Thinking about Parents: Gender and Field of Study

By Michela Carlana, Lucia Corno*

Educational choices are still highly segregated by gender in most countries around the world (Altonji et al., 2012; Blau and Kahn, 2017), with women persistently underrepresented in highly remunerated fields, such as science, technology, engineering, and mathematics (STEM), and men underrepresented in areas such as the humanities, education, and health (Delfino, 2019). Skills, comparative advantage, and self-confidence in different fields are important predictors of educational choices (Breda and Napp, 2019; Carlana, 2019). Notably, parents play a crucial role in shaping their children's confidence, beliefs in their own abilities, and behavior through explicit or implicit recommendations. They transmit cultural traits, investments, and serve as role models (Giustinelli, 2016; Doepke and Zilibotti, 2017; Dizon-Ross, 2019; Attanasio et al., 2022). This implies that if parents hold gender-stereotypical views, they may cause belief distortion on the perceived ability of children, perpetuating gender segregation in the field of study (Bordalo et al., 2019; Coffman, 2014).

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In this paper, we implement a lab-in-field experiment among around 2000 children enrolled in 14 middle schools in Italy to investigate whether thinking about parental recommendation affects students' choice of the field of study, inducing girls into humanistic fields and boys into scientific fields. First, we show that children perceive gender-stereotypical recommendations from their parents: keeping constant ability, girls feel less supported in math and boys less supported in literature from their parents. Second, we show that thinking about mothers' recommendations exacerbates the gender gap in the choice of the field of study: it decreases the probability that girls choose math compared to literature by 10 percentage points but does not influence the choice of boys. Thinking about fathers' recommendations negatively influences the probability to choose math for girls and positively for boys, but the impact is not statistically significant at conventional level. Finally, consistent with the literature, we find that mothers have a stronger influence on their daughters' schooling decisions and fathers have a stronger influence on their sons' decisions with gender-stereotypical recommendations (Attanasio and Kaufmann, 2014).

Our results highlight the crucial role of parents in shaping children's choices and self-confidence in different fields: recommendations of parents induce equally able children to segregate into different fields, pushing more girls into humanities and more boys into sciences, thus exacerbating gender stereotypes in the choice of field.

The paper contributes to the literature on the influence of parents on children's preferences and decisions (Doepke et al., 2019; Lizzeri and Siniscalchi, 2008; Giustinelli, 2016; Bergman, 2015). Parents may directly or indirectly influence children's choices and induce them to behave in a direction congruent with their trans-

mission effort (Bisin and Verdier, 2011). Among the studies able to empirically identify the role of parents on the field of study, Dahl et al. (2020) find that if the father or the mother graduates in a certain field, their son is more likely to follow their track, while these effects are muted for daughters. Another recent paper by Tungodden (2022) studies the effect of parents in shaping their children's willingness to compete, showing that parents choose more competition for boys than for girls. Finally, Cheng et al. (2017) test the extent to which the mindsets of a student's parents regarding math ability influence their mindset on math ability and longer-term STEM-related outcomes. Different from these studies, we design a lab-in-the-field experiment to investigate the causal effect of parental influence on students' perceived comparative advantage in different fields and disentangle whether the effect is driven by the activation of mothers' or fathers' perceived recommendation or by parents' observability of students' choices.

I. Experimental Design

In the Fall 2019, we collected data among students enrolled in 14 middle schools in 7 provinces in Italy. To mimic gender-segregated track choices within the experiment, we incentivize students to choose the task they think they are better at between a male-stereotypical field (math) and a female-stereotypical field (literature) (Coffman, 2014). Before choosing, students were randomly exposed to different treatments, described below, and a control group:

- *Treatment 1: Mothers' Recommendation.* We asked students to think about whether their mother would recommend them to math or literature before they made their own choice.

- *Treatment 2: Fathers' Recommendation.* We asked students to think about whether their father would recommend them to choose math or literature before they made their own choice.

- *Treatment 3: Disclosure to Parents.* We told students that their choice may be revealed to their parents.

