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Nudging gender desegregation: a field experiment on the causal effect of information barriers on gender inequalities in higher education

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ABSTRACT



In this article, we propose and test a novel explanation for gender segregation in Higher Education that focuses on the misperceptions of economic returns to fields of study. We frame this explanation within the literature emphasizing the role of gender-stereotypical preferences and occupational plans, and we argue that counselling activities in school can play a crucial role in either reinforcing or countering the weight of these expressive mechanisms relative to more instrumental considerations involving occupational prospects of different fields. In particular, we suggest that the availability of reliable, ready-to-use information on these prospects enhances the probability that students, particularly females, opt for more rewarding fields. To test this argument, we present the results of a field experiment conducted in Italy that confronted high school seniors with detailed information concerning returns to tertiary education and field of study differentials, and we assess how girls and boys reacted to this counselling intervention.


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Introduction

Previous research indicates that gender segregation in Higher Education (GSHE) contributes to gender inequalities in the labour market because women major in tertiary fields that lead to less remunerative jobs (Bobbitt-Zeher 2007; Smyth and Steinmetz 2008). Understanding the mechanisms driving GSHE is therefore a major theoretical challenge with significant policy implications.

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Unfortunately, while the detailed patterns across time and space of GSHE have been extensively described (Barone 2011; Van de Werfhorst 2017), much less is known about the underlying mechanisms. It is broadly agreed that GSHE reflects the persistence of gender essentialism, understood as the belief that men and women are fundamentally different in their capacities and interests (Levanon and Grusky 2016), which promotes gender biases in the set of skills, beliefs and preferences that are socialized, internalized and performatively enacted as cultural scripts (Charles and Bradley 2009; Correll 2004).

However, as regards skills, there is evidence that gender differences in math and science average performance, as well as high-end performance, fail to account for GSHE (Hedges and Nowell 1995; Morgan *et al.* 2013). Still, gender differences in *perceived* skills mediate gender differences in the selection of a quantitative college major, though only to some extent (Correll 2004). Gendered beliefs concerning occupational returns to fields of study have been much less investigated (Wiswall and Zafar 2015a). As regards gendered preferences, a common explanation refers to work-family orientations: women would opt for less rewarding fields because they are more family centred and less career-oriented. However, gender differences in career orientations have narrowed in recent cohorts and the remaining differences fall short of explaining GSHE (Konrad *et al.* 2000; Bobbitt-Zeher 2007). A more promising argument relates to the expressive preferences of students concerning university curricula and aspired occupations (Morgan *et al.* 2013). When measured with sufficient detail to allow for 'horizontal differences' between school subjects and occupations, these preferences appear to be important mediators of GSHE (Morgan *et al.* 2013). For instance, girls more often display an expressive preference for humanistic subjects (e.g. literature) and for related jobs (e.g. teacher), which promotes enrolment in the humanities or the social sciences.

These gendered preferences should not be merely regarded as psychological mechanisms, but rather as the product of institutionalized practices that promote gender inequality (DiPrete and Buchmann 2013). Throughout educational and career exploration processes, parents, teachers and school counsellors tacitly encourage girls and boys to pursue different pathways into the labour market. For instance, gender differences in course-taking in high school also reflect social control mechanisms that operate through the gender-biased recognition of the 'talents' and preferences of students on the side of adults, as well as through peer pressure (Gabay-Egozi *et al.* 2015). There is also evidence that school-level

differences in curricular and extra-curricular activities display substantial effects on gendered field of study choices (Cech 2013; Legewie and DiPrete 2014).

Overall, the existing empirical literature undermines the hypothesis that a lack of relevant skills or ambition prevents girls from enrolling in more rewarding fields, and suggests that gender essentialism may induce gender-biases in self-assessments and expressive preferences which contribute to the overrepresentation of girls in less remunerative fields. Moreover, there are some indications that school environments actively fuel these gender biases. However, the full set of the underlying mechanisms of GSHE has yet to be identified: a fully fledged explanation for GSHE is still missing.

In this article, we propose and test a novel explanation for GSHE that focuses on the misperceptions of economic returns to fields of study, a mechanism that has received limited attention in previous research. We frame this explanation in the context of the above-cited research emphasizing the role of gender-stereotypical curricular preferences and occupational plans for GSHE, and we argue that counselling activities in school can play a crucial role in either reinforcing or countering the weight of these mechanisms relative to more instrumental considerations involving the occupational prospects of different fields. In particular, we rely on dual-process theory to argue that the availability of transparent information on these prospects enhances the probability that students, and particularly female students, opt for more rewarding fields. To support these arguments, we present the results of a field experiment conducted in Italy that confronted high school seniors with detailed information concerning returns to tertiary education and the related field of study differentials, and we assess how girls and boys reacted to this counselling intervention.

