Gender differences in high school choices: do math and language skills play a role?

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Abstract

This paper focuses on the gendered choice of high school in the Italian context, where children are tracked at age 14 and are free to choose the type of school, with no binding teacher recommendation or ability restriction. It is therefore a context in which preferences, however influenced by different factors, are freely expressed, without any institutional constraints imposed on the decision-making process. Previous literature has mainly analysed gendered educational choices by focusing on the field at later stages in life. The transition from lower secondary to upper secondary school is particularly relevant for children who do not go on to university and can help to understand gender segregation in low and middle-level occupations. We analyse the role of school performance in mathematics and Italian (teacher grades and standardized test scores), the position in the class ranking, the comparative advantage in one subject and find that, while school performance hardly explains the gender gap for the children with low educated parents, it explains part of the gender gap observed for children from more advantaged backgrounds.

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1. Introduction

Gender differences in educational choices, and in particular differences in the propensity to choose STEM fields, have attracted the attention of economists and social scientists for several years, as they have important long-term effects on men's and women's life options, limiting job opportunities and exacerbating the gender pay gap. Furthermore, narrowing the gender gap in STEM education would have important economic benefits for society in the long run, leading to an increase in the number of jobs and GDP (EIGE, 2018).

The under-representation of women in STEM fields in higher education and the labour market is particularly high in ICT and engineering. For example, in 2015 women represented 21% of ICT graduates and 28% of engineering graduates in European Union countries (EIGE, 2018). At the same time, men are still severely underrepresented in higher education in the fields of education, health, and social work. This educational segregation is reflected in a horizontal segregation in the labour market: to date, women make up 75% of the workforce in education, health, and social work occupations and 15% of the workforce in STEM-related occupations (EIGE, 2018).

Existing research has analysed possible determinants of these gaps, focusing on the role of gender stereotypes, differential competitiveness between girls and boys, and peer behaviour (see for example Buser et al., 2017; Mouganie and Wang, 2020 Card and Payne, 2021; among many others). While there is considerable evidence that these mechanisms are at play, the extent to which they contribute to the gender gap in STEM educational choices has not been assessed.

Following a recent strand of the literature, in this paper we examine another potential driver of gendered choices: the role of students' school achievements. Given the well-known gender gap in mathematics in favour of boys – which in itself could be a possible consequence of gender stereotyping (Boaler 2009, Carlana 2019) – it can be seen as natural that boys will ultimately choose STEM fields more than girls. Girls generally have a comparative advantage in literacy-related subjects, and this may drive their educational choices away from math-intensive programs.

Most of the existing literature does not seem to support this hypothesis. However, most of the research on gendered educational choices has largely focused on elective subjects towards the end of high school and the field of study at university, when decisions are likely to be strongly driven by labour market factors. Yet, the roots of the gender gap in educational choices are likely to be found at a young age (Fryer and Levitt, 2010), and policies are more likely to be effective if they target children at an age when skills and preferences are still relatively malleable.

In this perspective, we extend the literature by analysing the educational choices of Italian girls and boys at the transition between lower and upper secondary school, which takes place at the age of 14. At this stage, children must choose between a variety of high school types – broadly divided into academic, technical, and vocational tracks – characterized by level of difficulty and academic prestige. In addition to this vertical differentiation, Italian upper secondary schools differ greatly in the emphasis they place on different subjects (horizontal differentiation).

The Italian case is particularly interesting because students are tracked at a relatively young age and are free to choose the type of school they prefer, without merit restrictions or binding teacher recommendations. It is therefore a context in which preferences – however influenced by different factors – are freely expressed, without ability restrictions imposed on the decision-making process.

Another important contribution of this paper is that studying the gender gap at the transition from lower secondary to upper secondary education is particularly relevant for children who do not go on to university and can help to understand gender segregation in low and middle-level occupations. This is crucial for children from low socio-economic backgrounds because they tend to be disproportionately represented in the type of schools with the largest gender gaps, many of them enter the labour market directly after leaving high school and significant differences exist between students entering the labour market after high schools with STEM and non-STEM focus in terms of career opportunities and wages (Alma Diploma, 2021).

We explore the relevance of different channels through which one's own and peer performance may influence decision making and potentially help to explain the gender gap in educational choices at the upper secondary level. Specifically, we analyse the role of individual performance in mathematics and language and class ranks. The relative position may be important because the perception of one's own abilities is often also based on the comparison with the relevant others (see for example Delaney and Devereux, 2021). Finally, we test the empirical relevance of gender role models, conceived as exposure to female and male high achievers, as greater exposure to high achieving students of the opposite sex in a particular subject may undermine individual self-confidence in that subject (Mouganie and Wang, 2020).

To this aim, we use a rich longitudinal dataset that links data from two administrative data sources (Anagrafe Nazionale Studenti-MIUR and INVALSI), including information on the school pathways of Italian children who were in grade 8 in the 2015-16 school year, thus observing their initial schooling choices. This feature is important if we want to analyse choices rather than later attendance or high school completion, which may differ from initial enrolment due to endogenous school failures. The dataset includes extensive information on children's academic performance in various subjects, including teacher grades and standardised test scores, as well as family background and school characteristics related to the socio-demographic composition of the student body.

While gender differences are mainly expressed in terms of horizontal differentiation (field of study), we argue that it is not appropriate to analyse educational choices ignoring the vertical differentiation, because the Italian upper secondary school system is highly tracked and social differences in choices along this dimension are dramatic (Checchi and Flabbi, 2013). Since relevant interactions may exist between gender and social strata, we conduct our empirical analyses on a cross-classification of high school types that includes both the horizontal and vertical dimensions (similarly to the analysis in Rapoport and Thibout, 2018 for France). The underlying assumption is that when girls and boys choose which high school to attend, they simultaneously opt between humanities or STEM (or other areas) and the degree of academic content. By making appropriate aggregations, we ultimately analyse choices among seven different types of school (detailed in section 4).

We find a huge gender gap in high school choices. Girls are much less likely to select STEM studies, and differentials are particularly relevant for school types in the middle range of the vertical differentiation. To assess whether the different channels through which achievement may affect choices explain the observed gender differences, we first analyse educational choices using multinomial logit models with gender as the main independent variable of interest. Our first finding is that, overall, own and peer achievement explain gendered choices only to a small extent.

In a second step, we split the sample by gender to assess whether girls and boys respond to school performances in a similar way. We find that choices are very sensitive to performances in Italian and math. The direction of the effects is most often the same for girls and boys, but the magnitude of the effects is different. Altogether, it seems that female students require stronger prior signals of mathematical ability to choose STEM fields.

These models include parental background as a control. However, it is reasonable to allow gender differences in choices to vary between advantaged and disadvantaged backgrounds.

Furthermore, there is evidence that young women from low socio-economic families are particularly vulnerable to factors that drive students away from STEM studies (see, for example, Archer et al., 2012; Codiroli and Mcmaster, 2017). For this reason, we also analyse the choice *by* parental education. This analysis highlights that school performance explains very little of the gender gap for children of low-educated parents, but it explains part of the gender gap for children of parents with a tertiary degree.

Finally, to explore how choices would change if girls were to close the gap with boys in math test scores, we simulate an increase in female test scores so that they reach the average of males, without changing the other performance measures. In this scenario, holding behaviour constant (i.e., parameter estimates), the gender gap in the choice of the STEM Lyceum would decrease by about 20%, while the gap in the choice of the STEM technical school choice would remain almost unchanged.

2. Literature

The impact of culture, gender stereotypes and norms has received increasing attention from social scientists in recent years (Charles and Bradley, 2009, Nollenberger et al. 2016). Stereotypes can impact the choice of study fields or occupations of man and women by driving interest in subjects that are deemed 'appropriate' for them (Reskin and Bielby 2005). The dominant association of science and technology as masculine fields makes it more difficult for girls to choose STEM as a potential career and may provide boys with pre-established roles in these fields (EIGE 2018). Biased self-assessments of math competence among girls may also be at the root of gender differences in educational choices (Correll 2001). Carlana (2019) shows that when students have teachers with strong gender stereotypes girls are less likely to choose STEM-related fields of study. Similarly, Carlana and Corno (2021) demonstrate that children's choices are influenced by parental perceptions and gender stereotypes. Gender norms may also explain why the degree of gender imbalance is highly variable within scientific fields, being much lower (or even reversed) in medicine, natural sciences, and even mathematics. This may be because these fields of study provide access to careers that maintain a symbolic affinity with 'caring' jobs or lead to a caring job, such as teaching, as a second-best option (Barone, 2011).

A related strand of literature addresses performance under different levels of competitiveness, generally showing that women tend to balance their choices and reduce risks when possible and are less likely to engage in highly competitive situations (Delaney and Devereux, 2021a). This is important for educational choices and labour market outcomes because fields such as sciences and mathematics are viewed as more competitive. Sensitivity to competitive pressure is also likely to influence the investment in male-dominated or math-intensive fields where there are strong stereotypes on female inabilities (Niederle and Vesterlund, 2010, Buser et al. 2014).

The role of peers has also been extensively studied, focusing on the proportion of girls or boys in the school or classroom (Lavy and Schlosser, 2011; Anelli and Peri 2019; Brenøe and Zolits 2020, among others) and the ethnic and socio-economic composition of the student body (see for example Carrell and Howkstra, 2010; Carrell et al., 2018). Some studies analyse the impact of peer achievement (see for example Niederle et al., 2010 and 2013; Landaud et al. 2020), for which attitudes towards competition is a possible explanation.

Research on the impact of students' ability and school performance on educational choices focuses on different aspects of individual performance. First, several studies have shown that gender differences in previous mathematics achievement do not drive gendered patterns in educational choices (Card and Payne, 2021; Friedman-Sokuler and Justman, 2016; Kahn and Ginther, 2017). Overall, the evidence suggests that a comparative advantage in STEM skills compared to verbal skills seems to explain educational choices more than STEM skills alone (Riegle-Crumb 2013). Some studies find that the gender gap is significantly reduced when one controls for the gender gap in the individual differences between math and literacy performance (Breda and Napp, 2019; Mostafa, 2019; Stoet and Geary, 2018). However, the main message is that achievements are only a minor explanation of the gender differences in educational choices. Second, students do not only look at their own performance when making decisions. They also look at how they perform in relation to relevant others, especially their classmates. So, in addition to absolute measures of performance, individual rankings can be important. Existing studies have examined the impact of individuals' class rank on long-term educational and labour market outcomes (Murphy and Weinhardt, 2020; Denning et al., 2018). Few studies also analyse the gendered impact of rankings. Delaney and Devereux (2021) analyse the importance of individual rankings in English and mathematics in explaining choice of major and show that the tendency for girls to be ranked lower in mathematics helps explain part of the STEM gender gap. Similar results are found by Goulas et al (2022). Lastly, some research is dedicated to the effect of 'gender role models', conceived as exposure to female and male high achievers. Pagani and Pica (2021) show that students who have been exposed to a high share of academically gifted peers of the same gender in primary school are more likely to choose a high school with an emphasis on science, while the effect of peers of the other gender is the opposite. Cools et al. (2019) show that greater exposure to high-achieving boys (proxied by their parents' education) in high school reduces girls' self-confidence and the likelihood to enrol in an undergraduate degree. Mouganie and Wang (2020) and Feld and Zolitz (2018) find that women with higher achieving male peers choose fewer mathematical and science courses and majors.

We extend this literature by analysing different channels through which school achievement may play a role in the educational choices of girls and boys at the transition between lower and upper secondary school. We focus on Italy, a relevant case study because, unlike in other contexts, students are tracked at a relatively young age and are free to choose the type of school without institutional constraints based on their ability. Educational choices at this stage are particularly important for those entering the labour market after high school and are crucial for understanding gender segregation at lower levels of the social ladder.

3. The Italian Context

In Italy formal education begins at the age of 6 and is organised into three stages. Students attend five years of primary school (up to the age of 11), three years of middle school (11-14) and five years of high school (14-19). Education is compulsory until the age of 16. The school system is mainly public: the share of children in private schools from primary to upper secondary level is around 5% (MIUR 2022). Unlike in other countries, public schools tend to be of higher quality, in particular at the upper secondary level, as most private schools are attended by low-achieving pupils from middle and upper social classes who struggle in public schools. To monitor the effectiveness of the educational system, standardised tests in Italian and mathematics (INVALSI) are administered to all pupils enrolled in schools in year 2, 5, 8 and 10 and 13.

The Italian school system is comprehensive up to middle school, at the end of which, students take a national exam and move on to high school. The high school system is heavily tracked. High schools vary in terms of the emphasis of the curricula in terms of disciplinary content – STEM, Humanities, and other content (most often business-related studies), and are ranked in terms of the academic level and prestige – Traditional Lyceums, Non-Traditional Lyceums, Technical schools, Vocational schools. Lyceums offer a generalist academic education, conceived as the natural path to university. Until the 1980s, there were only three types of Lyceums: the Classical Lyceum, focusing on Humanities and classical studies, the Scientific Lyceum, with a stronger emphasis on STEM subjects and the Linguistic Lyceum, with a focus on humanities and modern languages. Less prestigious schools, aimed at preparing employees in middle-level white collar occupations also existed, were repeatedly reformed, and more recently attached the label "Lyceum". These school types include the current Artistic Lyceum and the Human science Lyceum. However, the Classic and Scientific Lyceum are still considered the most academically challenging and prestigious schools. The technical and the vocational tracks offer a more applied preparation, with the technical track generally being more academically demanding than the vocational track. These are often perceived as suitable alternatives for those students – typically of middle-low social backgrounds – who are not sure of pursuing tertiary education at the end of high school.

At all school levels there is no streaming by ability, and students do not select elective subjects. The school curricula are the same in all Italian schools, and follows the so-called '*programma ministeriale*', national guidelines that teachers must stick to. Thus, at least in principle, learning targets do not vary across schools (in primary and middle school) nor across school types (in high school).

The choice of high school is made in January, mid-way throughout the last year of middle school (grade 8), when most students are 13 years old. By law, class teachers must give a recommendation for a specific high school type, but this is not binding.[5] Students are free to apply to any school they wish. High schools cannot select pupils based on their previous academic ability.[6] If there is an excess of demand, priority is given to students living in the local catchment area.

Despite the extreme openness of the system at enrolment, some ability streaming is achieved through the institution of grade repetition, which consists in holding back students who do not reach the target learning level. Grade repetition is rare in primary and middle school, but very common in high school, especially at the end of grade 9 (Contini and Salza, 2023).