Appendix Table A1 shows that the characteristics of students are balanced across treatment arms. More details on the sample and experimental design are available in Carlana and Corno (2023).[1]

II. Descriptive Evidence on Perceived Recommendations

We start by examining whether students perceive a gender-stereotypical recommendation from their parents. Appendix Figure A1 plots the raw data of students' beliefs on their mothers' advice (left panel) and their fathers' advice (right panel) by gender. When thinking about mothers' recommendation, 44% of girls and 50% of boys believe math would be recommended to them. When thinking about fathers' advice, 62% of girls and 67% of boys believe math would be recommended to them. Students believe that mothers are, on average, more likely to recommend literature than fathers, but overall the gender gap in students' beliefs is similar for both parents (around 6 percentage points).

As shown in Appendix Table A2, the gender gap in perceived recommendations for math is only marginally affected when controlling for students' comparative advantage in math with respect to literature in the baseline grades (column 2) and for other baseline characteristics, including family background and class fixed effects (column 3). For a limited sample of students, we managed to collect the actual parental recommendation through a questionnaire to their mothers and fathers. Restricting the analysis to this sample, we find that the perception of students is highly correlated with the actual parental recommendation

[1] The original experimental design include two additional arms: i) in one group, we told students that their choice of the task will be revealed to their peers; ii) in another group, we told that their choice will be revealed to their peers and that they need to interact in the task's correction with peers who have made their same choice. The focus of this paper is to examine parents' influence and we thus restrict the sample to students in Treatments 1-3.

of both mothers and fathers, even when controlling for the comparative advantage in the subject and other students' controls (columns 5 and 6).

These gender-stereotypical associations may reduce girls' perceived comparative advantage in math and boys' perceived comparative advantage in literature compared to what they would have done without thinking about their parents' recommendations, potentially leading to a mismatch of talents. If this were the case, we would expect the effect of our experimental treatments to depend on parental recommendation toward scientific or humanistic fields.

III. Main results

The main results of our experiment are presented in Figure 1. In the control group, 47% of girls and 59% of boys believe they have a comparative advantage in math compared to literature, reflecting a substantial gender-stereotypical gap that cannot be explained by observed ability as we discussed in the section above. Our experimental results suggest that simply thinking about mothers' recommendation (Treatment 1: Mothers' Recommendation) exacerbates the gender gaps: it decreases the probability that girls choose math by around 10 percentage points, a decrease of 21% compared to the control group, while it does not affect the perceived comparative advantage of boys in math with respect to literature. Overall, we do not find a statistically significant effect on either genders from thinking about their fathers' recommendation (Treatment 2: Fathers' Recommendation). Appendix Table A3 shows that results are quantitatively unaffected by the specification chosen.

To further understand whether students' perceived comparative advantage is affected by the activation of parental recommendation or by the fear of disappointing parents with their choice, we include a third treatment arm with explicit information to students that their choice may be revealed to their parents (Treatment 3: Disclosure to Parents). When exposed to this information, girls decrease their probability of choosing math by around 7 percentage points, and boys increase their probability of choosing math by 3 percentage points: the effects are qualitatively smaller than Treatment 1 and are not statistically significant at conventional levels.

The results for Treatment 3 suggest that the revelation of students' choices to parents is not sufficient to lead to a change in students' perceived comparative advantage: families may openly discuss preferences and perceived ability (even if with biased information on actual ability driven by stereotypes), and therefore students may not be concerned by the disclosure of information to parents (Giustinelli, 2016; Dizon-Ross, 2019). However, parents, in their interaction with children, help them build their self-confidence in different domains. Thinking about one's mother's and father's recommendations (as in Treatment 1 and 2) may directly influence the perception of one's comparative advantage as it potentially activates a gender-stereotypical recommendation.

IV. Mechanisms

To investigate whether the parental recommendation is the mechanism driving the results, we analyze the heterogeneous treatment effects depending on students' perceived recommendation from mothers and fathers. As shown in Appendix Figure A2, in the control group 58% (78%) of girls (boys) decide to choose math when they believe this would be consistent with their mother's recommendation, while this share is only 39% (43%) among those who believe their mother would recommend them literature. This mean difference in the control group partly reflects actual differences in performance or knowledge of one's own comparative advantage.

