Gender, competitiveness and study choices in high school - evidence from Switzerland

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While women outnumber men on university campuses in most developed countries, strong gender differences in field of study persist. Science, Technology, Mathematics and Engineering (STEM) related subjects attract relatively few women while the humanities are predominately female.[1] In many European countries, specialization into different academic fields begins in high school, and studies show that girls shy away from math-intensive specializations already at that stage.[2] The choice of a more math-intensive high school specialization has been shown to causally affect labor market earnings (Joensen and Nielsen 2009) and the reluctance of women to pick such specializations is therefore a partial explanation for the gender gap in earnings.

Recent evidence suggests that gender differences in study choices are partially determined by the well-documented gender gap in willingness to compete.[3] We contribute to this literature by examining whether Swiss students' Baccalaureate school (high school) specialization choices can be predicted by an experimental measure of willingness to compete that was elicited before entering the Baccalaureate school. The aim of Baccalaureate schools is to prepare students for

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1 See e.g. http://nces.ed.gov/programs/digest/d13/tables/dt13_322.40.asp and http://nces.ed.gov/programs/digest/d13/tables/dt13_322.50.asp.

2 See e.g. Buser, Niederle and Oosterbeek (2014) and Joensen and Nielsen (2016).

3 Niederle and Vesterlund (2011) provide an extensive overview on the gender gap in willingness to compete.

university and students are asked to choose a specialization at the beginning. While girls outnumber boys in Baccalaureate schools[4], boys are more likely to specialize in math.

Willingness to compete is typically measured by giving individuals a choice between piece-rate and competitive incentives for their performance in a simple task in a laboratory setting (Niederle and Vesterlund 2007). A small but growing literature shows that this competition decision is a predictor of study choices and labor market outcomes outside of the lab. Closest to our study is Buser, Niederle and Oosterbeek (2014) who look at high school students in the Netherlands, and find that competitiveness predicts the choice of more math-heavy specializations in high school. They also find that the gender gap in competitiveness can partially account for the gender differences in specializations. Further studies link competitiveness to the starting salary and industry choice of MBA students (Reuben, Sapienza and Zingales 2015), to actual and expected labor market earnings (Reuben, Wiswall and Zafar 2015; Buser, Geijtenbeek and Plug 2015), to participation in a competitive high school entry exam (Zhang 2012), and to investment choices of entrepreneurs (Berge et al. 2015).

Our findings are in line with the previous literature. We show that conditional on grades and performance in the experiment, students who compete are significantly more likely to choose a math-intensive specialization in Swiss academic high schools (Baccalaureate schools). Boys are more likely to compete and this gender difference in competitiveness can explain a significant portion of the gender difference in specialization choices. We also show that our conclusions stay the same after controlling for socio-economic characteristics.

[4] Boys are more likely to opt for vocational education within the Swiss apprenticeship system.

I. Background and Data Collection

In this section, we will first give relevant details on the Swiss education system and then explain the data collection process.

A. Education in Switzerland

Compulsory schooling in Switzerland consists of six years of primary school followed by three years of lower-secondary school.[5] After the 9th grade, students can proceed to upper-secondary education. Most students either opt for vocational education within the Swiss apprenticeship system or for Baccalaureate school, an academic high school which prepares students for university. Admission to Baccalaureate schools is selective and depends on grades in lower-secondary school (in some instances also entry tests are required). In the canton of Bern, where we collected our data, about 1 in 5 students continue on to Baccalaureate school.

At the start of their upper-secondary education, Baccalaureate school students have to choose one of the following specializations: Physics & Math, Biology & Chemistry, Economics & Law, Ancient Languages, Modern Languages, Music & Arts[6], and Philosophy, Pedagogy & Psychology. As we will show, this choice is strongly gendered. Physics & Math and Economics & Law are the most popular choices for boys while girls tend towards Music & Arts, languages or Philosophy, Pedagogy & Psychology (see also Erziehungsdirektion des Kantons Bern 2009).

These gender differences foreshadow striking gender differences in the choice of major at Swiss universities. While women make up around three quarters of students in languages,

5 Recently the attendance of two years of pre-school also became obligatory. In Switzerland the cantons have authority over the school system, so a few cantons divide the years among the stages slightly differently.

6 Music and Arts are actually separate specializations but because of their similarities we group them together.

literature and social sciences, they make up only one tenth of students in engineering, one quarter in exact sciences and one third in economics and business (Federal Office for Statistics 2011).

B. Data collection

In 2013 we experimentally measured the willingness to compete of students at the beginning of 8th grade. The experiment was part of a larger project which collected data from 1514 students from 28 schools in the canton of Bern.[7] We managed to resurvey more than 95% of the students in 2015, at the end of 9th grade, and ask them about their educational and labor market choices and expectations. In this paper we look at specializations in academic high schools and hence we examine on the 259 students who chose to continue their studies at a Baccalaureate school.[8]

Our measure of willingness to compete follows Niederle and Vesterlund (2007). Participants perform one of two simple math tasks: adding up sets of four two-digit numbers or counting the number of times a certain letter appears in a random sequence of 50 letters. Participants had 3 minutes per round to do as many of these problems as possible and the task type (summation or counting) was randomized across classrooms. The experiment was conducted on computers.

