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Gender Equity in Science: Still an Elusive Goal

*A variety of
subtle barriers
are impeding
women's careers;
more help
is needed.*

Women in science have gained a lot of ground in recent years. Once reserved primarily for men, tenured faculty positions, corporate research jobs, and government posts are being filled by more and more women. But there

is still a tough row to hoe. Although stiff social and legal pressures now make blatant discrimination less likely than in the past, subtle barriers and biases are far from removed. These small, incremental obstacles are compounded over time, resulting in significant disparities in the career advancement of women and men.

A study undertaken in the late 1980s and early 1990s by myself and Gerald Holton at Harvard University lays plain these obstacles. Results from the study also indicate how the barriers might be overcome, as well as the strong need for better local policies—at the university, corporate, and government

agency levels—before women have a truly equal chance for advancement in scientific fields. Expanded efforts by key national organizations such as the National Science Foundation (NSF), the American Association for the Ad-

vancement for Science (AAAS), and others are needed as well. Although outright discrimination must still be met with swift action, it is time to focus on the web of hidden processes that significantly thwart the careers of many women.

Most national studies and programs addressing inequality have focused on high school and college education and on early career opportunities; relatively little attention has been paid to gender disparities in the later stages of science careers. This neglect is a major reason why our study, called Project Access, examined the career progress of an elite group of men and women who had received prestigious post-doctoral fellowships in the sciences. The study was based on 699 questionnaires and 200 face-to-face interviews. The participating men and women worked mainly in academic and nonacademic research settings; a small group had left research science.

Because our participants had all begun from roughly the same starting line, we could track the de-

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velopment of gender disparities in later career stages. The main question was: Had the women, as a group, passed a threshold beyond which gender no longer mattered in determining career outcomes, or did they hit a "glass ceiling"?

We first examined whether or not gender disparities existed in the career success of our group. The clearest evidence came from the academic community, where advancement is easier to measure than in industry or government. Although 41 percent of the men held the rank of full professor, only 23 percent of the women did, even though the average professional age was similar. The men produced an average of 2.8 publications per year, whereas the women produced 2.3.

Interestingly, there were very significant differences between scientific disciplines. Women biologists in our group did about as well as their male counterparts. But glass ceilings were found in the other sciences. Among the younger women in the physical sciences, mathematics, and engineering, for example, the average academic status was almost one full rank below the men's. A partial explanation may be that women have achieved a "critical mass" in biology, where they make up a higher percentage of the population than in physics or chemistry. In addition, the attitudes and behaviors of female and male biologists may have created an atmosphere that is more hospitable to women, thus shrinking the gender gap.

Nonetheless, gender discrimination appears far from eradicated; 73 percent of the women we interviewed told us about career experiences that they regarded as discriminatory. A few women reported flagrant cases, such as the denial of jobs and tenure, even though the women considered themselves well-qualified. More frequently, however, we heard about more subtle obstacles. These barriers appeared to accumulate over time to create a significant disadvantage—a phenomenon first observed by Robert K. Merton and Harriet ^{Buchman} several decades ago.

To give an example of a subtle obstacle, many women found themselves feeling somewhat left out, standing on the fringes of their own academic or corporate groups. Colleagues, co-workers, and superiors didn't talk to them as much or consult them as often for input. This subdued but noticeable marginalization in the social system of science made it harder

for the women to achieve visibility. One woman in academic science observed: "There's always a sense, especially in a group that does not include many women, that you're not one of the guys, and that works against you, and that is impossible to fight." Another woman at a nonacademic research institute said that colleagues viewed her work with suspicion: "They don't believe your findings or your data, or they don't believe you are a serious scientist."

These processes of marginalization may have important ramifications for a scientific career. One woman who eventually gave up a research career said: "Certain things were clearly closed to me. There were little social hours and stuff that involved male camaraderie that I really didn't feel like busting in on. But I knew that those were the places where hiring decisions got worked on."