When looking at the effect of Treatment 1 (Mothers' Recommendation), we find that students who think about their mother's recommendation before choosing the field react by aligning their choice with their mother's. However, the effect is economically and statistically significant only for girls when they perceive a push to-

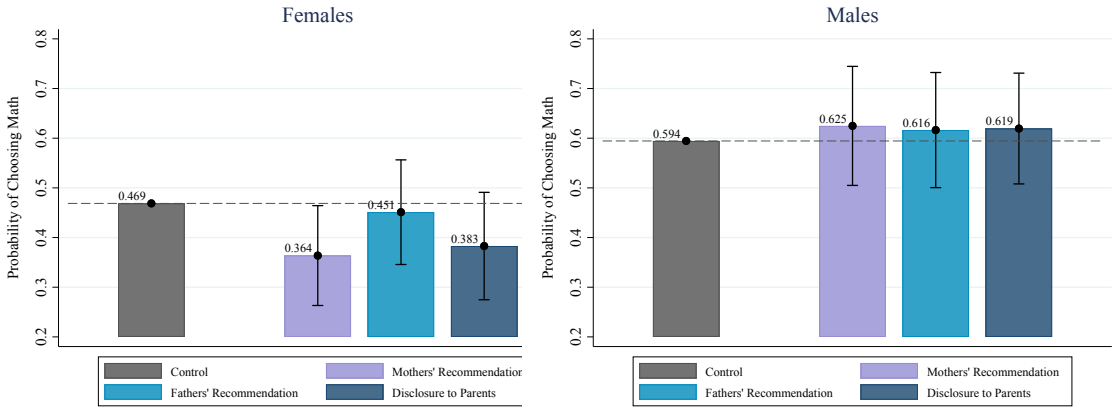

Figure 1. : Treatment Effect

Note: This figure shows the mean of the probability of choosing math for students in the control group, treatment group 1 (Mothers' Recommendation), treatment group 2 (Fathers' Recommendation), and treatment group 3 (Disclosure to Parents). The coefficients are obtained from a regression including class fixed effects and all baseline controls. We also report the 95% confidence intervals for each estimate.

ward the gender-stereotypical subject: literature. Among girls who perceive their mother would recommend literature, the probability of choosing math decreases by 53% (from 39% to 18%; Figure A2, top right panel).

Interestingly, as shown in Figure A3, we find a symmetric pattern for boys. The point estimate suggests an alignment of students' choices to fathers' perceived recommendation, statistically significant at 5% level only for boys who expect a gender-stereotypical recommendation from their fathers. Indeed, when boys believe their father would recommend math, they increase their probability of choosing math by 15% (from 72% to 83%) if they are induced to think about their father's recommendation before choosing the subject. Appendix Table A4 (Panels A and B) reports the coefficients plotted in Figures A2 and A3, correcting for multiple hypothesis testing using the Westfall-Young step-down-adjusted p-values, which also control for the FWER and allow for dependence among the p-values. The results are neither qualitatively nor quantitatively different from the main specification.

Even when parents do not directly impose their choices on children, the results show that they can indirectly influence their children's perceived comparative advantage, leading to an exacerbation of gender stereotypes in the choice of field. If students perceive counter-stereotypical recommendations from parents, they are not influenced in their decision of math versus literature. However, gender-stereotypical recommendations of same-gender parents induce children to segregate in different fields, pushing more girls into literature and more boys into math. This may activate stereotypes associating gender and field of study that are deeply rooted in exposure since early childhood (Ambady et al., 2001; Banse et al., 2010).

V. Conclusion

The results from our lab-in-the-field experiment suggest that parents of the same gender as their child have an impact on their children's choices in stereotypical domains (i.e., fathers influence boys in choosing more math, and mothers influence girls in choosing more literature): conditional on ability, girls are 33% more likely to think they are better in literature when they expect their mothers recommending it, and boys are 15% more likely to believe they are better in math when they expect their fathers to recommend it. The effect is driven by the activation of parental recom-

mendation inducing children to think about the stereotypical choice and not necessarily from the fear of disappointing parents with their choice. Interventions aimed at raising awareness among parents regarding the impact of gender stereotypes on their children's choices may be instrumental in mitigating gender disparities.

