Competitive Schools and the Gender Gap in the Choice of Field of Study

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ABSTRACT

In most developed countries, students have to choose a major field of study during high school. This is an important decision because it largely determines subsequent educational and occupational choices. Using French data, this paper reveals that enrollment at a more selective high school, with higher-achieving peers, has no impact on boys, but a strong impact on girls' choices: they turn away from scientific fields and settle for less competitive ones. Our results are not consistent with two commonly advanced explanations for gender differences in field of study—namely, disparities in prior academic preparation and in sensitivity to rank in class.

I. Introduction

In most developed countries, male and female students still choose very different major fields of study during high school or college. In French high schools for instance, male students are about 40 percent more likely than female students to specialize in science.[1] These gender differences have attracted considerable attention

1. See Direction de l'évaluation, de la prospective et de la performance (2014). The requirement to choose major fields of study during high school is not specific to the French system. Similar requirements exist in the UK, Spain, Italy, Switzerland, Denmark, Norway, and Korea for instance. For evidence on the gender gap in

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because they likely explain a significant part of labor market differentials across gender groups. The choice of science as a major field of study is typically associated with the best prospective outcomes, but female students are still dramatically underrepresented in this field.

A long-standing literature has explored the causes of the gender gap in the choice of field of study, with a specific emphasis on gender differences in ability, expectations, or preferences. Several influential studies have also emphasized the role of teaching practices and teachers' stereotypes.[2] Here we analyze the role of another potential determinant of students' choices—namely, the school environment in which they make their decisions. Specifically, we look at whether the choice of field of study of girls and boys depends on the academic level of the schoolmates with whom they have to compete. In more selective schools, with higher-achieving peers, students may be induced to form new expectations about their chances of success in the different fields, which may eventually affect their choices.

It has long been recognized that enrollment at a more selective school, with higher-achieving peers, may affect students' subsequent performance and graduation probability, even though empirical evidence is mixed (see, for example, Pop-Eleches and Urquiola 2013; Abdulkadiroğlu, Angrist, and Pathak 2014). Much less is known, however, about whether enrollment in selective schools affects students' choice of field of study. One basic reason for this lack of evidence is that the choice of major field of study often occurs at the same time as the high school choice, so that it is logically very difficult to define the impact of the latter on the former. Another basic difficulty is that the choice of enrolling in a more selective school and the choice of field of study likely depend on the same explanatory factors, such as students' willingness to compete. In such a context, where two decisions potentially share the same causes, it is typically very hard to evaluate the influence that they exert on each other, even when they do not take place at the same time. Students enrolled in selective schools tend to choose more demanding fields of study, but it does not follow that their choice is influenced by their school environment.

We build on the features of the Parisian high school system to overcome these issues. One feature of this system is that middle school students are assigned to high schools through a centralized process that gives priority to students with the best average grades in middle school. About half of high schools receive more applications than they have places to offer, and enrollment at each of these schools is restricted to students whose middle school average grade is above a specific cutoff level computed by the system. The second basic feature of the system is that students do not have to choose their major field of study at the start of high school, but only after one year (that is, Grade 10). In this context, it is possible to isolate the impact of enrollment at an oversubscribed high school on subsequent choices of field of study by comparing students whose middle

field of study in secondary education, see, for example, Buser, Niederle, and Oosterbeek (2014) for the Netherlands; Joensen and Nielsen (2016) for Denmark; Office for Standards in Education (2015) for the UK; and Buser, Peter, and Wolter (2017) for Switzerland. For evidence on the gender gap in the choice of field of study in U.S. postsecondary education system see for example Chen and Weko (2009).

2. For an analysis of teachers and teaching practices, see Carrell, Page, and West (2010); Joensen and Nielsen (2009); and Lavy and Sand (2015). For an analysis of the role of attitude toward competition, see Buser, Niederle, and Oosterbeek (2014); Croson and Gneezy (2009); and Niederle and Vesterlund (2010, 2011). For an analysis of gender differences in preferences and expectations, see Zafar (2013).

school achievements were either just above or just below the specific cutoff level of this more selective high school.

This regression discontinuity analysis first confirms that eligibility for enrollment in a more selective school is associated with a very significant increase in the ability level of high school peers. It also reveals that this increase in peer ability is even more significant in science than in humanities, so that enrollment in a more selective school is first and foremost associated with an increase in competition in science. Importantly, these first-stage effects on peer ability are very similar for boys and girls, consistent with the assumption that, in our setup, there is no gender gap in the willingness to attend higher-ranked schools.

In contrast, eligibility for admission into a more selective school, with higher-achieving peers, has very different effects on the choice of major field of study made by boys and girls one year later, at the end of Grade 10. Specifically, it has no effect on boys, but induces a significant decrease in the probability that girls choose science and a symmetrical increase in the probability that they choose humanities. Eventually, enrollment at a more selective school is not followed by any significant change in students' overall graduation probability, but by a significant decrease in the share of girls who graduate in science.

Generally speaking, our results are consistent with experimental findings showing that female students are more likely to turn away from competitive settings than their male counterparts (see, for example, Croson and Gneezy 2009; Niederle and Vesterlund 2011). They are also consistent with Rask and Tiefenthaler (2008) or Goldin (2015), who suggest that female students tend to be more responsive to a decline in performances than males. Our work contributes to showing the decisive impact of these gender differences on the choices made by girls and boys during high school. Because science is the field of study where competition increases the most in sought-after schools, gender differences in attitudes towards grades and competition appear to induce many female students to turn away from science. Our findings are also reminiscent of the literature on college major choice in the United States and on the role played by students' expectations in this choice (see, for example, Stinebrickner and Stinebrickner 2014; Wiswall and Zafar 2015). In a related contribution, Arcidiacono, Aucejo, and Hotz (2016) show that the probability that a minority student graduates in science may be much lower in more selective Californian universities than in less selective ones.

Finally, our study contributes to the literature on the effect of going to a more selective school with higher-achieving peers (see, for example, Abdulkadiroğlu et al. 2017; Clark and Del Bono 2016; Cullen, Jacob, and Levitt 2006; Jackson 2013). Several recent papers build on a similar regression discontinuity design to provide evidence on the effect of selective schools on students' performance in various institutional contexts (see, for example, Abdulkadiroğlu, Angrist, and Pathak 2014; Dobbie and Fryer 2014; Pop-Eleches and Urquiola 2013). This literature finds mixed evidence on the impact of elite schools on student academic performance.[3] Because French students have to

3. Most studies on elite schools in the United States find little or no effects on academic achievement (Abdulkadiroğlu, Angrist, and Pathak 2014; Cullen, Jacob, and Levitt 2006; Dobbie and Fryer 2014), but positive effects are found in other contexts (Estrada and Gignoux 2017; Jackson 2010; Pop-Eleches and Urquiola 2013). There is a small related literature on the impact of students' rank within their school on their subsequent academic performance (see Murphy and Weinhardt 2014).

choose a major field of study at the end of their first year of high school, we are able to look not only at the impact on academic performance, but also on the choice of field of study. The effect of gaining admission to a more selective school appears to be much stronger on field of study than on academic performance. There is a small recent literature that documents similar findings about tracking within schools (see, for example, Dougherty et al. 2017; He 2016).

The paper is organized as follows. Section II describes the institutional context. Section III describes our administrative data sources, while Section IV provides basic graphical evidence on the impact of being eligible for admission into a selective school on students' subsequent choices of field of study or graduation probabilities. Sections V develops our regression discontinuity analysis. Section VI explores the candidate mechanisms that may explain that more competitive school contexts induce female students to turn away from science.

II. Institutional Context

In this section, we provide information on how middle school students are assigned to high schools in Paris, as well as on the exams that they have to take and the choices that they have to make during their high school years. In the following sections, the main research question will be whether the high school to which a middle school student is assigned affects her subsequent choices and performance on exams.

A. The Assignment of Middle School Students to High Schools

In France, middle school runs from Grade 6 to Grade 9. Students complete Grade 9 the year they turn 15. The curriculum is the same in all middle schools, and there is no streaming by ability. At the end of Grade 9, students enter into high school, which runs from Grade 10 to Grade 12. This paper focuses on students who completed Grade 9 in public middle schools in the education region of Paris, in either 2009 or 2010.

France is divided into 30 education regions and the education region of Paris represents about 3 percent of French middle school students. In this region, there are about 100 public middle schools and about 50 public high schools where middle school students can pursue general education courses. Middle school students are assigned to public high schools through a centralized process called *Affelnet*, which is completely gender-blind and is described in detail in Hiller and Tercieux (2014) and in Fack, Grenet, and He (2015). Students are first asked to list up to six choices of public high schools in descending order of preference.[4] Paris is divided into four geographical districts (West, East, North, and South), and there is a very strong incentive to apply to high schools in one's district of residence since the system gives priority to home-district over out-of-district applications. Also, within each district, a priority is given to low-income

4. Students from public middle schools can also apply to private high schools, but this is not processed by *Affelnet*. As discussed below, we checked that eligibility for admission into a more selective public high school has no effect on the probability that students from public middle schools go to a private high school. Students from private middle schools can also apply to public high schools, but their applications are processed separately, after those of students from public middle schools.

students, namely the 20 percent students eligible to means-tested financial assistance. For the other students, the system ranks their applications according to the average of their Grade 9 marks across all subjects and assigns them to as many seats as possible using a deferred acceptance algorithm (Roth 1982) and a multiround process.[5] There are 12 subjects (Mathematics, Physics, Biology, Technology, French, History/Geography, Sport, two foreign languages, Art, Music, and Discipline), and the marks used to compute the average score used by the system are first standardized at the region level. Standardization amounts to weighting each mark by the inverse of its standard deviation. These weights being revealed only ex post (that is, after all students have submitted their choices), the weighted average marks used by the system are ex ante impossible to precisely predict or manipulate.