Theoretical framework

In this section, we rely on dual-process theory to sketch a micro-level model of field of study choices that incorporates both expressive preferences and instrumental considerations, and that defines some contextual conditions of their activation. Gender-stereotypical beliefs and choices are typical instances of the fast, automatic and intuitive Type 1 processes of human cognition and decision-making that are identified by dual-process theories (Evans and Stanovich 2013). In contrast, Type 2 processes involve slow, controlled, deliberative thinking and consequentialist models of decision-making. The distinction and the interplay between these two types of processes have become the focus of much interest in

contemporary research on decision-making processes. Dual-process researchers have documented that individuals display a relentless tendency to rely on intuitive, heuristic devices instead of engaging in analytical processes (Kahneman 2011). Even when individuals are confronted with novel problems for which they lack relevant experience and information, their default strategy is *not* to engage in systematic processes of information gathering. Instead, they rely on the information more readily available in their immediate environment, and they process it by means of simplified heuristic devices. However, this does not mean that individuals are insensitive to the prospective costs and benefits of their decisions: if better quality information becomes accessible and salient, they will make use of it. Dual-process theories thus entail a *situational* perspective on the classical dichotomy between rational and irrational behaviour that pervades sociological debates, including the debate about GSHE where culturalist explanations focusing on socialization influences are opposed to rational choice explanations considering only utility maximization mechanisms.

Drawing on this framework, we can expect that, in the absence of accurate information concerning the long-term career consequences of field of study choices, students tend to rely on simplified heuristics that mobilize their expressive curricular preferences and aspired occupations, as reported in previous research (Cech 2013; Morgan *et al.* 2013; Wiswall and Zafar 2015a): their preferred school subjects and ‘dream’ occupations represent simple, intuitive criteria to choose a field of study. Because these preferences are highly gender-stereotyped, they contribute to GSHE. However, this does not imply that students are insensitive to the profitability of different fields. Instead, they are poorly informed and highly uncertain in this regard, as reported by research on student expectations about returns to education (Wiswall and Zafar 2015b; Abbiati and Barone 2017). Therefore, if students are confronted with clear and pertinent information about these career consequences, they will incorporate this information in their decisions. Hence, the availability of reliable information concerning economic rewards reinforces their decisional gradient relative to expressive preferences. We can thus expect that, when provided with information about returns to tertiary fields, students will make use of it and thus switch to more rewarding fields.

Moreover, girls are more likely to be affected by the availability of this type of information. This is because in the case of boys, expressive preferences for technical disciplines and related occupations overlap with instrumental considerations concerning their profitability, while the expressive

preferences of girls more often involve humanistic and social science disciplines and occupations, which have lower profitability. Moreover, for boys, the informal pressures from significant others (parents, teachers, counsellors, peers) are aligned with the objective incentives to invest in STEM fields, whereas for girls there is a mismatch between these pressures and the profitability of gender-stereotypical fields. Therefore, girls are more often undecided as to whether to choose these less rewarding fields.

Accordingly, receiving transparent information concerning their poor labour market prospects should be more consequential for girls: such information tips the balance in favour of more rewarding fields. These theoretical arguments thus lead to the expectation that providing all students with information about the profitability of tertiary fields will reduce the overrepresentation of girls in less rewarding fields. Hence, universalistic, light-touch information initiatives may ‘nudge’ gender desegregation in HE, that is, gender differences across fields may be reduced without forcing or forbidding any educational option: in line with the definition of nudge proposed by Thaler and Sunstein (2008), the choice frame is modified by removing information barriers.

The Italian educational system and GSHE

In this section, we describe the main characteristics of the Italian educational system and the weaknesses of existing counselling activities. In Italy, primary and lower secondary education is comprehensive and lasts between the ages of 6 and 14. Upper secondary education comprises academic tracks (*licei*), technical tracks (*istituti tecnici*) and vocational tracks (*istituti professionali*). They all require five years to complete and provide access to college in any field. Higher Education in Italy comprises a large university sector and a small but growing sector of two-year vocational programmes. University education involves three-year bachelor courses and two-year master courses. Field of study choice mostly occurs at the bachelor level, and mobility between fields in the transition to master courses is uncommon. As regards postsecondary vocational education, it is highly fragmented, but the main option consists of two-year work-study programmes (*istituti tecnici superiori*) that offer a combination of theoretical and practical training. Graduates from these programmes enjoy positive occupational prospects relative to both high school graduates and bachelor’s graduates of less rewarding fields (Alma-laurea 2015; Indire 2015). However, these courses were only introduced in

2011, and they currently enrol a small number of students. Therefore, students are often unaware of this option.

