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

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We investigate inequalities in access to permanent positions in professional astronomy in France, focusing on the hiring stage. We use results from a national survey conducted on behalf of the French society of astronomy and astrophysics (SF2A) aimed at young astronomers holding a PhD obtained in France, and answered by over 300 researchers.

We find that women are nearly two times less likely than men to be selected by the (national or local) committees attributing permanent positions ($p = 0.06$). We also find that applicants who did their undergraduate studies in an elite school (“Grande École”), where women are largely under-represented, rather than in a university, are nearly three times more likely to succeed in obtaining a position ($p = 0.0026$). Our analysis suggests the existence of two biases in committees attributing permanent positions in astronomy in France: a gender bias, and a form of elitism. These biases against women in their professional life impacts their personal life as our survey shows that a larger fraction of them declare that having children can have a negative effect on their careers. They are half as many as men having children in the sample. National committees (such as the CNRS) have acknowledged this issue for several years now, hence one can hope that changes will be seen in the next decade.

Introduction

Gender inequalities in science have been the focus of numerous studies involving sociology, psychology, economics, etc. Although these inequalities have been well identified for several decades, little progress has been achieved [1], in particular in several fields of Science Technology Engineering and Mathematics (STEM) where women remain under-represented [2], including in physics [3]. Astronomy is also a field where women are under-represented. For instance, there are only 18% of members of the international astronomical union (IAU, the largest organisation of professional astronomers) who are females. This

under-representation is often attributed to some forms of discrimination against women astronomers in their careers, one striking example in the discipline being access to observing time on telescopes. Decades ago already it was reported by e.g. Vera Rubin, that access to Mount Wilson observatory for women was a struggle [4]. Recent empirical studies have shown that gender biases in the attribution of telescope time persist at major facilities such as the Atacama Millimeter Array [5], the Hubble Space Telescope [6], the European Southern Observatory [7], and the NRAO [8]. Although women are now better represented in large scientific collaborations in astronomy, only few of them serve as leaders in these teams [9], and when it gets to receiving a share of a prize, they can be forgotten [10]. Regarding the success of women in obtaining permanent/faculty positions, a study by Flaherty [11] 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 on long-term positions in astronomy (or closely related fields) in the United States is similar to that of men [12]. The existence of gender inequalities in the field of astronomy has been covered mostly in the United States, but interest has sparked in other countries (see e.g. [13, 14, 15]). Studies for the case of France, which is one important nation in the field, and where only 22% of astronomers holding a permanent position are women lack. In addition, while there are, as we have seen, several studies on gender biases in astronomy, research addressing the articulation between gender and other types of biases at hiring, 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 amongst young astronomers in this country.

1 A national survey on French astronomy

The survey was elaborated by the council of the French Society of Astronomy and Astrophysics (SF2A, www.sf2a.eu), and conducted using an online form. It was aimed at researchers who obtained their PhD in astronomy between 2007 and 2017, in France, but not limited to French nationals. Questions in the survey concerned the profile of the young astronomers, their current status in particular in terms of employment, their applications to permanent positions and the perception of their careers. Profile includes gender, year of PhD, city where PhD was obtained and type of undergraduate studies. Status concerns their current position, either in or outside of research, public or private, permanent or short-term as well as a personal status i.e. 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 if they had or not applied to permanent positions, of which type (researcher, dep. astronomer, ass. prof), and whether they had succeeded or not. Several questions were devoted to their perception on their careers, in particular if they “[...] believe that having children can be an obstacle in [their] career[s]?”. The survey was distributed through