In the first of three rounds, participants are paid according to a piece rate of 25 cents per correct answer. In the second round, participants are in competition with three other randomly selected anonymous participants. If they outperform all three participants, they earn Sfr.1 per correct answer. If they lose, they receive nothing. In the third round, participants can choose

[7] To implement the data collection, all lower-secondary schools were contacted in the German-speaking part of the canton of Bern. Twenty-eight of these schools (approximately 10%) wanted to take part. The survey was administered during class hours.

[8] In a companion paper, we concentrate on the relation between competitiveness and vocational career choices in the Swiss apprenticeship system (Buser, Peter and Wolter 2016).

which of the two incentive schemes they prefer. This choice is our measure of willingness to compete.[9]

After the experiment, students answered a detailed questionnaire, which was also part of the larger data collection project. The survey included questions on students' grades, socio-economic background, preferences (e.g. risk) and future plans.[10] Our data on the specialization choices comes from the second data collection that took place in 2015.

II. Analysis

In this section, we will first present descriptive statistics of the educational and experimental choices of the students and then examine whether their experimental choices predict their later choice of specialization.

A. Descriptive statistics

Our sample consists of 259 students who plan to continue their education at a Baccalaureate school. Of these, we have to drop 10 students who did not state a clear choice of specialization in the questionnaire. As in the canton as a whole, girls are overrepresented in our sample of Baccalaureate school students (the sample consists of 159 girls and 90 boys).

Figure 1 shows the proportions of boys and girls who pick each of the seven specializations. Physics & Math is the only one which requires taking more math classes. It attracts 27 percent of boys and 7 percent of girls (p=0.00, chi-squared test). As a further illustration of the gender differences in specialization choice, consider that 76 percent of boys but only 36 percent of girls

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[9] The performance of those who compete is compared to a new random set of performances from the same round. Students were informed about their absolute performance after every round but no relative feedback was given during the experiment.

[10] The risk preference question was incentivized. In particular, the question that we use here asks participants to make a single incentivized choice between a sure payment of Sfr.2 and four 50/50 lotteries of increasing variance and expected payoff: 3.50 or 1.50, 4 or 1, 5 or 0.50, 6 or 0 (Eckel and Grossman 2002). As the survey was part of a larger data collection effort, it also contained questions on other variables, such as time preferences, locus of control and sunk cost aversion. The locus of control measure from this data collection is used in Jaik and Wolter (2016).

pick either Physics & Math, Biology & Chemistry, or Economics & Law (p=0.00, chi-squared test).

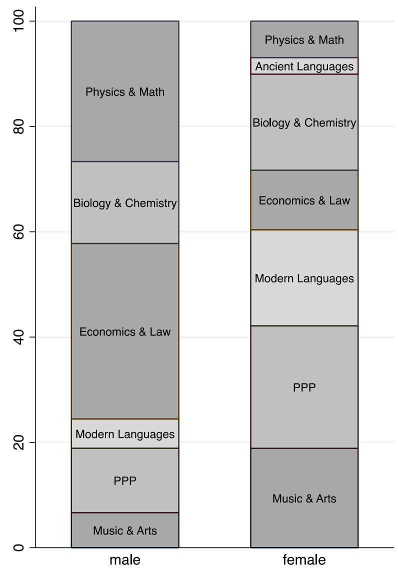

FIGURE 1. SHARE OF CHOSEN SPECIALIZATION BY GENDER

Note: PPP means Philosophy, Pedagogy & Psychology

68 percent of boys and 51 percent of girls chose to compete in the experiment, a difference of 17 percentage points (p=0.01). Conditional on task type and performance in rounds 1 and 2, this difference is 20 percentage points (p=0.00).[11]

B. Regression analyses

In this section, we will regress students' specialization choices on gender and a competition dummy to determine whether competitiveness predicts the choice of more math-intensive specializations and whether the gender gap in competitiveness can partially explain the gender differences in specialization choice.

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[11] From an OLS regression of a dummy for choosing the competitive option on a task dummy, number of points scored in rounds 1 and 2, interactions of task and points scored.

We will run two regression analyses. First, we will look at the binary choice between Physics & Math and the other specializations. Second, we will use a measure of the chosen specializations' math intensity as an outcome variable, to see whether competitiveness predicts the choice of more math-intensive specializations beyond a dummy-specification. To get an objective approximation of the specializations' level of math intensity, we use the so-called "EVAMAR" math scores. EVAMAR was a research project commissioned by the Swiss Conference of Cantonal Ministers of Education to evaluate the Baccalaureate school reform of 1995 which introduced the specializations that we examine in this paper.[12] In Phase II of this project, students were tested at the end of Baccalaureate school in several subjects, among them in math. This resulted in the following average math scores by specialization: Physics & Math: 614, Ancient Languages: 512, Biology & Chemistry: 504, Economics & Law: 485, Modern Languages: 475, Philosophy, Pedagogy & Psychology: 462, Music & Arts: 460.[13] We use these EVAMAR scores as our outcome variable in Panel B of Table 1.