In Italy, school-based college advising mainly offers broad overviews of the contents of college curricula. Students have limited access to figures concerning differences between fields in terms of academic selectivity and labour market outcomes. As in other western countries (Aastrup 2007), the emphasis of counselling activities is instead on self-expression and self-realization. Similarly, universities propose counselling initiatives that mainly focus on university curricula, while they deliver scant and opaque information with regard to the profitability of tertiary fields (Abbiati and Barone 2017). However, fields of study differences in labour market outcomes are substantial (Almalaurea 2015). Bachelor degrees in the humanities and social sciences, where girls are overrepresented, offer modest occupational returns over high school diplomas. Gender differences in field of study choice are strong and weakly declining over time (Barone 2011; Triventi 2010). In the online appendix, we describe in more detail existing counselling activities and occupational differences between fields.

The experimental design

In this section, we first present the overall experimental design; then, we illustrate the contents of the information initiative, the data collection design and, finally, we discuss the internal and external validity of this experiment. We ran a multi-site clustered randomized controlled trial that involved all of the senior students of 62 high schools, from all types of upper secondary tracks. The schools are located in four provinces (Milan, Vicenza, Bologna and Salerno) that cover different areas of the country. We first drew a random sample of schools proportionally stratified by province and school track. This procedure resulted in 31 pairs of schools that belong to the same province and school track. We invited these schools to participate in the project, and only four of them refused; these were easily replaced with schools of the same stratum. Then, we randomly assigned one school of each pair to the treatment and the other to the control status. No school left the experiment after we communicated the results of the randomization.

Treatment design

The experimental treatment provided senior students with detailed information concerning the profitability of educational options, that is their costs, academic selectivity and occupational prospects, with particular

attention to differences between fields of study and between college and postsecondary vocational programmes. We met each single class separately on three occasions for a total of five hours. All of the meetings occurred during school hours to maximize student participation. Indeed, treatment compliance was high: 90.4% of the treated students attended at least two meetings. The meetings were held by community workers that routinely work with the schools.

In the first hour of the first meeting (October 2013), students filled out a questionnaire concerning their family and school background, as well as their beliefs about college education and college plans. Then, the educators introduced the project and explained that its main goal was to help them carefully consider the pros and cons of different options after high school graduation. Finally, the educators provided detailed figures concerning college costs and opportunities for financial aid in order to invite all of the students, regardless of the economic situation of their families, to consider the information about tertiary education to be delivered in the next two meetings.

The second meeting (February 2014) was the core of this intervention. Students were confronted with figures on occupational returns to college degrees in comparison with the prospects of high school diplomas. The marked differences between fields across both undergraduate and graduate programmes were stressed, with a focus on four indicators of occupational returns: first job search duration, net monthly salary, risks of overeducation and of horizontal mismatch.

In the third meeting (March 2014), the educators reiterated the main messages of the previous meetings and then delivered information about dropout risks across fields of study for different student profiles, defined by gender, parental education, school track and previous academic performance. Finally, the educators provided information about the vocational sector of Higher Education in terms of available study opportunities and related occupational prospects. It was stressed that these programmes represent an alternative to direct entry into the labour market, particularly for students with a weak academic orientation.

These materials were based on high-quality data collected by the National Statistical Office (*ISTAT*) that are available for recent cohorts of students. We used statistical modelling to control for selection into different educational programmes and to compute the predicted values for different student profiles. These statistical results were then summarized into simple messages using visual formats that were suitable for power-point presentations in the classroom. For instance, the educators

first showed the figures displaying detailed comparisons between fields of study for each of the four above-mentioned occupational indicators. Then, they summarized these differences using a three-step scale with the less rewarding fields at the bottom (the humanities and the social sciences), highly rewarding fields at the top (engineering, computing, medicine and other health-related fields) and the remaining fields (economics, law, math, physics and life sciences) in an intermediate position. We focused on this simplified, three-step occupational hierarchy between fields because it is robust across undergraduate and graduate studies as well as across occupational indicators. This basic pattern is well-established in the empirical literature concerning the Italian case (Almalaurea 2015) as well as other western countries (Reimer *et al.* 2011).

It should be stressed that this information initiative was not specifically targeted to female students, nor did it specifically aim to redress gender inequality. Moreover, it must be noted that, while female graduates face poorer occupational prospects than their male counterparts, the magnitude of this gender gap is highly similar across fields, and the above-described three-step hierarchy of occupational profitability does not vary by gender.

In sum, this information initiative explicitly encouraged students to compare educational options with respect to their overall profitability (costs, benefits and chances of success), rather than focusing only on self-expressive preferences that, as argued above, can be a powerful driver of gender-stereotypical choices. To be sure, the educators did not promote a purely instrumental model of college choice either. Instead, the message was that, if a student was interested in two or more fields, assessing their career prospects could help to resolve his or her indecision.

