

Science and gender

Gender stereotypes prevent women from attaining full recognition of their research careers.

Despite an increase in the proportion of women receiving doctorates over the past three decades, females who hold high-ranking positions in academia and enjoy full recognition of their scientific achievements are still a very rare breed. According to reports by the European Commission and National Science Foundation in 2006, less than 15% of the full professorship positions in Europe and around 19% in the USA are held by women. Survivors of a very stringent selection process, through sheer excellence or combinations of happy circumstances, they still unfortunately represent more of an exception than the rule.

Various surveys and studies have been conducted by governments and academic institutions to understand the root causes and various factors that contribute to the persistent under-representation of women in the high ranks of academia. The transition from postdoctoral fellow to faculty emerges as the first and most critical step at which a worrying number of female postdoctoral fellows are lost to academic research (E.D. Martinez *et al.*, *EMBO Rep.* 8, 977–981, 2007). A combination of external, family-related challenges and internal, self-confidence challenges negatively influence the opportunities and choices of women and make this transition a much more critical period in the career of a female scientist than that of a male scientist. Those who make it through this bottleneck continue to face these and other challenges when trying to achieve scientific recognition.

Beyond the postdoctoral level, women scientists have slower rates of promotions and less recognition through awards and hold fewer departmental chairs relative to the eligible pool (National Academy of Sciences, *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*, 2007). When controlled for by rank, women scientists have lower salaries (research on academic pay shows differences ranging from a few percent to almost 30 percent), receive less research funding (http://grants.nih.gov/grants/policy/sex_gender/q_a.htm) and publish fewer papers than male scientists. Independent studies and self-evaluations by many academic institutions have aimed at understanding why, by all these measures of success, women score lower than men.

It has been documented since the 1980s that women publish less throughout their career, a discrepancy that emerges within a couple of years after their first publication. Although recent studies have shown that there is no difference in the number of citations per paper for male and female scientists, women are seemingly more consistent in producing good quality work, whereas men produce a greater quantity of more variable quality. A study of publication outputs of male and female faculty between 1990 and 2006 in British and Australian universities (M.R. Symonds, N.J. Gemmell, T.L. Braisher, K.L. Gorringer and M.A. Elgar, *PLoS One*, 1, e127, 2006) concluded that men who produce work of 'poor quality' are more likely to survive in science.

An analysis of research grant submissions from 2001 to 2003 in eight Harvard Medical School-affiliated institutions revealed that success rates in obtaining grants were similar for female and male faculty. However,

women investigators submitted fewer applications, applied for fewer years of funding and requested less research money, especially at lower academic ranks. The good news emerging from this and other studies is the absence of gender bias in the grant-reviewing process. The bad news is that female scientists seem to suffer from the same lack of self-confidence that plagues women in the work force in general. A case in point, according to Catherine Sautes Fridman, the president of the European Federation of Immunological Societies, is that none of the eight candidates for the 2009 Schering-Plough Prize recognizing outstanding European immunologists were women. In contrast, 14 exceptional applications competed for the Ita Askonas Prize established specifically for women immunologists.

A 1999 Massachusetts Institute of Technology report showed that female researchers may have fewer institutional resources and receive less administrative and technical support than men do. Women have a greater burden of non-research activities, such as teaching and administrative duties (due to institutional efforts to have equal representation of women in committees and boards, but with selection from a smaller pool of female faculty), but find themselves more often excluded from the informal network of intellectual mentoring and guidance toward leadership positions (A. Ledin, L. Bornmann, F. Gannon and G. Wallon, *EMBO Rep.* 8, 982–987, 2007). Women are less often recruited into the hierarchy of academic administration, such as department chairs and faculty deans.

Women are often busier doing other things. Many studies have shown that at all stages of their scientific career women are more likely than men to take parental leave, have partners who work full time and move to accommodate their partner's work or career. Women on average carry a heavier burden outside the lab and are expected to make more concessions to accommodate their spouse (A. Ledin, L. Bornmann, F. Gannon and G. Wallon, *EMBO Rep.* 8, 982–987, 2007, and E.D. Martinez *et al.*, *EMBO Rep.* 8, 977–981, 2007).

The problems faced by women in science, including self-imposed doubts, are complex and deeply rooted in the structure of our society. A report by the European Commission (*Gender and Education*, July 2009) points out that gender is a socially and educationally constructed identity. Parents, peers and teachers contribute to creating gender stereotypes in which women are seen as caregivers and men are seen as authority figures. Achieving gender equality requires that these norms be challenged. Although altering cultures and attitudes is a very slow process, certain policy changes are attainable and should be implemented. Closing the salary gap between men and women, establishing more family-friendly work environments and actively increasing the visibility of positive role models should make a faculty career more attractive to women. Education fosters change, so universities and institutes should support educational and research programs on gender equality and have policies that are regularly monitored and publicly appraised. In today's society, science should be a place where women belong at all levels.