Moreover, women had a less collaborative working style than men did during and after the postdoctoral fellowship, even though their working style was more collaborative before the fellowship. In addition, the nature of collaboration itself may differ by gender. Although a highly collaborative research style during the postdoctoral fellowship correlated with positive career outcomes for men, it correlated with negative career outcomes for women. This discrepancy may indicate that the women postdoctoral fellows were more likely than men to occupy an ancillary position in the collaboration. More women than men in our study complained that their postdoctoral advisors treated them as subordinates. Such forms of collaboration at early career stages may in some cases even constitute a surprising "collaboration trap" for women.

The men and women we interviewed also reported gender differences in scientific styles: Women's professional conduct was often perceived as less careerist and self-promoting than men's. Furthermore, numerous participants said that women tended to follow a niche approach to problem selection, creating their own area of expertise rather than competing with other researchers in a race to the solution of a "hot" problem.

In terms of methodology, many women reported that they were extra careful, to the point of perfectionism. The responses also indicated that women have a propensity for doing comprehensive and synthetic work. A combination of these tendencies to-

ward thoroughness and comprehensiveness may contribute to the gender gap in publication productivity. A small side study of ours showed that among academic biologists, women received more citations per article published than men did—a gender difference that was also found by other researchers. This appears to back up what several of our participants perceived as a “less quantity/more quality” approach among women scientists. We also found that women held slightly different views of what constituted “good science.” For instance, 36 percent of the women interviewed, but only 20 percent of the men, mentioned that good scientific work had to be thorough or comprehensive. By contrast, men were more likely than women to refer to creativity or originality as characteristics of good scientific work (43 percent vs. 30 percent). This is an intriguing area that calls out for more research.

Interesting in their own right, these findings also appear to be at the heart of the disparities in career advancement. In academia, scientists are conventionally judged by volume; the sheer number of papers they have published or grant money they have attracted weighs heavily in the decision to award them tenure or better positions. Although these ways of determining scientific performance are clearly problematic, judgments of a scientist's performance are even more intractable in industry and other nonacademic sectors.

Differences in personal traits may also contribute to a disparity in career outcomes. Even our group of women—who as doctoral-level scientists and recipients of prestigious fellowships hardly conformed to the stereotype of the shy, nurturing homemaker—had a slightly but noticeably lower estimation of self-confidence, ambition, and related traits than the men did. One of the most successful academic women scientists we interviewed recounted that she had to fight tough inner battles at the early stages of her career to overcome profound self-doubts. She noted: “The barriers to me were all internal, my sense of not belonging, my sense of anxiety at failure.”

Slowing down the tenure track by one year or a semester could help alleviate family-related burdens.

The issue of family is another prime example of how obstacles have become more subtle. For our respondents, current marital and parental status were unrelated to basic career outcomes for men and women. However, we did not conclude that family priorities were unrelated to the career success of women. Rather, we discovered that the interactions between family and science career have become too complex and idiosyncratic to be captured by the broad variables

used by us—and most other researchers to date. For example, the people who said that they accepted their postdoctoral fellowship in order to be in the same location as their spouse had less successful careers in academic science later on, compared with those who did not have this motive. And more women than men gave this reason.

The very notion of a glass ceiling may be misleading. The popular metaphor implies a well-defined (albeit invisible) barrier that either repels the unfortunate or is shattered by the fortunate. But small incremental obstacles that slow down careers appear to be much more prominent than clearcut barriers.

Explaining the disparities

Why do gender disparities among scientists persist? In the research literature, there are two basic explanations that we call the “deficit model” and the “difference model.”

The deficit model concerns formal and informal exclusions of women scientists from resources. It emphasizes structural obstacles—legal, political, and social—that exist (or existed earlier) within the social system of science. These may be blatant or subtle. Although some past atrocities, such as the practice of not allowing women to attend certain institutions of higher learning, have been eliminated, some social and cultural barriers still face women in science.

The difference model, by contrast, emphasizes deep-rooted differences in the outlook and goals of women and men, be they innate or the result of socialization and cultural values. These differences are said to make women less likely to aspire to science careers and less likely to achieve success in them.

