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Decisions**

Monique Löwe
Ulf Rinne
Hendrik Sonnabend

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University of Hagen

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ABSTRACT

Gender Role Models and Early Career Decisions*

This paper analyzes the link between the subject choices of German students in upper secondary school and teacher gender when these choices are taken. Our results corroborate the hypothesis that teacher gender matters in this regard, and they indicate that girls respond more strongly than boys to same-sex role models. While the probability to choose German as an advanced course in upper secondary school increases to a rather similar (i.e., symmetric) extent for both girls and boys when having a same-sex teacher in this subject in grade 10, teacher gender matters only for girls with respect to choosing math on the advanced level.

JEL Classification: I21, J16, J24

Keywords: gender, education, STEM, subject choices

Corresponding author:

Hendrik Sonnabend
University of Hagen
Department of Economics and Business Administration
Universitätsstraße 11
58097 Hagen
Germany
E-mail: hendrik.sonnabend@fernuni-hagen.de

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1 Introduction

At a very early stage in life, students take far-reaching decisions with consequences for their educational and professional career. Depending on the flexibility of the school system, the choice of major subjects often sets the course for more technically- and mathematically-oriented or different career paths.

At the same time, there is widespread concern about persistent gender gaps in STEM subjects and occupations. A growing literature has linked teacher gender with subject choices, in particular with those associated with gender stereotypes (e.g., [Carrell et al., 2010](#); [Bottia et al., 2015](#); [Sansone, 2017](#); [Lim and Meer, 2020](#); [Porter and Serra, 2020](#)), which could be due to a role-model effect (e.g., [Bettinger and Long, 2005](#)).

We analyze the link between the subject choices of German students in upper secondary school and teacher gender when these decisions are taken. For the final two years, students in Germany have to bindingly decide between basic and advanced courses, with only minor variations across federal states and school types. We not only consider girls' subject choices, but also analyze boys' decisions to test for symmetric effects of same-sex teachers.

2 Data

We use data from the German National Educational Panel Study (NEPS). These rich longitudinal data ([Blossfeld et al., 2011](#)) allow us to examine the decision between basic and advanced courses in two subjects that arguably involve gender stereotypes: math and German. We focus on the sub-sample *Starting Cohort Grade 9* with information on the educational paths of ninth graders just before they enter upper secondary level (16,425 students)¹. The first wave (of nine waves) was carried out in fall/winter 2010, and the last wave in 2016/2017.

When restricting the sample to school types actually offering the upper secondary level, we are left with 1,871 individuals with information about their own gender, their math teacher's gender (in grade 10), and whether they choose math on the basic or advanced

¹A documentation can be found at DOI: [10.5157/NEPS:SC4:11.0.0](https://doi.org/10.5157/NEPS:SC4:11.0.0).

Table 1: Summary statistics: Math

	All			Girls			Boys			Diff.
	M	S.D.	N	M	S.D.	N	M	S.D.	N	
Female	0.54	-	1871							
Advanced course math	0.50	-	1871	0.46	-	1011	0.54	-	860	-0.09***
Female math teacher (grade 10)	0.45	-	1871							
Same gender dummy (grade 10)	0.49	-	1871	0.44	-	1011	0.55	-	860	-0.11***
<i>Student's characteristics</i>										
Math performance grade 10 ^a	2.83	1.06	1842	2.90	1.05	991	2.76	1.07	851	0.15***
Self-concept math (grade 9)	2.62	0.93	1784	2.41	0.89	967	2.86	0.91	817	-0.46***
Traditional gender roles (score)	2.93	0.62	1863	3.22	0.43	1009	2.59	0.63	854	0.63***

- * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

- ^a 6-point grading scale ranging from 1 (excellent) to 6 (insufficient).

Table 2: Summary statistics: German

	All			Girls			Boys			Diff.
	M	S.D.	N	M	S.D.	N	M	S.D.	N	
Female	0.52	-	1642							
Advanced course German	0.54	-	1642	0.62	-	859	0.47	-	783	0.15***
Female German teacher (grade 10)	0.63	-	1642							
Same gender dummy (grade 10)	0.50	-	1642	0.62	-	859	0.36	-	783	0.26***
<i>Student's characteristics</i>										
German performance grade 10 ^a	2.67	0.81	1616	2.48	0.79	841	2.87	0.79	775	-0.39***
Self-concept German (grade 9)	3.03	0.59	1571	3.14	0.54	826	2.90	0.63	745	0.23***
Traditional gender roles (score)	2.93	0.61	1638	3.23	0.42	858	2.60	0.61	780	0.63***

- * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

- ^a 6-point grading scale ranging from 1 (excellent) to 6 (insufficient).

level (in grade 11). For the choice of German as a basic or advanced course, the number of observations is slightly lower (1,642).

Tables 1 and 2 show that the gender gaps in performances in grade 10, as measured by grades, and the tendency to choose an advanced-level course are more pronounced in German (to the disadvantage of boys) than in math (to the disadvantage of girls). Teacher gender is unevenly distributed across subjects: 45 percent of all students in our sample have a female math teacher in grade 10, and 63 percent have a female German teacher.