Admission rates of PhD holders to permanent positions in academia France

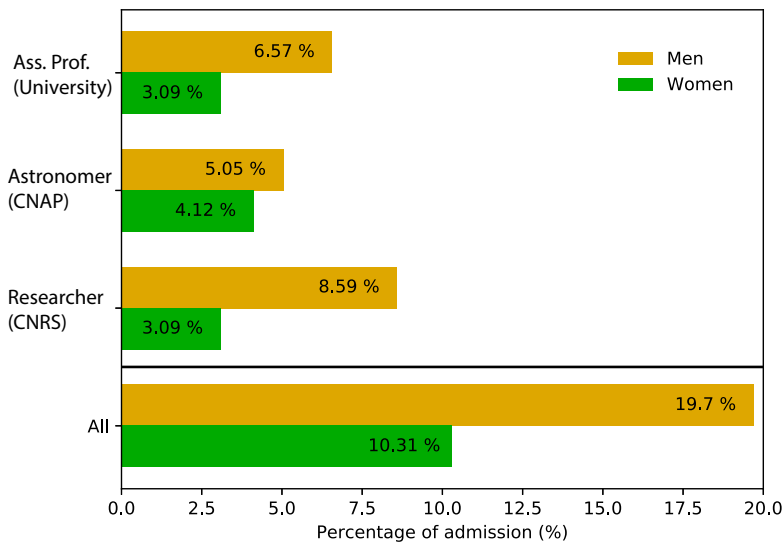


Figure 1: Admission rates of applicants (< 10 years after PhD)) to permanent positions in France.

national professional astronomy canals, including the newsletter of SF2A.

In total, the survey received 301 answers. This is approximately a third of the total population: about 1000 students obtained their PhD in astronomy between 2007 and 2017 in France according to data collected by the doctoral school of the Paris Observatory. Amongst the 301 answers, 198 self declare as men, 97 as women, and 6 as "do not want to answer". This corresponds to 33% women amongst those who answered, which is very close to the ratio that is observed, independently, of women who defended a PhD in astronomy in France between 2012 and 2018 (32% of PhDs in astronomy in France were defended by women, according to data collected by the doctoral school of the Paris Observatory).

2 Elitism and gender biases in French astronomy

We studied the admission rates to permanent positions, defined as the ratio between the number people who have 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 for details about types of permanent positions in France). It is important to note that hiring at a permanent position in France mostly occurs less then 10 year after PhD. Hence the

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 the 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 to, and elite schools i.e. “Grandes Écoles”, which are selective and where the “best” high school students go to. The two most prestigious and selective “Grandes Écoles” are the École Normale Supérieure (ENS), and the École Polytechnique, which can be compared in terms of status prestige to Harvard or Cambridge in the “anglo-american education system” [16], however there are a number of other engineering schools which are also considered as “Grandes Écoles”. Based on our data, we find that “Grandes Écoles” graduates have a success rate in their applications to permanent positions of 26.6%, nearly three times that of applicants who did their undergrad studies at the university (10.6%). In order to assess the significance of these results, we perform a χ^2 test on these data. We find an overall probability for the null-hypothesis (fortuitous occurrence of the factor nearly three between university and GE 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 already decades ago by P. Bourdieu and is described in details in his book “The state nobility” [17]. In this work, Bourdieu studies what he calls “School mediated forms of [elite] reproduction” (p 285) to access the “field of power” (p 267) which includes the highest positions in academia (e.g. university professors). He defines this mechanism using a comparison with the forms of cooptation that exist in family-run business : “In the [School mediated mode of reproduction], the academic title becomes a genuine entry pass : the school, in the form of the Grande Ecole - and the corps, a social group that the school produces [...] take the place of the family and family ties, with the cooptation 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 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, there are 16% and 17% women at École Polytechnique and École Normale Supérieure, respectively [18], whereas at the university, there are, according to the ministry of higher education, 52% women (more specifically, for the fields of science: 28% in “fundamental science an applications”, and 60% in “natural science and biology”). Hence, if recruiting committees in French astronomy tend to favour applicants from “Grandes

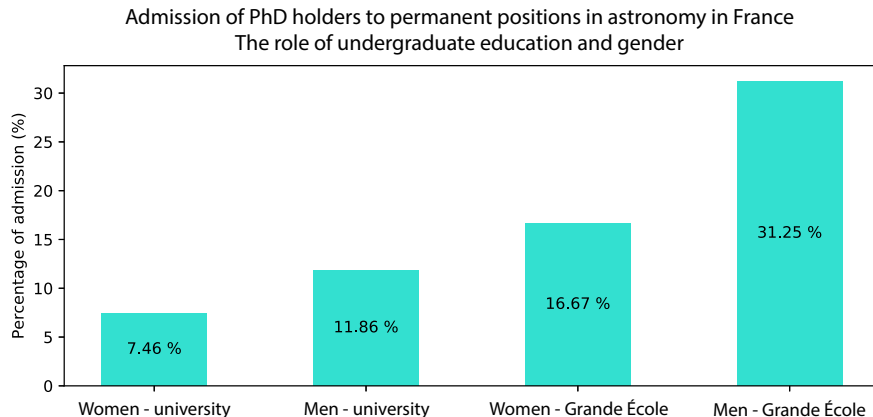


Figure 2: Success rates of four different classes of applicants to permanent positions in astronomy in France.

