Bias in Science:
From Maria Goepper Mayer to today
and what research suggests can be done.

Sharon Bertsch McGrayne

June 28, 2017


Emilio
Segrè
Visual
Archives

Status of Women Microbiologists

A study of microbiologists based on objective and subjective criteria is presented.

Eva Ruth Kashket, Mary Louise Robbins, Loretta Leive, and Alice S. Huang

The women's rights movement in American society has manifested itself in the raised aspirations of women in most academic and professional fields. For this reason, a study of women microbiologists was made by some members of the American Society for Microbiology (ASM) under the auspices of that society's Committee on the Status of Women Microbiologists. A questionnaire was designed in order, first, to determine the present status of women in the profession and, second, to inquire into the possible reasons for that status. Reported here are some of the most interesting results obtained from that questionnaire, which was distributed to the registrants at the 1971 annual meeting of the ASM (*1*). Also included are data on salaries obtained from the total membership of the society (*2*).

The ASM is a suitable organization for such an inquiry because it is a large professional society encompassing academic, governmental, clinical, and industrial employees. The ASM has an open membership and requires of its members a bachelor's degree in microbiology or a related field or equivalent training and experience. The proportion of women in the society is relatively high, and, therefore, a valid comparison can be made between women microbiologists and their male counterparts.

In this article, we present evidence that the status of women microbiologists is lower than that of men and that the lower status of the women results, to a large degree, from inequality of opportunity throughout their careers. We believe that these findings would also apply to women in other professions (*3*).

Composition of the Sample

The overall educational profile of the respondents to the questionnaire was fairly representative of the ASM membership (Table 1). Women accounted for 29 percent of the respondents, compared to 23 percent of the total membership. In the society, proportionately fewer women than men hold doctoral degrees; women account for 16 percent of the persons with doctorates. Among the respondents, there was a slight overrepresentation of Ph.D.'s, which probably indicates that persons with the higher degree were more likely to attend meetings.

Because marriage and children are considered dominant factors in the career patterns of women, the answers given by the respondents were analyzed not only by sex, but also by marital status (*1*). Women differed significantly from men in marital status: only 44 percent of the women were married, while 90 percent of the men were married. Abut half of the women with doctorates were married, and the same was true for those without the advanced degree. Of the women who were married or who had been married prior to the study, 54 percent had no children, while only 12 percent of the men in a comparable group had no children.

Job Performance

Because there was such a difference between the family responsibilities of the sexes, it was interesting to determine the amount of time that each group spent at work. The respondents were asked to give the total number of hours they work each week, including work at home or in the library and time spent at meetings. Among the full-time employees (more than 95 percent of the respondents in any group, excluding students), there was no differ-

Dr. Kashket is principal associate in the department of physiology, Harvard Medical School, Boston, Massachusetts 02115. Dr. Robbins is professor of microbiology at the George Washington University Medical Center, Washington, D.C. 20005. Dr. Leive is a research biologist at the Laboratory of Biochemical Pharmacology, National Institute of Arthritis, Metabolic, and Digestive Diseases, National Institutes of Health, Bethesda, Maryland 20014. Dr. Huang is associate professor of microbiology and molecular genetics at Harvard Medical School.

WOMEN PRESIDENTS OF THE AMERICAN SOCIETY FOR MICROBIOLOGY AFTER 1985.

1985	Rita Rossi Colwell
1986	Moselio Schaechter
1987	Jean E. Brenchley
1988	Barbara H. Iglewski
1989	Alice S. Huang
1990	Walter R. Dowdle
1991	Joan W. Bennett
1992	Richard L. Crowell
1993	John Ingraham
1994	Gail Cassell
1995	David Schlessinger
1996	Carol A. Nacy