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Online Appendix

Table A1—: Balance Table

	(1) Control	(2) Diff. Treat. 1	(3) Diff. Treat. 2	(4) Diff. Treat. 3
Student Characteristics				
Female	0.469	0.062	0.024	0.041
	(0.500)	[0.106]	[0.539]	[0.265]
Immigrant	0.144	-0.030	-0.002	-0.007
	(0.352)	[0.178]	[0.926]	[0.765]
Std IAT	-0.043	-0.036	0.017	0.045
	(1.013)	[0.624]	[0.831]	[0.563]
Std Explicit Gender Index	-0.027	0.054	0.125	0.024
	(1.007)	[0.476]	[0.100]	[0.740]
Math Grade (Pre-Experiment)	7.196	-0.094	-0.022	-0.155
	(1.493)	[0.531]	[0.905]	[0.298]
Italian Grade (Pre-Experiment)	7.221	-0.103	-0.055	-0.116
	(1.101)	[0.322]	[0.645]	[0.191]
Family Characteristics				
Education level of mum: primary or junior sec.	0.193	-0.020	0.028	0.010
	(0.395)	[0.512]	[0.269]	[0.732]
Education level of mum: high school	0.393	0.002	-0.031	-0.012
	(0.489)	[0.969]	[0.422]	[0.751]
Education level of mum: university	0.201	-0.042	-0.044	0.000
	(0.401)	[0.156]	[0.152]	[0.997]
Education level of dad: primary or junior sec.	0.203	0.021	0.016	0.014
	(0.403)	[0.509]	[0.569]	[0.667]
Education level of dad: high school	0.398	-0.024	0.013	0.001
	(0.490)	[0.494]	[0.693]	[0.985]
Education level of dad: university	0.168	-0.060**	-0.040	-0.055*
	(0.374)	[0.026]	[0.174]	[0.060]
Lives with both parents	0.835	-0.005	0.015	0.002
	(0.372)	[0.845]	[0.582]	[0.949]
Mother Works	0.686	-0.015	0.080**	0.041
	(0.465)	[0.688]	[0.022]	[0.238]
Father works	0.958	0.004	-0.001	-0.023
	(0.200)	[0.788]	[0.934]	[0.209]
Low wage job - mum	0.373	-0.005	0.051	0.027
	(0.485)	[0.910]	[0.248]	[0.578]
Medium or high wage job - mum	0.335	-0.024	-0.010	0.014
	(0.473)	[0.622]	[0.792]	[0.763]
Low wage job - dad	0.314	-0.021	0.005	0.045
	(0.465)	[0.547]	[0.891]	[0.257]
Medium or high wage job - dad	0.351	-0.025	-0.028	-0.069*
	(0.478)	[0.560]	[0.506]	[0.092]
Number of observations	409	430	429	402

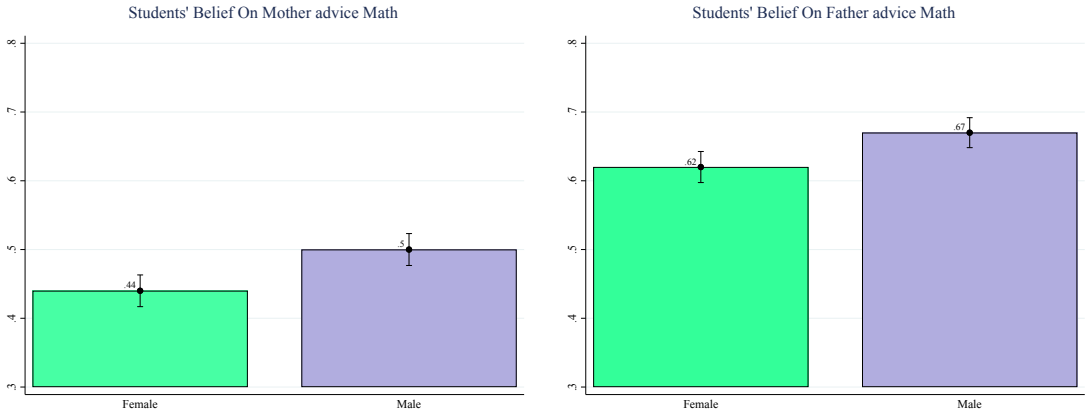
Notes: Column 1 presents the mean of the variable for the control group with respective standard deviations in parentheses. Columns 2–4 present the difference between the mean by treatment arm and the control group. Treatment 1 is Mothers' Recommendation, Treatment 2 is Fathers' Recommendation, and Treatment 3 is Disclosure to Parents. The index of explicit stereotypes is constructed using the first principal component from the following seven questions: i) there are biological differences in men's and women's innate math abilities; ii) earning money to support the family is a father's responsibility; iii) taking care of the house and children is a mother's responsibility; iv) psychologist is not a job suitable for women; v) a computer programmer is not a job suitable for women; vi) even if they work hard, women cannot be good at football; and vii) even if they work hard, men cannot be good at cooking. A low-wage job is considered as being a construction worker, salesperson, hairdresser, cook, or similar type of job for both mothers and fathers. The mother's occupation skill level is also set to one if she is living with someone employed in a job of that skill level. P-values for the two-sided test of equivalence in means are in square brackets. All columns include fixed effects for the experimental session (class), and standard errors are clustered at the same level. For brevity, the balance on the missing variable is omitted. Significance levels: *** p< 0.01, ** p< 0.05,* p< 0.1.