Children normally attend a school in their local catchment area, but exceptions are allowed as schools may take into account family preferences for enrolment (e.g. proximity to parents' place of work or grandparents' home). At all school levels, within the school, children are assigned to a particular class – defined as a group of pupils with a specific group of teachers, which remains the same throughout the school cycle. In principle, class formation is quasi-random to ensure heterogeneity in terms of gender, family background and prior achievement.

[5] On the contrary, most students (especially those from high socio-economic backgrounds) who receive a teacher recommendation that differs from their preferences do not follow the advice (Borgna and Contini, 2021).
[6] However, there is anecdotal evidence of selection in a small number of cases in very popular high schools in few large cities such as Milan or Rome.

In most cases, different types of high schools are located in different buildings and in different areas, so that pupils do not have contact (at least during school hours) with pupils attending other types of schools. This feature implies that in Italy, even more than in other contexts, the choice of upper secondary school is crucial for the formation of an individual's peer group, which is likely to influence later educational and professional careers.

Admission to the university is also free of merit restrictions, and students with any type of high school diploma have access to university. Some university courses (e.g. medicine) have entry tests, but the high schools' graduation grades matter very little for admission. While most students with a Lyceum diploma continue their studies in tertiary education, the proportions from technical and vocational schools are much lower (76% from Lyceums, 46% from technical schools, 25% from vocational schools, ANVUR 2023). Not surprisingly, students from advantaged backgrounds are over-represented in Lyceums, especially in Traditional Lyceums, and previous research has shown that social stratification in high school choices is particularly strong in Italy (Checchi & Flabbi, 2013, Contini & Scagni, 2013), even in comparison to other early tracked systems (Jackson, 2013). It should be noted that the proportion of young people with tertiary education is still particularly low in Italy (28% of the population aged 25-34, OECD 2021).

In this study, we group high school choices in 7 categories: Traditional Lyceum with a focus on STEM subjects (Traditional STEM Lyceum); Traditional Lyceum with a focus on Humanities subjects (Traditional Humanities Lyceum); Non-Traditional Lyceum, focused on Humanities (Non Traditional Humanities Lyceum); Technical schools with a focus on STEM subjects (Technical STEM); Technical schools with focus on Business studies (Technical Business); Vocational schools with focus on STEM subjects (Vocational STEM); and Vocational schools with focus on Business studies (Vocational Business).

Table 1 here

Data on the career tracks of high school students show significant disparities between students with and without a STEM background, especially when they do not continue to university (Alma Diploma, 2021). Over 25% of students from Technical STEM schools have ongoing contracts one year after graduation (versus around 10% from Technical Business schools or non-Traditional Lyceums with Humanities focus). Further, average starting salaries after high school diploma are around 15% higher for students who come from technical STEM high schools (Alma Diploma, 2021). Among those who go on to university, most students with a technical-STEM diploma or scientific Lyceum choose a STEM field in university (with larger shares for boys) while the majority of students with non-STEM diplomas choose non-STEM majors (Alma Diploma, 2021). In particular, over 70% of graduates from technical-STEM schools who attend university select STEM studies at university, compared to less than 10% for students from Technical Business schools or non-Traditional Lyceums (Alma Diploma, 2021). In sum, for both students who go on to university and those who enter the labour market directly after high school, the STEM choice increases the likelihood of a STEM-related academic career or STEM-related jobs.

4. Data

This study uses a longitudinal dataset linking two administrative data archives: the Italian National Register of Students (Anagrafe Nazionale Studenti), recording the students' paths within the school system and the National Institute for the Evaluation of the Educational System (INVALSI), providing standardized test scores in specific grades of primary and secondary school when children sit the national assessments.

The linkage allows us to get an unusually complete picture of students' scholastic achievements prior to choosing high school – i.e. test scores and teachers' grades - and their careers, together with variables capturing their socioeconomic background.

In terms of students' careers, we have information on dropouts, grade repetitions, school and class attended, as well as high school choice – which is the main focus of this research. Thanks to the presence of class and school identifiers, we can also link information on classmates' and schoolmates' scholastic attainment and background.

Data are available for secondary students enrolled in school years 2013/14 to 2016/17 in three Italian regions: Piedmont, Lombardy and Veneto. Given the purpose of this analysis, we analyse the cohort of students enrolled in first year of middle school in 2013/14 (grade 6). In school year 2016/17, these students start their first year of high school (grade 9), when tracking begins. The population of students in the dataset consists of 173,684 students; for 97% of them we can trace high school enrolment (168,445 students clustered in 1837 middle schools).

Table 2 presents descriptive statistics of educational choices and shows that boys are over-represented in schools focusing on STEM subjects. They are much more likely to attend Technical STEM schools, chosen by over a third of the boys and by only 7% of girls. The gap in favour of boys is sizable also for attendance in Traditional STEM Lyceum (around 27% of boys and 19% girls), and for the less common Vocational-STEM schools (5% of boys and 2%

of girls, 3 percentage points difference, but the ratio of the shares is 2.5). On the other hand, girls disproportionately attend schools with a focus on humanities and social sciences, as well as business related subjects. The largest gaps (in terms of both difference and ratio of attendance shares) are observed for the non-Traditional Lyceums with a focus on humanities and the Technical-STEM.

Table 2 here

Table 3 shows gender gaps in academic performance in Italian and mathematics, as measured by test scores and teachers' grades. Throughout the paper, we refer to *grades* to indicate teachers' grades at the end of year 7 – the last available measures before students actually choose high school during grade 8– and *test scores* to indicate the performance in students' INVALSI tests administered at the end of grade 8 (last year of middle school). Although the latter cannot, in principle, be considered in school selection because the results are released after the choice has been made, we believe it is important to take them into account because these tests are designed to capture different aspects of ability than grades. While grades include an assessment of effort and commitment, tests focus on actual skills and it is likely that students and families are at least somewhat aware of these abilities.

Girls outperform boys in both Italian and mathematics when performance is measured by teachers' grades, but their performance in standardized math tests is significantly lower than the boys' one. If test scores reflect actual skills, boys' higher test scores may convey the perception that they are actually better at math ("he is really good at maths, although he could work harder" versus "she works hard").

Table 3 here

We take advantage of the richness of this dataset and add a detailed list of control variables in the main model. This includes individual-level variables such as socio-economic background – measured by parental education, migration status, and ESCS (a synthetic index drawn from the PISA survey, that considers parental occupation; parental education; and the so called 'home possessions'[7]) – and school-level characteristics (average students' performance in Italian and mathematics, average socio-economic background of students attending the middle school, share of females, share of students with an immigrant background). A detailed description of the

[7] Number of books at home, computer, a quiet place to study, an internet connection etc…

explanatory variables and their descriptive statistics are presented in Appendix A (Table A1). This table reports all measures of performance we use in the analysis (grades, test scores, individual ranking by subject, peers' performance, etc.), as well as all the other independent variables included in all models.

5. Empirical strategy

The aim of our analysis is to understand how the gender gap in high school choices is related to past performance. To this end, we model high school choices with a multinomial logit model. We begin by analysing the whole sample, to investigate the extent to which the gender gap is explained by different mechanisms involving individual and peer performances, and then run separate analyses by gender, to explore whether girls and boys respond similarly to their array of ability measures.

We model the $M = 7$ high school options described in section 4 using a multinomial logit model:

$$P(Y_i = j|X_i) = \frac{exp\,(X_i\beta_j)}{1+\sum_{m=1}^{M-1}\exp(X_i\beta_m)} \tag{1}$$

where the vector of explanatory variables X includes the different measures of performance and several control variables, describing family background (parental education; migrant status and an index of socio-economic disadvantage) and middle school-level characteristics (percentage of students whose parents have a university degree, percentage of students with migrant background in the school, percentage of girls in the school, average and standard deviation of test scores in Italian and Mathematics).

We estimate various versions of this model, focusing on the different mechanisms that may influence students' educational choices. First, we analyse the effect of students' grades and test scores in Italian and mathematics. To see whether what matters is the grade in each subject or the comparative advantage in a particular subject (in other words, the fact of being better at maths or Italian), we replace the two grade variables with a variable that measures the difference between these grades. Next, we add individual class rankings in both subjects to the first model, to test the relevance of relative performance in addition to absolute performance. Finally, we include the class proportion of high achievers in mathematics among girls and boys in the class, interacted with one's own gender, to test for the existence of gender role models.

Two potentially problematic issues in model estimation are now discussed.

1) A potential threat to identification of the effect of performances is due to unobserved variables affecting both past achievements and later educational choices. This could occur for several reasons:

- If there are anticipatory effects that induce students to work harder to achieve better results, to enrol in more demanding or prestigious high schools. However, unlike in many other tracked systems, school recommendations in Italy are not binding and there are no restrictions on access to the different high school types based on results. Thus, there are no real incentives to perform well in middle school to gain access to the most prestigious high school types.
- If we neglect possible unobserved confounders such as individual commitment and self-confidence. However, since we consider both teacher grades and standardised test scores (the former recognising individual effort and knowledge, the latter capturing competences), we believe we are including all the relevant measures of prior ability in the model.
- If students self-select in middle schools according to their family background or past performance, and school context matters for high school choices. This is very likely. However, we observe the most relevant aspects of the contexts and can control for these characteristics. In our data, students are nested in classrooms and schools, so it is possible to derive different measures of school composition in terms of socio-demographic variables (percentage of females, percentage of students from a migrant background, average SES) and measures of ability (means and standard deviations of school test scores).

In sum, since anticipatory effects are not very relevant in the Italian school system and we observe a rich set of individual and school characteristics, the endogeneity of test scores should not be a major issue in the present context.

We also believe that the strategy used in related research to deal with the possible endogeneity of performance at the time of choice, which consists of using prior performance measures as an instrumental variable for later performance, would not be appropriate in our case study. The reason for this is that prior performance (e.g. at the end of primary school) is not exogenous to the school choice decision, because if, contrary to our beliefs, anticipatory effects exist, prior performance would influence prior school intentions, thus invalidating the assumptions underlying the IV strategy (see discussion in the Appendix B). Note also that many eminent causal inference scholars (see for example Cunningham, 2021) caution against the use of potentially inappropriate instrumental variables, as this can introduce additional bias in the estimates.

Further, the focus of this paper is on what explains the gender differences in educational choices rather than on the effect of performances *per se*. Despite all this discussion, caution is needed in interpreting the results as causal effects.

2) We recognise that the contexts in which individuals are embedded are important in shaping life choices. In addition to families, school contexts are particularly important for educational careers. Since our aim is not to study these effects but to control for them, the most appropriate strategy would be to include school fixed effects in our models. However, the estimation of a multinomial logit model with seven choices with school fixed effects on such a large sample turns out to be computationally unfeasible. For this reason, we tested the actual relevance of introducing school fixed effects by comparing the results of our analyses with and without school fixed effects in a feasible context, i.e. separately on the three vertical school categories (Lyceums, Technical and Vocational), and the three horizontal school categories (STEM, Humanities, and Other)[8]. In the model without school fixed effects, we include several observed school characteristics (average academic performance and socio-economic background of the children in the school). The empirical challenges of estimating a model with school fixed effects are discussed in greater detail in Appendix C. Since the results of interest are very similar across the two specifications (see Appendix C1-C4), we present results without school fixed effect throughout the paper.

6. The role of performance: full sample analysis

In this section we present results from the estimation of multinomial logit models on the complete dataset, aimed at assessing on how high school choices are influenced by various measures of school performance.

6.1 Is the gender gap in high school choices explained by individuals' school performance?

To answer this question, we estimate a set of multinomial logit models for educational choices on the complete sample of students and observe if and how the gender gap in educational choices

[8] Estimating a fixed effects multinomial logit model is computationally challenging, as the time and memory required to do so increase exponentially with the number of alternative school choices and the size of the class.

is explained as we progressively add different control variables (representing different mechanisms). Results are shown in Figure 1 and in Table A2 in Appendix A.

To visualize the raw gap, we first estimate a model that only includes a gender binary variable (model 1, M1). In model 2 (M2), we add test scores and teachers' grades, and in model 3 (M3) we add individual family background (parental education, ESCS and migrant origin) and school characteristics (share of girls, share of migrant background students, share of students with parents with university degree, average and standard deviation of test scores in language and math) as control variables. In model 4 (M4), we add individual class rankings in all performance measures (a variable ranging between 0 and 1, depending on the student's ranking in the class in the specific subject). In model 5 (M5), we analyse the role of comparative advantage in one of the two subjects by including, instead of grades in Italian and mathematics, the difference between the two. Finally, in model 6 (M6) we add to model 4 two variables representing the share of girls and boys with top grades in maths in the class. Average marginal effects of the female indicator can be visualised in Figure 1 (and in Tables A2, Appendix A).

As mentioned above, girls are significantly less likely to select schools with an emphasis on STEM subjects, including the more academically demanding ones (Traditional STEM Lyceum) and, to an even higher degree, the Technical-STEM paths. On the other hand, they are disproportionately more likely to select Humanities-focused schools (in particular, non-Traditional Lyceums and, to a lesser degree, business related Technical schools). The interesting finding is that these differentials remain quite stable when all the different mechanisms involving performance – teacher grades and standardized test scores in Italian and math, individual rankings in the classroom and the share of high achieving girls and boys – are taken into account. Altogether, we conclude that past achievements only marginally explain the gender gap in high school educational choices.

Figure 1 here

We then decompose the gender gap in the choice of high school into an explained and an unexplained component using an Oaxaca-Blinder-like procedure for categorical dependent variables (Fairlie, 2005).[9] We estimate the decomposition using estimates from Model 3. The

[9] In practice, we compute the explained component by multiplying their observed characteristics to the estimated coefficients resulting from the boys' model, which delivers the girls' expected probabilities of enrolling in each type of school if they behaved as boys (counterfactuals). Since the two groups now share the same behaviour while individual characteristics vary, we refer to this as the explained component of the gap. The explained component of the gender gap is then subtracted from the observed gap to obtain the unexplained component, i.e. the part of the

results are shown in Figure 2 and confirm that the gender gap in educational choices is mostly unexplained by observed characteristics, pointing to mechanisms related to 'behavioural' differences. Interestingly, if girls' characteristics were rewarded with the same betas as boys, the gender gap in the choice of the Traditional Lyceum-STEM would be (slightly) in favour of girls, meaning that, despite their lower results in mathematics, girls' better skills in Italian would be enough to reverse the direction of the gap. This will be further discussed in section 6.2

Figure 2 here

6.2 Does performance in Italian and math matter for high school choices? Does it matter differently for girls and boys?

Prior achievement does not seem to explain the gender gap in high school educational choices. However, as we now show, performance in Italian and math are very important for high school choices, and the direction of these effects does not significantly vary by gender. In this section we analyse how different dimensions of school performance matter for the educational choices of boys and girls.

