nature neuroscience

Women in neuroscience: a numbers game

Only one in five papers published in *Nature Neuroscience* has a female corresponding author. This number might simply reflect the low representation of women among neuroscientists, but it could also contribute to perpetuating the problem, as high-profile publication influences hiring and promotion decisions. For this reason, we examined whether our authors' gender correlates with their chances of publication, and we are pleased to report that papers from female authors are sent for peer review and published in proportion to their representation among submissions to *Nature Neuroscience*. However, female scientists still face barriers to career success that cannot be explained by their individual talents and preferences.

We analyzed the 469 papers submitted in January through March 2005 because almost all these papers have received a final editorial decision by now. With the help of people from Japan, China, India, the United States and Germany, along with web research, we identified the gender of 449 corresponding authors. Of this sample, 92 (20.5%) were female, and 357 (79.5%) were male.

The overall acceptance rates were statistically indistinguishable: 10.9% for papers with female corresponding authors and 11.8% for those with male corresponding authors (Pearson $\chi^2 = 0.057$, $P = 0.811$). The odds of acceptance among papers that were sent for peer review were also similar (female 40.0%, male 37.8%, $\chi^2 = 0.040$, $P = 0.841$), as were the odds of a paper's being sent for peer review initially (female 28.3%, male 31.4%; $\chi^2 = 0.333$, $P = 0.564$). We evaluated the same measures for female first authors or last authors and found that none of the differences was statistically significant.

The composition of our referee pool also reflects the demographics of our authors. Among 940 reviewers for the journal, 152 (16.2%) were female and 788 (83.8%) were male. This proportion of women is slightly higher than their representation among last authors in our manuscript sample (67 of 449, 14.9%), but lower than the proportion of female first authors (125 of 397, 31.5%; the sample size is smaller because it was harder to identify first authors' gender).

We were not surprised to find that women are more common among first authors than last authors. Women leave the laboratory at higher rates than men throughout the world and across their careers, and the percentage of women in the top ranks is very low. In 2000, about half of European graduate students in life sciences were female, in contrast to only 10% of full professors. Similarly, in 2001, 53.9% of US graduate biology students, 37.7% of postdoctoral fellows, 34.5% of assistant professors and 15.8% of full professors were female. The situation is similar for neuroscientists. The Association of Neuroscience Departments and Programs in 2003 reported that half of neuroscience graduate students were female, but 25% of tenure-track faculty were female. Over half of tenured men, but only 22% of tenured women, were full professors. Gender discrepancies persist in longitudinal studies that track the same group of people over time.

The reasons for this progressive loss of women from science careers are hotly debated. Some people attribute it to institutional discrimination, for which there is some evidence. For example, in 1999, the Massachusetts Institute of Technology found that female faculty had lower salaries, less space and fewer resources than men with equivalent accomplishments. Psychology studies also show that when evaluating resumes, people tend to rate the accomplishments of moderately good male candidates as better than those of equivalent female candidates.

Another possibility is that women reduce their career success by investing more effort in their home life than men. This idea was strongly supported by a multivariate analysis from the US National Science Foundation in 2004, which found that gender differences in career success were entirely attributable to the differential effects of marriage and family on women and men. Women who were married and had children were substantially less likely to be in tenure track positions or to have tenure than their male counterparts, whereas males showed no effect of family status. Women who had children later in their careers were more likely to earn tenure, suggesting that early childbearing may interfere with career success. Thus having a family has a detrimental effect on women's careers, but not on men's careers.

Other commentators have suggested that the discrepancy is a natural result of differences in talent or inclination between women and men, and thus it is not realistic to aim for gender parity in scientific careers. The strong form of this argument is that innate cognitive differences cause fewer women than men to have the ability to do good work in certain fields, particularly those requiring mathematical expertise. A softer variant says that academic success requires an aggressive and competitive attitude that is more common among men[1].

As we have discussed previously[2], women and men do show consistent cognitive differences in some areas, such as spatial reasoning, that are probably biological. However, it seems disingenuous to attribute the entire gender discrepancy to innate factors while female scientists remain demonstrably disadvantaged by the uneven allocation of career resources at work and at home. The situation is reminiscent of the debate over the US Title IX law, which prohibited sex discrimination in any educational activity, including sports programs, for schools receiving federal funding. Opponents argued that few girls wanted to play sports, so the money would be wasted. In 1972, when the law passed, 1 in 27 high school girls played varsity sports; today the number is 1 in 2.5. Similarly, removing structural barriers to women's success in the laboratory should be the minimal prerequisite to determining appropriate goals for female representation in science. ■

1. Lawrence, P.A. *PLoS Biology* **4**, e19 (2006).
2. *Nat. Neurosci.* **8**, 253 (2005).