Table A2—: Students' Belief of Parental Advice

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Mother's Advice					
	Full Sample			*Parents' Sample*		
Dep. Var.: = 1 if student believed the Mother would advise Math						
Girl	-0.065***	-0.054**	-0.059***	-0.134**	-0.089*	-0.072
	(0.021)	(0.021)	(0.022)	(0.057)	(0.053)	(0.061)
Grade math-Grade lit		0.079***	0.077***			0.097***
		(0.014)	(0.014)			(0.035)
Mother advice: Math					0.258***	0.216***
					(0.051)	(0.056)
Mean Y: Boys	0.50	0.50	0.50	0.57	0.57	0.57
Mean Y: Girls	0.44	0.44	0.44	0.43	0.43	0.43
Obs.	2,511	2,511	2,511	409	409	409
R^2	0.004	0.018	0.045	0.018	0.082	0.175
Performance	N	Y	Y	N	Y	Y
Controls	N	N	Y	N	N	Y
	Panel B: Father's Advice					
	Full Sample			*Parents' Sample*		
Dep. Var.: = 1 if student believed the Father would advise Math						
Girl	-0.057*	-0.049*	-0.057*	-0.053	-0.013	0.001
	(0.022)	(0.022)	(0.021)	(0.075)	(0.073)	(0.079)
Grade math-Grade lit		0.054*	0.050*			0.026
		(0.013)	(0.013)			(0.070)
Father advice: Math					0.308*	0.322*
					(0.073)	(0.085)
Mean Y: Boys	0.67	0.67	0.67	0.74	0.74	0.74
Mean Y: Girls	0.62	0.62	0.62	0.69	0.69	0.69
Obs.	2,511	2,511	2,511	128	128	128
R^2	0.004	0.010	0.043	0.003	0.118	0.341
Performance	N	Y	Y	N	Y	Y
Controls	N	N	Y	N	N	Y

Notes: The dependent variable indicates whether the student believes the parents (mother in Panel A, father in Panel B) would recommend that they choose math versus literature in our lab-in-the-field experiment. Controls include baseline grades in math and literature, an indicator for the student being an immigrant, the IAT score, an indicator of explicit stereotypes, if the student lives with both parents and the presence of siblings, dummy variables indicating parents' level of education, and employment and job skill category as defined in Table A1 For each variable, we include an indicator controlling for when the answer is missing. Robust standard errors, clustered at the class level, are in parentheses. Significance levels: *** p< 0.01, ** p< 0.05, * p< 0.1.

Figure A1. : Descriptive Statistics: Students' Beliefs on Parents' Recommendation



Notes: These graphs plot the belief of children on the parental recommendation. The figure on the left is about students' belief on their mothers' recommendation and the figure on the right is about students' beliefs on their fathers' recommendation. The green bar is for girls and the purple bar for boys. The full sample includes 1,670 observations from the students' questionnaire.