Results are summarized in Figure 3. The effects of teachers' grades and standardised test scores on educational choices are almost always in the same direction, although their magnitudes are quite different. In some instances, grades matter more than test scores, because grades are always disclosed to pupils and parents, and are the most visible measure of performance, but this is not always the case.

For both girls and boys, the probability of choosing a Lyceum with a focus on STEM increases as mathematics performance increases, and the effect is even larger for girls than for boys. The same direction, but much smaller effects, apply to the choice of technical STEM. Instead, the probability of choosing schools with other focuses decreases with mathematics proficiency. On the other hand, the probability of choosing schools with a focus on humanities increases with performance in Italian for both sexes. However, while boys are also more likely to choose a Traditional STEM Lyceum as their Italian test scores increase, this is not the case for girls (for this reason, if girls - who outperform boys in Italian - were to make their choices as boys do, they would choose the Traditional STEM Lyceum even more than boys, as Figure 3 suggests). In other words, boys are more likely to choose a STEM Lyceum if they perform well in both

gender gap that cannot be ascribed to the different composition of the two groups, but instead to their different behaviour.

Italian and mathematics, and girls are more likely to make this choice if they perform well in mathematics but not so well in Italian. Due to its lower prestige, the probability of choosing the vocational track decreases with performance in both subjects, regardless of the school's focus.

Figure 3 here

Next, we examine the role of comparative advantage in a subject and instead of both grades, we include in the model a variable measuring the difference between Italian and Maths grades. Results are presented in Table A7 and show that increasing the comparative advantage in Italian, students are less likely to choose STEM-oriented schools. These effects seem to be larger for girls.

Students also take into consideration their own proficiency in relative terms. In the next version of the model, we include four variables measuring students' class ranking in teachers' grades and test scores both in Italian and mathematics. In this model, we want to understand whether relative performance matters in educational choices, in addition to the absolute one.

Results are presented in Tables A8 and show that class rankings play an important role in shaping educational choices (in the same direction of absolute measures of performance). However, these effects are very similar for boys and girls. Ranking in teachers' grades seem more relevant than ranking in test scores, especially in Italian (results for ranking in test scores are hardly significant), and this is true for both boys and girls.

6.3 Does the performance of classmates matter for educational choices? Does it matter differently for girls and boys?

We focus here on the impact of peer's performance in mathematics (Table A9). We introduce two variables representing the share of high achieving girls and boys in the class (a high achiever is a student who received a grade of 9 or 10, out of 10, in the year 7's school report). Surprisingly, educational choices are not affected by the shares of high achieving peers in the class, and results are similar for boys and girls, as well as for peers of same and opposite gender. This result does not support the hypothesis that the perception of the existence of a gender gap in mathematical skills can be inferred from the shares of high-achieving students in the class and that this element is taken as an element for decision-making.

6.4 Results for other control variables: individual family background and school context

In this section, we discuss results related to the other independent variables included in the model. Coefficients for the baseline model 2 are presented in Tables A3 and A4, while marginal effects are presented in Tables A5 and A6. Results are similar for all other specifications (results are available on request).

Not surprisingly, family background strongly directly influences educational choices and students from advantaged background are much more likely to attend Traditional Lyceums. The family background effect is larger for boys than for girls. *Ceteris paribus* students who are second generation migrants, are more likely to attend a Traditional STEM Lyceum than their peers from Italian families.

We now discuss the marginal effects of variables related to the school's context. The proportion of female peers in the class does not affect educational choices, while peers' socio-economic background has a similar effect to the individual one: students who attend classes with a high share of pupils whose parents have a university degree are more likely to attend Lyceums and less likely to choose Technical or Vocational schools. This effect is similar for girls and boys.

Average peers' performance in the class is also relevant for educational choices, as the probability to enroll in STEM focused high schools decreases as the average performance of classmates in mathematics increases and this effect is similar for girls and boys. In a way, this result is unexpected. However, net of individual performance measures, being in a class with many high performing peers implies being relatively less able, so this result may simply be interpreted as additional evidence that individuals assess their skills relative to others.

7. The role of performance: analyses by parental education

As explained in Section 2, in the Italian education system, high schools vary across two dimensions. The first one (by subject or horizontal) is especially relevant for gender differences, while the second one (by academic content and prestige, or vertical) is particularly important for socio-economic stratification.

To examine whether the gendered choice patterns differ by socio-economic background, we now analyse educational choices by parental education. In particular, we analyse below the educational choices of three groups of children: students with at least one of the two parents with higher education qualification (High parental education), students with at least one of the two parents with high school diploma (Medium parental education) and students whose parents have no high school diploma (Low parental education).

Descriptive statistics on the shares of students enrolled in each school type by gender and two measures of the gender gap – differences and ratios of the percentages of males and females -

are reported in Table 4. Unsurprisingly, differences by parental education are striking. The choice of Traditional Lyceums is far less common for girls and boys from parents with low levels of education, while these children are highly over-represented in the Technical-STEM and all Vocational schools, and, to a lower extent, in Technical-Business and Non-Traditional Lyceums with a focus on humanities. Further, the percentage of girls enrolled in STEM schools (Lyceum, Technical or Vocational) is always higher for girls with highly educated parents.

Although we usually describe the gender gap in terms of percentage differences, here we prefer to focus on the ratio between percentages because the ratio is a pure number and does not depend on the total proportion of individuals making each choice. As shown in Table 4, the raw gender gaps in educational choices are broadly similar across parental education levels, in terms of ratios (column 4). However, there are some notable differences. For example, for the Traditional Lyceum - STEM choice, the gender gap in favor of boys is larger for families with high education than for families with low education (1.51 vs. 1.24). The opposite is true for Vocational STEM, where the male advantage is greater among low-educated families (1.63 vs. 2.75). Instead, the ratios are very similar for Technical STEM (more than 5 for both groups).

Table 4 here

We now present results from multinomial logit models on the three subsamples of students defined by parental education. In doing so, we want to investigate whether the effect of control variables representing different mechanisms varies across socio-economic background.

First, we replicate the analyses conducted on the full sample to estimate whether different aspects of performance explain the gender gap in mathematics (Figure 1 in Section 6.1 above). Figure 4 shows the marginal effects of gender on the different school options.

Results show that, for children with highly educated parents, grades and test scores explain part of the gender gap. More specifically, more than half of the gap for the Traditional Humanities Lyceum and 16-30% of the gap for the Traditional STEM Lyceum is explained by past performance. The raw gap (in favour of boys) for the latter is almost 19 percentage points, but when controlling for achievements, it is reduced to about 16 p.p. (13 p.p. with the comparative advantage model). This is not the case for children of medium- and low-educated parents (for whom the gap is practically unchanged for both types of Traditional Lyceum), although the proportion of low SES students enrolled in these most prestigious school types is much lower.

Similarly, the gender gap for the choice of Technical STEM is reduced by 20% for children with highly educated parents when grades and test scores are included in the analysis, and this is more than double of the reduction in the gap for the other two subsamples.

Figure 4 here

We now estimate model 3 (see Section 3) by parental education and derive the predicted probabilities of educational choices at different levels of performance in Italian and math. In Figure 5, we show how these probabilities vary for different levels of performance in Italian and math (measured by teachers' grades).

The upper panels refer to Traditional Lyceums. Consider STEM Lyceum first (panel 1). Expected probabilities are steadily rising with math grades for both socio-economic groups and both genders, but the gradient is steeper for the students with high educated parents, in particular girls. Choices are less sensitive to grades in Italian: still, well-performing students have a higher probability to choose this school type, except for girls with high educated parents, for whom the direction is reversed. The largest gender gap in the choice of the Traditional-STEM school is observed among children of high educated parents who perform well in Italian. This occurs because in this group, a large proportion of boys enrolls in this school type (the expected probability varies between nearly 30% and 80% according to math performance), while high performing girls in Italian often prefer the Traditional humanities Lyceums (see panels 2 and 4).

Considering expected probabilities to enroll in technical-STEM schools (panel 3), we observe huge differences between girls and boys, particularly within the low educated group, for whom this choice is far more common. The expected enrolment probability is declining sharply with language grades for both boys and girls in all socio-economic groups, while the pattern for math grades is less clearcut.

Figure 5 here

To better appreciate which choices are made at different combinations of performance, depending on gender and parental education, we have summarized the preferred options in Figure 6, where we present expected probabilities of attending each school type by Math and Italian grades and parental education.

Boys from low educated backgrounds always place the Technical STEM option as the preferred choice, although the expected probability differs across performance levels, being the highest for the ones performing poorly in Italian and medium-high in math. Traditional STEM Lyceums are a relevant second option only for boys who perform well both in math and Italian.

Boys from high educated backgrounds always place the Traditional STEM option among the preferred choices, particularly when both performances are at least average. In this case, when math performance is high, the likelihood goes up to almost 80%. Other relevant choices include the technical-STEM if performance in Italian is medium or low, and the non-Traditional humanities if performance in math is low.

Girls from middle or low educated backgrounds make more varied choices. The technical-business option is always among the preferred ones, as well as the non-Traditional humanities, except for the case of low performance in both subjects. The vocational-business option is among the preferred options if performance is low in both subjects, or one is medium and the other is low. The Traditional-STEM option becomes relevant only for those well performing in math. Interestingly, this group almost never places STEM schools as the preferred option, not even when math results are in the top part of the distribution. This shows that the gender disadvantage in selecting STEM studies is amplified for families with low socio-economic status.

Girls from high educated backgrounds base their preferences mainly according to performance in math: the first option is either the non-Traditional humanities Lyceum, if not performing well in math, or the Traditional-STEM Lyceum, if good at math. When very good at math, the expected probability of the latter reaches the value of 60-70%.

Overall, our findings confirm that girls, even from highly educated families, need very strong signals about their math's performance, in order to choose STEM studies.

Figure 6 here

8. What if the gender gap in math performance were to close?

The previous findings show that – except for the students from high educated backgrounds – the gender gap in high school choices is only marginally explained by absolute and relative achievements. At first glance, this result seems to imply that if girls were to close the gender gap in math not much would change in terms of the gender gap in choices. However, this is not necessarily the case. This question is relevant because it has often been argued that reducing the gender gap in math could have a substantial impact on STEM choices (See for example PISA, 2019).

It is important to note that our previous results were obtained by analysing choices given the full set of performance measures, including teacher grades and test scores in Italian and mathematics. However, as shown in Table 3, girls underperform with respect to boys in math test scores (but not in grades). Given that we have also shown that achievement matters for choice, and that girls' STEM choices are very sensitive to math achievements, girls' choices might change if they improve their results in math test scores while holding other abilities constant.

To estimate the extent to which girls' educational choices would be affected by the change in mathematics performance, we simulate an increase in girls' mathematics test scores equal to the average difference of test scores between boys and girls with the same grade in maths, and compute the expected probability of making each of the seven available choices. Given the differences observed across socioeconomic backgrounds, the probabilities are computed for each level of parental education.

Results are presented in the Appendix (Table A10) and show that, overall, this change in girls' test scores distribution would have a sizeable effect on girls' probability to select the Traditional STEM Lyceum, which would increase from 20.3% to 22.5 % (reducing the current gender gap from 10.1 pp to 7.8 pp, i.e., by more than 22%). However, there would not be any noticeable effect on the probability of selecting Technical STEM schools, where the gender gap would only be reduced by 2%.

The analysis by parental education shows that the potential reduction in the gender gap in STEM Lyceum would be driven mainly by girls of highly educated parents for whom this choice is more common. The gap would fall from 18.6 to 15.2 pp for children with highly educated parents, from 8.6 to 6.3 pp for the medium-educated group, and from 3.2 to 1.8 pp for the low-educated group. These are quite large effects, larger in absolute terms in the first group and in relative terms in the last. On the other hand, when it comes to the choice of Technical STEM schools, the reduction in the gender gap is always almost negligible, suggesting that this choice is strongly related to other factors, presumably related to gender norms in education and in the labour market.

9. Discussion and conclusions

Women are still severely underrepresented in STEM subjects in higher education, especially in fields with growing labour market demand (IT, engineering, etc.). However, the choice of university studies is often a consequence of decisions made earlier, in upper secondary school.

In addition, many young people do not enrol in tertiary education and enter the labour market directly after high school (in Italy, this proportion is around 31%, Alma Diploma, 2021). For this group, which is largely made up of individuals from low socio-economic backgrounds, large gender differences in high school choices can fuel horizontal segregation in the labour market, with women strongly overrepresented in lower paid fields, with fewer career prospects.[10]

In some school systems, students choose elective subjects and the level of core subjects such as language and mathematics towards the end of upper secondary school. In tracked systems, on the other hand, students are streamed into different school types at the beginning of upper secondary education, where curricula and learning goals, set at the central level, diverge from the very beginning.

This paper complements the existing literature on gender gaps in education by shedding some light on the gendered pattern of educational choices at a relatively young age. We focus on the educational choices in Italy – a heavily tracked system – where children choose the high school type at age 13, in the last year of middle school. The Italian case is particularly interesting because the system does not impose ability restrictions in high school choices, nor in access to university, and thus preferences are not constrained by ability restrictions imposed on the decision-making process.

Our analyses show that the gender gaps in educational choices are wide and persist throughout the performance distribution. While the gender gap is significant in the STEM Lyceum, the highest differences are found in the technical-STEM schools, which are almost exclusively attended by males. Females are instead largely overrepresented in humanities-oriented schools, especially in non-Traditional Lyceums.