Widely discussed in the psychological literature, these gender differences include women's lower levels of career orientation, ambition, and aggressiveness.

A key point to realize is that the deficit and difference models are not mutually exclusive. On the contrary, small structural propensities and small individual propensities compound to strongly influence women's career paths. The kick/reaction model, developed by Jonathan Cole and Burton Singer, describes how: Progress in a science career can be viewed as a series of positive or negative "kicks" from the environment and the individual's reactions to those kicks. Careers are thus shaped by a multitude of reinforcing kicks and reactions.

Understanding how gender disparity in science careers occurs is important, but the situation will not change unless society finds a reason to change it. In the past, a human resource argument was forceful: It was in the nation's best interest to fully tap the pool of talent, to secure preeminence in military and commercial science and technology. For a while, the projection of a serious shortfall in U.S. scientific personnel focused attention on women as an underutilized resource. However, because recent projections have hinted at an oversupply of scientists, support for women's advancement must come from elsewhere.

A second well-known argument is the equity argument, which asserts the right of all citizens to fulfill their potential unhampered by discrimination. The moral force of this argument is compelling, regardless of temporary fluctuations in the labor market. But is society willing to make the policy decisions necessary to move toward the goal of gender equality?

There is also a practical reason to bolster the number of women at all levels of science: It ensures attention to traditionally neglected yet important areas of research. For example, women's health studies, lacking for decades, have improved dramatically in recent years, apparently because there are more women working in the health sciences.

Policies to aid scientists

Legal safeguards to level the playing field for women, although still needed, are of little use in combating the increasingly important subtle social processes of marginalization. What kinds of policies, added to those we have now, promise success in further nar-

rowing the gender gap in science? Although the scope of our research does not allow me to address the complete spectrum of possible policies supporting women scientists' careers, the following policy suggestions emerged from our work.

First of all, students and beginning scientists need to be more aware of the social factors that determine scientific career outcomes. We must end the widespread naiveté among young scientists. Almost all the people we talked with simply loved what they were doing. Clearly, they would much rather think about science than strategize about their careers. However, this leads them to presume that, if their scientific endeavors work out, their career advancement will automatically follow. This view was particularly prevalent among our female respondents. At a minimum, universities should offer real-world career counseling. They should also include courses that offer some eye-opening advice on how careers work.

Both young scientists and prospective employers would benefit even further if national organizations such as NSF, AAAS, the National Research Council, and the Association for Women in Science offered more conferences, seminars, and workshops on explicit strategies that lead to successful science careers. Such meetings would be useful to many men scientists as well.

It's also essential to raise men's awareness of gender issues. Although one may suppose most male scientists today would not deliberately discriminate against women, there are many well-intentioned men who have little grasp of the more hidden and complex issues. For instance, if more men who mentor women students and scientists realized the possibility of subtle effects (such as the trap of early collaborations that do not serve women's long-term careers), the preparation of women scientists would improve.

As we noted, a crucial problem for many women was subtle exclusion from collegial networks and less visibility in their professions. Therefore, more programs that focus attention and create opportunities in later career stages for promising women, such as the NSF Visiting Professorships for Women and the NSF Faculty Awards for Women, should be encouraged. In addition to benefiting the recipients, such programs would make it easier for women students at the participating institutions to find successful role models.

Many in the group that we studied indicated networking at conferences was crucial for career advancement. Special conference travel funds for emerging women scientists would help them develop professional contacts. Moreover, new electronic means of communication such as the Internet are also excellent ways for women scientists to counteract isolation and create a network.

We urge institutions that award fellowships to broaden their perspective and treat the fellowship as a lifetime investment in a scientist. One inexpensive measure with potentially large benefits would be to keep in touch with, or at least keep track of, former recipients. This would provide the nucleus for an alumnae network. A database of former awardees might also be of use to potential employers, who often lament the lack of exceptionally qualified women candidates.

Changes in the working environment may also be helpful. Scientists typically prefer easygoing, informal work groups. However, research has found that discrimination and disparities develop in an environment in which role expectations are not clearly defined or communicated. Newcomers, such as women, are at a particular disadvantage in an informal environment whose unwritten role expectations they may not know quite so well. Furthermore, an informal group provides few safeguards against prejudicial treatment.