In substance, the algorithm first assigns the students with the best Grade 9 average marks to their preferred schools until one school starts being oversubscribed. This top school is then dropped from the application lists of the remaining (not yet assigned) students. These students are then reranked and the process is reiterated until another school starts being oversubscribed, and so on. At the end of this first round, there are no seats left in a fraction of schools (that is, the oversubscribed ones), whereas the other schools are still undersubscribed. Similarly, a fraction of students are assigned to one of the schools of their list, whereas the other fraction are still unassigned (that is, they applied for oversubscribed schools only). To further improve the assignment rate, each unassigned student is then asked to form new choices, namely to apply to at least one of the undersubscribed schools, and the process is reiterated. At the end of this second round, some students are still unassigned, and the education administration helps them find a seat in one of the remaining undersubscribed schools in an informal way. Undersubscribed schools are typically those that end up admitting a significant proportion of out-of-district students.

The key feature of this assignment process is that it is possible to define a minimum admission score for a large fraction of high schools, namely the oversubscribed ones. As discussed below, in 2009 and 2010, about half of the public high schools of the region of Paris were oversubscribed, with very significant discontinuities in the rate of enrollment of students at specific cutoff points of the distribution of Grade 9 scores. This feature will make it possible to build on a regression discontinuity analysis to evaluate the effect of being admitted to these schools on subsequent educational outcomes. Specifically, we focus on students whose Grade 9 scores fall either just above or just below the cutoff point of an oversubscribed school, and we compare the outcomes of those just above with those just below. The vast majority of these students continue general education in high school, and the question is whether enrollment at a higher-ranked school affects either their major field of study in high school or the level of their academic performance.[6]

Generally speaking, our research strategy relies on the assumption that individual Grade 9 scores and schools' minimum admission scores cannot be manipulated and predicted. As discussed above, there is little scope for manipulation of individual scores.

5. A bonus is granted for students who apply to high schools where they have a brother or a sister.

6. It should be emphasized that no school is oversubscribed with low-income students (the maximum proportion of low-income students is 60 percent). Hence, there is no school that can define a minimum admission score for low-income students. Minimum admission scores are defined for non-low-income students only.

With respect to schools' minimum admission scores, they depend on many factors that are no easier to predict than individual scores, such as the exact number of low-income students and the exact distribution of their choices across schools in each district. In this setup, there is again little scope for manipulation or prediction.[7] As discussed below, we find no evidence of discontinuities in the density of individual scores—or in students' preassignment characteristics—at the cutoff.

B. Major Field of Study and High School Exit Exams

At the end of their first year of high school (Grade 10), French students can either pursue general education or enter a technical or a vocational education program. Furthermore, those who pursue general education have to choose a major field of study. There are three possible fields: science (field "S"), economics and social sciences (field "E/S"), or languages and literature (field "L"). The number of students per school and field of study is not set. It can vary significantly from one year to another to meet the choices of students.[8] At the end of Grade 10, students are asked the field of study that they prefer, and, eventually, the vast majority of students are allowed to pursue the track that they prefer. This is a key choice: each field of study corresponds to a very specific curriculum, specific high school examinations, and specific opportunities after high school.

For example, for those who choose to specialize in science, the scientific subjects represent 50 percent to 60 percent of compulsory courses in Grades 11 and 12. By contrast, for those who choose to specialize in languages and literature, scientific subjects represent less than 5 percent of compulsory courses. With respect to postsecondary education, it is virtually impossible to enter an engineering school or a medical school after nonscientific studies in high school.[9]

Generally speaking, science is the most prestigious field of study. Students in the scientific track performed on average 60 percent of a standard deviation higher in middle school than students in the social sciences track and 75 percent of a standard deviation higher than those in the languages and literature track. In our working sample, about 31 percent of students choose the scientific track, 13 percent specialize in literature and languages, 22 percent specialize in social sciences, and about 34 percent opt for a more technical or vocational program or drop out of school.

The first year of high school (Grade 10) is dedicated to exploring the different subjects and to choosing a major field of study. After this exploration year, students have very little leeway to change their major field of study. In Paris, only about 2.5 percent of students change their major field of study after Grade 10. The two last years of high school (Grades 11 and 12) are dedicated to the preparation of the national high school

7. We checked that most schools do not have the same minimum admission score for the first and for the second cohort. About half of schools do not even have the same exact rank within their district (in terms of minimum admission score) from one cohort to another.

8. We checked that the number of students who choose science as major field of study actually varies significantly from one year to the other within most schools. The within-school variation rate is on average 10 percent.

9. According to a national longitudinal survey conducted by the Ministry of Education (so-called Panel d'élèves du second degré, recrutement 1995), only about 1 percent of students who graduate in humanities pursue a science track after high school (see also Direction de l'évaluation, de la prospective et de la performance 2012).

exit exam, the *baccalauréat*, which is a prerequisite for entry into postsecondary education. Students have to take one exam per subject, and they obtain their diploma if their weighted average mark across subjects is 10/20 or more, where subjects taken and weights depend strongly on the major field of study. For instance, the weights of exams in scientific subjects represent about 50 percent of the total for students who choose these subjects as major field of study, whereas the weights of these subjects is only about 20 percent for those who choose social sciences and 5 percent for those who choose languages and literature. Most exams are taken at the end of Grade 12, except for exams in French (oral and written), which are taken at the end of Grade 11. Students whose weighted average mark across subjects is 12/20 or more graduate with honors. Graduation with honors is granted to about half of the students each year in each field.

C. Selective Undergraduate Programs

High school graduation is a prerequisite for admission into postsecondary education programs. About half of these programs are selective, and selection depends on the grades obtained in the two last years of high school as well as on students' ranks within their class. The *Classes Préparatoires aux Grandes Écoles* (CPGE) are among the most prestigious such selective programs. These two-year programs prepare students to take the entry exams of the most prestigious graduate programs (so-called *Grandes Écoles*). The last important question addressed in this paper is whether enrollment at a more selective high school at the end of Grade 9 affects the subsequent probability of gaining access to CPGE programs at the end of Grade 12.

There are different types of CPGE programs: some specialize in science (they prepare for entry exams at engineering graduate schools), some specialize in economics and business (they prepare for entry exams at business schools), and some specialize in literature and languages (they prepare for entry exams at top graduate programs in this field). Each year, in Paris, about 20 percent of students from high school general education programs gain access to a CPGE. The vast majority graduate from high school with honors. When a student applies to a CPGE program, her high school has to provide the average marks (as assessed by teachers) that the student obtained in each subject for each quarter during Grades 11 and 12, as well as the corresponding rank within their class. Hence, students from more selective high schools may benefit from the prestige of their schools, but may suffer from being less well ranked within their class.

III. Data and Methods

A. Data

In our empirical analysis, we use administrative data providing detailed information on students who finished middle school (Grade 9) in either 2009 or 2010 in the education region of Paris. For each student, we know the high school to which she was assigned after Grade 9, the field of study chosen at the end of Grade 10, and the field of study in which she graduated at the end of Grade 12. For each student, we also know whether she repeated a grade during high school, whether she dropped out from education before graduation, and whether she was admitted into a CPGE program after high school.

With respect to students' academic performance, we know the average marks given by teachers in each subject during Grade 9, as well as results at the national exams taken in Mathematics and French at the end of Grade 9 (externally set and marked). We also know students' results at the national examination (*baccalauréat*, externally set and marked) taken at the end of high school (Grade 12). As discussed previously, the score used to assign middle school students to high schools corresponds to an average of the average marks given by Grade 9 teachers.

To construct this data set, we used schools' registration records as well as administrative records with exhaustive information on results at the end of middle school and at the end of high school national exams, for each year between 2009 and 2014. We were able to match these different data sources using students' ID numbers.

Finally, we augmented our individual-level database with information coming from school-level administrative data sets, namely information on high school size, the proportion of female teachers, and the distribution of teachers' ages.

B. Cutoff Scores

In this section, we consider the 52 public high schools that entered the centralized assignment system in 2009 or 2010. For each cohort and each district, we focus on the Grade 9 students whose applications went through the standard assignment process; that is, the students are not classified as low-income and come from a public middle school of the district.[10] Our purpose is to identify the public high schools that received more applications than they could accommodate and to estimate the lowest Grade 9 score that students had to earn to gain admission into these schools.

Our data do not provide information on students' rank order lists, so it is not possible to identify which schools are oversubscribed (and their minimum admission scores) directly from the data. To overcome this issue, we built on a method developed by Hansen (2000). Among all possible minimum admission scores, the method first identifies for each school the scores that coincide with a significant discontinuity in enrollment rates. If any such thresholds exist, the method amounts to choosing for each school the specific threshold that corresponds to the most significant discontinuity. More details on how we implemented this procedure are provided in Online Appendix B.

Card, Mas, and Rothstein (2008) used this method to estimate for each large American city the minimum proportion of minorities above which white residents start to flee a neighborhood. Hoekstra (2009) also used this method in his analysis of the benefits of attending a flagship university. In a recent contribution, Porter and Yu (2015) show that regression discontinuity estimates and standard errors are unaffected when using this two-stage method, where cutoffs are estimated first, followed by a standard regression discontinuity model.