We show that teacher grades and test scores play an important role in affecting boys' and girls' choices, even if past performance may have a different effect on boys and girls. Girls are systematically less likely than boys to choose STEM high school types and tend to avoid STEM studies unless they are very good at mathematics, or have a very strong comparative advantage in mathematics. Instead, boys are more likely to select STEM studies even when their past performance in mathematics is average and continue to select STEM studies even when they achieve very high results in Italian. We conclude that girls need stronger signals of their

[10] As shown by Mussida and Picchio (2014), the wage penalty for women in Italy is large especially among the low educated, and one of the reasons may be the segregation of women into certain types of occupation.

mathematical ability than boys to pursue STEM careers, which may be due to the evidence that girls tend to underestimate their own competence in mathematics (Correll 2001).

Despite this evidence, we find that the gender gap in choice is only weakly attenuated when we take into account absolute and relative performance, peer ability and school context. Instead, there is evidence that achievement is more important in explaining the gender gap for children with highly educated parents, in particular for the Traditional Lyceum with a focus on humanities and for STEM Lyceum, and technical STEM.

What's the reason for this difference? Recalling that the acronym STEM stands for "Science, Technology, Engineering and Math", it must be noted that STEM in Lyceums means the study of science and mathematics, while STEM in technical and vocational schools means a focus on mechanics, technology and engineering-related subjects.

One possible explanation is that among more advantaged backgrounds - whose children are much more likely to attend the more prestigious Traditional Lyceums - there are more gender-egalitarian views (Dryler, 1998). However, due to the strong socio-economic stratification of educational choices in Italy, we believe that this difference is mostly because the preferred STEM option, among low SES families is within technical (or vocational) schools, with a strong focus on technical subjects (while high SES students choose among highly academic high schools, such as Traditional Lyceum-STEM and Traditional humanities Lyceum). As argued by Barone (2011), there is a noticeable technology/care divide in STEM, and the largest gender gaps are found in fields such as engineering and ICT, possibly because other STEM fields (such as, for example, mathematics, science or health) retain a symbolic affinity with care work (including teaching). Therefore, it is not surprising that girls from disadvantaged backgrounds are less likely to choose STEM high schools than girls from high SES families. This is because for them the choice is between humanities or business and technology rather than between humanities and sciences.

It is often argued that one of the reasons for closing the maths skills gap is that it would help reduce the gap in STEM educational choices and, ultimately, in the STEM careers. What are the implications of our findings in this regard? To get an idea of how choices would change if girls were to close the gap with boys in math test scores without changing the other performance measures, we run a simulation in which, *ceteris paribus*, we increased the test scores of females so that they would reach the average of males, and predicted their high school choices. We found that the gender gap in the choice of the STEM Lyceum would decrease by about 20%, while the gap in the choice of the STEM technical school choice would remain almost unchanged.

This paper shows that, in line with the research focusing on educational choices in late high school or university, the gender gap is only partially driven by gender differences in ability even at earlier educational choices. This leads to the conclusion that the gap is mostly due to other factors that have been shown to be relevant in the existing literature: gender norms, gender biases in the evaluation by parents and teachers, different competitiveness of girls and boys. It is therefore important to invest in policies that can help deconstruct stereotypes and prejudices about women and STEM and men and the humanities. Note that our findings do not necessarily imply that promoting girls' math skills would not help much. While we show that other things being equal, closing the gender gap in math is unlikely to significantly reduce the gender gap in choices, it could be one of the channels through which girls become more interested in math-related fields and thus increase their participation in STEM studies at all levels.

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Table 1 - High school classification

	STEM	Other (business-related)	Humanities
Traditional Lyceum	Scientific Lyceum (Traditional STEM Lyceum)		Classical Lyceum (Traditional Humanities Lyceum)
Non-Traditional Lyceum			Linguistic Lyceum Artistic Lyceum Human sciences Lyceum (Non-Traditional Humanities Lyceum)
Technical track	Technical paths e.g. Informatics, Chemistry, Electronics (Technical STEM)	Technical paths e.g. accounting, marketing (Technical Business	
Vocational track	Vocational paths e.g. Agricultural Mechanical operator (Vocational STEM)	Vocational paths (Business) e.g. Commercial operator, Catering school, Hotel management school (Vocational Business)	

Table 2 - Shares of girls and boys in the different high school types and gender gap

Horizontal classification (subject)	Boys (%)	Girls (%)	Gender gap Difference	Gender gap Ratio
STEM	67.2	27.5	39.7	2.44
Other	22.3	34.3	-12.0	0.65
Humanities	10.5	38.2	-27.7	0.27

Vertical classification (academic content)	Boys (%)	Girls (%)	Gender gap Difference	Gender gap Ratio
Traditional Lyceum	29.5	24.6	4.9	1.20
Non-Traditional Lyceum	9.5	36.4	-26.9	0.26
Technical track	47.0	24.5	22.5	1.92
Vocational track	14.1	14.4	-0.3	0.98

Extended classification (academic content*subject)	Boys (%)	Girls (%)	Gender gap Difference	Gender gap Ratio
Traditional STEM Lyceum	26.7	18.7	8.0	1.43
Traditional Humanities Lyceum	2.8	5.9	-3.1	0.47
Non-Traditional Humanities Lyceum	7.7	32.3	-24.6	0.24
Technical-STEM	35.5	6.8	28.7	5.23
Technical-Business	13.2	21.9	-8.7	0.60
Vocational-STEM	5.0	2.0	3.0	2.50
Vocational-Business	9.1	12.4	-3.3	0.73

NOTE. N=148,943 Computed on the entire population of students in the Piedmont (N= 31,731), Lombardy(N= 73,149) and Veneto (N= 37,953) region.

Table 3 – Grades and Test scores by gender and subject

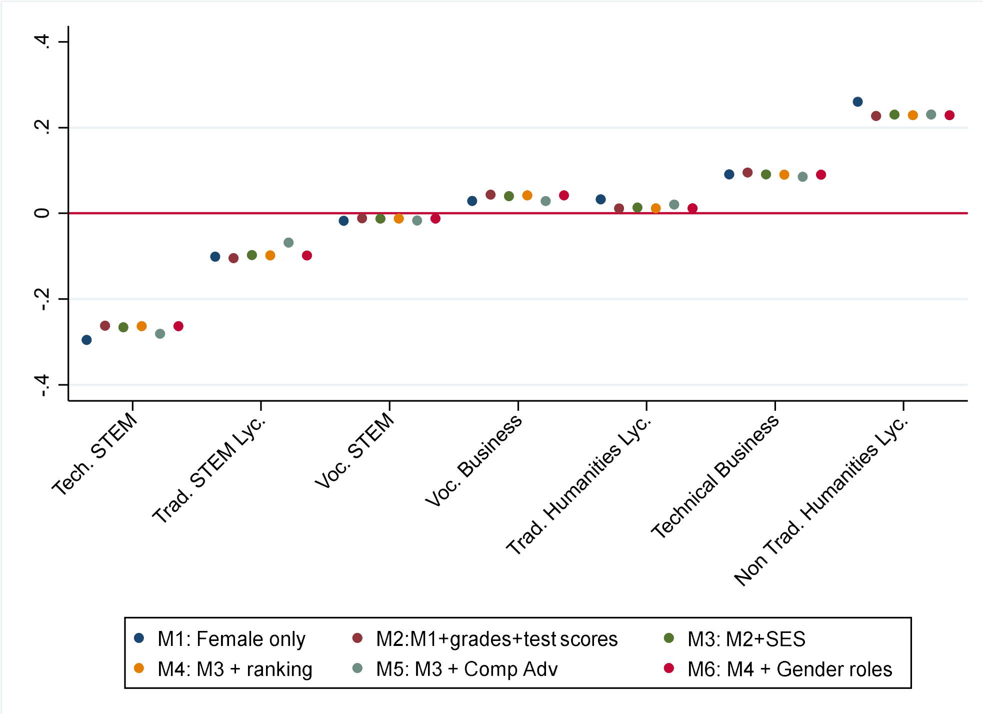
	Boys			Girls		
	N	Mean	SD	N	Mean	SD
Test score in Italian (year 8)	65,128	0.078	0.897	67,233	0.318	0.923
Test score in mathematics (year 8)	65,112	0.325	1.135	67,227	0.093	1.068
Grade in Italian (year 7)	67,485	7.081	0.987	67,678	7.499	1.049
Grade in mathematics (year 7)	67,486	7.246	1.209	67,675	7.403	1.237

Table 4–Educational choices by gender and parental education

	(1)	(2)	(3)	(4)
	Boys (%)	Girls (%)	Difference (M-F)	Ratio (M/F)
Low educated parents				
Traditional-STEM Lyc.	12.0	9.7	2.3	1.24
Traditional-Humanities Lyc.	0.7	1.8	-1.1	0.38
Non-Traditional Hum. Lyc.	5.6	28.2	-22.7	0.20
Technical-STEM	45.4	8.7	36.7	5.20
Technical-Other	14.7	28.5	-13.7	0.52
Vocational-STEM	8.2	3.0	5.2	2.75
Vocational-Other	13.6	20.1	-6.5	0.68
Medium educated parents				
Traditional-STEM Lyc.	26.4	18.5	7.9	1.43
Traditional-Humanities Lyc.	2.0	4.9	-2.8	0.42
Non-Traditional Hum. Lyc.	8.2	36.3	-28.1	0.23
Technical-STEM	39.4	7.3	32.1	5.41
Technical-Other	14.2	23.1	-8.9	0.61
Vocational-STEM	3.2	1.5	1.8	2.21
Vocational-Other	6.6	8.5	-1.9	0.78
High educated parents				
Traditional-STEM Lyc.	52.5	34.8	17.7	1.51
Traditional-Humanities Lyc.	7.2	14.6	-7.4	0.50
Non-Traditional Hum. Lyc.	8.8	32.8	-24.0	0.27
Technical-STEM	18.9	3.5	15.4	5.37
Technical-Other	8.8	10.9	-2.1	0.81
Vocational-STEM	0.9	0.6	0.4	1.63
Vocational-Other	2.9	2.8	0.1	1.03

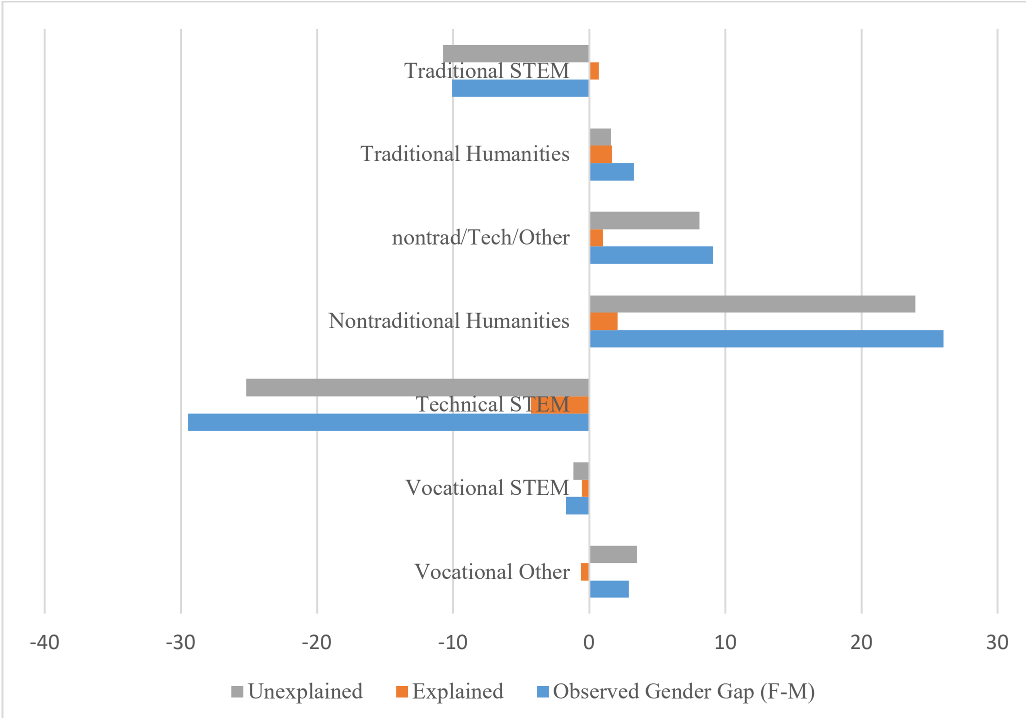
NOTE. N=124,654. Parental levels of education are defined in section 7 (p.18).

Figure 1 – Marginal effects of gender (female vs males) on school choice



Note: Models 3 to 6 include the following individual control variables: a measure of students' socio-economic status (ESCS index, calculated considering parental occupation; parental education; and availability of a series of items that can favour quiet study time, such as a computer, a quiet place to study, an internet connection etc.); parental education (ref. no high school diploma; high school diploma; higher education); migrant status (ref. citizen; first- or second-generation immigrant); they also include middle school-level variables: proportion of students with parents with a university degree; proportion of migrants; proportion of girls; average and standard deviation of test scores in Italian and Maths. Model 5 does not include grades in year 7 but includes the difference between Italian and Mathematics grades, in addition to the above mentioned variables. Model 6 includes two variables for the percentage of girls and boys who are high achievers in the class in Mathematics. Models are estimated using the *mlogit* routine in Stata.

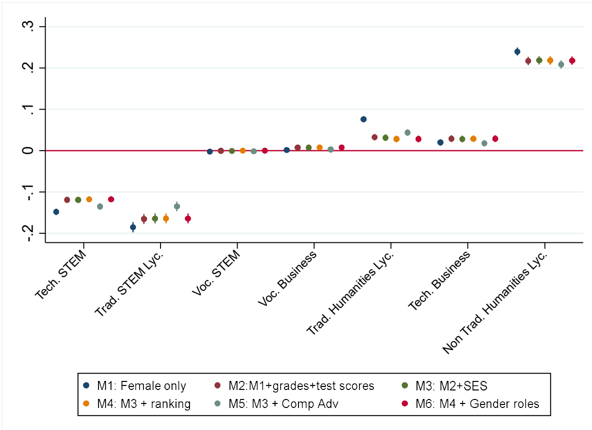
Figure 2 – Oaxaca-Blinder decomposition of the gender gap in educational choices.