Data collection

Longitudinal data concerning the students' initial college plans and final college decisions were collected among treated and control students before and after the information treatment. The first wave was conducted at the beginning of the school year (October 2013) and it involved self-administered questionnaires in the classrooms; the response rate was 99%. The second wave occurred at the end of the school year (May 2014), after the treatment but before the opening of university registration. This wave was based on telephone interviews, and it assessed whether students had updated their beliefs and college plans; the cumulative response rate was 82.8%. The third wave was conducted in November 2014 and

recorded the students' final college decisions using telephone interviews; the cumulative response rate was 79%, which was virtually identical for treated and control students (78.9% and 79.1%, respectively). Overall, the high level of participation of schools and students in the experiment and in the longitudinal survey ensures high external validity for our study.

Moreover, using the data of the first wave, we compared the two groups across several pre-treatment predictors of college choice. As reported in the appendix (Table A1), we could never reject the null hypothesis that the two distributions come from the same population. Overall, we would maintain that equivalence between the two groups, their identical attrition rates, as well as the absence of treatment contamination,¹ ensure also high internal validity for our study.

Modelling strategy

The primary outcome of interest for our analyses is field of study choice among students who attend college. In line with the contents of the experimental treatment, we will assess the effects of the treatment on *enrolment* in occupationally 'weak' fields (the humanities and social sciences), in occupationally 'strong' fields (engineering, computing, medicine and other health-related fields) and in intermediate fields. Moreover, we will consider the effects of the treatment on taking undergraduate college *entrance exams* in different fields. The counselling initiative may have modified the field preferences of treated students but, due to the ability barriers of entrance exams, these effects may not carry over into actual enrolments. Finally, we know that, as an alternative to bachelor's courses, upper secondary graduates may opt for *postsecondary vocational education*. Therefore, we will assess whether the treatment also affected this outcome. Because our outcomes are dichotomous, we use binomial logit models and report their marginal effects that are easily interpretable and comparable across categories, such as girls and boys (Mood 2010).

Our main independent variable (T) is a dummy for treatment status. To gain statistical power, all the models incorporate the two sampling stratification variables, province (P) and high school track (S), as well as study intentions in wave one (I).² Hence, for individual i attending school j in

¹In the second wave of the study, we asked control students whether they had received any specific information about the profitability of college degrees in relation to our project. Only 3.3% of control students answered positively. These internal validity checks are documented in more detail in Barone *et al.* (2017).

²We measured college plans using two questions. First, we asked students whether they planned to attend college or to pursue vocational training. Second, we asked them in which field of study they would enrol. We combined these two questions into one single variable.

province k , the general equation that underlies all of the models takes the following form:

$$y_{ijk} = \alpha + \beta T_j + \gamma P_k + \delta S_j + \sigma I_i + \varepsilon_{ijk} \quad (1)$$

Standard errors are clustered at the school level.

Results

Descriptive results

In this subsection, we present some descriptive analyses concerning the pattern of gender differences in field preferences among the students of the control group, that is, in the absence of the treatment. These analyses provide the background for the experimental results presented in the next subsection. [Figure 1](#) refers to variations across waves in the field preferences of male and female students of the control group who enrolled in college. The data for waves one and two refer to intended field choices at the beginning and end of the high school senior year, while wave three refers to the actual decisions.

As seen, we observe a marked decline over time of strong fields and a corresponding increase of intermediate and weak fields for both male and female students. Hence, the field preferences at the beginning of the senior year (wave one) are more ambitious than the actual decisions (wave three). This trend is definitively more pronounced for girls: 27.8% of them initially planned to choose a strong field, but only 13.9% finally chose one. This decline is twice as large as the corresponding decline observed among the boys (from 44% to 36.6%). Conversely, the share of girls who enrol in a less rewarding field (33.8%) is considerably higher than

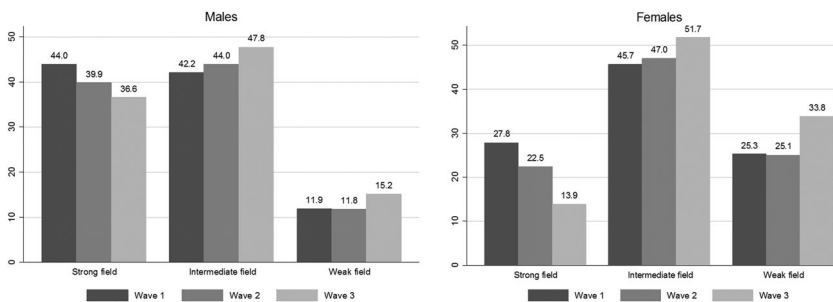


Figure 1. Variations over time of field preferences by gender (control group, percentages).

the share of girls who initially planned to do so (25.3%); among the boys, we detect a much smaller increase (+3.3%). Hence, the gender gap in access to more rewarding fields of study widens substantially over the senior year (for more detailed descriptive evidence, see Section 4 of the online appendix).

