Inequalities faced by women in access to permanent positions in astronomy in France

A recent national survey on behalf of the French Society of Astronomy and Astrophysics highlights the elitism and gender discrimination faced by women — particularly women educated in universities rather than *grandes écoles* — when applying for permanent positions in astronomy in France.

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Inequalities in science, and in particular gender inequalities, have been the focus of numerous studies involving sociology, psychology, economics and so on. Although these inequalities have been well identified for several decades, little progress has been achieved, particularly in several fields of science, technology, engineering and mathematics (STEM), including physics, where women remain under-represented. Astronomy is another field where women are under-represented: for instance, only 18% of the members of the International Astronomical Union (the largest organization of professional astronomers) are women. This under-representation is often attributed to forms of discrimination against women astronomers in the course of their careers, with one striking example being limited access to observing time on telescopes. Decades ago Vera Rubin reported that gaining access to Mount Wilson telescopes. Although the Hubble Space Telescope and the National Radio Astronomy Observatory are two examples of large observatories, the National de la Recherche Scientifique (CNRS) is the largest organization of professional astronomers in France, which is an important nation in the field of astronomy. The French academic system in the field of astronomy

Box 1 | The French academic system in the field of astronomy

There are three types of permanent positions in French academia: researcher (chargé de recherche), assistant professor (maitre de conférence) and deputy astronomer (astronome adjoint). Researchers are hired by the Centre National de la Recherche Scientifique (CNRS) and are entitled to do research only. Assistant professors are hired in universities and teach 196 hours per year in addition to their research. Deputy astronomers are hired in ‘observatories’ by universities and teach 66 hours per year, and in addition are entitled to devote a third of their time to service to the community. Senior categories of these positions are ‘director of research’, ‘astronomer’ and ‘professor’. While it is technically possible to access these positions directly from a non-permanent position, this is in practice very rarely the case, and most often these positions are accessed through career progression (for example, from CNRS researcher to director of research). Researcher and deputy astronomer positions are allocated on a yearly basis through national competitive examinations by a committee whose members are elected by the community and named by representatives of the CNRS and ministry of research and higher education. Assistant professor positions at universities are allocated locally by a jury composed of internal and external members.

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Recent empirical studies have shown that gender biases in the attribution of telescope time persist at major observing facilities such as the Atacama Large Millimeter/submillimeter Array, other European Southern Observatory telescopes, the Hubble Space Telescope, and the National Radio Astronomy Observatory. Although women are now better represented in large scientific collaborations in astronomy, few of them serve as leaders in these teams, and when it comes to receiving a share of a prize, they are often forgotten. Regarding the success of women in obtaining permanent/faculty positions, a study by Flaherty has shown, for instance, that female astronomers leave the academic labour market at a much higher rate than men. This result was, however, mitigated by another study in which it was found that the rate at which women are hired in long-term positions in astronomy (or closely related fields) in the United States is similar to that of men. The existence of gender inequalities in the field of astronomy has been covered mostly in the United States, but interest has been sparked in other countries (see, for example, refs. 11-13). Studies for the case of France, which is an important nation in the field, and where only 22% of astronomers holding a permanent position are women, are lacking. In addition, while there are, as we have seen, several studies on gender biases in astronomy, research addressing the link between gender and other types of biases in the hiring process, as well as the impact of such biases on the personal life of female astronomers, are scarce. Here we provide an example of such an analysis for the case of France using the results of a survey conducted in 2017 among young astronomers in that country.

A national survey of French astronomy

The survey was elaborated by the council of the French Society of Astronomy and Astrophysics (SF2A), and conducted using an online form. It was aimed at researchers who obtained their PhD in astronomy between 2007 and 2017 in France, but was not limited to French nationals. Questions in the survey concerned the profile of the young astronomers and their current status, in particular in terms of employment, their applications to permanent positions, and their perception of their careers. Profile information includes gender, year of PhD, city where PhD was obtained and type of undergraduate studies. Status information concerns their current position (either in or outside of research, public or private, permanent or short-term) as well as personal status (for example, whether they have children or not). A fraction of the survey was dedicated to applications by young astronomers to permanent positions in academia, so as to identify whether they had applied to permanent positions or not, the type to which they had applied (researcher, deputy astronomer, assistant professor), and whether they had succeeded or not. Several questions were devoted to their perception of their careers, in particular if they “believe that having children can be an obstacle in [their] career[s]”. The survey was
Elitism and gender biases in French astronomy

We studied the admission rates to permanent positions, defined as the ratio of the number of people who applied to the number of applicants who succeeded in obtaining a position, for the three major types of permanent positions available in astronomy in France (see Box 1 for details about types of permanent position in France). It is important to note that hiring at a permanent position in France mostly occurs less than ten years after the award of a PhD. Hence the overall measured admission rate, which is 16.6%, can be considered as an estimate of the total rate at which the academic system absorbs applicants in astronomy.