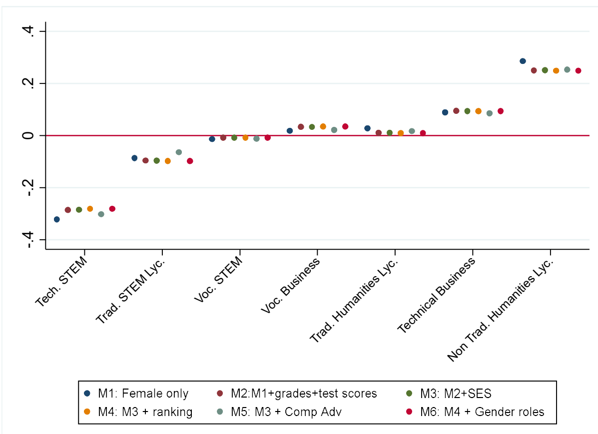
Note: complete estimates are in Table A11

Figure 3. Effect of school grades and test scores in Italian and math on school choices (AME) by gender.

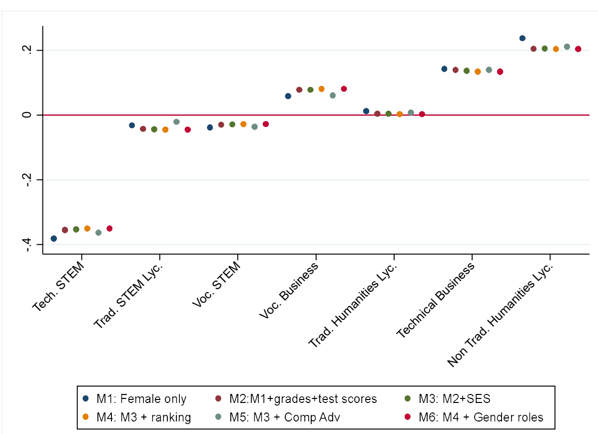
Figure 4 - Marginal effects of gender (F-M) on school choices, by parental education
High Parental Education



Medium Parental Education

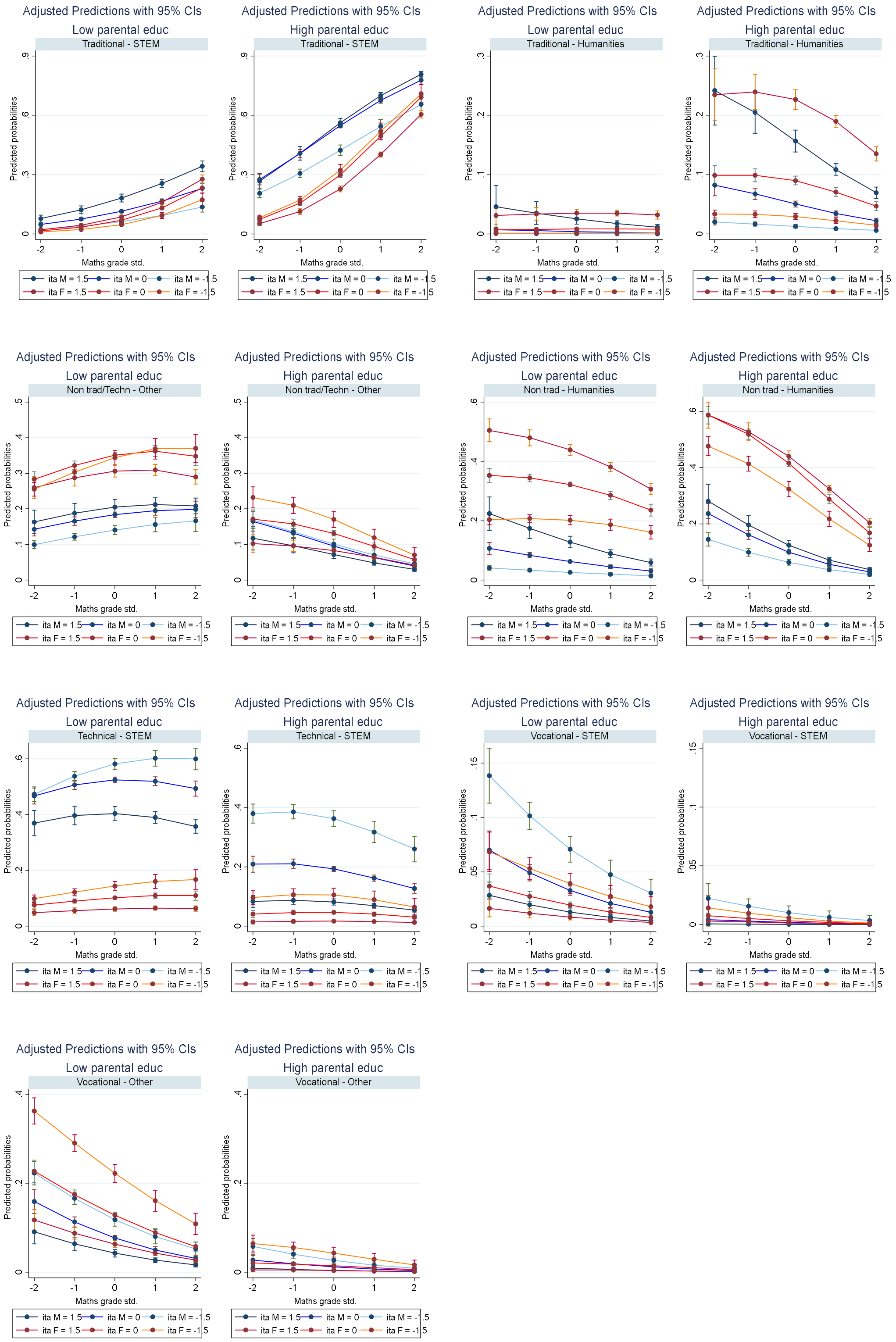


Low Parental Education



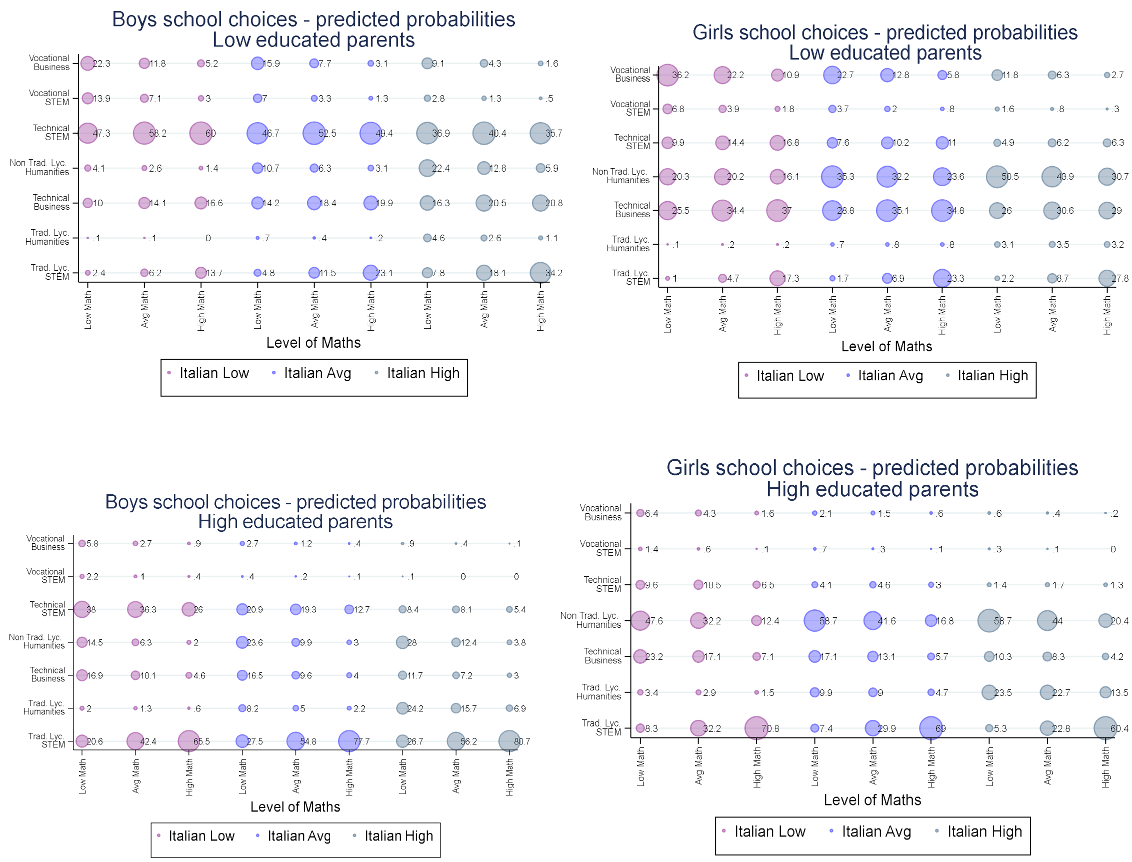
Note: Parental levels of education are defined in section 7 (p.18).Models 3 to 6 include the following individual control variables: students' socio-economic status (ESCS index); parental education migrant status; middle school-level variables: proportion of students with parents with a university degree; proportion of migrants; proportion of girls; average and standard deviation of test scores in Italian and Maths. Model 5 does not include grades in year 7 but includes the difference between Italian and Mathematics grades, in addition to the above mentioned variables. Model 6 includes two variables for the percentage of girls and boys who are high achievers in the class in Mathematics. Models are estimated using the *mlogit* routine in Stata.

Figure 5. Changes in expected educational choices by grades in Italian and math, gender, and parental education



NOTES. Parental levels of education are defined in section 7 (p.18). Predicted probabilities of choosing school type i=1,…,7 by gender, parental education (high parental education vs. low parental education), by level of standardized maths grades (-2 to +2), and by level of standardized Italian grades (-1.5 to +1.5). All other variables of the model are fixed at their means, which however are computed separately by gender and by level of parental education

Figure 6: Expected educational choices by grades in Italian and math, gender, and parental education



NOTES. Parental levels of education are defined in section 7 (p.18). Predicted probabilities of choosing school type i=1,…,7 by gender, parental education (high parental education vs. low parental education), at three levels of standardized maths grades (-2,0,+2), and at three levels of standardized Italian grades (-1.5,0,+1.5). All other variables of the model are fixed at their means, which however are computed separately by gender and by level of parental education

Appendix A – Tables of Descriptive Statistics and Main Results

In this Appendix, we report the complete results described in the paper (Section 4 and 5)

In addition to the various measures of students' performance detailed in each table, all models include the following individual control variables: a measure of students' socio-economic status (ESCS index, calculated considering parental occupation; parental education; and availability of a series of items that can favour quiet study time, such as a computer, a quiet place to study, an internet connection etc.); parental education (ref. no high school diploma; high school diploma; higher education); migrant status (ref. citizen; first- or second-generation immigrant). Further, all models control for the following middle school-level variables: proportion of students with parents with a university degree; proportion of migrants; proportion of girls; average and standard deviation of test scores in Italian and Maths.

Results for the control variables are only reported for the main model (Tables A3 to A6) and are available on request for all other models (they are very similar to those presented for the main model.

For reasons of parsimony, we report coefficients and marginal effects of results for the main model (Tables A3 to A6) and marginal effects for the other specifications (Tables A7 to A9). Coefficients are available on request.

Table A1 – Descriptive Statistics of all independent variables

	Boys			Girls		
	N	Mean	SD	N	Mean	SD
Ranking in:						
Test score in Italian (year 8)	64,787	0.431	0.281	66,869	0.502	0.285
Test score in mathematics (year 8)	64,772	0.496	0.287	66,862	0.439	0.282
Grade in Italian (year 7)	67,354	0.435	0.272	67,595	0.552	0.274
Grade in mathematics (year 7)	67,355	0.475	0.281	67,592	0.511	0.283
Comparative advantage						
Difference between grade in Italian and grade in mathematics	67,482	-0.165	0.889	67,675	0.096	0.908
Gender roles						
% of girls high achievers in mathematics (having a grade of 9 or 10)	67,196	0.219	0.182	67,677	0.221	0.183
% of boys high achievers in mathematics (having a grade of 9 or 10)	67,471	0.179	0.162	67,776	0.177	0.161
Other Control variables (school-level)						
Prop of students with parents with university degree in middle school	71,042	0.229	0.161	71,281	0.225	0.158
Prop of migrants in middle school	71,300	0.122	0.089	71,533	0.122	0.089
School average test score in Italian	71,226	0.098	0.260	71,472	0.103	0.258
School average test score in mathematis	71,226	0.118	0.324	71,472	0.113	0.321
School SD for test score in Italian	71,158	0.913	0.109	71,404	0.915	0.110
School SD for test score in mathematis	71,158	1.057	0.127	71,404	1.055	0.128
Prop of girls in middle school	71,300	0.478	0.070	71,533	0.498	0.068
Other Control variables (individual-level)						
ESCS index	59,055	0.209	0.967	62,689	0.165	0.967
Other Control variables (individual-level) (Categorical variables)	N	%		N	%	
Parental education						
No diploma (omitted category)	18,066	29.3		19,848	31.51	
High school diploma	28,804	46.71		29,058	46.13	
Higher education	14,790	23.99		14,088	22.36	
Total	61,660	100		62,994	100	
Migration status						
Citizen (omitted category)	65,465	87.82		64,862	87.18	
Second generation	4,282	5.74		4,586	6.16	
First generation	4,797	6.44		4,952	6.66	
Total	74,544	100		74,400	100	

Note: high achievers are students who received 9 or 10 in grades in Mathematics in year 7 (grades are on a scale 0-10 in the Italian school system). Ranking is a variable ranging between 0 and 1, depending on the student's ranking in the class in the specific subject. ESCS is a synthetic index of socio-economic status (see previous section for details.

Table A2 - Is the gender gap in high school choices explained by individuals' school performance?