In our case, this method makes it possible to identify 23 schools that were likely significantly oversubscribed in 2009, and 26 in 2010 (out of 52). For each oversubscribed school j, it is possible to define the subsample S_j of students who are not low-income, who come from a public middle school located in the same district as j, and whose Grade 9 scores are closer to the minimum admission score of j (denoted q_j*) than

10. As mentioned above, low-income students and students from private middle schools are processed separately by the centralized system.

to any other minimum admission score in the district. This subsample S_j covers the set of students who are either just above or just below the minimum required score for admission into j, but for no other school. For each student i in S_j, we can also define her percentile rank distance D_i to the cutoff admission score of j, where $D_i > 0$ corresponds to students above the cutoff and $D_i < 0$ to students below the cutoff.[11]

In the remainder of the article, we develop a regression discontinuity analysis using D_i as the running variable and focusing on the students in the pooled sample of all S_j whose distance D_i to the admission cutoff is smaller than 25 percentiles.[12] We also drop from our working sample students whose Grade 9 scores fall just between the two quantiles below and above q_j*, namely students whose Grade 9 scores are too close to the cutoff to know for sure whether they are above or below.

Overall, our working sample consists of about 7,500 students whose Grade 9 scores fall close to an admission cutoff, and our basic research question will be whether we observe discontinuous behavior and performance above and below the $D_i = 0$ cutoff. In Online Appendix Tables A1–A4, we report basic descriptive statistics for students in this pooled sample. In this sample, about 24 percent of girls choose to specialize in science after Grade 10 versus about 38 percent for boys.

IV. Graphical Evidence

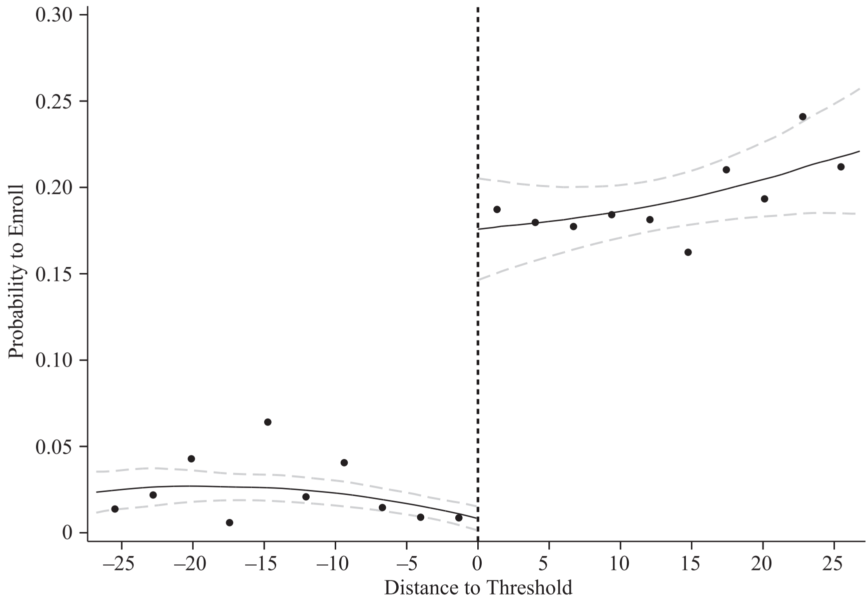
Before moving on to a more comprehensive regression analysis, we start by providing graphical evidence on the effect of eligibility for admission into a higher-ranked school on three basic outcomes, namely the type of school in which students end up attending after Grade 9, their choice of field of study at the end of Grade 10, and their performance on the high school exit exam at the end of Grade 12. As discussed above, we focus on the pooled sample of students whose Grade 9 score is either just above or just below the minimum admission score of an oversubscribed high school. The basic question is whether we observe discontinuities in enrollment, choice, and performance between students above and below the cutoff score. Another important issue is whether we observe similar discontinuities for boys and girls.

A. First Stage: Effect of Eligibility on Enrollment

To start with, Figures 1a and 1b show the probability of enrollment at a higher-ranked high school for students whose Grade 9 score is either just above or just below the minimum admission score.[13] Figure 1a focuses on girls, whereas Figure 1b focuses on

11. Within each sample S_j, we first define the percentile rank of each student using their Grade 9 score. We then rescale this percentile rank variable so that the rescaled rank is zero for students whose Grade 9 score is equal to the minimum admission score. This running variable is the same as the one used by Abdulkadiroğlu, Angrist, and Pathak (2014).
12. We obtain this bandwidth using Calonico, Cattaneo, and Titiunik (2014). As discussed in the next section, we checked that our results are robust to alternative bandwidths.
13. For each figure, the solid line shows smoothed values of a kernel-weighted local polynomial regression of the dependent variable on the standardized distance to the threshold. We use a triangular kernel and a degree one polynomial smoothing. Smoothed values are estimated separately on each side of the cutoffs. Plotted points represent the mean of the dependent variable for all applicants in a one-unit bin width. The bandwidth is computed following Calonico, Cattaneo, and Titiunik (2014).

Panel A: Girls



Panel B: Boys

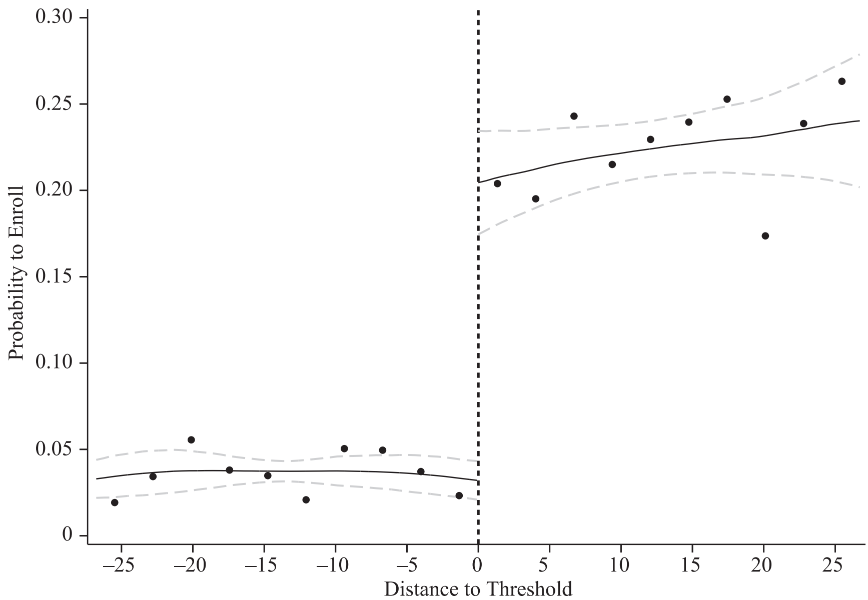


Figure 1

Enrollment Probability

Notes: The figure refers to the sample of middle school students who were in their last year of middle school (Grade 9) in 2009 or 2010 and whose Grade 9 score fell either just below or just above the admission threshold of an oversubscribed high school. The bandwidth is computed following Calonico, Cattaneo, and Titiunik (2014). The figure shows the probability to enroll into this school, plotted against the standardized distance to the threshold.

boys. Reassuringly, they show a very significant shift at the cutoff, with the probability of enrollment at a higher-ranked high school about 17 percentage points higher for students just above the cutoff than for students just below the cutoff. This finding suggests that, among students whose Grade 9 score falls close to the minimum admission score of an oversubscribed school, about 17 percent prefer this school to any lower-ranked school. Results are very similar for girls and boys. It is consistent with the assumption that girls are no less willing than boys to enroll in selective schools.[14]

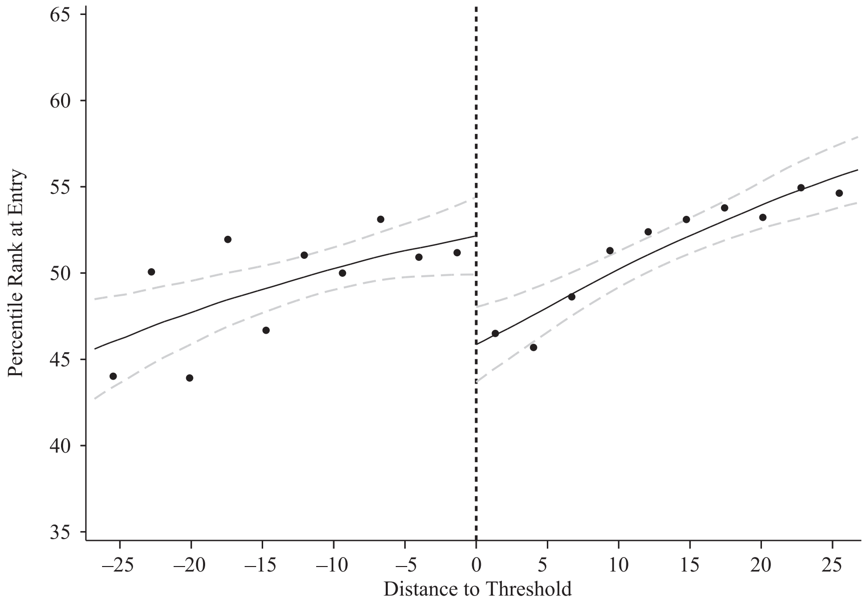
The first potential reason for why enrollment at a higher-ranked high school may matter is that it is likely associated with a strong increase in the ability level of high school peers and, consequently, with a strong decline in students' own ability rank. To provide evidence on this issue, we define for each student her percentile rank in the distribution of Grade 9 scores across her high school peers. Figures 2a and 2b show the variation in this rank variable for students just above and just below the minimum admission score. On the left-hand side of Figures 2a and 2b, we observe a smooth increase in students' ranks as their (absolute) score increases and gets closer to the cutoff. On the right-hand side, we observe a similar mechanical improvement as we consider students with better scores. But, when we compare the first noneligible students (just below the cutoff) with the last eligible ones (just above), we observe a significant downward shift of about –6 percentile ranks. Consistent with Figures 1a and 1b, the shift is similar for boys and girls. Figures 3a and 3b further explore the nature of the change in peer competition at the cutoff. We considered marks in Mathematics and French (using results at end-of-middle school national exams, externally set and marked), and we divided students' marks in Mathematics by their marks in French, so as to construct (after standardization) a measure of students' relative ability in Mathematics. The figures plot the average of this Mathematics/French ratio across high school peers, above and below the cutoff. They reveal a significant upward shift in peers' relative ability in Mathematics at the cutoff, for both male and female students. We checked that these results are very similar when we use marks given by Grade 9 teachers to construct our Mathematics/French ratio. These findings likely reflect that the willingness to attend a higher-ranked school is stronger among students who are relatively stronger in Mathematics. More importantly, these results show that enrollment at a higher-ranked school is associated with an increase in peer competition, which is even stronger in science than in humanities.