Interestingly, if we take a closer look at initial preferences, we observe a considerable degree of fluidity. When expressing their field preferences in wave one, the students could indicate up to three fields, and the pattern of their multiple initial preferences is revealing. Table 1 classifies field preferences at the beginning of the school year according to the number and type of field options that were mentioned by the students.

As expected, the boys more often indicated only strong fields ('certainly strong') and the girls more often indicated only weak fields ('certainly weak'). Most importantly, the table reveals a high degree of uncertainty in student preferences: more than half of both the male and the female students were undecided between fields that differ substantially in their economic prospects. Crucially, more often than boys, the girls considered the alternative between a weak field and a more rewarding field (30.2% vs.

Table 1. Number and type of field preferences expressed in wave one by gender.

	Male	Female	Total
No preference	1.5	1.1	1.3
Certainly strong	19.7	8.2	13.0
1 preference	8.7	3.0	5.4
2 preferences	6.6	3.1	4.5
3 preferences	4.4	2.1	3.1
Certainly intermediate	22.2	22.3	22.3
1 preference	10.2	9.0	9.5
2 preferences	6.8	8.7	7.9
3 preferences	5.2	4.6	4.9
Certainly weak	4.9	11.8	8.8
1 preference	1.9	4.6	3.4
2 preferences	1.6	3.7	2.8
3 preferences	1.4	3.5	2.6
Undecided between weak and other fields	17.2	30.2	24.7
1 weak + 1 strong	1.3	1.6	1.5
1 weak + 1 intermediate	3.0	7.8	5.8
1 weak + 1 intermediate + 1 strong	4.1	5.5	4.9
1 weak + 2 intermediate	4.2	6.7	5.6
1 weak + 2 strong	0.9	1.4	1.2
1 intermediate + 2 weak	3.1	6.2	4.9
1 strong + 2 weak	0.6	1.0	0.8
Undecided between intermediate and strong fields	34.5	26.3	29.8
1 intermediate + 1 strong	10.9	8.2	9.3
1 intermediate + 2 strong	10.1	7.8	8.8
1 strong + 2 intermediate	13.5	10.3	11.7
Total	100.0	100.0	100.0
<i>N</i>	1878	2578	4456

17.2%). Conversely, the boys were more often undecided between an intermediate and a strong field; however, this gender gap was much smaller (34.5% vs. 26.3%). Overall, these descriptive analyses point to a high degree of fluidity and interchangeability in student preferences among fields that differ significantly in their employment prospects. The question is whether providing students with relevant and reliable information on these prospects affects their final decisions, as discussed in the next section.

Experimental results

The first three lines of [Table 2](#) refer to the effects of the treatment on enrolment in either weak, or intermediate or strong fields. We report the marginal effects of the logit parameters. As seen, the treatment reduced enrolments in weak fields by 2.8%. If we consider that the share of control students who enrolled in these fields is 26.2%, we can conclude that this effect size is far from negligible. Most importantly, if we estimate treatment effects separately for male and female students, we find that they are even stronger for girls (−4.5%), while they are negligible

Table 2. Effects of the treatment on access to fields of study and to postsecondary vocational programmes (marginal effects from binomial models expressed in percentage points; standard errors clustered at the school level in brackets).

	Overall	Males	Females	<i>p</i> -value of the test for gender differences in treatment effects
Enrolment in weak fields	−2.8** (1.2)	−0.3 (1.6)	−4.5*** (1.7)	0.061
Enrolment in intermediate fields	1.3 (1.6)	−1.0 (2.6)	2.6 (1.8)	0.223
Enrolment in strong fields	1.6 (1.4)	1.2 (2.4)	2.1 (1.4)	0.707
Enrolment in selected intermediate and strong fields ³	4.7*** (1.3)	0.4 (1.9)	8.0*** (1.7)	0.003
Enrolment in weak fields: students undecided between a weak field and another field	−6.7** (3.1)	−3.8 (5.4)	−8.3** (4.1)	0.389
At least one entrance test in a strong field	1.7 (1.2)	2.7 (1.9)	1.0 (1.6)	0.483
At least one entrance test in a weak field	−1.8 (1.3)	1.6 (1.3)	−4.2** (1.9)	0.002
Enrolment in postsecondary vocational programmes	1.5** (0.6)	0.7 (0.7)	2.2* (0.8)	0.082
<i>N</i>	4453	1870	2563	

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; models control for sampling stratification variables and pre-treatment study intentions.