\

Journal of Personality and Social Psychology
2002, Vol. 83, No. 1, 44–59

0022-3514/02/$5.00 DOI: 10.1037//0022-3514.83.1.44

Math = Male, Me = Female, Therefore Math ≠ Me

Brian A. Nosek and Mahzarin R. Banaji
Yale University

Anthony G. Greenwald
University of Washington

College students, especially women, demonstrated negativity toward math and science relative to arts and language on implicit measures. Group membership (being female), group identity (self = female), and gender stereotypes (math = male) were related to attitudes and identification with mathematics. Stronger implicit math = male stereotypes corresponded with more negative implicit and explicit math attitudes for women but more positive attitudes for men. Associating the self with female and math with male made it difficult for women, even women who had selected math-intensive majors, to associate math with the self. These results point to the opportunities and constraints on personal preferences that derive from membership in social groups.

When the *New York Times* interviewed the three living female descendants of Elizabeth Cady Stanton, the focus was not on the indisputable mark she had left on American society but rather the effect she had had on her own family (Bumiller, 1998). The accomplishments of this housewife who organized the historic 1848 Seneca Falls convention to demand the right of women to vote were visible even in the careers of her own daughters and their daughters. The youngest of the women interviewed, also named Elizabeth and 13 years old at the time, said that she would like to be an engineer or an architect, following in the footsteps of her grandmother and great-grandmother. Although she showed cognizance of the hurdles that stood in the way of her ancestor's battle for a simple equality, she was optimistic about the present, remarking that now "anything's possible for anyone" (p. B6).

The idea that anything ought to be possible for anyone is the foundation of many proclamations of equality, such as the constitutions of nations and their legal codes. Yet, as even a superficial historical glance reveals, demarcations of humans into social groups and their unequal access to resources have been the primary impetus for theory and action to achieve social justice. As psychologists, we are interested in the mechanisms by which aspira-

such processes can be subversive—they appear to reflect a free and individually determined choice when in fact they reflect group membership, the strength of identity with the group, and beliefs about the capability of the group.

In this article, we focus on the fundamental dichotomy of gender as we investigate preferences for mathematics (and science) versus the arts (and language). The covariation between gender and orientation toward math and science is well known: Men are assumed to be and demonstrated to be more inclined to participate and excel in math and science, at least as compared with women (National Science Foundation [NSF], 1996). If membership in the groups *male* or *female* is associated with differing preferences and choices, no legal remedy to address such disparities is even at issue—an individual, it appears, freely chooses to participate in a system of self-imposed social segregation on the basis of a personal preference.

The appearance of free choice, however, does not preclude the possibility that group membership and group expectancies have a subtle relationship with personal preference and choice. Thoughts and feelings that occur outside conscious awareness or control may

Malcolm Gladwell: BLINK: The Power of Thinking Without Thinking.

https://implicit.harvard.edu/implicit/takeatest.html

IAT: https://implicit.harvard.edu/implicit/takeatest.html

Science faculty's subtle gender biases favor male students

Corinne A. Moss-Racusin[a,b], John F. Dovidio[b], Victoria L. Brescoll[c], Mark J. Graham[a,d], and Jo Handelsman[a,1]

[a]Department of Molecular, Cellular and Developmental Biology, [b]Department of Psychology, [c]School of Management, and [d]Department of Psychiatry, Yale University, New Haven, CT 06520

Edited* by Shirley Tilghman, Princeton University, Princeton, NJ, and approved August 21, 2012 (received for review July 2, 2012)

Despite efforts to recruit and retain more women, a stark gender disparity persists within academic science. Abundant research has demonstrated gender bias in many demographic groups, but has yet to experimentally investigate whether science faculty exhibit a bias against female students that could contribute to the gender disparity in academic science. In a randomized double-blind study (n = 127), science faculty from research-intensive universities rated the application materials of a student—who was randomly assigned either a male or female name—for a laboratory manager position. Faculty participants rated the male applicant as significantly more competent and hireable than the (identical) female applicant. These participants also selected a higher starting salary and offered more career mentoring to the male applicant. The gender of the faculty participants did not affect responses, such that female and male faculty were equally likely to exhibit bias against the female student. Mediation analyses indicated that the female student was less likely to be hired because she was viewed as less competent. We also assessed faculty participants' preexisting subtle bias against women using a standard instrument and found that preexisting subtle bias against women played a moderating role, such that subtle bias against women was associated with less support for the female student, but was unrelated to reactions to the male student. These results suggest that interventions addressing faculty gender bias might advance the goal of increasing the participation of women in science.