B. Field of Study at the End of Grade 10

Enrollment in a higher-ranked school is associated with an increase in the level of peer competition, and the next basic question is whether it affects students' subsequent choices and performance. Figures 4a and 4b show the probability of choosing science as a major field of study at the end of Grade 10 for students just above and just below the minimum admission score. Similarly, Figures 4c and 4d show the probability of choosing humanities as a major field of study, namely the probability to choose either

14. It should be noted that enrollment rates are not exactly equal to zero for students to the left of the cutoff in Figure 1. This fact reflects that some schools are allowed to develop programs that are focused on a specific theme (sports, music, arts…) and that applications to these specific programs are processed directly by schools, not by the centralized system.

Panel A: Girls



Panel B: Boys

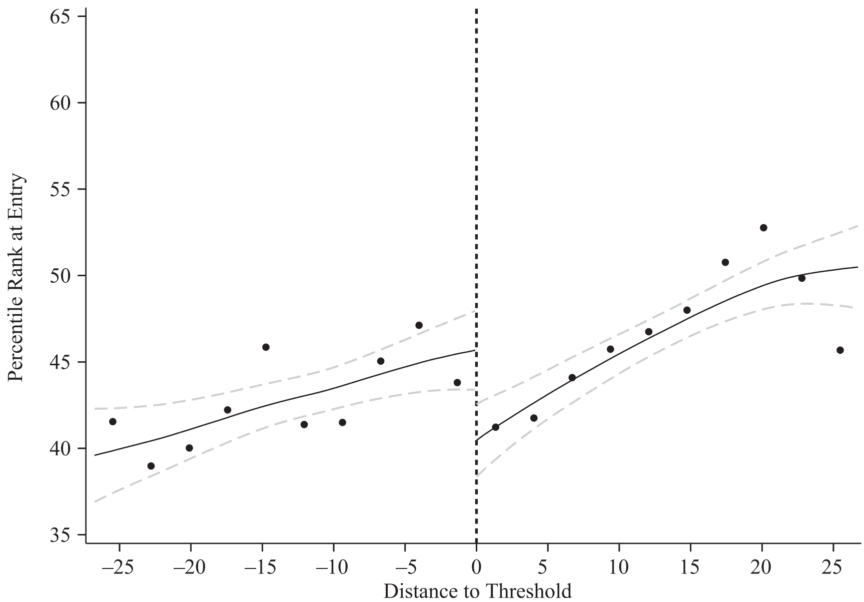


Figure 2

Rank at Entry

Notes: Same sample as for Figure 1, restricted to students who enrolled in general education in a public high school in Paris. For each student in this sample, we computed her percentile rank in the distribution of Grade 9 scores among students admitted into her high school. The figure shows average percentile ranks, plotted against the standardized distance to the threshold.

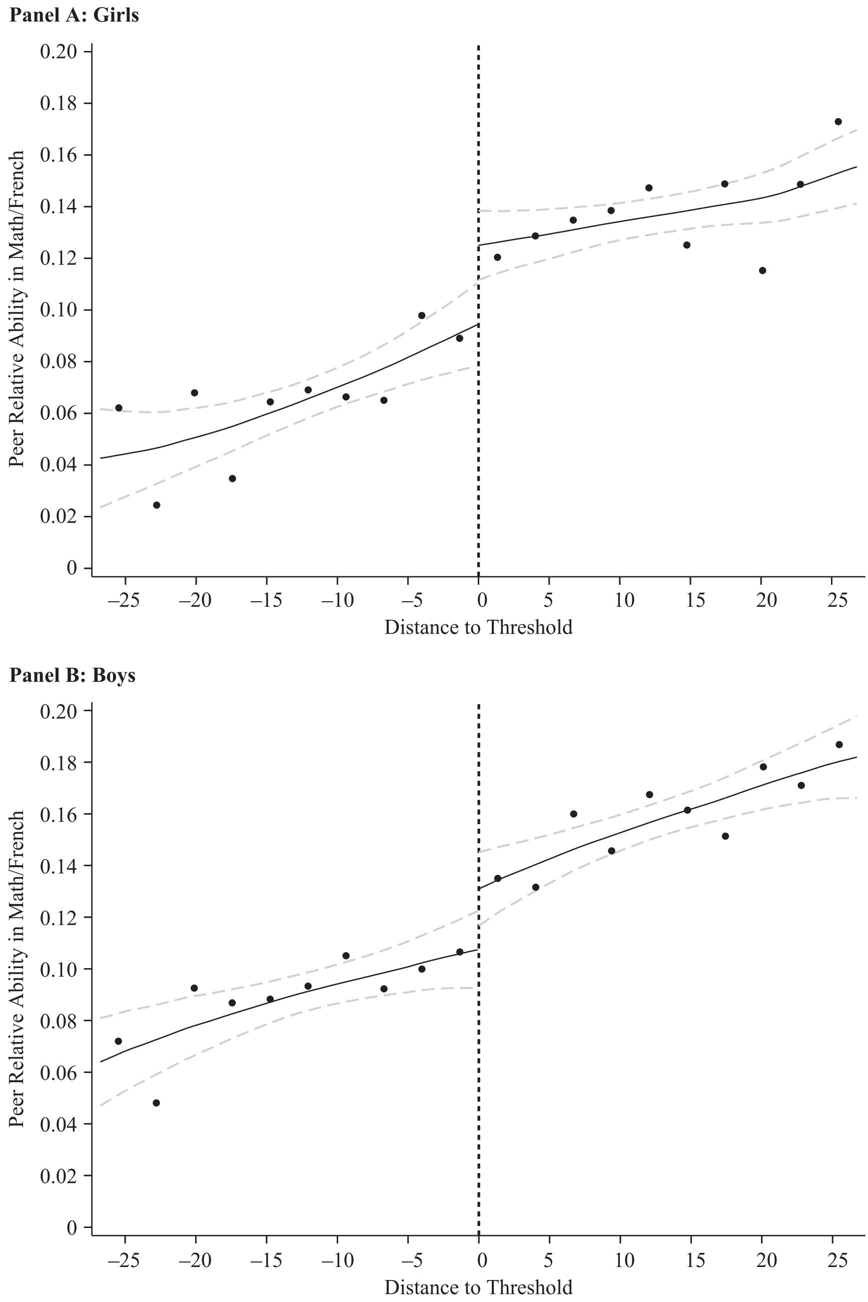


Figure 3

Peer Average Relative Mark Mathematics/French

Notes: Same sample as for Figure 1, restricted to students who enrolled in general education in a public high school in Paris. For each student in this sample, we computed her Grade 10 peers' relative mark in Mathematics/French (using results of middle school national exit examinations). The figure plots a standardized version of this measure of peers' relative ability in Mathematics, against the standardized distance to the threshold.

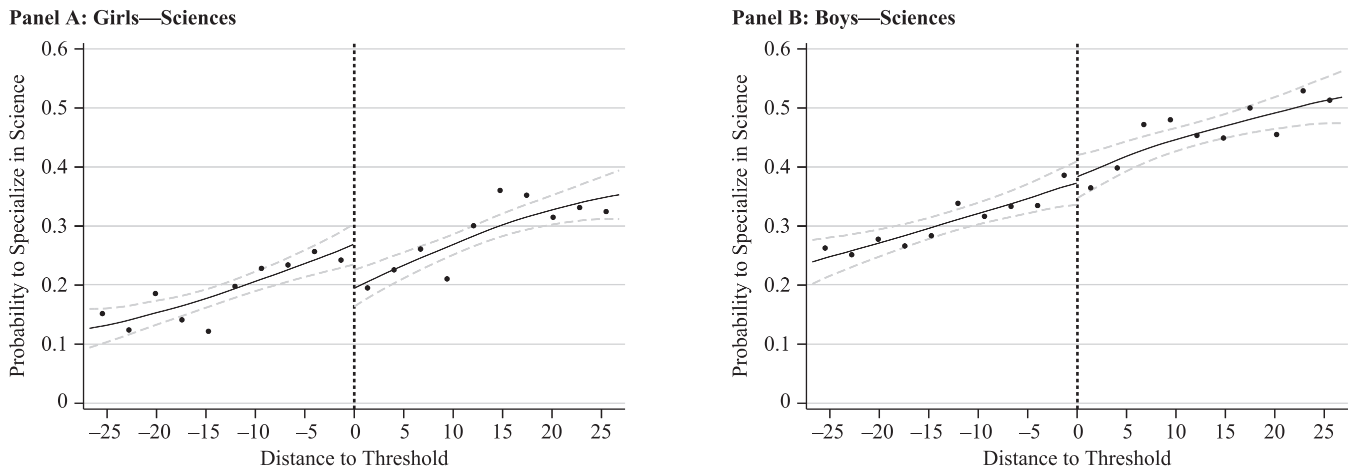


Figure 4
Main Field of Study

Notes: Same sample as for Figure 1. The figure shows the proportion of students who choose science as their major field of study (Panels A and B), humanities (Panels C and D), or technical/vocational education (Panels E and F), plotted against the standardized distance to the threshold.