	Marginal effect of the indicator variable "Female"					
	Model 1 – Raw gender Gap	Model 2:	Model 3:	Model 4:	Model 5:	Model 6:
Traditional STEM Lyceum	-0.100***	-0.104***	-0.097***	-0.098***	-0.068***	-0.098***
	(0.002)	(0.0026)	(0.0025)	(0.0025)	(.0025)	(0.0026)
Traditional Humanities Lyceum	0.032***	0.011***	0.013***	0.012***	0.020***	0.012***
	(0.0013)	(0.0013)	(0.0021)	(0.0013)	(0.013)	(0.0013)
Non-Traditional Humanities Lyceum	0.2601***	0.230***	0.230***	0.230***	0.230***	0.228***
	(0.0023)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Technical STEM	-0.294***	-0.261***	-0.265***	-0.262	-0.280***	-0.262***
	(0.0023)	(0.002)	(0.002)	(0.003)***	(0.024)	(0.002)
Technical Business	0.0909***	0.095***	0.091***	0.090***	0.085**	0.090***
	(0.0023)	(0.0025)	(0.002)	(0.003)	(0.025)	(0.0025)
Vocational STEM	-.0171***	-0.011***	-0.012***	-0.012***	-0.016***	-0.012***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.001)
Vocational Business	0.0289***	0.043***	0.040***	0.041***	0.028***	0.042***
	(0.001)	(0.002)	(0.002)	(0.002)	(.002)	(0.002)
Gender dummy	Yes	Yes	Yes	Yes	Yes	Yes
Test scores and grades	No	Yes	Yes	Yes	Yes	Yes
Middle school characteristics	No	No	Yes	Yes	Yes	Yes
Individual characteristics	No	No	Yes	Yes	Yes	Yes
Ranking within class	No	No	No	Yes	No	Yes
Comparative advantage	No	No	No	No	Yes	No
Peer performance (by gender)	No	No	No	No	No	Yes

Note: Standard errors are in brackets. Models 2 to 6 include the following individual control variables: a measure of students' socio-economic status (ESCS index, calculated considering parental occupation; parental education; and availability of a series of items that can favour quiet study time, such as a computer, a quiet place to study, an internet connection etc.); parental education (ref. no high school diploma; high school diploma; higher education); migrant status (ref. citizen; first- or second-generation immigrant); they also include middle school-level variables: proportion of students with parents with a university degree; proportion of migrants; proportion of girls; average and standard deviation of test scores in Italian and Maths. Model 5 does not include grades in year 7 but only includes the difference between Italian and Mathematics grades. Model 6 includes two variables for the percentage of girls and boys who are high achievers in the class in Mathematics. Models are estimated using the *mlogit* routine in Stata. * indicates significant at 10 % level, ** at 5 % and ***1 %.

Table A3 - Does performance in Italian and math matter for high school choices? Does it matter differently for girls and boys? (Coefficients for girls)

	Traditional Humanities Lyc.	Technical Business	Non trad. Humanities Lyc.	Technical STEM	Vocational STEM	Vocational Business
Grade in Italian (year 7)	0.800***	-0.186***	0.149***	-0.424***	-0.621***	-0.582***
	(0.031)	(0.022)	(0.020)	(0.031)	(0.062)	(0.032)
Grade in Mathematics (year 7)	-0.700***	-0.711***	-0.819***	-0.628***	-1.038***	-1.048***
	(0.030)	(0.022)	(0.020)	(0.031)	(0.066)	(0.034)
Test score in Italian (year 8)	0.672***	-0.199***	0.191***	-0.287***	-0.571***	-0.579***
	(0.033)	(0.026)	(0.023)	(0.035)	(0.066)	(0.035)
Test score in Mathematics (year 8)	-0.519***	-0.527***	-0.594***	-0.289***	-0.567***	-0.744***
	(0.029)	(0.022)	(0.020)	(0.031)	(0.060)	(0.031)
ESCS index	0.074*	-0.221***	-0.138***	-0.293***	-0.441***	-0.477***
	(0.031)	(0.022)	(0.019)	(0.030)	(0.057)	(0.030)
Highest parental education (ref. no diploma)						
High school diploma	0.095	-0.316***	-0.076*	-0.225***	-0.456***	-0.531***
	(0.074)	(0.041)	(0.039)	(0.053)	(0.095)	(0.052)
Higher education	0.267**	-1.124***	-0.484***	-0.867***	-1.217***	-1.301***
	(0.087)	(0.060)	(0.052)	(0.083)	(0.179)	(0.090)
Migrant status (ref. citizen)						
second generation	-0.824***	-0.224***	-0.603***	-0.783***	-0.360*	-0.580***
	(0.153)	(0.067)	(0.067)	(0.099)	(0.144)	(0.085)
first generation	-0.353*	0.091	-0.354***	-0.360**	0.063	-0.106
	(0.171)	(0.091)	(0.090)	(0.122)	(0.168)	(0.105)
Middle school-related variables						
Prop of students with parents with	1.552***	-3.345***	-1.576***	-3.740***	-4.269***	-5.119***
university degree	(0.151)	(0.131)	(0.108)	(0.193)	(0.393)	
						(0.202)
Prop of migrants	0.193	0.841***	0.213	0.676*	0.866	1.125***
	(0.306)	(0.209)	(0.192)	(0.282)	(0.491)	(0.277)
Average test score in Italian	-0.016	0.220*	0.176	0.340*	0.458	0.326*
	(0.142)	(0.105)	(0.095)	(0.146)	(0.274)	
Average test score in Mathematics	0.324**	0.466***	0.255***	0.104	0.159	0.840***
	(0.109)	(0.081)	(0.072)	(0.110)	(0.208)	(0.108)
SD test scores in Italian	-0.411	-0.461**	-0.237	-0.374	-0.435	0.171
	(0.224)	(0.156)	(0.142)	(0.213)	(0.402)	(0.205)
SD test scores in Mathematics	0.065	0.488***	0.134	0.238	-0.484	0.150
	(0.198)	(0.139)	(0.125)	(0.190)	(0.362)	(0.188)
Percentage of girls	0.266	-0.520*	-0.443*	0.153	-1.854***	-0.668*
	(0.308)	(0.228)	(0.201)	(0.312)	(0.546)	(0.304)
Constant	-2.178***	1.998***	1.895***	0.787**	0.884	0.945***
	(0.277)	(0.197)	(0.175)	(0.269)	(0.497)	(0.267)
N. Observations	53,919	53,919	53,919	53,919	53,919	53,919

Note: Standard errors are in brackets. Models are estimated using the *mlogit* routine in Stata. Traditional STEM Lyceum is the omitted category. * indicates significant at 10 % level, ** at 5 % and ***1 %.

Table A4 - Does performance in Italian and math matter for high school choices? Does it matter differently for girls and boys? (Coefficients for boys)

	Traditional Humanities Lyc.	Technical Business	Non trad. Humanities Lyc.	Technical STEM	Vocational STEM	Vocational Business
Grade in Italian (year 7)	0.713***	-0.223***	0.126***	-0.507***	-1.023***	-0.713***
	(0.039)	(0.025)	(0.028)	(0.020)	(0.058)	(0.038)
Grade in Mathematics (year 7)	-0.564***	-0.499***	-0.751***	-0.425***	-0.925***	-0.805***
	(0.040)	(0.024)	(0.029)	(0.019)	(0.057)	(0.039)
Test score in Italian (year 8)	0.633***	-0.177***	0.194***	-0.392***	-0.786***	-0.569***
	(0.044)	(0.028)	(0.034)	(0.023)	(0.050)	(0.039)
Test score in Mathematics (year 8)	-0.482***	-0.540***	-0.662***	-0.219***	-0.610***	-0.685***
	(0.040)	(0.028)	(0.028)	(0.018)	(0.042)	(0.033)
ESCS index	0.193***	-0.236***	-0.106***	-0.296***	-0.505***	-0.419***
	(0.042)	(0.023)	(0.027)	(0.019)	(0.041)	(0.032)
Highest parental education (ref. no diploma)						ref.
High school diploma	0.013	-0.289***	-0.081	-0.328***	-0.698***	-0.642***
	(0.113)	(0.044)	(0.055)	(0.037)	(0.071)	(0.056)
Higher education	0.149	-0.939***	-0.455***	-1.092***	-1.727***	-1.328***
	(0.129)	(0.062)	(0.073)	(0.051)	(0.137)	(0.093)
Migrant status (ref. citizen)						ref.
second generation	-1.307***	0.136	-0.590***	-0.217**	0.157	-0.625***
	(0.336)	(0.077)	(0.116)	(0.068)	(0.108)	(0.105)
first generation	-0.674	0.117	-0.080	0.134	0.410**	-0.378**
	(0.346)	(0.101)	(0.131)	(0.087)	(0.132)	(0.128)
Middle school-related variables						
Prop of students with parents with university degree	1.671***	-2.763***	-1.289***	-4.145***	-5.210***	-4.997***
	(0.203)	(0.135)	(0.150)	(0.115)	(0.300)	(0.220)
Prop of migrants	-0.589	1.163***	0.527	0.517**	0.725	1.379***
	(0.447)	(0.221)	(0.270)	(0.186)	(0.377)	(0.300)
Average test score in Italian	-0.488*	0.138	-0.084	0.286**	0.422*	0.270
	(0.197)	(0.111)	(0.134)	(0.092)	(0.210)	(0.160)
Average test score in Mathematics	0.551***	0.529***	0.448***	0.264***	0.457**	0.806***
	(0.157)	(0.085)	(0.104)	(0.070)	(0.156)	(0.117)
SD test scores in Italian	0.467	-0.491**	-0.073	0.231	-0.057	0.381
	(0.305)	(0.167)	(0.209)	(0.138)	(0.294)	(0.228)
SD test scores in Mathematics	-0.371	0.105	0.101	0.119	0.224	-0.115
	(0.260)	(0.150)	(0.182)	(0.124)	(0.268)	(0.204)
Percentage of girls	0.180	0.100	-0.089	-0.178	-0.895*	-0.693*
	(0.455)	(0.236)	(0.285)	(0.195)	(0.420)	(0.316)
Constant	-3.235***	0.901***	-0.398	1.687***	-0.749*	0.138
	(0.380)	(0.202)	(0.242)	(0.165)	(0.359)	(0.269)
Observations	50,685	50,685	50,685	50,685	50,685	50,685

Note: Standard errors are in brackets. Models are estimated using the *mlogit* routine in Stata. Traditional STEM Lyceum is the omitted category. * indicates significant at 10 % level, ** at 5 % and ***1 %.

Table A5 - Does performance in Italian and math matter for high school choices? Does it matter differently for girls and boys? (Marginal effects for girls)

						Parental education (ref. no high school diploma)		Migrant status (ref. citizen)	
	Grade in Italian (year 7)	Grade in Maths (year 7)	Test score in Italian (year 8)	Test score in Mathematics (year 8)	ESCS Index	High school diploma	Higher education	Second generation	First generation
Trad STEM	-0.0123***	0.0977***	-0.0132***	0.0695***	0.0191***	0.0186***	0.0796***	0.0738***	0.0288**
Lyc.	(0.00222)	(0.00217)	(0.00256)	(0.00217)	(0.00224)	(0.00430)	(0.00642)	(0.00882)	(0.0110)
Trad Hum.	0.0408***	-0.0115***	0.0332***	-0.00921***	0.00934***	0.00879**	0.0367***	-0.0233***	-0.0106
Lyc,	(0.00149)	(0.00137)	(0.00159)	(0.00138)	(0.00147)	(0.00283)	(0.00405)	(0.00532)	(0.00729)
Tech.	-0.0204***	-0.00380	-0.0276***	-0.00881***	-0.00551*	-0.0278***	-0.0920***	0.0447***	0.0550***
Business	(0.00257)	(0.00261)	(0.00294)	(0.00263)	(0.00253)	(0.00474)	(0.00676)	(0.00787)	(0.00990)
Non Trad. Hum.	0.0548***	-0.0581***	0.0638***	-0.0459***	0.00660*	0.0293***	0.0314***	-0.0624***	-0.0625***
Lyc.	(0.00284)	(0.00287)	(0.00331)	(0.00295)	(0.00287)	(0.00531)	(0.00809)	(0.00914)	(0.0112)
Technical	-0.0219***	0.00400*	-0.0140***	0.0130***	-0.00655***	-0.00145	-0.0119**	-0.0220***	-0.0144**
STEM	(0.00165)	(0.00160)	(0.00184)	(0.00162)	(0.00157)	(0.00282)	(0.00436)	(0.00385)	(0.00501)
Vocational	-0.00632***	-0.00391***	-0.00589***	-0.000411	-0.00280***	-0.00291*	-0.00528*	0.00119	0.00287
STEM	(0.000854)	(0.000896)	(0.000889)	(0.000808)	(0.000773)	(0.00132)	(0.00212)	(0.00197)	(0.00242)
Vocational	-0.0347***	-0.0243***	-0.0363***	-0.0182***	-0.0202***	-0.0244***	-0.0386***	-0.0120**	0.000864
(Business)	(0.00186)	(0.00203)	(0.00196)	(0.00182)	(0.00168)	(0.00293)	(0.00479)	(0.00409)	(0.00497)

Middle school characteristics

	Prop of students with parents with university degree	Prop of migrants	Average test score in Italian	Average test score in Mathematics	SD test scores in Italian	SD test scores in Mathematics	Percentage of girls
Trad STEM	0.230***	-0.0550*	-0.0223*	-0.0415***	0.0396*	-0.0265	0.0407
Lyc.	(0.0122)	(0.0222)	(0.0110)	(0.00832)	(0.0164)	(0.0145)	(0.0233)
Trad Hum.	0.149***	-0.00295	-0.00711	0.00701	-0.0123	-0.00338	0.0272
Lyc,	(0.00717)	(0.0146)	(0.00674)	(0.00520)	(0.0107)	(0.00947)	(0.0147)
Tech.	-0.206***	0.0719**	0.00527	0.0284**	-0.0501**	0.0624***	-0.0290
Business	(0.0162)	(0.0228)	(0.0119)	(0.00915)	(0.0175)	(0.0157)	(0.0259)
Non Trad. Hum.	0.119***	-0.0696*	0.00289	-0.0126	-0.000185	-0.0174	-0.0379
Lyc.	(0.0170)	(0.0274)	(0.0138)	(0.0106)	(0.0204)	(0.0183)	(0.0294)
Technical	-0.0892***	0.0107	0.00977	-0.0157**	-0.00951	0.00207	0.0365*
STEM	(0.0106)	(0.0145)	(0.00767)	(0.00577)	(0.0110)	(0.00986)	(0.0163)
Vocational	-0.0181***	0.00313	0.00332	-0.00377	-0.00316	-0.0104*	-0.0204**
STEM	(0.00537)	(0.00653)	(0.00371)	(0.00281)	(0.00541)	(0.00490)	(0.00733)
Vocational	-0.184***	0.0419**	0.00814	0.0381***	0.0357**	-0.00675	-0.0171
(Business)	(0.0123)	(0.0152)	(0.00800)	(0.00611)	(0.0113)	(0.0106)	(0.0171)
N	53,919						

Note: Standard errors are in brackets. Models are estimated using the *mlogit* routine in Stata. * indicates significant at 10 % level, ** at 5 % and ***1 %.

