in brief...
Science: why the gender gap?

Are professors to blame for the fact that there are so few young women in science? Analysing data on the entrance exam for a top French university, **Thomas Breda** and **Son Thierry Ly** argue that it is not the selection process in higher education that is perpetuating this gender gap.

Gender differences have disappeared in many educational settings, yet male and female students remain strongly segregated across what Americans call their 'majors', the main subject they study at university. Of the US workforce with a background in science, technology, engineering and maths (STEM), only a quarter are women. And in the UK, the Institute of Physics recently reported that physics is the fourth favourite A-level subject for boys but only the nineteenth most popular among girls.

Understanding the origin of these discrepancies is important from an economic perspective. Gender differences in entry into science as opposed to non-science careers account for a significant part of the gender pay differential among graduates. They may also reduce aggregate productivity because of misallocation of talent.

The reasons for the under-representation of women in science have been debated in research papers and government reports. We know that gender differences in maths and science test scores at 15 years old have fallen in recent decades and, according to the OECD's Programme for International Student Assessment (PISA), they are now very small in most developed countries. (PISA also shows that the UK's gender differences in maths are among the highest, probably because of early specialisation.)

These small gender differences in ability cannot explain the gender gap that emerges later on in young people's science careers. For example, even looking at students with identical abilities, women are still between 50% and 70% less likely than men to complete a degree in the STEM subjects.

So what explains the gender gap in science? A potential explanation is that women are discouraged or even discriminated against by professors when they choose to study science at university. Evidence certainly indicates that professors influence students' educational choices by serving as role models: having a female teacher in traditionally 'masculine' subjects strongly increases female students' attainment and their likelihood of majoring in science.

Other studies also suggest that gender stereotypes – such as 'boys excel at maths and science while girls do better in other subjects' – may serve as the basis for steering young women towards more 'female' occupations and be partly responsible for gender gaps at university and in the labour market.

But to date, there is almost no evidence of a direct link between stereotypes and discrimination. We don't really know how professors in different subjects evaluate their students. Do science professors want female students? This is a key concern if we are to ensure that young men and women are given equal opportunities and are equally treated when they make their educational and career choices.

In our research, we use a unique dataset on the entrance exam for a leading higher education institution in France – the École Normale Supérieure (ENS) – to investigate the potential links between gender stereotypes and discrimination. To get into the ENS, each student is tested on subjects where boys are usually thought to be better than girls – maths and physics, for example – as well as on subjects that are assumed to be better suited for girls – for example, biology and foreign languages.

This specific context enables us to identify precisely how both the direction and degree of gender discrimination vary with gender stereotypes. We use the fact that candidates to get into the ENS have to take both a blind written test (their gender is not known by the professor who marks the test) and a non-blind oral test.

The 'difference-in-differences' between the young men and women in the blind and the non-blind test scores gives a measure of professor-driven gender discrimination in a given subject. Moreover, since students are tested in more than one subject, it is possible to investigate how professors' gender bias varies across subjects for the same candidate.

We find that discrimination goes systematically against gender stereotypes: the more masculine a subject is thought to be, the more favoured are the female candidates. In maths and physics tests, for example,

young women overtake about 10% of the young men due to discrimination while the exact opposite happens in biology and foreign languages tests.

This implies that the demand for students in different majors is biased in favour of the minority gender: for example, the share of female students who are admitted to major in maths and physics jumps from 8% to 12%. These results show that professors' evaluations are not directly driven by simplistic stereotypes such as 'girls are no good at science'.

Having seen that professors react to gender stereotypes 'in opposition to them', we may wonder how candidates themselves react to these gender stereotypes. After all, our study focuses on a very competitive contest: it may be that the female candidates at the ENS feel especially self-confident in maths, which explains their good performance in the oral tests.

But this is not what we find. The performance of the female candidates we analyse is consistent with what is usually found in other contexts: although the differences are small, female candidates tend to perform slightly worse in written tests in more male-dominated subjects (such as maths) and slightly better in more female subjects (such as foreign languages). What's more, when they have to choose an additional test, females are a lot less likely to choose the most masculine one. This is true even comparing candidates with the same ability.

These results imply first, that in opting for non-science subjects, young women behave exactly as the stereotypes would predict; and second, that this choice is irrational given professors' actual evaluations of their performance in masculine subjects. To maximise their chances of success, young women should choose masculine subjects more often and benefit from professors' seeming bias against gender stereotypes.

Different mechanisms could explain the fact that professors tend to favour young women in typically male-dominated subjects. One is that we may simply observe 'affirmative action' to produce more equal sex ratios in the different majors. But unlike in the United States, there is no legal base for affirmative action in France. The ENS is also one of the most prestigious higher education institutions in the country and it has a strong reputation for rewarding pure talent only. Thus, there are probably no coordinated decisions among the professors towards favouring female candidates for science majors.

This leaves us with two other possible explanations. The first is pure preference-based discrimination: maths professors are just happier when they have the unusual occasion to interview a female candidate; and the same is true for literature professors with respect to male candidates.

The second and more plausible mechanism is directly linked to students' abilities. Paradoxically, professors may rationally favour young women in science even if they have negative stereotypes about their abilities. For a given test performance, the professor may think that the female candidates signal higher effort, self-investment or perseverance and they therefore reward these non-cognitive attributes.

These mechanisms need to be investigated further. But we already know that stereotypes do not always harm young women, which can be seen as good news about the capacity of our societies to move quickly from awareness to action against longstanding imbalances. It would be valuable to know if such behaviours are already widespread and to what extent they may help to reduce the very large gender gap in science that still exists in most countries.

This article summarises 'Do Professors Really Perpetuate the Gender Gap in Science? Evidence from a Natural Experiment in a French Higher Education Institution' by Thomas Breda and Son Thierry Ly, Centre for the Economics of Education Discussion Paper No. 138 (http://cee.lse.ac.uk/ceedps/ceedp138.pdf).

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