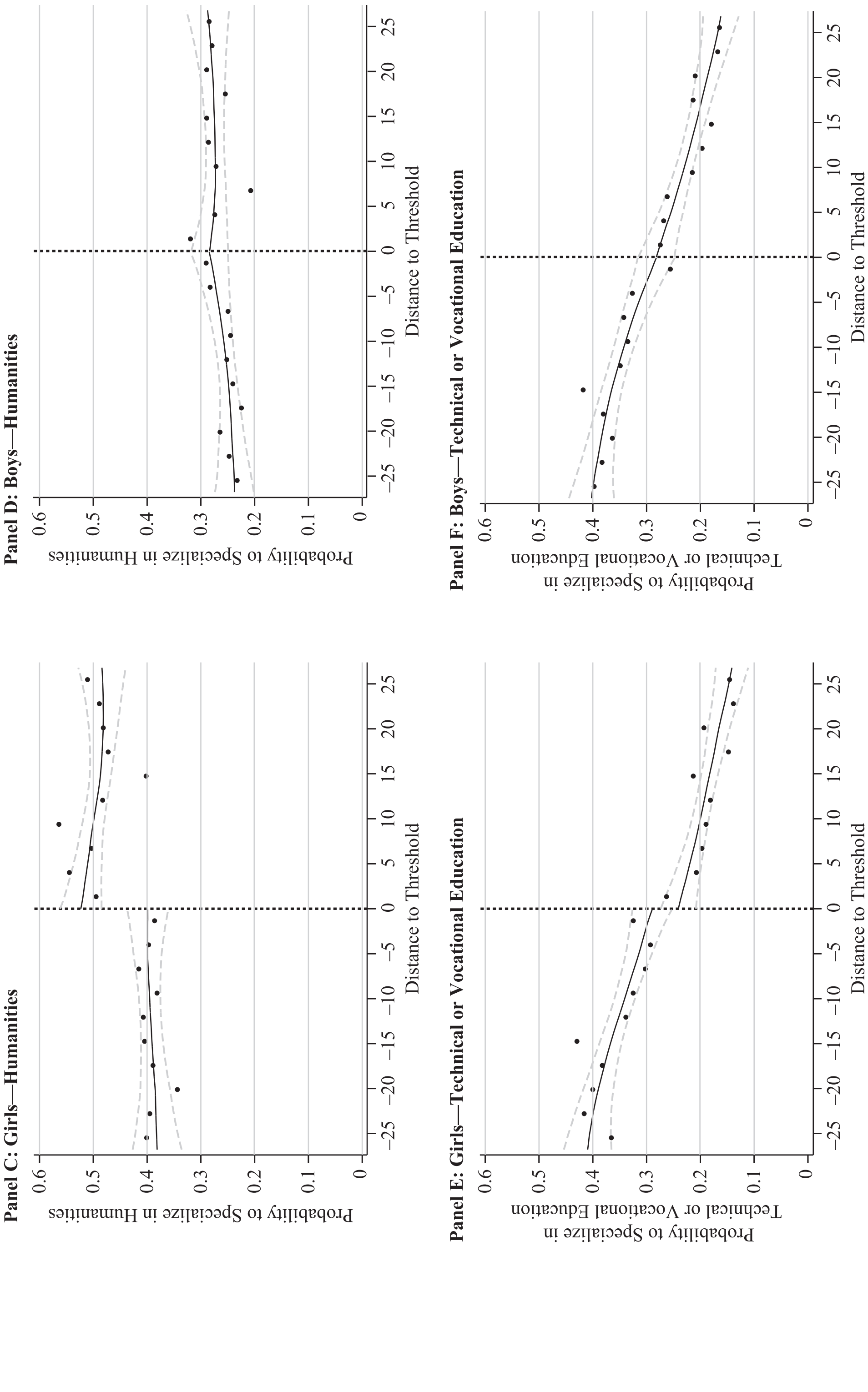


Figure 4 *(continued)*

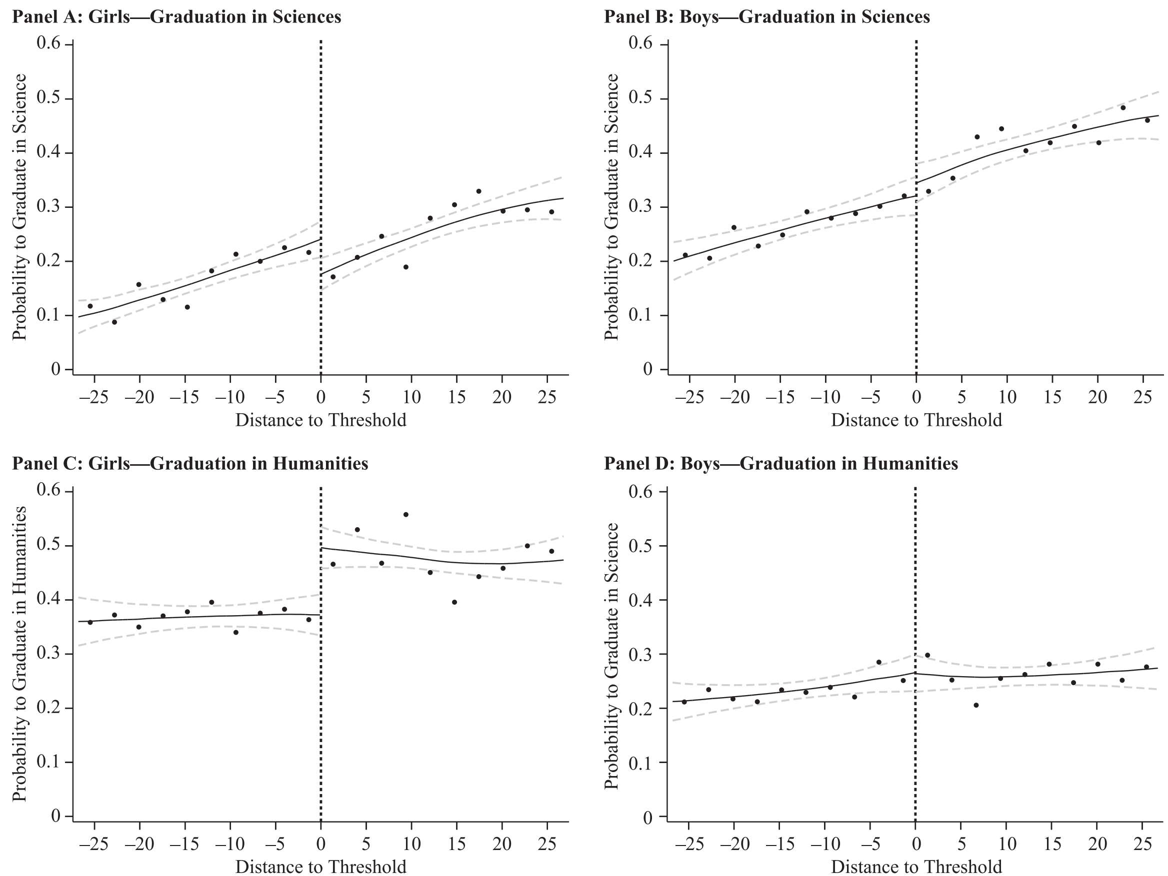


Figure 5
Graduation

Notes: Same sample as for Figure 1. The figure shows the proportion of students who graduate in science (Panels A and B) or in humanities (Panels C and D) plotted against the standardized distance to the threshold.

social sciences or languages and literature. Finally, Figures 4e and 4f show the probability of opting for technical or vocational education at the end of Grade 10. Taken together, these figures reveal that eligibility for admission into a higher-ranked school induces a significant fraction of girls to choose humanities rather than science as a major field of study. We observe a significant rise in the proportion of girls who choose humanities,[15] a significant decline in the proportion who choose science, and a marginal decline in the proportion who opt for technical or vocational education. By contrast, we do not observe any significant shifts for boys.

Figure 5a further shows that the negative shift in the probability that female students choose science at the end of Grade 10 is followed by a shift of similar magnitude in the probability that they graduate in science at the end of Grade 12. Similarly, Figure 5c shows that the positive shift in the probability that girls choose humanities at the end of Grade 10 is followed by a parallel shift in the probability that they graduate in humanities at the end of Grade 12.

Taken together, Figures 5a and 5c suggest that girls who are induced by competition to turn away from science actually succeed in graduating in humanities at the end of Grade 12, but would also have succeeded in graduating in science, had they been assigned to a less competitive school. Finally, consistent with Figures 4b and 4d, Figures 5b and 5d show no shift in the probability that boys graduate in humanities and no shift in the probability that they graduate in science. Hence, enrollment at a more selective school has no effect either on boys' choice of field of study at the end of Grade 10 or on their performance on high school exit exams.

Overall, enrollment at a higher-ranked school does not seem to affect students' graduation probability, only the field in which girls choose to graduate. The fact that we find similar reduced form effects on the field of study chosen by boys and girls at the end of Grade 10 as on the field in which they graduate at the end of Grade 12 is also consistent with the fact that very few students change fields after Grade 10.

