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Why don't more girls do science?

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Why do fewer female students take maths and related subjects than male students? This became a highly controversial political issue in England in April 2022.

By Simon Burgess & Hans Sievertsen

Why do fewer female students take maths and related subjects than male students? This became a highly controversial political issue in England in April 2022. The Chair of the Social Mobility Commission, Katharine Birbalsingh, speaking to a Parliamentary committee gave her opinion why fewer girls took physics A-level: "they don't like it, there's a lot of hard maths in there that I think they would rather not do". A couple of months later, the holder of another high profile role, the Children's Commissioner for England, Rachel de Souza, countered with the view that a more likely explanation was the lack of female role models in STEM subjects (science, technology, engineering and maths).

This is a live and important question. For example, in the UK, while 58% of all graduates were female, that number falls to only 21% in Engineering and IT (according to OECD statistics). In many countries, women are still less likely to enroll and graduate in STEM degrees, and because STEM degrees often lead on to STEM careers, which are typically among the highest paid, so lower female participation in STEM has implications for gender earnings inequality.

We do not know for sure why this is. One potential explanation for lower STEM enrollment is a gender difference in students' beliefs about their ability in these subjects. Other ideas include levels of academic skills and preparation, social and family background and expectations, or tastes.

None of these things are easy to test rigorously. But it is hard to address the issue without knowing the cause. In a newly published paper (Burgess et al, 2022) we bring some causal evidence to this.

We make use of a feature in the system of high school assessment in Denmark. Students are randomly assigned to have an oral exam with an external examiner present in a subset of the subjects they are taking. Briefly, this means that some students receive additional feedback on their ability in maths, from a qualified person other than their own teacher. Crucially for understanding the causal effect of this on subsequent outcomes, who gets this extra feedback is random, unrelated to the pupils' abilities or preferences. This new and external information might update students' beliefs about their maths abilities and change subsequent educational choices. Given the ample evidence (see for example Burgess and Greaves, 2013; Rangvid, 2015; and Carlana, 2019) of biases in teacher assessments, the exam lottery might play a non-trivial role in shaping individuals' beliefs.

What difference does it make? We find that for a female student, being randomly assigned the extra feedback is a win. The baseline gender gap in graduating from a maths-requiring STEM degree is substantial: 4.6 percent of girls graduated from such a degree, and 10.1 percent of boys. With an external expert present in the high school oral exam in maths, this gap is reduced by 1.2 percentage points, or more than a fifth. The effect is stronger still for graduating from a degrees typically attracting the best performing students in maths, where the gender gap is reduced by more than a half. Here the baseline gap is 1.1 percentage points, between 1.9% of girls and 3% of boys. Among students assigned to have the external present, this gap falls to 0.4 percentage points.

The impact of this external information is clear. But why? Why might this have such a powerful effect? It seems likely that it might affect the students' beliefs about their maths skills. Providing students with an additional "second opinion", the view of an external assessor, may influence their own estimation of their ability in maths, and so lead them to adjust their future plans, including their university course choices. In our paper we discuss other potential mechanisms and find little effect, so this change in beliefs seems the most likely route in our view.

What can be done to address this gender gap in STEM courses, careers and earnings? Our findings stress the importance of beliefs and information. We show that being randomly allocated to an oral exam with an external present in advanced maths reduces the gender gap in graduating from some of the most math demanding higher education degrees ten years later.

The same idea of providing credible, external, information that girls indeed can do maths, physics and all the other STEM subjects is embodied in the idea of female STEM role models. Back to the Children's Commissioner for England, Rachel de Souza: "The girls I spoke to talked about the importance of female STEM role models – that was more the issue … It wasn't that they couldn't do hard maths." Others agree, including Rachel Youngman, the deputy chief executive of the Institute of Physics, quoted in response to Birbalsingh "[we are] very concerned at the continued use of outdated stereotypes as we firmly believe physics is for everyone regardless of their background or gender."

If the gender gap in STEM is to be closed, it seems that providing external assessment data that girls can do hard maths is important. In which case, having a leading figure in education, the Chair of the Social Mobility Commission no less, say that girls don't like hard maths is ... not helpful.

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