diversity | lifestyle choices | science education | science workforce

A 2012 report from the President's Council of Advisors on Science and Technology indicates that training scientists and engineers at current rates will result in a deficit of 1,000,000 workers to meet United States workforce demands over the next decade (1). To help close this formidable gap, the report calls for the increased training and retention of women, who are starkly underrepresented within many fields of science, especially among the professoriate (2–4). Although the proportion of science degrees granted to women has increased (5), there is a persistent disparity between the number of women receiving PhDs and those hired as junior faculty (1–4). This gap suggests that the problem will not resolve itself solely by more generations of women moving through the academic pipeline but that instead, women's advancement within academic science may be actively impeded.

With evidence suggesting that biological sex differences in inherent aptitude for math and science are small or nonexistent (6–8), the efforts of many researchers and academic leaders to identify causes of the science gender disparity have focused instead on the life choices that may compete with women's pursuit of the most demanding positions. Some research suggests that these lifestyle choices (whether free or constrained) likely contribute to the gender imbalance (9–11), but because the majority of these studies are correlational, whether lifestyle factors are solely or primarily responsible remains unclear. Still, some researchers have argued that women's preference for nonscience disciplines and their tendency to take on a disproportionate amount of child- and family-care are the primary causes of the gender disparity in science (9–11), and that it "is not caused by discrimination in these domains" (10). This assertion has received substantial attention and generated significant debate among the scientific community, leading some to conclude that gender discrimination indeed does not exist nor contribute to the gender disparity within academic science (e.g., refs. 12 and 13).

Despite this controversy, experimental research testing for the presence and magnitude of gender discrimination in the biological and physical sciences has yet to be conducted. Although acknowledging that various lifestyle choices likely contribute to the gender imbalance in science (9–11), the present research is unique in investigating whether faculty gender bias exists within academic biological and physical sciences, and whether it might exert an independent effect on the gender disparity as students progress through the pipeline to careers in science. Specifically, the present experiment examined whether, given an equally qualified male and female student, science faculty members would show preferential evaluation and treatment of the male student to work in their laboratory. Although the correlational and related laboratory studies discussed below suggest that such bias is likely (contrary to previous arguments) (9–11), we know of no previous experiments that have tested for faculty bias against female students within academic science.

If faculty express gender biases, we are not suggesting that these biases are intentional or stem from a conscious desire to impede the progress of women in science. Past studies indicate that people's behavior is shaped by implicit or unintended biases, stemming from repeated exposure to pervasive cultural stereotypes (14) that portray women as less competent but simultaneously emphasize their warmth and likeability compared with men (15). Despite significant decreases in overt sexism over the last few decades (particularly among highly educated people) (16), these subtle gender biases are often still held by even the most egalitarian individuals (17), and are exhibited by both men and women (18). Given this body of work, we expected that female faculty would be just as likely as male faculty to express an unintended bias against female undergraduate science students. The fact that these prevalent biases often remain undetected highlights the need for an experimental investigation to determine whether they may be present within academic science and, if so, raise awareness of their potential impact.

Whether these gender biases operate in academic sciences remains an open question. On the one hand, although considerable research demonstrates gender bias in a variety of other domains (19–23), science faculty members may not exhibit this

Author contributions: C.A.M.-R., J.F.D., V.L.B., M.J.G., and J.H. designed research; C.A.M.-R. performed research; C.A.M.-R. analyzed data; and C.A.M.-R., J.F.D., V.L.B., M.J.G., and J.H. wrote the paper.

The authors declare no conflict of interest.