Before moving on to our regression analysis, it should be emphasized that our figures represent the effects of eligibility for enrollment (reduced form effects), not the effects of enrollment (local average treatment effects). Given that we find that about 17 percent of eligible students actually enroll in the higher-ranked school at the cutoff (the compliers), enrollment effects on compliers are likely about six times larger than eligibility effects (where $6 \approx 1/0.17$). For example, under the maintained assumption that eligibility matters only insofar as it affects enrollment, a −6 percentage point effect of eligibility on the probability to graduate in science can be interpreted as a −36 percentage point effect of enrollment on the same probability for the 17 percent of students whose assignment is actually affected by eligibility at the cutoff.

V. Regression Results

The previous graphical analysis focused on the most basic high school outcomes: students' ability rank, main field of study, and performance on exit exams. To complement and test the robustness of these graphical findings, this section provides a

15. There is an increase in both the proportion of girls who specialize in social sciences and the proportion who specialize in language/literature, though the increase is stronger for specialization in social sciences.

regression analysis of the effect of eligibility for admission into a higher-ranked school on a more comprehensive set of outcomes, using a large set of control variables and a standard regression discontinuity model as in Lee and Lemieux (2010). We continue to use the same pooled sample of students as in the previous section, namely the pooled sample of students whose Grade 9 score is either just above or just below the minimum score required for admission into a higher-ranked school. For each student in this sample, we still denote D_i the percentile rank difference between the Grade 9 score of student i and the minimum admission score to which her score is close. Variable D_i is positive if student i is just eligible for admission into the higher-ranked school to which her score is close to, and D_i is negative if student i is not eligible for admission into this higher-ranked school. For each outcome Y_i available in our longitudinal database, we estimate the following model:

$$(1) \quad Y_i = \alpha I\{D_i \geq 0\} + f(D_i) + X_i\gamma + u_i$$

where variable X_i is a set of control variables that includes controls for students' age, gender, family background, and average marks in Grade 9, as well as a full set of dummies indicating the high school that corresponds to the nearest cutoff. Function $f(D_i)$ is a first-order spline function of D_i, and we use a tent-shaped edge kernel centered around the admission cutoffs.[16] Variable u_i represents the unobserved determinants of students' choices and performance in high school. The parameter of interest is α. Under the maintained assumption that there is no discontinuity in the distribution of unobserved u_i at the cutoff, this parameter can be interpreted as the causal effect of eligibility for admission in a higher-ranked school on the outcome under consideration. Tables A2–A4 in the Online Appendix provide the means and standard deviations of the different set of outcomes used in this regression analysis. In the same Online Appendix, Table A5 reports the results of regressing the different observed baseline characteristics (gender, age, family background, and average marks in Grade 9) on a dummy indicating eligibility for admission into a higher-ranked school, that is, $I\{D_i \geq 0\}$ using Model 1. Consistent with our identifying assumption, we do not find evidence of any discontinuous variation in baseline characteristics at the eligibility cutoff; that is, the "effect" of $I\{D_i \geq 0\}$ on baseline characteristics is never statistically significant at standard level. Also, when we regress the eligibility dummy $I\{D_i \geq 0\}$ on the full set of baseline variables, an F-test does not reject the null assumption that the coefficients are jointly equal to zero. Figures A1a–A1k in the Online Appendix provide additional graphical evidence on the smoothness of baseline characteristics in the neighborhood of admission cutoffs. Finally, as a last specification test, we build on McCrary (2008) to test for manipulation of the running variable around the cutoff. The test does not show any significant difference in the (log) height at the cutoff and does not reject the null assumption of continuous distribution of the running variable at standard level (p-value = 0.75). The result holds true for both male and female samples.

16. This specification is similar to the nonparametric specification used by Abdulkadiroğlu, Angrist, and Pathak (2014). In Section V.C, we check that our results are robust to using higher-order spline functions with a uniform kernel.

A. First-Stage Effects on School Environment

The first panel of Table 1 shows the estimated effects of eligibility for enrollment into a higher-ranked Parisian public school at the end of middle school (Grade 9) on the type of school attended during the following academic year. It shows that eligibility has no significant effect on the probability that students repeat Grade 9, nor on the probability that they drop out from education. Put differently, there is no evidence that middle school students who fail to be eligible for their preferred high school would rather repeat Grade 9 (or dropping out from education) than go to another high school. The table also shows that eligibility for admission into a higher-ranked public school in Paris has no effect on the probability that students go to a private high school or leave the education region of Paris. Students who do not obtain their preferred choices do not fly away from public education nor from Paris. Overall, consistent with Parisian institutions, the table shows that the main effect of eligibility for enrollment into a selective high school is to induce a very significant rise in the probability of enrollment at this very high school. Findings are very similar for boys and girls.

Since we find no impact on the proportion of students who repeat Grade 9 nor on the proportion of students who drop out of school, it is possible to focus on the subsample of students who go to high school and to look at how eligibility affects their peers' characteristics and school environment at entry into high school. The second panel of Table 1 shows that eligibility has no significant effect on the proportion of female students or on the proportion of low-income students among high school peers.[17] However, eligibility for enrollment into a selective high school is associated with a significant rise in their level of ability. This rise in peer ability translates into a significant decline in students' ability rank within their school, as well as with a very significant rise in students' probability to fall into the bottom quartile of the distribution of peer ability within their school (+14 percentage points). These shifts are about as significant for female and male students.

The table also confirms that the rise in peer ability in higher-ranked schools is even stronger in Mathematics than in French, regardless of whether we focus on girls or boys and regardless of whether ability is measured through teachers' assessment or through results on the middle school exit exams. When we divide baseline marks in Mathematics by baseline marks in French, we find that the average of this Math/French ratio across high school peers is significantly stronger for students eligible for enrollment at a higher-ranked school. Again, we checked that this result holds true regardless of whether ability is measured through teachers' assessment or through results on middle school exit exams. Overall, we get an array of results suggesting that enrollment at a higher-ranked school is associated with an increase in peer competition that is even stronger in Mathematics than in French.

To further explore why enrollment at a more selective school may make a difference, Online Appendix Table A6 shows the results of reestimating Model 1 using the characteristics of teachers and schools as dependent variables. It reveals that there is little

17. This result is a consequence of the fact that low-income students have priority access to the different high schools of their district and, consequently, are not constrained by the admission thresholds under consideration. In that sense, the Parisian setup offers the possibility to analyze the effects of a rise in peer ability holding peer family background and peer gender composition constant. Studies by Jackson (2012) or Eisenkopf et al. (2015) suggest that the gender composition of schools may affect students' achievement and choices.

Table 1
Type of School Attended and Characteristics of High School Peers

	All (1)	Girls (2)	Boys (3)
Panel A: Type of Schools Attended			
Higher-ranked high school	0.173**	0.172**	0.172**
	(0.016)	(0.021)	(0.021)
Private high school	–0.013	–0.027	0.001
	(0.010)	(0.015)	(0.011)
Non-Parisian high school	0.002	0.004	0.000
	(0.006)	(0.008)	(0.008)
Middle school (grade repetition)	0.006	–0.000	0.014
	(0.008)	(0.013)	(0.011)
Dropout (after Grade 9)	0.002	–0.004	0.008
	(0.008)	(0.009)	(0.013)
N	7,573	3,691	3,882
Panel B: Characteristics of High School Peers			
Peers' average Grade 9 score	0.066**	0.080**	0.051*
	(0.014)	(0.019)	(0.020)
Students rank in the distribution of peers' scores	–5.940**	–6.416**	–5.288**
	(1.070)	(1.489)	(1.435)
Students' probability to fall in the bottom quartile of peers' scores	0.140**	0.144**	0.136**
	(0.021)	(0.027)	(0.031)
Proportion of girls among peers	–0.003	0.005	–0.011
	(0.005)	(0.006)	(0.007)
Proportion of low-income students among peers	–0.004	0.003	–0.010*
	(0.003)	(0.005)	(0.005)
Average mark in Mathematics	0.065**	0.070**	0.058**
	(0.014)	(0.019)	(0.020)
Average mark in French	0.047**	0.056**	0.039*
	(0.012)	(0.016)	(0.017)

(*continued*)

Table 1 (*continued*)

	All (1)	Girls (2)	Boys (3)
Average relative mark Mathematics/French	0.026** (0.007)	0.027** (0.008)	0.024* (0.010)
N	5,903	2,937	2,966

Notes: Panel A refers to the sample of middle school students who were in their last year of middle school (Grade 9) in 2009 or 2010 and whose Grade 9 score fell either just below or just above the admission threshold of an oversubscribed public high school in Paris. Panel B refers to the same sample restricted to students who enrolled in general education in a public high school in Paris. For both panels, the bandwidth is computed following Calonico, Cattaneo, and Titiunik (2014). Column 1 refers to the full sample, Column 2 to the subsample of female students, and Column 3 to the subsample of male students. Each row corresponds to a specific dependent variable, namely enrollment at the higher-ranked high school (Row 1), enrollment at a private high school (Row 2), enrollment at a non-Parisian high school (Row 3), Grade 9 repetition (Row 4), and dropping out after Grade 9 (Row 5). Row 6 corresponds to Grade 10 peers' average ability. Row 7 corresponds to students' percentile rank within the distribution of their Grade 10 high school peers, and Row 8 shows students' probability to fall in the bottom quartile of their high school. For those three rows, ability is measured by the Grade 9 score. Row 9 corresponds to the proportion of girls, and Row 10 gives the proportion of low-income students among Grade 10 peers. Rows 11 and 12 correspond to Grade 10 peers' average ability in Mathematics (Rows 11) and French (Rows 12), and Row 13 shows peers' relative ability in Mathematics and French, where relative ability is measured by the standardized ratio between peers' grades in Mathematics and French. For each dependent variable and each sample, the table shows the impact of falling just above the admission threshold. Standard errors clustered at the school and cohort level are in parentheses. Each cell corresponds to a specific regression. All regressions include controls for students' age, gender, family background, average marks in Grade 9, as well as a full set of dummies indicating the nearest cutoff. *$p < 0.05$, **$p < 0.01$.

variation in teachers' gender and age across higher- and lower-ranked schools. Teachers tend to be older in higher-ranked schools, but the age shift is small (about +0.5 years) and not significantly different for girls (+0.6 years) and boys (+0.3 years). The size of schools and the number of teachers per student are also very similar above and below the cutoff. Similarly, there is no significant shift in the distance (in meters) between students' former middle school and students' current high school. These results suggest that enrollment at a more selective school does not come at the cost of more crowded classrooms or longer travel distance from home to high school.[18] Not surprisingly, the main shift in school characteristics is observed for past results on the high school exit exam (the *baccalauréat*). Students just above the cutoff are assigned to high schools that obtained significantly better results on the *baccalauréat* the year before the assignment. This finding is consistent with schools' results on the exit exam being the main driver of middle school students' choices.[19] Further explorations reveal that the increase in

18. The resources allocated to each school are defined each year by the central administration so as to guarantee maximum equality across schools. In this setup, it should come as no surprise that we find little variation in the quality and quantity of teachers across schools.