Table A6 - Does performance in Italian and math matter for high school choices? Does it matter differently for girls and boys? (Marginal effects for boys)

						Parental education (ref. no high school diploma)		Migrant status (ref. citizen)	
	Grade in Italian (year 7)	Grade in Maths (year 7)	Test score in Italian (year 8)	Test score in Mathematics (year 8)	ESCS Index	High school diploma	Higher education	Second generation	First generation
Trad STEM	0.0367***	0.0781***	0.0252***	0.0594***	0.0317***	0.0408***	0.139***	0.0397***	-0.00268
Lyc.	-0.002	-0.002	-0.003	-0.002	-0.002	-0.005	-0.007	-0.009	0.012
Trad Hum.	0.0223***	-0.00926***	0.0192***	-0.00827***	0.00777***	0.00326	0.0147***	-0.0210***	-0.0146**
Lyc,	-0.001	0.001	-0.001	0.001	-0.001	-0.002	-0.003	0.003	0.005
Tech.	0.0115***	-0.0104***	0.00724**	-0.0300***	-0.00300	-0.00341	-0.0228***	0.0436***	0.00884
Business	-0.002	0.002	-0.003	0.002	0.002	0.004	0.006	-0.008	-0.009
Non Trad. Hum.	0.0271***	-0.0272***	0.0274***	-0.0274***	0.00539**	0.0112***	0.0170***	-0.0268***	-0.00813
Lyc.	-0.002	0.002	-0.002	0.002	-0.002	-0.003	-0.005	0.005	0.007
Technical	-0.0618***	0.000276	-0.0501***	0.0332***	-0.0258***	-0.0205***	-0.103***	-0.0229*	0.0282*
STEM	0.003	-0.003	0.004	-0.003	0.003	0.006	0.008	0.009	-0.012
Vocational	-0.0177***	-0.0126***	-0.0136***	-0.00709***	-0.00678***	-0.0112***	-0.0203***	0.0118***	0.0122**
STEM	0.002	0.002	0.001	0.001	0.001	0.002	0.003	-0.003	-0.004
Vocational	-0.0180***	-0.0189***	-0.0153***	-0.0198***	-0.00924***	-0.0201***	-0.0243***	-0.0243***	-0.0238***
(Business)	0.002	0.002	0.002	0.002	0.002	0.003	0.004	0.003	0.004
				Middle school characteristics					
	Prop of students with parents with university degree	Prop of migrants	Average test score in Italian	Average test score in Mathematics	SD test scores in Italian	SD test scores in Mathematics	Percentage of girls		
Trad STEM	0.430***	-0.0840***	-0.0181	-0.0593***	-0.0111	-0.00781	0.0157		
Lyc.	0.014	0.025	0.012	0.009	0.019	0.016	-0.025		
Trad Hum.	0.0787***	-0.0235*	-0.0148**	0.0105*	0.0127	-0.0111	0.00614		
Lyc,	0.005	0.012	0.005	0.004	0.008	0.007	0.012		
Tech.	0.00125	0.0803***	-0.00261	0.0281***	-0.0712***	0.00513	0.0326		
Business	0.013	0.019	0.010	0.008	0.015	0.014	0.022		
Non Trad. Hum.	0.0782***	0.00347	-0.0152	0.0116	-0.00830	0.00367	0.00160		
Lyc.	0.009	0.016	0.008	0.006	0.013	0.011	0.018		
Technical	-0.444***	-0.0197	0.0409**	-0.0196	0.0628**	0.0176	-0.00675		
STEM	0.019	0.027	0.014	0.011	0.021	0.019	0.029		
Vocational	-0.0487***	-0.0000280	0.00614	0.00188	-0.00439	0.00457	-0.0201		
STEM	0.008	-2.800	0.006	0.004	-0.008	0.007	0.011		
Vocational	-0.0962***	0.0434**	0.00367	0.0268***	0.0194	-0.0121	-0.0292*		
(Business)	0.011	0.014	0.008	0.006	0.011	0.010	0.015		
N	50,685								

Note: Standard errors are in brackets. Models are estimated using the *mlogit* routine in Stata. * indicates significant at 10 % level, ** at 5 % and ***1

Table A7 – - Does performance in Italian and math matter for high school choices? Does it matter differently for girls and boys? Impact of comparative advantage on educational choices - Marginal effects

	Girls	Boys
	Difference in grades in year 7 (Italian-Mathematics)	Difference in grades in year 7 (Italian-Mathematics)
Trad. STEM Lyc.	-0.0582***	-0.0331***
	(0.00171)	(0.00204)
Trad. Hum. Lyc.	0.0197***	0.0128***
	(0.00112)	(0.00083)
Tech. Business	-0.00285	0.0010***
	(0.0020)	(0.00180)
Non trad.Hum. Lyc.	0.053***	0.0245***
	(0.0022)	(0.00140)
Technical STEM	-0.00897***	-0.0182***
	(0.00122)	(0.0023)
Vocational STEM	-0.00046	0.00047
	(0.00055)	(0.00086)
Vocational (Business)	-0.0021	0.00357**
	(0.0013)	(0.00124)
N	53,919	50,685

Note: Standard errors are in brackets. Grades by subject in year 7 are not included, but the difference is. Control variables at individual level: a measure of students' socio-economic status (ESCS index, calculated considering parental occupation; parental education; and availability of a series of items that can favour quiet study time, such as a computer, a quiet place to study, an internet connection etc.); parental education (ref. no high school diploma; high school diploma; higher education); migrant status (ref. citizen; first- or second-generation immigrant). Control variables at middle school-level: proportion of students with parents with a university degree; proportion of migrants; proportion of girls; average and standard deviation of test scores in Italian and Math Coefficients of other variables are not reported for parsimony but are available on request. Models are estimated using the *mlogit* routine in Stata with Control Function Approach. * indicates significant at 10 % level, ** at 5 % and ***1 %.

Table A8- Does performance in Italian and math matter for high school choices? Does it matter differently for girls and boys? Impact of rankings on educational choices - Marginal effects

	Girls				Boys			
	Ranking in test scores (year 8)		Ranking in grades (year 7)		Ranking in test scores (year 8)		Ranking in grades (year 7)	
	Italian	Mathematics	Italian	Mathematics	Italian	Mathematics	Italian	Mathematics
Trad. STEM Lyc.	-0.0152	0.0479***	-0.0199	0.112***	-0.0262	0.0297*	0.0244	0.111***
	(0.0138)	(0.0135)	(0.0146)	(0.0152)	(0.0157)	(0.0148)	(0.0152)	(0.0161)
Trad. Hum. Lyc.	0.0211*	-0.0423***	0.0824***	-0.00755	0.0140*	-0.0262***	0.0485***	-0.0102
	(0.00851)	(0.00841)	(0.00999)	(0.00972)	(0.00624)	(0.00627)	(0.00646)	(0.00694)
Tech. Business	0.00649	0.00457	-0.0104	0.0309	0.00325	-0.00866	0.0540***	-0.0259
	(0.0159)	(0.0156)	(0.0159)	(0.0167)	(0.0140)	(0.0133)	(0.0138)	(0.0143)
Non trad.Hum Lyc.	-0.00460	-0.0384*	0.0816***	-0.0979***	-0.0199	-0.0333**	0.0486***	-0.0335**
	(0.0178)	(0.0178)	(0.0180)	(0.0190)	(0.0108)	(0.0103)	(0.0101)	(0.0113)
Technical STEM	-0.00206	0.0174	-0.0400***	-0.00934	0.0369	0.0562**	-0.147***	-0.0161
	(0.00987)	(0.00968)	(0.00979)	(0.0103)	(0.0189)	(0.0175)	(0.0186)	(0.0194)
Vocational STEM	0.00704	0.00374	-0.0121*	-0.00860	-0.00772	-0.00545	-0.0127	-0.00991
	(0.00467)	(0.00497)	(0.00477)	(0.00526)	(0.00729)	(0.00710)	(0.00833)	(0.00856)
Vocational (Business)	-0.0128	0.00709	-0.0816***	-0.0198	-0.000383	-0.0121	-0.0156	-0.0149
	(0.0106)	(0.0108)	(0.0109)	(0.0120)	(0.00983)	(0.00960)	(0.0103)	(0.0111)
N	53,917				50,680			

Note: Control variables at individual level: grades and test scores in Italian and math; a measure of students' socio-economic status (ESCS index, calculated considering parental occupation; parental education; and availability of a series of items that can favour quiet study time, such as a computer, a quiet place to study, an internet connection etc.); parental education (ref. no high school diploma; high school diploma; higher education); migrant status (ref. citizen; first- or second-generation immigrant). Control variables at middle school-level: proportion of students with parents with a university degree; proportion of migrants; proportion of girls; average and standard deviation of test scores in Italian and Math Coefficients of other variables are not reported for parsimony but are available on request. Models are estimated using the *mlogit* routine in Stata.
* indicates significant at 10 % level, ** at 5 % and ***1 %.

Table A9 – Does the performance of classmates matter for educational choices? Does it matter differently for girls and boys? – Marginal effects

	Girls		Boys	
	% of girls high achievers in Mathematics	% of boys high achievers in Mathematics	% of girls high achievers in Mathematics	% of boys high achievers in Mathematics
Trad. STEM Lyc.	-0.00434 (0.0106)	-0.00669 (0.0115)	-0.0155 (0.0117)	-0.0172 (0.0128)
Trad. Hum. Lyc.	-0.00799 (0.00686)	-0.0137 (0.00743)	0.00934 (0.00492)	0.000469 (0.00550)
Tech. Business	0.00164 (0.0115)	0.0127 (0.0129)	-0.00170 (0.00982)	0.00705 (0.0106)
Non trad.Hum Lyc.	-0.00515 (0.0133)	-0.00362 (0.0147)	0.00411 (0.00767)	-0.00416 (0.00844)
Technical STEM	0.00892 (0.00718)	0.00577 (0.00777)	-0.00997 (0.0133)	0.00746 (0.0146)
Vocational STEM	0.000960 (0.00307)	0.00162 (0.00361)	0.00338 (0.00463)	-0.00116 (0.00549)
Vocational (Business)	0.00596 (0.00728)	0.00391 (0.00808)	0.0104 (0.00664)	0.00750 (0.00726)
N	53,859		50,574	

Note: Control variables at individual level: test scores in Italian and math; individual ranking in grades and test scores; a measure of students' socio-economic status (ESCS index, calculated considering parental occupation; parental education; and availability of a series of items that can favour quiet study time, such as a computer, a quiet place to study, an internet connection etc.); parental education (ref. no high school diploma; high school diploma; higher education); migrant status (ref. citizen; first- or second-generation immigrant). Control variables at middle school-level: proportion of students with parents with a university degree; proportion of migrants; proportion of girls; average and standard deviation of test scores in Italian and Math Coefficients of other variables are not reported for parsimony but are available on request. Models are estimated using the *mlogit* routine in Stata.
* indicates significant at 10 % level, ** at 5 % and ***1 %.

Table A10 – Predicted change in high school choices when closing the gender gap in maths test scores

Overall sample	Model predicted choices (%)			Simulated choices (%)		
	M	F	Gap M-F	M	F	Gap M-F
Trad. Lyc. STEM	30.4	20.3	10.1	30.3	22.5	7.8
Trad. Lyc. Humanities	3.0	6.3	-3.3	3.1	6.1	-2.9
Technical Business	13.2	22.3	-9.1	13.3	21.9	-8.7
Non Trad. Lyc. Humanities	7.5	33.5	-26.0	7.7	32.2	-24.5
Technical STEM	36.3	6.8	29.5	36.0	7.1	28.9
Vocational STEM	3.2	1.5	1.7	3.2	1.5	1.8
Vocational Business	6.3	9.2	-2.9	6.4	8.7	-2.4
High parental education	Model predicted choices (%)			Simulated choices (%)		
	M	F	Gap M-F	M	F	Gap M-F
Trad. Lyc. STEM	54.3	35.8	18.6	54.1	38.9	15.2
Trad. Lyc.Humanities	7.3	14.9	-7.6	7.6	14.2	-6.7
Technical Business	8.7	10.7	-2.0	8.7	10.3	-1.5
Non Trad. Lyc. Humanities	8.4	32.4	-24.0	8.5	30.4	-21.9
Technical STEM	18.3	3.5	14.9	18.2	3.5	14.6
Vocational STEM	0.7	0.4	0.3	0.7	0.4	0.3
Vocational Business	2.2	2.4	-0.1	2.3	2.2	0.0
Med parental education	Model predicted choices (%)			Simulated choices (%)		
	M	F	Gap M-F	M	F	Gap M-F
Trad. Lyc. STEM	27.9	19.2	8.6	27.8	21.4	6.3
Trad. Lyc.Humanities	2.2	5.0	-2.8	2.2	4.8	-2.6
Technical Business	14.4	23.3	-8.9	14.5	22.9	-8.4
Non Trad. Lyc. Humanities	8.2	36.8	-28.6	8.3	35.3	-27.0
Technical STEM	39.3	7.1	32.2	39.1	7.5	31.6
Vocational STEM	2.6	1.3	1.3	2.6	1.2	1.4
Vocational Business	5.5	7.3	-1.8	5.5	6.9	-1.4
Low parental education	Model predicted choices (%)			Simulated choices (%)		
	M	F	Gap M-F	M	F	Gap M-F
Trad. Lyc. STEM	13.7	10.5	3.2	13.6	11.9	1.8
Trad. Lyc.Humanities	0.8	2.0	-1.2	0.8	2.0	-1.2
Technical Business	15.2	29.5	-14.3	15.2	29.3	-14.0
Non Trad. Lyc. Humanities	5.7	29.4	-23.8	5.8	28.6	-22.9
Technical STEM	46.9	8.7	38.2	46.6	9.2	37.4
Vocational STEM	6.4	2.6	3.8	6.5	2.6	3.9
Vocational Business	11.3	17.2	-5.9	11.4	16.4	-5.0

Notes: Model predicted choices are computed based on a model estimated separately by gender, and are calculated for the overall sample, and also separately by level of parental education. Control variables at individual level: test scores and grades in Italian and math; individual ranking in grades and test scores; a measure of students' socio-economic status (ESCS index, calculated considering parental occupation; parental education; and availability of a series of items that can favour quiet study time, such as a computer, a quiet place to study, an internet connection etc.); parental education (ref. no high school diploma; high school diploma; higher education); migrant status (ref. citizen; first- or second-generation immigrant). Control variables at middle school-level: proportion of students with parents with a university degree; proportion of migrants; proportion of girls; average and standard deviation of test scores in Italian and Math. Simulated choices are computed by simulating a change in girls' mathematics test scores equal to the average difference of test scores between boys and girls with the same grade in maths. The change in girls' test scores also leads to a change in both boys' and girls' ranking in test scores. Simulated choices are therefore computed for both boys and girls, are calculated for the overall sample, and also separately by level of parental education.