Panel A of Table 1 shows the results for choosing Physics & Math. Conditional on grades and school fixed effects, girls are 16 percentage points less likely to choose this specialization, a large difference considering only 14 percent of students make this choice (Column 3). In Column 4, we add the binary competition variable. Students who choose to compete are 12 percentage points more likely to specialize in Physics & Math. Controlling for competitiveness reduces the gender difference by 17 percent (compare Columns 3 and 4). Conditional on risk attitudes and socio-economic controls, competitiveness increases the likelihood of choosing Physics & Math by 11 percentage points and explains 14 percent of the gender difference (Columns 7 and 8).

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[12] The reform had several other elements as well, see Eberle et al. (2008) for further details on this and on the EVAMAR project.

[13] While only Physics & Math contains additional, more advanced math, some specializations contain additional math related courses such as chemistry or economics. The second-placed Ancient Languages seems to be the odd-one out. However, this specialization requires learning Latin and Ancient Greek and is seen as a highly demanding option that is chosen by very few students. In our sample it is chosen by only five students (all female) and eliminating these observations or grouping them with Modern Languages does not change the results.

TABLE 1— CHOICE OF SPECIALIZATION, GENDER AND COMPETITIVENESS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Choosing Physics & Math (OLS)								
Female	-0.216***	-0.195***	-0.156**	-0.130**	-0.138**	-0.117**	-0.134**	-0.115**
	(0.050)	(0.049)	(0.059)	(0.057)	(0.056)	(0.054)	(0.055)	(0.053)
Compete		0.108***		0.115**		0.112**		0.107**
		(0.036)		(0.044)		(0.047)		(0.050)
Reduction in Female coefficient	10.0 percent		16.5 percent		15.3 percent		14.3 percent	
P-value for reduction	0.001		0.004		0.007		0.015	
Panel B. EVAMAR math score of the chosen specialization (OLS)								
Female	-33.077***	-30.165***	-24.626***	-21.179***	-22.291***	-19.519***	-22.205***	-19.692***
	(6.444)	(6.356)	(7.348)	(7.355)	(7.029)	(7.032)	(6.915)	(6.897)
Compete		14.446***		15.435**		14.646**		14.035*
		(5.114)		(6.517)		(6.982)		(7.339)
Reduction in Female coefficient	8.8 percent		14.0 percent		12.4 percent		11.3 percent	
P-value for reduction	0.003		0.003		0.009		0.022	
Task and performance	x	x	x	x	x	x	x	x
Grades and school fixed effects			x	x	x	x	x	x
Risk attitudes					x	x	x	x
Socio-economic controls							x	x
N	249	249	249	249	249	249	249	249

Notes: Panel A: the outcome variable is a binary indicator for choosing the Physics & Math specialization. Panel B: the outcome variable is the average EVAMAR math score in the chosen specialization. Compete is a binary indicator for choosing the competitive payment scheme in the experiment; Task and performance means a dummy for task (summation or counting), number of points scored in round 1 and round 2 and interactions; Grades and school fixed effects means math grade and GPA in 8th grade, level of lower-secondary school (elite track or not) and interactions, plus dummies for the attended lower-secondary school; Risk attitudes means dummies for the chosen lottery; and socio-economic controls includes age in months, dummies for number of siblings, dummies for whether mother and father attended university, and dummies for whether father and mother were born abroad. The p-values for the reduction in the female coefficient upon controlling for the competition dummy are bootstrapped (10.000 repetitions, stratified by gender and school; p-value is equal to the number of repetitions in which the change is negative divided by 10.000). Standard errors in parentheses are clustered at the classroom level. ***/**/* means significant at the 1/5/10 percent level.

In Panel B, we use the EVAMAR math score of the chosen specialization as our outcome variable. The results again show that girls choose less math-intensive specializations and competitive students pick more math-intensive specializations. Conditional on grades and school fixed effects, competitiveness reduces the gender gap by 14 percent. If we control for socio-economic variables as well, this reduction is 11 percent.

III. Concluding Remarks

Women are strongly underrepresented in math-intensive fields in most developed countries. This gender difference in study choices is of great policy relevance because it contributes to the gender-earnings gap and because many countries are faced with a shortage of STEM graduates.

By linking incentivized measures of competitiveness to real-life career choices, a small but growing literature demonstrates that gender differences in willingness to compete can be a partial explanation for gender differences in career choices, including course choices in high school.

We add to this literature by showing that a binary choice between piece-rate and competitive payment in an experiment is a significant predictor of choosing a math-intensive specialization in academic high schools in Switzerland. The effects are sizeable. For example, the effect of competitiveness on the likelihood of specializing in Physics & Math is almost as large in magnitude as the gender coefficient.

We also find that controlling for competitiveness can explain between 9 and 17 percent of the gender difference in study choices. Given that our binary competitiveness measure surely misses a lot of individual variation in preferences for competition, this is probably a lower bound.

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