³Engineering and ICT, health-related fields, pharmacy and veterinary, business and economics, psychology and teacher education.

(−0.3%) and not statistically significant for boys. Moreover, if we formally test the null hypothesis that the difference between the treatment effects for the girls and the boys is zero, we obtain a p -value of 0.06. Hence, there is evidence that the treatment reduced the gender gap in access to weak fields.

However, treatment effects on enrolment in strong fields are smaller and non-significant. The main treatment effect is in the expected direction (+1.6%) and there are some indications also in this case that the girls were more reactive to the treatment (+2.1%) than the boys (1.2%), but the gender differential in treatment impact does not reach statistical significance (p -value: 0.707). We detect a similar picture as concerns treatment effects for enrolment in intermediate fields. Hence, the counselling initiative did not have uniform positive effects on access to either strong fields or intermediate fields. We cannot formally test the statistical significance of treatment effects for specific fields due to constraints of statistical power, but if we inspect these detailed field-specific shifts by means of binomial contrasts, we find that: (i) the treatment redirected the girls out of both the humanities (−2.4%) and the social sciences (−2.4%); (ii) the treatment failed to increase female enrolments in medicine, law and in some scientific fields (math, physics and life sciences); (iii) girls were attracted to a broad range of both intermediate and strong fields: business and economics (+2.2%), engineering and computing (+1.2%), education and psychology (+2.5%), health-related fields (+1.2%) and pharmacy and veterinary (+1.1%). As reported in [Table 2](#), if we estimate the effect of the treatment on enrolment in these selected fields altogether, we detect a positive and sizeable overall impact (+4.7%), which is again entirely driven by the girls (+8.0%). The p -value reported in the last column of [Table 2](#) indicates that the confidence intervals of the treatment effects for male and female students do not overlap. Hence, the treatment redirected girls from weak fields into a *broad range* of more rewarding fields. Moreover, because these fields are less feminized than the humanities and the social sciences, the treatment reduced the overall level of gender segregation across fields. The dissimilarity index for a detailed 12-fold classification of fields of study is significantly lower among treated students (0.26) than among the controls (0.31).

Moreover, we estimated treatment effects for the subpopulation of the students who were initially undecided between a weak field and an intermediate or strong field. As reported in [Table 2](#), the departure from weak fields (−6.7%) was much stronger than the main treatment effect for the whole population of college students (−2.8%). This is consistent with our

expectation that the counselling intervention would have a greater effect on students who were considering multiple field options. Interestingly, if we look at the point estimates, this conclusion applies more to the girls (−8.3%) than to the boys (−3.8%), but the test for the difference in treatment effects is not statistically significant (p -value: 0.389). However, our main point is not that undecided girls were more reactive than undecided boys, but rather that indecision about weak fields is far more widespread among the girls. Even if among these undecided students the treatment was equally effective for girls and boys, we know from the previous section that the girls were much more often undecided between a weak and a more rewarding field. Hence, the treatment necessarily more often channelled the girls into more rewarding fields.

Table 2 also reports treatment effects on applications to at least one college entrance exam in a strong field, or in a weak field. Access to medicine is highly selective, and even if engineering and computing less often have a *numerus clausus*, their math-intensive entrance exams are highly challenging. Therefore, one could suspect that the treatment persuaded some girls to enrol in these fields, but that these girls did not pass the entrance exams. However, our analyses do not support this hypothesis. On the contrary, there is evidence that, if anything, treated boys were pushed to apply to entrance tests in strong fields more often than girls (+2.7% and +1%, respectively). At the same time, Table 2 indicates that the treatment had a negative effect on applications to entrance tests in weak fields (−1.8%) and that this effect was particularly strong for girls (−4.2%). Overall, the pattern for applications to admittance tests reproduces the results concerning actual enrolments, which suggests that ability barriers did not weaken the effects of the treatment on girls to any significant extent. Finally, the last row of Table 2 indicates that the counselling intervention had an additional effect: it raised participation in postsecondary vocational education.³ The main effect of +1.5% is statistically significant and, given the low share of control students who enrolled in these programmes (4%), it is a substantial effect. Moreover, the girls were more reactive to the treatment (+2.2%) than the boys (+0.7%) also in this respect. Hence, among the students who did not attend college, the girls were more inclined to use information about educational alternatives to direct entry into the labour market, possibly

³Of course, the models for this outcome are estimated using the whole sample of high school seniors, instead of the subsample of college students, because enrolment in these programs is not compatible with college attendance.

because girls tend to rely more on educational credentials for labour market insertion.

Overall, we conclude that the treatment had two important beneficial effects. First, it improved the occupational prospects of the students by enhancing their presence in both more rewarding university fields and in postsecondary vocational programmes. Second, it improved the relative prospects of the girls over the boys in both respects.

