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Who Resembles a Scientific Leader – Jack or Jill? How Implicit Bias Could Influence Research Grant Funding

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When women advance in medicine, so does women's health. In cardiology, women have led major research studies examining and confirming sex and gender differences in cardiovascular disease risk factors, manifestations, and outcomes; providing essential data for evidence-based approaches to women's heart health. The inclusion of women in cardiovascular research studies paralleled the entry of women physicians into cardiology. When women were absent as principal investigators, women were also missing from the tens of thousands of participants in the early cardiovascular prevention trials including the Coronary Drug Project, Physicians Health Study, Lipid Research Clinics Coronary Primary Prevention Trial, and Multiple Risk Factors Intervention Trial (so called "mister fit").

Given the association between women entering cardiology and research in women's heart health, it is worrisome that women comprise < 20% of cardiologists (lowest among internal medicine subspecialties).[1] Furthermore, while women cardiologists are more likely than their male peers to practice in academic settings where most research is conducted (43% vs. 34%), they are less likely in these settings to be involved in research[2] or achieve the rank of full professor[1] and more likely to report lower levels of career attainment.[2] Since conducting research as an independent investigator is critical for academic career advancement[3]—and holding NIH grants is associated with the rank of full professor[1]—it is important to examine NIH research award success by gender, particularly R01 awards: the "gold standard" of independence. With some exceptions, studies find no difference in overall award rates for men and women applying for NIH R01 (or R01 equivalent) awards (Supplemental Table 1). However, studies that examine new (Type 1) and renewal (Type 2) awards separately, consistently find women to have lower Type 2 success rates. Data from NIH confirm

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equivalent success rates for men and women applying for Type1s, but higher success rates for men's Type 2 awards by ~4% for nearly 20 years.

Blumenthal and colleagues[1] found women cardiologists are less likely to hold the rank of full professor than their male counterparts. In their data, men and women cardiology faculty were equally likely to hold an NIH grant overall, but women held significantly fewer NIH grants between the associate and full professor ranks. This is exactly where the consequences of the gender differences in R01 renewals would manifest, because failing to renew an R01 could prevent women cardiologists from advancing to full professor. Specifically, if women and men cardiology faculty are equally likely to obtain a Type 1 R01 and launch an independent research program, they are equally likely to advance from assistant to associate professor. If women are subsequently less likely than their male peers to maintain their research program by renewing their R01s as Type 2s, women will be less likely to advance to full professor. The negative impact of this gender gap in NIH Type 2 renewals is twofold: A talented group of women cardiologists are blocked from attaining sequential leadership roles as division head, chair, or dean − robbing cardiology and all of academic medicine of their vital perspectives; and the pool of investigators most likely to lead research on cardiovascular disease in women is diminished.

The reason women are less successful than men in renewing their R01 awards is unknown. It is possible women more than men investigate areas of lower funding priority or that women conduct lower-quality research. However, irrefutable evidence demonstrates that the mere existence of gender stereotypes can unintentionally and unwittingly invoke implicitly different referent standards when judging the identical performance of a man or woman. Women are most disadvantaged by such "implicit bias" when being evaluated in roles that are more strongly associated with men than women.[4] Implicit Association Tests confirm that both science and leadership are more strongly associated with male-gendered than female-gendered names.[4] If implicit gender bias were to influence scientific peer review of R01s, it would most likely occur in review of Type 2s, because successful applicants must be considered scientific leaders. Reviewers would implicitly invoke different referent standards for men and women in the evaluation of their performance as *both* a scientist and as leader, doubly disadvantaging women.

Our research group has begun to examine R01 reviewers' written critiques as a window into their decision-making processes. We have found evidence that implicit gender bias could be operating in the review of Type 2 R01s in two studies evaluating samples of critiques from investigators at the University of Wisconsin. We found that given the same priority score, critiques for applications from women contained significantly more words of praise while those from men contained more negative evaluation words. In a second sample, we found no difference in scoring or descriptors in critiques of men's and women's Type 1 applications. However, women's Type 2 applications had significantly worse priority scores than men's—even though more critiques of women's applications had standout adjectives (e.g., *excellent*, *outstanding*) and words about their ability. These studies are consistent with the implicit application of different referent standards when evaluating R01 renewals, depending on the applicant's gender. However, experimental studies are needed to confirm whether implicit gender bias contributes to observed disparities in Type 2 funding. In the meantime, avoiding

semantic priming of male gendered stereotypes is one practice that appears to reduce implicit bias. When NIH replaced male gendered semantic primes (e.g., *high risk; technological breakthroughs*) in the solicitation and review instructions for the NIH Director's Pioneer Award, women recipients increased from zero in 2004 to an average of ~30% in the ensuing 12 years.

Fortunately, NIH is currently undertaking a large experimental study to explore whether implicit bias enters the peer review process, and our team at the University of Wisconsin is concurrently conducting an experimental study assessing the effect of manipulating demographics of R01 applicants on the same applications. These are challenging undertakings given the amount of randomness and subjectivity involved scientific peer review[5]. However, if implicit bias is found to be influencing Type 2 award success rates, then interventions can be developed, tested, and implemented.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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