19. Schools' results at high school exit exams are the only information on schools' outcomes that is publicly available. Each year, in early April, the ministry of education publishes the results of all high schools for the previous academic year. High school league tables are published extensively in the main newspapers.

schools' graduation rates at the cutoff is significant in science, but not in humanities. This latter result is consistent with our previous finding that enrollment at a higher-ranked school is first and foremost associated with a rise in peer competition in science.

B. Major Field of Study and Performance on Exams

Table 2 shows the effect of eligibility for admission into a more selective school on students' choices and performance. Consistent with the graphical evidence, it shows that eligibility has no effect on boys, but induces a very significant decline in the probability that girls choose science as major field of study at the end of Grade 10 (−7.2 percentage points) and a rise in the probability that they choose humanities (11.0 percentage points). These effects on girls' choices translate into a significant negative effect on the probability that they graduate in science at the end of Grade 12 and into a significant positive effect on graduation in humanities.

Given that boys' field of study choices are the same below and above the threshold, the fact that their performance on exit exams are also the same above and below the threshold can be interpreted as meaning that enrollment at a more selective school has no effect on their performance on exit exams, be they taken in science or in humanities. For girls, the analysis is less straightforward because they do not choose the same fields of study above and below the threshold. Our regression results suggest, however, that girls who are induced to fly away from science would have succeeded in graduating in science, had they not been admitted into a higher-ranked school. In fact, most of them would have succeeded in graduating in science with honors, as suggested by the significant decline in the proportion who graduate in science with honors observed at the cutoff (−5.6 percentage points). Changing field of study does not appear to be a way for girls to improve their overall probability to graduate with honors.

Another reason for why many students enrolled at higher-ranked schools choose humanities rather than science may be that humanities classes are of a specific quality in these schools, so that students have better chances to be admitted into the most selective undergraduate programs (CPGE) specialized in humanities. But this is not what we observe, regardless of whether we focus on female or male students. In fact, there is no significant increase in the probability of being admitted into a CPGE program specialized in humanities and no significant decline in the probability of being admitted into a CPGE program specialized in science at the cutoff.[20]

It should again be emphasized that these estimates capture the reduced form effects of eligibility for enrollment, not the effect of enrollment per se. Tables A7–A9 in the Online Appendix provides estimates of the corresponding LATE, under the standard assumptions that eligibility matters only insofar as it affects actual enrollment and that eligibility never induces students not to enroll (monotonicity assumption). The LATE suggest that enrollment at a higher-ranked school induces a rise of about 67 percentage points in the probability to fall in the bottom quartile of the distribution of peer ability, followed by a decline of about 36 percentage points in the probability that female

20. The latter finding also likely reflects that our working sample consists of students who are good students, but not top students. As shown in Table A4 in the Online Appendix, on average only about 2 percent of our sample obtain admission into a CPGE specialized in science each year, so that there is little room for this proportion to be negatively impacted at the cutoff.

Table 2
Choice of Major Field of Study and Performance on High School Exit Exams

	All (1)	Girls (2)	Boys (3)
Main field of study			
Science	−0.033	−0.072**	−0.001
	(0.020)	(0.025)	(0.026)
Humanities	0.050*	0.110**	−0.005
	(0.021)	(0.029)	(0.027)
Technical or vocational education	−0.011	−0.035	0.015
	(0.016)	(0.022)	(0.023)
Dropout (after Grade 10)	−0.016	−0.015	−0.018
	(0.013)	(0.017)	(0.020)
Graduation			
Graduation in science	−0.022	−0.061**	0.012
	(0.019)	(0.023)	(0.025)
Graduation in science with honors	−0.028	−0.056**	−0.002
	(0.016)	(0.020)	(0.021)
Graduation in humanities	0.049*	0.109**	−0.006
	(0.021)	(0.030)	(0.027)
Graduation in humanities with honors	0.014	0.036	−0.011
	(0.015)	(0.025)	(0.019)
Graduation (any field)	0.027	0.048	0.007
	(0.017)	(0.024)	(0.025)
Graduation with honors (any field)	−0.014	−0.020	−0.013
	(0.018)	(0.026)	(0.024)
Selective undergraduate program in science	−0.001	−0.002	0.001
	(0.010)	(0.007)	(0.017)
Selective undergraduate program in humanities	0.006	0.018	−0.002
	(0.008)	(0.014)	(0.010)
Selective undergraduate program (any field)	0.005	0.015	−0.001
	(0.013)	(0.016)	(0.020)
N	7,573	3,691	3,882

Notes: Same sample of students as in Table 1 Panel A. Column 1 refers to the full sample, Column 2 to the female subsample, and Column 3 to the male subsample. Each row corresponds to a specific dependent variable. The first three rows correspond to dependent variables describing major fields of study at the end of Grade 10, namely science (Row 1), humanities (Row 2), or technical/vocational education (Row 3). The fourth row corresponds to a variable indicating whether students drop out of school after Grade 10. The next six rows correspond to variables indicating graduation in science at the end of Grade 12 (Row 5), graduation in science with honors (Row 6), graduation in humanities (Row 7), graduation in humanities with honors (Row 8), graduation in general education (Row 9), and graduation in general education with honors (Row 10). The three last rows correspond to dependent variables indicating whether students gain access to a selective program in science (Row 11), in humanities (Row 12), or in any such selective undergraduate program (Row 13) after high school. For each dependent variable and each sample, the table shows the impact of falling just above the admission threshold. Standard errors clustered at the school and cohort level are in parentheses. Each cell corresponds to a specific regression. All regressions include the same controls as in Table 1. *$p<0.05$, **$p<0.01$.

compliers graduate in science. These LATE suggest that falling in the bottom of one's class has very direct effects on girls' choices, but little effects on boys' choices.

C. Robustness and Falsification Tests

As a falsification test, we first replicated our regression analysis on the sample of low-income students as well as on the sample of students coming from private middle schools, namely the two groups of students whose applications are processed separately by the centralized system. Comfortingly, we find no effects on enrollment and no effects on field choice for both groups of students (see Online Appendix Tables A10 and A11). Effects on enrollment and field choice are significant only for students whose applications are actually constrained by the thresholds under consideration, namely only for non-low-income students from public middle schools.

As a robustness check, we also replicated our basic regression analysis separately on the 2009 and 2010 cohorts (see Online Appendix Table A12). Comfortingly, both first-stage effects on enrollment and reduced form effects on field of study appear to be similar for both cohorts, even though they are a bit less well estimated with the first cohort. Our findings do not seem to be driven by the behaviors and choices of a specific cohort.

We also replicated our analysis separately on subgroups defined by family background (see Panel A of Online Appendix Table A13). Both first-stage and reduced form effects tend to be stronger for girls with a better family background. We also divided our sample according to whether the closest admission threshold is located in the top or the bottom tercile of the distribution of admission thresholds. Again, both first-stage and reduced form effects tend to be stronger for students whose scores are close to top admission thresholds (see Panel B of Online Appendix Table A13). However, it should be emphasized that effects are less well estimated on the various subsamples than on the full sample and differences across subgroups (be they defined by family background or by the level of the threshold) are not significant at standard level.

To further assess the robustness of our results, we reestimate Model 1 with a bandwidth computed following Imbens and Kalyanaraman (2012) rather than with a bandwidth computed with the method by Calonico, Cattaneo, and Titiunik (2014). We obtain qualitatively similar results (see Online Appendix Table A14). We also find similar results when we reestimate Model 1 without any controls for preassignment characteristics, consistent with the assumption that there is no discontinuity in preassignment characteristics at the cutoff (see Online Appendix Table A15). Finally, Online Appendix Table A16 shows that our basic results are unchanged when we use a uniform kernel and alternative spline functions.

VI. Mechanisms

The results obtained so far are suggestive that enrollment in a higher-ranked school is associated with an increase in peer ability that is even more significant in science than in humanities. The results also suggest that this change in peer group composition induces a significant decline in the proportion of female students who choose science as their major field of study, whereas it has no effect on male students. In this section, we discuss in turn the main mechanisms that may help to explain this finding. In particular, it is still to be explained why an increase in peer competition in science should affect female students and not male students.