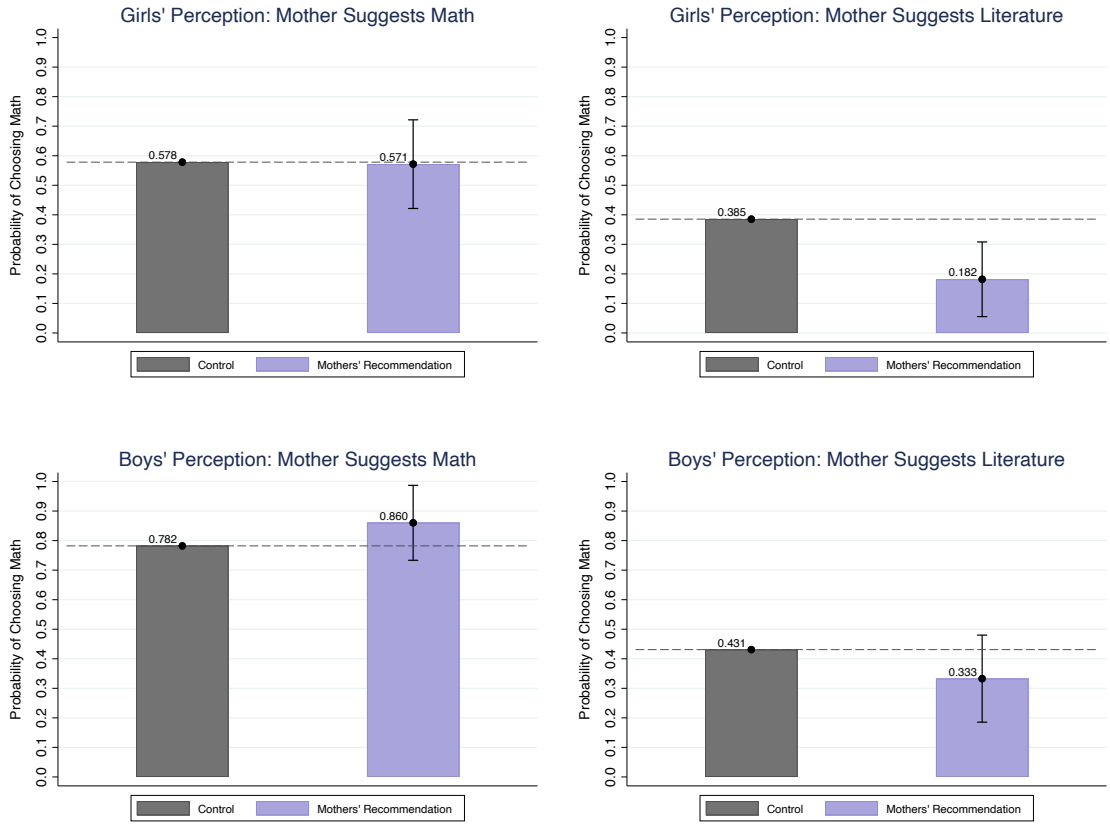
Table A3—: Treatment Effects, by gender

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.: = 1 if student decided to study Maths						
	Female students			*Male students*		
TE 1: Mother's Recommendation	-0.071*	-0.087*	-0.105**	-0.002	0.003	0.025
	(0.042)	(0.051)	(0.051)	(0.048)	(0.058)	(0.060)
TE 2: Father's Recommendation	-0.033	-0.015	-0.018	0.048	0.008	0.023
	(0.048)	(0.056)	(0.054)	(0.047)	(0.056)	(0.057)
TE 3: Disclosure to Parents	-0.064	-0.083	-0.086	0.045	0.020	0.036
	(0.047)	(0.056)	(0.056)	(0.047)	(0.056)	(0.056)
Mean (control group) in Math Choice	0.469	0.469	0.469	0.594	0.594	0.594
Obs.	837	837	837	833	833	833
R^2	0.003	0.267	0.373	0.002	0.238	0.337
Class FE	N	Y	Y	N	Y	Y
Student controls	N	N	Y	N	N	Y
Family controls	N	N	Y	N	N	Y