Table A11 – Oaxaca-Blinder decomposition of the gender gap in educational choices– full results

	Trad. Lyc. STEM	Trad. Lyc.Humanities	Technical Business	Non Trad. Lyc. Humanities	Technical STEM	Vocational STEM	Vocational Business
Boys (model predicted choice)	30.4	3.1	13.2	7.5	36.3	3.2	6.3
Girls (model predicted choice)	20.3	6.3	22.3	33.5	6.8	1.5	9.2
Gender gap (F-M)	-10.1	3.3	9.1	26.0	-29.5	-1.7	2.9
Girls (simulated choice)	31.1	4.7	14.3	9.6	32.0	2.6	5.7
Explained Gap	0.7	1.7	1.0	2.1	-4.3	-0.5	-0.6
Unexplained Gap	-10.8	1.6	8.1	23.9	-25.2	-1.2	3.5

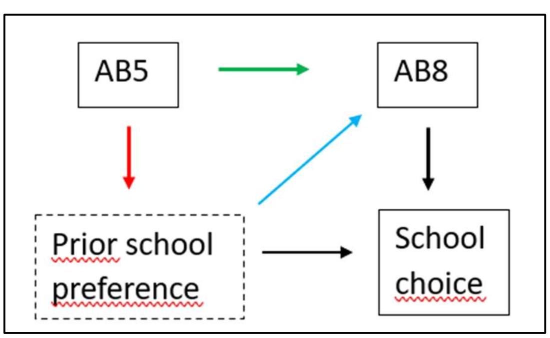
Appendix B. Anticipatory effects in school choices

We explain here why we do not use Instrumental Variable estimation to instrument teachers' grades in year 8 using teachers' grades in year 5.

Many children and their families have an idea of what kind of high school they would like to choose some time before the moment of choice: we call these ideas 'prior preferences'. The motivation for using an IV strategy is related to the existence of anticipatory effects, that may induce middle school children with ambitious prior preferences to work harder, to achieve better results and be able to enrol in the more demanding or prestigious high schools. However, unlike in many other tracked systems, school recommendations in Italy are not binding and there are no restrictions on access to the different high school types based on results. Thus, we argue, there are no real incentives to perform well in middle school to gain access to the most prestigious high school types.

Nonetheless, let us assume for the moment that there are anticipatory effects. In Figure A1 we show a Direct Acyclic Graph (DAG) depicting the relevant causal relations in this scenario. Prior preferences, unobserved to the researcher, affect ability at the time of choice (blue arrow). Since ability in year 8 is influenced by ability in year 5 (green arrow), we could think of prior ability as a valid instrument. It is extremely unlikely, however, that prior preferences are not influenced by prior performance. Consider, for example, a pupil who is good at maths: this is likely to encourage a preference for a high school with a STEM focus (and vice versa if the pupil is bad at maths). Thus, the red arrow would also exist, implying that prior ability is not exogenous to the actual choice, and therefore it would not be an appropriate instrument.

Figure B1. Direct Acyclic Graph (DAG) for school choices in the presence of anticipatory effects



NOTES. AB5: ability measure in year 5. AB8: ability measure in year 8.
Prior preferences not observed.

A few additional considerations need to be made.

1) In a scenario without anticipatory effects, only the black arrows would be at play, and the coefficients of the ability variables estimated from a model that does not include (unobserved) prior preferences could be safely interpreted as causal effects.

2) In the scenario depicted in Figure A1, the coefficients of the current ability variables only have a descriptive interpretation, and precisely:

$$E(CHOICE|AB8 = x + 1) - E(CHOICE|AB8 = x) =$$

$$\sum_{PP} E(CHOICE|AB8 = x + 1, PP = z)P(PP = z|AB8 = x + 1) - \sum_{PP} E(CHOICE|AB8 = x, PP = z)P(PP = z|AB8 = x)$$

where AB8 is ability in year 8, AB5 is ability in year 5, PP stands for prior high school preferences, and CHOICE is the actual school choice.

3) In the scenario depicted in Figure B1, if we were able to correctly estimate the coefficients of current ability given prior preferences, we would be estimating "causal effects". However, the salience of such effect is unclear, as it relates to the comparison of actual choices made by pupils who had the same preferences before but reached different levels of ability at the end of middle school.

4) We run some simulations to explore the consequences of using prior ability as IV in the scenario depicted in Figure A1. The ability coefficients end up being heavily upward biased. Results are available upon request.

Appendix C

Empirical challenges in estimating a multinomial logit model with school fixed effects

We investigated the possibility to estimate a multinomial logit model with Fixed Effects to deal with unobserved heterogeneity at the level of the class of origin in year 8.

However, this has proved to be computationally extremely challenging, as the time and memory required to do so increase exponentially with the number of alternative school choices and the size of the class in year 8. As explained by D'Haultfoeuille and Iaria (2016), the estimation of such model is carried out through a Conditional Maximum Likelihood estimator and requires the listing of all possible permutations of the observed sequence of students' school choices within class of origin. With seven possible high school choices, and an average class size of 16 students, with a maximum size of 31 students, this has resulted in STATA running out of memory when estimating our full model (regardless of the computer memory size).

A strategy to deal with this issue consists in cutting the number of permutations. Reducing the number of permutations can be achieved either by reducing the number of alternative school choices, or the size of the class of origin. A further option is to run the analysis on a random sample of permutations. As suggested by D'Haultfoeuille and Iaria (2016), this is an effective way to cut estimation times and to run estimates that would otherwise not be feasible, although this may be costly from an efficiency point of view.

To implement these strategies, we have run our multinomial logit models with fixed effects not on the full set of school choices, but separately on the three vertical school categories (Lyceums, Technical and Vocational), and the three horizontal school categories (STEM, Humanities, and Other). For computational reasons, we have estimated our multinomial logit models with fixed effects on a random sample of the total numbers of permutations (1% of permutations per estimate, i.e. approx. 500,000 permutations for the horizontal model and 90,000 for the vertical model). To test the consistency of our results, the estimate has been repeated on several different random samples of permutations. The results have been compared to the results of a multinomial logit model without fixed effects but including school level variables (Table C1-C4). Although not perfectly overlapping, the estimates (coefficients and AME) are in most cases quite similar.

Table C1 – Coefficients. Multinomial logit models with and without fixed effects - 3 options horizontal

	Multinomial Logit with FE with permutation reduction (estimated using different random samples of 1% of total permutations)					Multinomial logit without FE but school variables
	(1)	(2)	(3)	(4)	(5)	(6)
STEM (base outcome)						
Other subjects (business)						
Grade in Italian	-0.122***	-0.074*	-0.103**	-0.069*	-0.088**	-0.069***
	(0.034)	(0.033)	(0.033)	(0.032)	(0.033)	(0.018)
Grade in Mathematics	-0.530***	-0.538***	-0.528***	-0.562***	-0.546***	-0.514***
	(0.033)	(0.032)	(0.032)	(0.032)	(0.032)	(0.018)
Test score in Italian	-0.102**	-0.095**	-0.064*	-0.079*	-0.125***	-0.124***
	(0.033)	(0.032)	(0.033)	(0.033)	(0.033)	(0.022)
Test score in Mathematics	-0.491***	-0.502***	-0.528***	-0.514***	-0.501***	-0.462***
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.020)
Humanities						
Grade in Italian	0.515***	0.529***	0.515***	0.539***	0.532***	0.396***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.016)
Grade in Mathematics	-0.645***	-0.665***	-0.666***	-0.670***	-0.673***	-0.588***
	(0.030)	(0.029)	(0.029)	(0.029)	(0.029)	(0.016)
Test score in Italian	0.405***	0.414***	0.427***	0.434***	0.389***	0.401***
	(0.029)	(0.028)	(0.028)	(0.028)	(0.029)	(0.019)
Test score in Mathematics	-0.552***	-0.538***	-0.548***	-0.555***	-0.533***	-0.507***
	(0.026)	(0.026)	(0.026)	(0.025)	(0.026)	(0.017)
Observations	52832	52832	52832	52832	52832	53920
Log-likelihood	-7435.1	-7459.5	-7454.0	-7416.1	-7408.9	-51736.2
Pseudo R2						0.119

* 0.05 ** 0.01 *** 0.001

NOTE. In column (6), in addition to individual variables, we have added the following school-level variables: average math test scores, average Italian test scores, % students with high educated parents, % students with migrant background, % girls.

Table C2 - Marginal Effects - Multinomial logit models with and without fixed effects - 3 options horizontal

	Multinomial Logit with FE with permutation reduction (estimated using different random samples of 1% of total permutations)					Multinomial logit without FE but school variables
	(1)	(2)	(3)	(4)	(5)	(6)
Grade in Italian						
STEM	-0.058***	-0.064***	-0.059***	-0.065***	-0.063***	-0.040***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Other	-0.064***	-0.058***	-0.062***	-0.058***	-0.061***	-0.055***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Humanities	0.123***	0.122***	0.121***	0.123***	0.124***	0.095***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Grade in mathematics						
STEM	0.121***	0.124***	0.123***	0.126***	0.125***	0.101***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Other	-0.027***	-0.027***	-0.025***	-0.029***	-0.027***	-0.027***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Humanities	-0.094***	-0.098***	-0.098***	-0.097***	-0.099***	-0.074***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Test score in Italian						
STEM	-0.046***	-0.047***	-0.051***	-0.051***	-0.042***	-0.036***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Other	-0.052***	-0.051***	-0.048***	-0.050***	-0.054***	-0.065***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Humanities	0.097***	0.098***	0.098***	0.101***	0.096***	0.102***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)
Test score in mathematics						
STEM	0.106***	0.105***	0.108***	0.108***	0.104***	0.088***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Other	-0.029***	-0.032***	-0.035***	-0.032***	-0.032***	-0.027***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Humanities	-0.077***	-0.073***	-0.073***	-0.076***	-0.072***	-0.062***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Observations	52832	52832	52832	52832	52832	53920
Log-likelihood						
Pseudo R2						

* 0.05 ** 0.01 *** 0.001

Table C3 – Coefficients. Multinomial logit models with and without fixed effects - 3 options vertical

	Multinomial Logit with FE with permutation reduction (estimated using different random samples of 1% of total permutations)					Multinomial logit without FE but school variables
	(1)	(2)	(3)	(4)	(5)	(6)
Lyceum (base outcome)						
Technical						
Grade in Italian	-0.601***	-0.569***	-0.541***	-0.555***	-0.562***	-0.409***
	(0.036)	(0.036)	(0.035)	(0.036)	(0.035)	(0.017)
Grade in Math	-0.022	-0.016	-0.040	-0.032	-0.043	-0.075***
	(0.033)	(0.032)	(0.033)	(0.032)	(0.032)	(0.016)
Test score Italian	-0.436***	-0.387***	-0.439***	-0.416***	-0.379***	-0.388***
	(0.035)	(0.036)	(0.035)	(0.035)	(0.035)	(0.020)
Test score Math	0.045	-0.015	0.010	0.026	0.032	0.012
	(0.031)	(0.031)	(0.031)	(0.030)	(0.030)	(0.017)
Vocational						
Grade in Italian	-1.141***	-1.077***	-1.071***	-1.012***	-1.074***	-0.713***
	(0.060)	(0.058)	(0.060)	(0.059)	(0.061)	(0.026)
Grade in Math	-0.407***	-0.410***	-0.413***	-0.435***	-0.435***	-0.408***
	(0.056)	(0.055)	(0.058)	(0.056)	(0.055)	(0.028)
Test score Italian	-0.696***	-0.644***	-0.636***	-0.641***	-0.642***	-0.734***
	(0.057)	(0.055)	(0.057)	(0.056)	(0.058)	(0.030)
Test score Math	-0.226***	-0.183***	-0.220***	-0.231***	-0.226***	-0.246***
	(0.051)	(0.050)	(0.052)	(0.051)	(0.050)	(0.027)
Observations	47760	47760	47760	47760	47760	53920
Log-likelihood	-3790.1	-3915.2	-3922.4	-3870.8	-3886.5	-38470.4
Pseudo R2						0.177

* 0.05 ** 0.01 *** 0.001

Table C4 - Marginal Effects - Multinomial logit models with and without fixed effects - 3 options vertical

	Multinomial Logit with FE with permutation reduction (estimated using different random samples of 1% of total permutations)					Multinomial logit without FE but school variables
	(1)	(2)	(3)	(4)	(5)	(6)
Grade in Italian						
Lyceum	0.138***	0.133***	0.130***	0.126***	0.132***	0.083***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)
Technical	-0.027***	-0.025***	-0.020***	-0.028***	-0.025***	-0.043***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)
Vocational	-0.111***	-0.108***	-0.111***	-0.098***	-0.107***	-0.040***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.002)
Grade in mathematics						
Lyceum	0.029***	0.030***	0.033***	0.033***	0.034***	0.027***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)
Technical	0.023***	0.024***	0.021***	0.023***	0.021***	0.002
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)
Vocational	-0.052***	-0.054***	-0.054***	-0.056***	-0.055***	-0.029***
	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)	(0.002)
Test score in Italian						
Lyceum	0.091***	0.084***	0.089***	0.087***	0.083***	0.082***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)
Technical	-0.028***	-0.023***	-0.032***	-0.029***	-0.022***	-0.039***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)
Vocational	-0.063***	-0.062***	-0.058***	-0.058***	-0.061***	-0.043***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.002)
Test score in mathematics						
Lyceum	0.010	0.014**	0.014*	0.013*	0.012*	0.008**
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.003)
Technical	0.022***	0.010	0.017**	0.020***	0.020***	0.011***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Vocational	-0.033***	-0.024***	-0.031***	-0.032***	-0.032***	-0.020***
	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.002)
Observations	47760	47760	47760	47760	47760	53920
Log-likelihood						
Pseudo R2						

* 0.05 ** 0.01 *** 0.001