We first investigate admission rates as a function of academic background. In the French (mostly public) education system, two systems cohabit in science: universities, which are non-selective and where most students go, and elite schools, that is, grandes écoles, which are selective and where the ‘best’ high-school students go (judged predominantly on scholastic performance, as measured by examinations). The two most prestigious and selective grandes écoles are the École Normale Supérieure, and the École Polytechnique, which can be compared in terms of prestige to Harvard or Cambridge in the Anglo–American education system\textsuperscript{16}. However, there are a number of other engineering schools that are also considered as grandes écoles. Based on our data, we find that the graduates of grandes écoles have a success rate in their applications to permanent positions of 26.6%, nearly three times that of applicants who carried out their undergraduate studies at a university (10.6%). In order to assess the significance of these results, we perform a \( z^2 \) test on these data. We find an overall probability for the null hypothesis (fortuitous occurrence of the factor of nearly three between university and grandes écoles applicants) to be true of \( P = 0.0026 \). This result is reminiscent of the type of favouritism linked to the grandes écoles and part of a general elite reproduction scheme that was identified many years ago by Pierre Bourdieu and is described in detail in his book \textit{The State Nobility}\textsuperscript{17}. In this work, Bourdieu studies what he calls “school mediated forms of [elite] reproduction” to access the “field of power”, which includes the highest positions in academia (for example, university professors). He defines this mechanism using a comparison with the forms of co-optation that exist in family-run businesses: “In the [school-mediated mode of reproduction], the academic title becomes a genuine entry pass: the school, in the form of the Grande École — and the corps, a social group that the school produces […] take the place of the family and family ties, with the co-optation of classmates based on school and corps solidarity, taking over the role played by nepotism and marital ties in business”. The results presented here suggest that somehow the mechanisms described by Bourdieu are at play today in the field of French astronomy. In the rest of this paper we will refer to this specific mechanism simply as ‘elitism’.

In Fig. 1 we now compare admission rates as a function of gender. It can be seen that, for all types of positions, women have a lower success rate than men. Overall, the success rate for men is twice that of the success rate for women, with a significance of \( P = 0.06 \). Although this result is highly suggestive of a gender bias, it appears to be less important than elitism. A question one can thus ask is whether the observed gender bias is somehow tied to the strong form of elitism we have identified. Indeed, female students are significantly under-represented in grandes écoles: for instance, 16% and 17% of students at École Polytechnique and École Normale Supérieure, respectively\textsuperscript{18}, are women, whereas at universities there are, according to the ministry of higher education, 52% women overall (more specifically, for the fields of science there are 28% in ‘fundamental science and applications’ and 60% in ‘natural science and biology’). Hence, if recruiting committees in French astronomy tend to favour applicants from grandes écoles, as seems to be the case, this could reduce the number of women selected at the hiring stage. To untangle the effects of gender and elitism, we define four classes of applicants (women from a university, men from a university, women from grandes écoles, men from grandes écoles) and present their success rates at permanent job applications in Fig. 2. This figure shows that women from grandes écoles still have a two times smaller chance of success than men from the same schools. Hence, the observed elitism needs to be supplemented by a ‘genuine’ gender bias at hiring to explain the observations in Figs. 1
Interiorization of gender biases by women

We now investigate how such biases are interiorized (or not) by women in the perception of their careers. In particular, we look at their perception of the compatibility of pursuing a career in academia with maternity. We asked in the survey if respondents “believe that having children can be an obstacle in their careers” and provided five possible answers: “yes certainly”, “yes most likely”, “not really”, “not at all” and “do not want to answer”. In Fig. 3 we present the responses to this question as a function of gender. We find that the answer “not at all” is under-represented among women while the answer “most likely” is over-represented. The precise opposite trend is observed for men, although with a smaller significance. The overall statistical significance of these trends, however, is high, with $P = 0.001$. We can conclude that women fear the impact of having children on their careers more than men. This feeling translates into a real-life inequality: in our sample, 27.3% of male respondents have children while only 15.6% of women do (note that the age distributions in our sample for men and women are similar). This shows that gender equity in terms of familial achievements among astronomers is elusive, as is observed more generally in academia19. An additional interesting finding from our survey is that those who have children fear the effect of children on their career less than those who do not have children. This is a possible manifestation of bias: those that fear having children most either do not have children, or have changed careers and are therefore not included in the survey.

Conclusion

In conclusion, this study suggests that at least two forms of bias, namely elitism and gender bias, exist in hiring in French astronomy. Women declare having more difficulties in conciliating maternity and career. As a consequence, fewer women in astronomy in France have children than men. This could be because they fear that children will have a negative impact on their careers and/or because those who do have children are somehow ‘forced’ to leave academia. National committees (such as the CNRS) have acknowledged this issue for several years now (B. Mosser, private communication), hence one can hope that significant changes will be seen in the next decade.

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