A. Attitude Towards Competition

One first possible explanation for our findings is simply that female students are more responsive than male students to an increase in peer competition, as suggested by several recent studies (see, for example, Croson and Gneezy 2009; Niederle 2016; Niederle and Vesterlund 2007, 2011). In particular, choosing less competitive and prestigious fields of study may be a way to avoid signaling traits that could be sanctioned by potential male partners, such as ambition and assertiveness, as in Bursztyn, Fujiwara, and Pallais (2017). In this scenario, it should come as no surprise that female students end up turning away from science, if science is the field of study that is the most prestigious and where competition increases the most.

A reinforcing mechanism may be that female tenth-graders are more concerned about grades and maybe also about their future educational prospects, than their male counterparts, as in Goldin (2015) or Rask and Tiefenthaler (2008). There is a long-standing psychology literature suggesting that female students are more prone to anxiety than male students, especially when they have bad grades, maybe because they are more concerned with pleasing adults and professors (see, for example, Pomerantz, Altermatt, and Saxon 2002). Under this assumption, female students may turn away from science in order to reduce the psychological costs associated with poor academic performance.

Overall, gender differences in attitude towards competition and bad grades represent plausible mechanisms behind our main findings, even though we have no direct evidence for or against this type of explanations in our setting.

B. Rank Consideration

Another possible explanation for our findings is that female students choose their field of study so as to be assigned to classes in which they can reach better ranks and where they have better chances of gaining admission into more selective undergraduate programs. As mentioned above, about half of the programs available to students after high school are selective, and most of these programs take account of students' class rank in admission decisions. Given this, it may appear to be a good strategy to choose one's field of study so as to maximize class rank. In this scenario, estimated field effects on female students would not reflect their specific exposure to anxiety or their specific attitude towards competition, but their being more aware of the importance of being well ranked.

To explore this assumption, we constructed a variable describing the percentile rank that students can expect after Grade 10 if they choose science as a major field of study and the percentile rank that they can expect if they choose humanities.[21] We then

21. We have information on the score obtained by each student in each elementary subject during Grade 9 (Math, French, Physics, History, etc.). Hence, for each student, it is possible to compute a weighted average score using these elementary scores and the weights that corresponds to high school graduation in science (hereafter, science score). Similarly, we can compute for each student a weighted average score using the

analyzed these two expected rank variables (as well as the difference between them) using the same regression discontinuity design as in the previous sections (see Table A17 in the Online Appendix). This analysis confirms that enrollment at a higher-ranked high school is associated for both male and female students with a decline in expected ranks. But, we find that this negative effect is similar in science and in humanities. Hence, for both male and female students, we do not find any significant variation in the difference between expected ranks in science and expected rank in humanities at the cutoff. In that sense, enrollment at a higher-ranked school does not appear to induce specific incentive to choose humanities rather than science as a major field of study. This result is consistent with our previous findings showing that admission into a higher-ranked school has no effect on the probability of graduating with honors, meaning no effect on the probability to be in the top half of the distribution of high school graduation scores across students with the same field of study. If girls' choices were driven by the possibility to improve their relative ranks, we would likely observe something different, namely a positive effect on their probability to graduate with honors.

C. Comparative Advantages and Capacity Constraints

Another possible explanation for our findings may be that female and male students do not have ex ante the same strong points, namely female students tend to be relatively stronger in humanities whereas boys are relatively stronger in science. Specifically, at each point of the distribution of Grade 9 score, female students have relatively better grades in humanities, whereas male students have relatively better grades in science. In our working sample of students whose Grade 9 score is close to an admission cutoff, we checked that girls' preadmission grades in Mathematics are on average about 17 percent of a SD below that of boys with similar average scores, whereas their preadmission grades in French are about 16 percent of a SD above.

In this context, one reason for why girls just above an admission cutoff tend to be more responsive than boys to an increase in competition in science may be that they are relatively weaker in this subject and more likely to fall behind their peers if they choose this subject as a major field of study. It may even be that girls are overrepresented among students who are encouraged by teachers and schools to choose humanities rather than science as a major field of study.

In theory, there is no constraint on the number of students who can pursue the science track at the end of Grade 10. In practice, given that science is the most prestigious and sought-after track, it may be that schools induce students who are weaker in science than in humanities to choose humanities, if only to have a minimum number of students in their humanities courses at the start of Grade 11. In this scenario, the underrepresentation of female students in science would not reflect students' preferences, but constraints on field choices. Specifically, the stronger effects of selective schools on female

weights that correspond to high school graduation in humanities. Eventually, for each cohort t and each school s, it is possible to compute the percentiles of the distribution of science scores for science students (hereafter, the science track percentiles), as well as the percentiles of the distribution of humanities scores for humanities students (the humanities track percentiles). Eventually, for each student in school s and cohort t, our measure of her expected rank in science corresponds to her science track percentile rank within school s and cohort $t-1$, whereas our measure of her expected rank in humanities corresponds to her humanities track percentile rank.

students would reflect that female students are overrepresented among students who are initially relatively weak in science and that science is the most popular and constrained choice.

To further explore this assumption, we replicated our regression discontinuity analysis separately on the four subsamples defined by the quartiles of the distribution of students' relative strength in Mathematics (as measured by the standardized ratio between their score in Mathematics and their score in French at the end-of-middle school national exam). For each subsample, we estimated jointly the main effect of eligibility for enrollment at a higher-ranked school and the interaction between eligibility for enrollment at a higher-ranked school and a dummy indicating that the student is a girl (Online Appendix Table A18). For each subsample, the main effect captures the impact of eligibility on boys, whereas the interacted effect captures the differential impact on girls and boys.

Assuming that the gender-biased effects on field choices reflect girls' relative weakness in science, these effects should become much less significant when we compare boys and girls with similar relative strength in science, meaning no differential effects between boys and girls in the different subsamples. This is not what we find. Table A18 in the Online Appendix shows that we keep finding significant field effects on girls only, even when we compare boys and girls with similar relative strength in Mathematics. In contrast, Table A18 does not show any significant field effect on boys, regardless of their initial strength in science. Enrollment at a higher-ranked school does not induce any decline in boys' probability to graduate in science, even when we focus on those who are relatively weak in Mathematics.

The most significant field effects are actually observed for girls in the third, and, to a lesser extent, in the second quartile of the distribution of relative strength in Mathematics. The weaker field effects on girls in the bottom and top quartiles suggest that students who are top achievers in a given subject (be it science or humanities) choose this subject regardless of the context, that is, regardless of whether they are admitted into a higher-ranked school, with higher-achieving peers, or not. The school context makes a difference mostly for students with an initially balanced academic profile.

Overall, the fact that admission at a higher-ranked school has stronger effects on girls' choices than on boys' choices does not seem to be a mere consequence of the fact that girls are overrepresented among students who perform relatively poorly in Mathematics.

D. Teachers' Characteristics

Until now, our interpretations have focused on the fact that enrollment at a higher-ranked school is associated with an increase in peer competition in science. But enrollment at a higher-ranked school may be associated with other changes in the school environment. In particular, it may be associated with a change in who teaches science. There is evidence that a same-gender teacher may improve students' performance, especially for female students (see, for example, Bettinger and Long 2005; Dee 2007; Lim and Meer 2017; Rothstein 1995). Our estimated field effects could be explained in part by the fact that enrollment at a higher-ranked school is associated with a decrease in the relative proportion of women among science teachers, which could induce female students to choose alternative fields of study. To investigate this assumption we augmented our data set with administrative information on teachers' gender (and age) in each school and field of study. We then looked at whether enrollment at a higher-ranked high school was associated with a change in the proportion of women among science teachers, but we found no evidence of such a change. As discussed in previous sections, teachers tend to be slightly older in higher-ranked schools, which is consistent with the fact that teachers' access to more sought-after schools depends mostly on their level of seniority, but the age shifts are similar for science and humanities teachers. When we focus on the sample of female students, the age shift is only about +0.7 years for science teachers and +0.3 years for humanities teachers, the difference between the two effects being statistically nonsignificant at standard levels (these results are reported in the Online Appendix Table A6). Overall, it seems difficult to relate our main findings to changes in the age or gender composition of science teachers at the cutoff.

VII. Conclusion

French students must choose a major field of study at the end of their first year of high school. This is a very important decision as it is a key determinant of the higher education programs to which they can get access after high school. The results reported here suggest that peer competition has little effect on the field of study chosen by male students, but a very significant impact on the field of study chosen by female students. Specifically, we find that enrollment at the most sought-after Parisian high schools is associated with both a significant increase in peer competition (especially in Mathematics) and a significant decline in the proportion of female students who choose science as a major field of study. As it happens, many female students fly away from science, even though they would be able to graduate in science, were they assigned to different schools with less competitive schoolmates. The effect is particularly strong for female students with an initially balanced academic profile.

In terms of policy implication, our results suggest that the process that assigns students to high schools is a potentially important determinant of the gender gap in science and its variation across ability groups. When an assignment process gives priority to students with higher academic ability, it likely increases ability segregation across schools and increases the proportion of female students who opt for humanities, even though they could succeed in science.

Paris is the French region where districts include the largest number of high schools and where ability segregation across schools is highest. One option could be to modify the design of the assignment process to reduce the importance of middle school grades and give more weight to place of residence (with smaller districts and fewer schools per district, for instance). It would likely reduce ability segregation across Parisian schools and increase the correlation between students' rank within their school and their rank within the overall population. Eventually, it would likely reduce the influence of schoolmates on girls' choices. It should be emphasized, however, that such a reform would not necessarily be neutral in terms of students' overall performance. It may be that ability segregation across schools has a positive influence on students' average performance, if only because it makes it possible to have more homogeneous schools and classes (see, for example, Booij, Leuven, and Oosterbeek 2017). More research is needed to assess how and why changes in the design of the student assignment process affect the relationships between gender, ability, and field of study.

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