Therefore, a higher degree of explicitness and formality may be necessary. For example, clear criteria for performance evaluation of post-graduate students, junior faculty members, new company employees, and rising executives should be communicated plainly at an early time. Decisions concerning work should also be made and communicated in a relatively formal manner. One woman in our group vividly contrasted the management styles in her graduate and postdoctoral research groups. In the graduate laboratory, she said, the "old boys" made the decisions in a totally informal way and thereby excluded this woman from participating. However, in the postdoctoral laboratory, she said, "decisions

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would tend to be made at group meetings, instead of informally at the bar with whoever was there. [The female director] would go out of her way to make sure that everybody had a voice, that everybody knew what was going on. If there was information that everybody needed to know, it would get posted or it would be sent around the room with a routing slip. She didn't rely on informal ways of transferring information. And it was just little things like that that made such a difference."

Organizations can also take an appropriate interest in the personal lives of their employees. Many women scientists face the problem of synchronizing the often conflicting demands of three clocks: their own career clock, their spouse's career clock, and their biological clock. Science institutions should take a more active role in assisting with marriage and family-related burdens. Important support could be provided in the form of child-care facilities and parental-leave policies. In academia, another policy to alleviate the hardships brought about by pregnancy, childbirth, and infant care would be to allow a slowing down of the tenure clock. The critical time for establishing tenure credentials often coincides with the years for starting a family. Most institutions require a person to amass a certain amount of accomplishments within a set number of years, in order to be eligible for tenure. Although stopping the tenure clock for extended periods might be imprudent (because a person returning to a field after a substantial hiatus may find it difficult to catch up with new developments), slowing the tenure clock by one semester or one year is both doable and equitable.

Furthermore, conscious efforts should be made to accommodate two-career couples. A higher proportion of women scientists than men are married to another scientist: among our respondents 62 percent of the married women and 19 percent of the married men had a spouse with a doctorate. Thus, women scientists are much more likely than men to face the "two-body problem"—husband and wife needing to find two science jobs in the same location. Some possible initiatives include splitting a po-

sition in half, providing a sabbatical position for the spouse, or even offering some salary for a transitional period of time. It would be better still if scientific institutions in a geographic area would collaborate; they might be able to create more opportunities for two-career couples.

Policies for social change

When hiring, granting tenure, and giving promotions, institutions should become more sensitive to subtle factors that may explain what appears to be the lesser qualifications of a woman candidate. Recall that women scientists may generate fewer but more substantial publications than men. Thus, quality instead of quantity of publications should be emphasized in evaluating past performance. A potential employer should look at a small number of what each applicant considers his or her best work. Some institutions, among them NSF, have already implemented this strategy. In terms of family obligations, it should be recognized that raising a family is more than a personal whim; it is a societally useful contribution. These kinds of changes would also benefit men who produce fewer but more substantial publications or are a child's primary care giver. Because we found that large variations exist among men as well as among women and because a substantial overlap exists between men and women, it is important that key decisions affecting individuals' careers address specific circumstances rather than gender per se.

A final word is one of warning to policymakers. The men and women who at various levels seek to influence the social system of science always have to struggle with important factors that are beyond their control, such as demographic and economic

fluctuations as well as limitations in authority and budget. But in addition, the variety of idiosyncratic career paths we found, and the large impact of sheer luck, limit the efficacy of any one policy intervention in this area. The subtle nature of gender disparities implies that a quick fix is unlikely. What is called for is diversity and flexibility in policy initiatives. Rather than a neat policy master plan, the U.S. science community needs a large number of varied, even parallel programs that expose all the budding and active scientists to different opportunities, increasing the chances that a scientist will find one he or she can take advantage of. Lessons learned in supporting women in science may also be applied to making science more hospitable to underrepresented ethnic minorities. Our overall goal should be to accommodate members of all segments of our diverse population in the social system of tomorrow's science.

Recommended reading

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