greater scientific and quantitative competence and by endowing the cultural representation of science with greater androgyny (Koenig & Eagly, 2014; Miller et al., 2015). Despite these ongoing changes, publication and impact gaps have not yet disappeared, suggesting that gender equality in scientific eminence will not be attained soon.

Finally, we advise those women who aspire to scientific eminence to take our article's information about gender gaps as a cautionary tale. They should proceed with awareness of the various ways in which their progress toward this goal may potentially be compromised more than that of their male colleagues. Women who seek to excel as psychological scientists should vigorously pursue the options that are available in their environments such as submitting papers and grant applications, asking for resources, collaborating with talented colleagues, avoiding excessive teaching and service assignments, and freely citing their own work.

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