*This Direct Submission article had a prearranged editor.

Freely available online through the PNAS open access option.

[1]To whom correspondence should be addressed. E-mail: jo.handelsman@yale.edu.

This article contains supporting information online at www.pnas.org/lookup/suppl/doi:10.1073/pnas.1211286109/-/DCSupplemental.

PNAS 111 10107 (2014)

Elite male faculty in the life sciences employ fewer women

Jason M. Sheltzer[a,1] and Joan C. Smith[b]

[a]David H. Koch Institute for Integrative Cancer Research, Massachusetts Institute of Technology, Cambridge, MA 02139; and [b]Twitter, Inc., Cambridge, MA 02139

Edited* by Shirley Tilghman, Princeton University, Princeton, NJ, and approved June 5, 2014 (received for review March 25, 2014)

Women make up over one-half of all doctoral recipients in biology-related fields but are vastly underrepresented at the faculty level in the life sciences. To explore the current causes of women's underrepresentation in biology, we collected publicly accessible data from university directories and faculty websites about the composition of biology laboratories at leading academic institutions in the United States. We found that male faculty members tended to employ fewer female graduate students and postdoctoral researchers (postdocs) than female faculty members did. Furthermore, elite male faculty—those whose research was funded by the Howard Hughes Medical Institute, who had been elected to the National Academy of Sciences, or who had won a major career award—trained significantly fewer women than other male faculty members. In contrast, elite female faculty did not exhibit a gender bias in employment patterns. New assistant professors at the institutions that we surveyed were largely comprised of postdoctoral researchers from these prominent laboratories, and correspondingly, the laboratories that produced assistant professors had an overabundance of male postdocs. Thus, one cause of the leaky pipeline in biomedical research may be the exclusion of women, or their self-selected absence, from certain high-achieving laboratories.

women in STEM | gender diversity

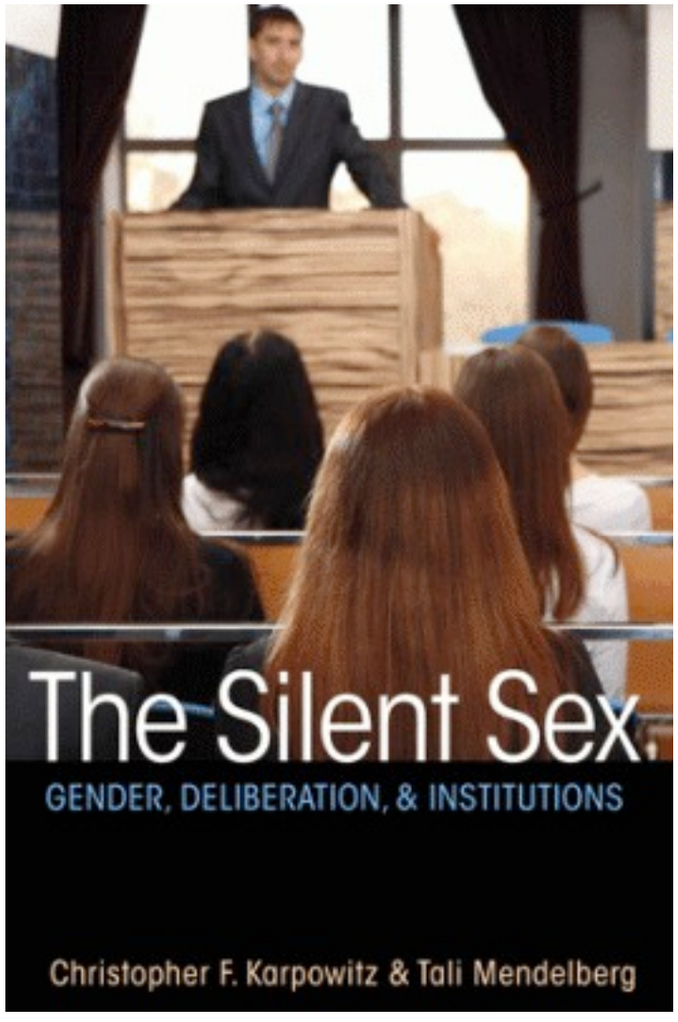
Between 1969 and 2009, the percentage of doctorates awarded to women in the life sciences increased from 15% to 52% (1, 2). Despite the vast gains at the doctoral level, women still lag behind in faculty appointments. Currently, only 36% of assistant professors and 18% of full professors in biology-related fields are women (3). The attrition of women from academic careers—known as the leaky pipeline problem (4)—undermines the meritocratic ideals of science and represents a significant underuse of the skills that are present in the pool of doctoral trainees.