Let us comment on the results of two robustness analyses that are reported in the appendix (Table A3). First, the models for field of study choice reported in Table 2 refer to the students who continued to college because, by definition, GSHE involves only students who attend college. However, it is important to assess the pattern of results for unconditional models that refer to the whole sample of students, regardless of college attendance. In these models, the reference outcome is leaving the educational system, and the four alternatives are continuing to college in (i) weak fields; (ii) intermediate fields; (iii) strong fields or, alternatively, (iv) pursuing vocational programmes. Of course, these models conflate continuation to college with field of study choice, but they do not entail any selection of the initial samples of treated and control students. However, it turns out that also with this specification we conclude that students were redirected from weak fields to more rewarding fields, and that this effect was much stronger for the girls. The similarity of the results between conditional and unconditional models reflects the fact that the treatment did not have an impact on the overall college enrolment rate, nor on the related gender differentials (Abbiati *et al.* 2017). Second, using Average Treatment estimates on the Treated, instead of Intention-To-Treat estimates, does not affect our results.

Finally, in Table 3 we assess some competing explanations for the treatment effects on fields of study choices. A first possibility is that girls and boys had different initial levels of information about the profitability of different fields and thus benefited differently from the counselling intervention. This hypothesis is not supported by our analyses. At the end of the senior school year (wave two), we assessed student expectations of career opportunities across different fields using this format: ‘It is easier to find a job with good career opportunities for a graduate in technical fields (engineering, computing) than for a graduate in the natural sciences (e.g. biology, chemistry)’. The students had to express their agreement on a 10-point scale, and we submitted to them four dichotomous contrasts between field clusters that reflect our threefold classification in occupationally strong, intermediate and weak fields. Table 3 reports the mean

Table 3. Beliefs and choice criteria for college choice. Descriptive evidence for control students and treatment effects.

	Control students Mean values (and % of ratings below 6)		Effects of the treatment		
	Male (a)	Female (b)	Male (c)	Female (d)	<i>p</i> -value of the difference (e)
In Italy it is easier to find a job with good career opportunities for ... (1–10 points scale)					
... a graduate in technical fields than for a graduate in the natural sciences	6.8 (19.2)	6.9 (19.0)	0.35*** (0.07)	0.29*** (0.06)	0.510
... a graduate in the natural sciences than for a graduate in the humanities	6.7 (23.4)	6.7 (24.1)	0.42*** (0.06)	0.51*** (0.06)	0.212
... a graduate in the natural sciences than for a graduate in the social sciences	6.0 (36.3)	6.0 (36.4)	0.51*** (0.06)	0.56*** (0.06)	0.43
... a graduate in the natural sciences than for a graduate in economics or law	5.0 (58.3)	5.1 (55.0)	0.11 (0.07)	0.20*** (0.07)	0.257
When deciding what to do after leaving school, how important to you are the following considerations ... ? (1–10 points scale)					
The difficulty of studying at university	6.4 (27.6)	6.3 (29.1)	0.02 (0.07)	−0.06 (0.07)	0.444
The possibility of having a good career	7.4 (10.9)	7.6 (9.1)	0.07 (0.06)	−0.07 (0.06)	0.060
The cost of studying at university	6.4 (26.9)	6.7 (24.6)	−0.23*** (0.07)	−0.33*** (0.07)	0.214
<i>N</i>	3,592	3,931	3,592	3,931	

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; the models for treatment effects control for sampling stratification variables; standard errors clustered at the school level in brackets.

agreement scores and the percentages of ratings that were below 6 for girls and boys. As seen from the first two columns, a substantial minority of students of the control group disagreed that the natural sciences offer better career prospects than the humanities (23.4% and 24.1%, respectively, for male and female students) or the social sciences (36.3% and 36.4%). There was also the limited knowledge that technical fields are more rewarding than the natural sciences (19.2% and 19% of disagreement). Moreover, the low mean agreement scores for these field comparisons suggest that, even when students had some awareness of these field differentials, they expressed a substantial degree of uncertainty. Hence, in the absence of the treatment, the students reveal limited awareness of field differentials in career prospects, and these initial information gaps were not gender-differentiated.

A second hypothesis is that the girls more strongly internalized the messages of the information initiative because they paid more attention during the meetings. The third and fourth columns of Table 3 show that treated students agree more often that technical fields offer better prospects than the natural sciences and that in turn the latter are in a better position than the humanities and the social sciences. Hence, they internalized the threefold hierarchy of profitability between fields. However, we can see in Table 3 that treated male and female students were equally receptive. Finally, a third possibility is that the treatment encouraged students, and particularly girls, to be more instrumental in their educational decisions. To assess this possibility, in wave two we asked treated and control students to indicate the importance that they attached to three decision-making criteria: the costs, career prospects and chances of success of educational investments. First, our findings show that, in the absence of the treatment (columns one and two), girls and boys attached similar importance to these criteria. Second, the treatment reduced student concerns about college costs, but it did not impact on the subjective importance attributed to career prospects for either the girls or the boys: students did not become more career-oriented.