Notes: The dependent variable indicates if the student chose math versus literature in our lab-in-the-field experiment. Columns 2-3 and 5-6 control for class fixed effects. Columns 3 and 6 add controls for the student: baseline grades in math and literature (for students in grades 7 and 8 of our experiment), an indicator for whether the student is an immigrant, the IAT score, and an indicator of explicit stereotypes as described in the footnote of Table A1. The specification in column 3 and 6 further adds a set of family controls that include the following: if the student lives with both parents and the presence of siblings, dummy variables indicating the parents' level of education, and employment and job skill category as described in the footnote of Table A1. For each variable, we include an indicator controlling for when the answer is missing. Robust standard errors, clustered at the class level, are in parentheses. Significance levels: *** p $<$ 0.01, ** p$<$ 0.05, * p$<$ 0.1.

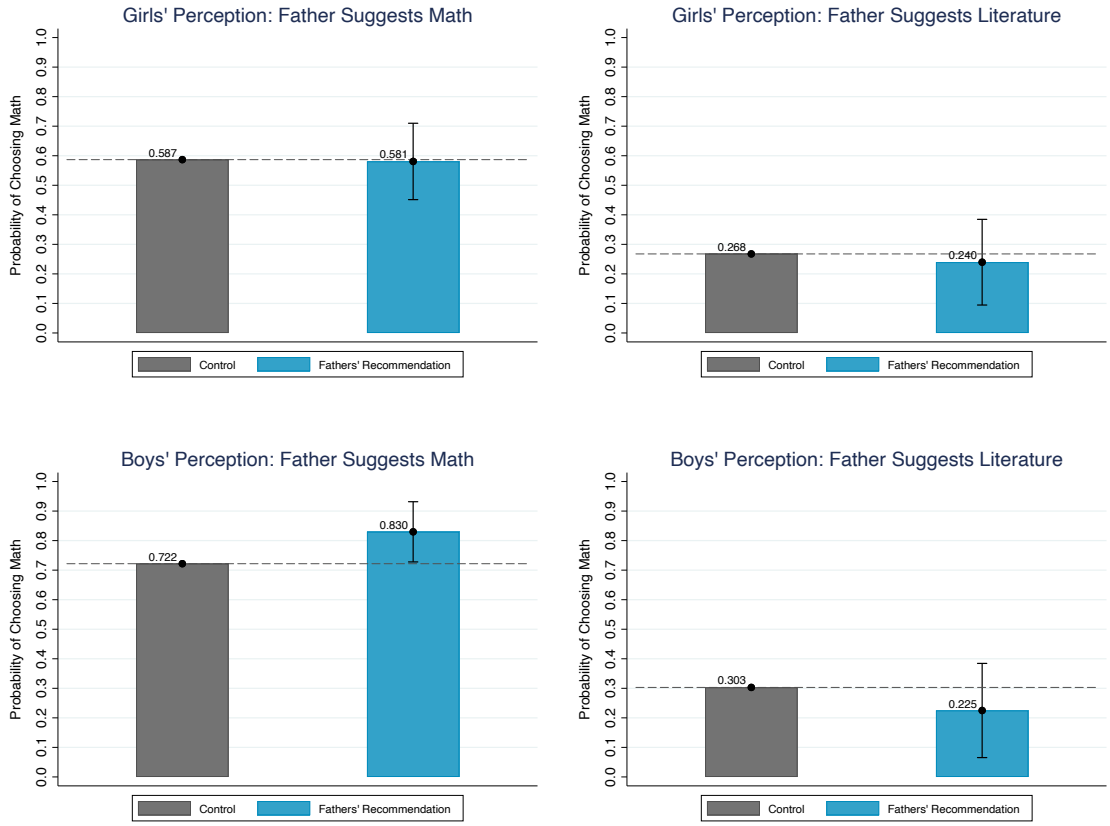
Significance levels: *** p$<$ 0.01, ** p$<$ 0.05, * p$<$ 0.1.