Additional variables for our empirical analysis are the student's self-concept (or: self-

assessment) related to subject-specific abilities and the student’s opinion on traditional gender roles. Both variables are based on the extent to which students agree to statements on a four-point scale. For the subject-specific self-assessments, only one question was asked for each subject.² We can elicit the student’s opinion on traditional gender roles based on their level of agreement with five statements.³

3 Empirical Analysis and Results

Although we cannot take advantage of a clean experimental setting, some institutional features may allow us to closely resemble causal effects. Teacher-to-class assignments can be viewed as quasi-random with respect to our key variable of interest as this assignment does not depend on teacher gender, but rather on teacher expertise. Within a given subject, teacher gender does not correlate with the share of male or female students in a class. Also the average ability of a class, proxied by the average grade, does not significantly correlate with teacher gender in math. Yet, female teachers in German give, on average, slightly better grades (2.624 vs. 2.748).⁴

Tables 3 and 4 display our main results of linear probability models.⁵ These models are gradually extended to also include student-specific and school-specific control variables. Furthermore, as Schöne et al. (2020) show that the gender ratio in class is associated with subject choices, we also include this variable.⁶

Our results confirm the hypothesis that girls who have a female math teacher in grade 10 are significantly more likely to choose math as an advanced course in upper secondary school than girls who are taught by a male teacher. Our point estimates in Table 3 correspond to an increased likelihood of 6.2 to 10.4 percentage points. We do not find a

²Math: “I get good grades in math” (1 = strongly disagree, 5 = strongly agree), German: “I am a hopeless case” (1 = strongly agree, 4 = strongly disagree)”.
³These were “Duties in life: men should earn money.” (1: totally disagree, 4: totally agree), “Men are more capable in some jobs.”, “Men and women have the same duties in house care work”, “There should be equal quotas in politics”, and “Men and women have equal control over technical devices”. We calculate the arithmetic mean across these statements so that the final variable is still between one and four. Note that Cronbach’s Alpha reliabilities (Cronbach, 1951) are high (0.76).

⁴*p*-values of Student’s *t*-tests: 0.734 (students’ gender, math), 0.869 (grades, math), 0.899 (students’ gender, German), and 0.003 (grades, German).

⁵Probit and logit models yield very similar results.

⁶Unfortunately, this information is only available for a subsample.

similar (i.e., symmetric) effect for boys.

In addition, our results support the hypothesis that both girls' and boys' choices of German as an advanced course in upper secondary school depend on teacher gender. Table 4 shows that while the same-sex teacher effect for girls is about the same in German as in math,⁷ the estimated coefficients for boys turn significant at the 10 percent level when we include a broader set of control variables. Moreover, these coefficients are also substantial in magnitude. The same-sex teacher effects on choosing German as an advanced course in upper secondary school are thus rather similar (i.e., symmetric) for boys and girls.

4 Conclusions

Our results corroborate the hypothesis that teacher gender matters at the time when subject choices of German students in upper secondary school are taken. Moreover, we find that girls respond more strongly than boys to same-sex role models regarding their choice of advanced courses, especially in math. Thus, if the policy goal is to increase the proportion of females in STEM subjects, it should make sense to match girls with female role models as math teachers early in their school career.

⁷The fact that the coefficient estimate on same-sex teacher for girls is insignificant after including the gender ratio in class in column (4) could be due to the substantially lower number of observations.

Table 3: Same gender effects: Math

	<i>Girls</i>				<i>Boys</i>			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Same-sex teacher	0.081** (0.032)	0.062** (0.030)	0.062** (0.031)	0.104*** (0.039)	-0.027 (0.034)	-0.042 (0.032)	-0.032 (0.032)	0.025 (0.041)
Math performance (grade 10)		-0.135*** (0.014)	-0.096*** (0.018)	-0.086*** (0.023)		-0.142*** (0.014)	-0.081*** (0.020)	-0.066** (0.027)
Self-concept Math ^a (z-score)			0.081*** (0.020)	0.048* (0.025)			0.121*** (0.021)	0.088*** (0.027)
Traditional gender roles ^b (z-score)			0.004 (0.022)	0.018 (0.029)			-0.011 (0.017)	0.007 (0.022)
Share of male students in class				0.007 (0.121)				0.329*** (0.125)
Type of school dummy	<i>No</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>No</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
East Germany dummy	<i>No</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>No</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>N</i>	1011	991	948	590	860	851	804	503
<i>R</i> ²	0.006	0.104	0.129	0.105	0.001	0.132	0.171	0.122

- Data: NEPS, Starting Cohort Grade 9.

- The dependent variable is a binary variable which is 1 if the student chooses math as an advanced course in grade 11 and 0 otherwise.

- ^a (Standardized) score, values between one (low) and four (high).

- ^b (Standardized) score, values between one (non-traditional) and four (very traditional).

- Robust standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Same gender effects: German

	<i>Girls</i>				<i>Boys</i>			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Same-sex teacher	0.112*** (0.034)	0.076** (0.035)	0.073** (0.035)	0.033 (0.046)	0.006 (0.037)	0.054 (0.037)	0.065* (0.038)	0.079* (0.048)
German performance (grade 10)		-0.081*** (0.021)	-0.047* (0.024)	-0.054* (0.032)		-0.133*** (0.022)	-0.122*** (0.025)	-0.138*** (0.030)
Self-concept German ^a (z-score)			0.050** (0.020)	0.043* (0.026)			0.013 (0.018)	0.008 (0.023)
Traditional gender roles ^b (z-score)			-0.031 (0.025)	-0.059* (0.031)			-0.029 (0.018)	-0.046** (0.022)
Share of male students in class				-0.232 (0.147)				0.241 (0.177)
Type of school dummy	<i>No</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>No</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
East Germany dummy	<i>No</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>No</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>N</i>	859	841	810	471	783	775	735	473
<i>R</i> ²	0.012	0.046	0.047	0.066	0.000	0.072	0.073	0.088

- Data: NEPS, Starting Cohort Grade 9.

- The dependent variable is a binary variable which is 1 if the student chooses German as an advanced course in grade 11 and 0 otherwise.

- ^a (Standardized) score, values between one (low) and four (high).

- ^b (Standardized) score, values between one (non-traditional) and four (very traditional).

- Robust standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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