A variety of factors has been suggested to influence the leaky pipeline in science, technology, engineering, and math (STEM) fields. For instance, scientists with children are more likely to be hired for tenure-track jobs than male scientists without children (13). Thus, a complex mixture of both free and constrained personal choices may contribute to the leaky pipeline in STEM fields.

In addition to the impact of gendered preference differences, the scarcity of female faculty may be, in part, because of persistent discrimination against women in science. Unlike systems of *de jure* discrimination, which were common until the middle of the 20th century and often explicitly excluded women from certain career paths, discrimination in the present day more often results from de facto differences in the treatment of men and women. Such behavior is linked to the problem of cumulative (dis)advantages: small differences in access to scientific goods (i.e., resources, mentoring, public visibility, etc.) may spiral over time, leading to significant divergence in achievement over the course of a career (14). These biases have been documented in both correlational and experimental studies of academic science. For instance, Moss-Racusin et al. (15) sent science faculty identical resumes for a laboratory manager position in which only the name and gender of the applicant were changed. The applicant with the male name was judged to be more competent and hirable and offered a larger starting salary than the female applicant.

How these gender biases affect the advancement of women in science is poorly understood. Moreover, in a field like biology—where women are well-represented at the doctoral and postdoctoral levels—it may be easy to assume that issues of gender are unimportant at early career stages. However, not all doctoral and postdoctoral positions are equivalent: vast interlaboratory differences exist in terms of reputation, mentoring, access to funding and equipment, networking possibilities, and more. Scientists who receive their training in particular laboratories may be at a disadvantage when applying for grants or faculty positions if their

Significance



Karpowitz and Mendelberg

mbio.asm.org

doi: 10.1128/mBio.00846-13
7 January 2014 mBio vol. 5 no. 1 e00846-13

The Presence of Female Conveners Correlates with a Higher Proportion of Female Speakers at Scientific Symposia

Arturo Casadevall[a], Jo Handelsman[b]

+ Author Affiliations

Address correspondence to Arturo Casadevall, arturo.casadevall@einstein.yu.edu.

Editor Jeff Miller, UCLA School of Medicine

ABSTRACT

We investigated the hypothesis that the gender of conveners at scientific meetings influenced the gender distribution of invited speakers. Analysis of 460 symposia involving 1,845 speakers in two large meetings sponsored by the American Society for Microbiology revealed that having at least one woman member of the convening team correlated with a significantly higher proportion of invited female speakers and reduced the likelihood of an all-male symposium roster. Our results suggest that inclusion of more women as conveners may increase the proportion of women among invited speakers at scientific meetings.

IMPORTANCE The proportion of women entering scientific careers has increased substantially, but women remain underrepresented in academic ranks. Participation in meetings as a speaker is a factor of great importance for academic advancement. We found that having a woman as a convener greatly increased women's participation in symposia, suggesting that one mechanism for achieving gender balance at scientific meetings is to involve more women as conveners.

OBSERVATION

In recent decades, the proportion of women entering scientific careers has increased substantially, but women remain underrepresented in academic ranks. A major problem contributing to the latter is the "leaky pipeline," whereby women

Research **Institute**

Thought leadership from Credit Suisse Research and the world's foremost experts

Gender diversity and corporate performance