Overall, gender differences in the initial beliefs and decision-making criteria, as well as in the related treatment effects, are negligible. What made a difference between male and female students was instead the propensity to make use of the information inputs, which was higher among the girls. As documented in Tables 1 and 2, girls were more often undecided between a weak field and a more rewarding field and the treatment impacted more on these undecided students. This information initiative was far more relevant to the college choices of girls. This explains why this universalistic initiative produced gender-differentiated effects.

Concluding remarks

This study has proposed and tested a novel explanation for the overrepresentation of girls in less rewarding fields, namely the lack of information concerning their occupational prospects. We argued that girls and boys are often undecided between two or more fields that offer different career prospects. If college advising fails to provide students with reliable information about these career prospects, students are likely to rely on oversimplified choice heuristics that solely focus on their expressive preferences for subject matter or ‘dream’ occupations. Because these preferences are gender-stereotyped, they fuel GSHE.

However, in line with our theoretical framework, we have seen that girls and boys also attach importance to the economic profitability of tertiary fields. We argued that this does not imply that they will look for relevant and reliable information. In the absence of pertinent information, their default strategy is instead to mobilize gender-stereotyped decision-making mechanisms. Conversely, if students receive transparent information concerning occupational differentials between fields, they will make use of it. In other words, the availability of reliable information on returns to tertiary fields reinforces the decisional gradient of this choice mechanism. Crucially, girls are more often undecided than boys between an occupationally weak field and a more rewarding field. Therefore, they are more reactive to information about career prospects.

The results of our experiment support this argument. We designed an intervention that provided students with detailed information about the profitability of different educational options. We confronted students with transparent information inputs concerning the costs and occupational rewards of different options, as well as the chances to succeed in different fields.

The results of our analyses confirm that information barriers fuel the overrepresentation of girls in less rewarding fields. Among treated students, enrolments in the humanities and the social sciences declined to the advantage of a broad range of more remunerative fields. Crucially, this treatment effect was entirely driven by the girls; therefore, their overrepresentation in weak fields was reduced. Because these fields are highly feminized, the overall level of gender segregation was also reduced. Moreover, the students who did not continue to college enhanced their participation rates to postsecondary vocational programmes. Again, this treatment effect was entirely driven by the girls.

Contrary to the claim that girls are less career-oriented than boys, we found that they are *more* responsive to information about the profitability of educational options. To put it bluntly, give girls more transparent information, and they will make more ambitious choices. Our results indicate that male and female students have similar career orientations, similar prior beliefs about HE and a similar propensity to interiorize the messages of the counselling initiative. The key difference is that girls more often consider the alternative between an occupationally weak field and a more rewarding field, and they are thus more penalized by information barriers. The weaknesses of college advising thus fuel the segregation of girls in less rewarding fields.

The main policy implication of our study is that improving the quality of college advising can promote a more efficient and equal allocation of students between tertiary programmes. This conclusion is in line with some previous information experiments that focused on the effect of information on college enrolment rates and the related socioeconomic differentials (Bettinger *et al.* 2009; Oreopoulos and Dunn 2013; Barone *et al.* 2017). Our study suggests that information barriers can also drive gender inequalities in education and that removing these barriers can promote a more efficient distribution of students across fields to the advantage of girls. On the one hand, this information initiative can reduce the overcrowding of weak fields, thus arguably improving the labour market prospects of their graduates, who are more often girls. On the other hand, it can persuade some girls to opt for more rewarding fields.

We would argue that this information-based intervention has three additional strengths from a policy perspective. First, it is an inexpensive, light-touch intervention that could be easily organized by school teachers or counsellors themselves. Second, in line with the definition of nudge (Thaler and Sunstein 2008), student behaviour is altered without forcing students to take (or not to take) some fields. Third, this information initiative does not involve any differential treatment: girls and boys receive the same information inputs.

Of course, information initiatives are not a panacea, and our own results indicate that they can only partially redress gender differences in college choice. Therefore, they should be integrated by more comprehensive actions to raise the awareness of parents, teachers and counsellors of gender biases in educational contexts. In turn, educational interventions should be integrated by welfare and employment policies aimed at promoting equal opportunities in the labour market, because research shows that significant gender differences in occupational outcomes persist when controlling for field of study (Smyth and Steinmetz 2008).

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No potential conflict of interest was reported by the authors.

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