Figure A2. : Heterogeneous Treatment Effects by Child's Perception of Mother's Suggestion



Notes: This figure shows the mean of the probability of choosing math for students in the control group, treatment group 1 (Mothers' Recommendation), and treatment group 2 (Fathers' Recommendation), divided by the child's perception of their mother's suggestion (math or literature). The coefficients are obtained from a regression including class fixed effects and all controls (as in columns 4 of Table A3). We also report the 95% confidence intervals for each estimate.

Figure A3. : Heterogeneous Treatment Effects by Child's Perception of Father's Suggestion



Notes: This figure shows the mean of the probability of choosing math for students in the control group, treatment group 1 (Mothers' Recommendation), and treatment group 2 (Fathers' Recommendation), divided by the child's perception of their father's suggestion (math or literature). The coefficients are obtained from a regression including class fixed effects and all controls (as in columns 4 of Table A3). We also report the 95% confidence intervals for each estimate.

Table A4—: Heterogeneous Treatment Effects by Perception of Parental Recommendation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dep. Variable: Student Chose Math							
	Female				Male			
Panel A: Belief of Mother's Advice								
Treatment 1 - Think of mother recommendation	-0.214***	-0.183***	-0.172***	-0.186***	-0.148**	-0.128	-0.093	-0.085
	(0.054)	(0.068)	(0.066)	(0.067)	(0.070)	(0.083)	(0.080)	(0.083)
	{ 0.020}**	{ 0.154}	{ 0.260}	{ 0.236}	{ 0.033}**	{ 0.075}*	{ 0.117}	{ 0.236}
Treatm. 1 × mum suggests math	0.270***	0.188	0.159	0.179	0.219**	0.219**	0.191*	0.161
	(0.092)	(0.115)	(0.116)	(0.117)	(0.086)	(0.107)	(0.101))	(0.105)
	{ 0.000}***	{ 0.018}**	{ 0.020}**	{ 0.010}***	{ 0.041}**	{ 0.154}	{ 0.260}	{ 0.256}
Mother suggests math	0.193***	0.195**	0.178**	0.164*	0.351***	0.336***	0.319***	0.348***
	(0.071)	(0.091)	(0.090)	(0.089)	(0.058)	(0.071)	(0.069)	(0.068)
Panel B: Belief of Father's Advice								
Treatment 2 - Think of father recommendation	-0.075	-0.143*	-0.124*	-0.132*	0.012	0.015	0.016	-0.044
	(0.070)	(0.079)	(0.074)	(0.077)	(0.073)	(0.089)	(0.088)	(0.094)
	{ 0.407}	{ 0.725}	{ 0.795}	{ 0.915}	{ 0.008}***	{ 0.219}	{ 0.419}	{ 0.411}
Treatm. 2 × dad suggests math	0.119	0.083	0.077	0.053	0.242***	0.165	0.129	0.142
	(0.089)	(0.109)	(0.113)	(0.115)	(0.085)	(0.106)	(0.106))	(0.114)
	{ 0.407}	{ 0.725}	{ 0.795}	{ 0.915}	{ 0.407}	{ 0.725}	{ 0.795}	{ 0.915}
Father suggests math	0.319***	0.288***	0.264***	0.262***	0.419***	0.432***	0.415***	0.414***
	(0.067)	(0.085)	(0.084)	(0.086)	(0.061)	(0.073)	(0.071)	(0.074)
Class FE	N	Y	Y	Y	N	Y	Y	Y
Student controls	N	N	Y	Y	N	N	Y	Y
Family controls	N	N	N	Y	N	N	N	Y

Notes: Standard errors in parentheses are clustered at the class level. FWER p-values are displayed in braces underneath standard errors. Columns 2-4 and 6-8 control for class fixed effects. Columns 3-4 and 7-8 add controls for the student: baseline grades in math and literature (for students in grades 7 and 8 of our experiment), an indicator for whether the student is an immigrant, the IAT score, and an indicator of explicit stereotypes as described in the footnote of Table A1. The specification in columns 4 and 8 further adds a set of family controls that include the following: if the student lives with both parents and the presence of siblings, dummy variables indicating the parents' level of education, and employment and job skill category as described in the footnote of Table A1. For each variable, we include an indicator controlling for when the answer is missing.

Significance levels: *** p< 0.01, ** p< 0.05, * p< 0.1.