“Écoles”, as is the case, this could mechanically 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 the university, men from the 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 two times less chances 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 and 2. It is also striking that the difference in success rate between men and women from “Grandes Écoles” is larger than the difference in success rate of male and female university graduates. In a way, it seems that prestige tends to amplify at the same time the absolute success rate and the gender inequality.

3 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 have asked in the survey if respondents “believe that having children can be an obstacle in their careers?” with 5 possible answers : “yes certainly”, “yes most likely”, “not really”, “not at all”, “do not want to answer”. In Fig. 3 we present the results to this question as a function of gender. We find that the answer “not at all” is under-represented amongst 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 is however high, with $p = 0.001$. We can conclude that women fear more the

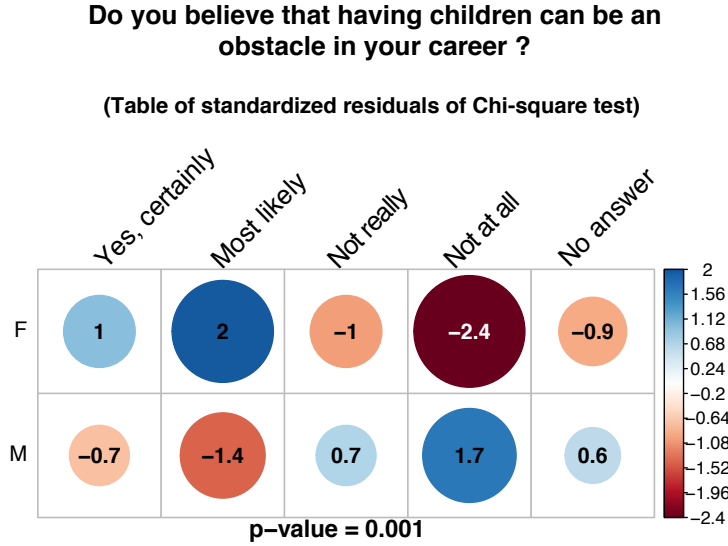


Figure 3: Results to the question “Do you believe that having children can be an obstacle in your career ?” as a function of gender, shown as a table of standardized residuals. These are the difference between the observed count and expected count in the chi-square hypothesis testing, normalized to the standard deviation σ of the expected count. Positive (negative) numbers z indicate that an answer is over(under)-represented in a population at $z \times \sigma$. More precisely, these numbers are Z -scores, with $|z| > 1.7$ corresponding to a probability $p < 0.045$ in a one-tailed normal distribution. The indicated p -value below the table concerns the results of the overall χ^2 -test of variables “gender” vs “are children an obstacle”.

impact of having children on their careers than men. This feeling translates into a real life inequality : in our sample, 27.3% of men have children against 15.6% for women (note that the age distributions in our sample for men and women are similar). This shows that gender equity in terms of familial achievements amongst astronomers is elusive, as is observed more generally in academia [19]. An additional interesting and perhaps non-intuitive result from our survey is that those who have children fear less the effect of children on their career than those who do not have children.

4 Conclusion

In conclusion, this study suggests that at least two forms of biases, namely elitism and gender bias exist at the hiring stage in French astronomy. Women declare having more difficulties to conciliate maternity and career. As a con-

sequence, fewer women in astronomy in France have children than men. This could be either because they fear that children 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.

5 Box: 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 CNRS and 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. Senior designations of these positions are “Director of research”, “Astronomer” and “Professor”. While it is technically possible to access to these position directly from a non-permanent position, this is in practice very rarely the case, and most often these position are accessed to through career progression (e.g. from CNRS researcher to director of research). Researcher and dep. astronomer positions are attributed on a yearly basis through national competitive examinations by a committee whose members are elected by the community and named by representative of the CNRS and ministry of research and higher education. Ass. prof. positions at universities are attributed locally by a jury composed of internal and external members.

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