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UNIVERSITÀ DEGLI STUDI DI MODENA E REGGIO EMILIA
Dipartimento di Economia Marco Biagi

DEMB Working Paper Series

N. 213

Gender inequalities in college major choices. The role of explicit and implicit stereotypes

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July 2022

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ISSN: 2281-440X online

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Keywords: Education gender gap, Major choice, Stereotypes, Field experiment, Implicit Association Test

JEL codes: J16, J71, I24, A21, C93, D91

ABSTRACT

College major choices are highly segmented by gender and generate persistent inequalities in the labour market at the disadvantage of women. The literature has underlined the role of gender stereotypes on college major choices and the costs both at individual and society level of the resulting mismatch of talents and wrong fields of education choices. Determinants of college major choices from a gender perspective are at the core of this paper which has also a special focus on the impact of gender stereotypes (implicit and explicit) and on the choice of economics as a college major.

Microdata are generated by a field experiment involving different high schools in the last year of attendance when students are close to the college major choice. The schools are located in two Northern districts of Italy a country characterized by a very high gender gap in the labour market at the disadvantage of women. Activities include role models, board game addressing gender stereotypes in professional choices and documentaries highlighting the impact of gender stereotypes in the labour market. A questionnaire including Implicit association tests has been submitted to the sample exposed to the treatment and to the control groups to measure gender stereotypes, individual and household characteristics and the impact of the treatment on college major choices and their determinants.

We find evidence of gender stereotypes among students, and – differentiating by gender – female students appear to have a higher level of implicit stereotypes than males. Female students participating in the experiment appear to increase their awareness concerning college major choice and their propensity for STEM and for finance over marketing within the economics courses whereas male students taking part in the activities appear to be more interested in pursuing higher education instead of looking for a job, are more uncertain about their future field of studies and increase their interest in humanities while showing a higher propensity for marketing instead than finance when compared to the male students' control group.

1. INTRODUCTION[1]

Differences in college major choices by gender are at the origin of the widespread underrepresentation of women -math-intensive - majors and doctoral courses (OECD, 2019, 2021; European Commission, 2021). While higher earnings and better career opportunities appear to be related to male-dominated majors such as hard STEM and finance, female-dominated majors (education, humanities and a set of social sciences) are characterized by lower work opportunities and lower salaries (Carlana & Corno 2021, Carlana 2019, Cimpan 2020, Goldin 2015, Ingellis et all 2018). Thus, persistence in gender differences in fields of study is bound to be reflected in persistence in gender inequalities in the labour market (OECD, 2021).

Understanding the origins of gender differences in college major choices is therefore crucial to evaluate the existing unbalances in the labour market, leading to key effects both at the individual and at the societal level. For individuals, the first important consequence of a wrong university choice is that it generates costs (Carlana & Corno 2021), ranging from having a lower performance at work, quitting work, or even not fitting properly into future employment. For society as a whole, wrong college major choices could cause a mismatch of talents and a loss in human capital, thus potentially reducing economic growth and development.

The aim of this paper is to investigate college major choices from a gender perspective, with a special focus on how gender stereotypes may affect the preferences about the chosen field of study. A special focus of this contribution will be devoted to the choice of economics as a college major, which appears to be gender unbalanced (Paredes Fuentes et al.2021; Avilova and Goldin, 2018), especially for highly quantitative economics degree programs such as finance (Bertocchi et al. 2022); the gap is mitigated by the business and marketing degree, which is characterized by a lower mathematical intensity and a higher percentage of females (Megalokonomou et al. 2021).

To analyse the determinants of college major choices, we perform a field experiment in a sample of high schools in two Northern districts of Italy by analysing the reported preferences of students belonging to the last year of studies, which is the period immediately preceding college major choice. The choice to focus on Italy is connected to the very high gender gap in the labour market at the disadvantage of women. Indeed, in 2021 (the year when the field experiment took place) in Italy, the average male employment rate in the 15-64 age group was 67% against 73% in EU-27, while the average female employment rate was 49% against 63% in EU-27 (Eurostat, 2022). This gap is also visible in the Gender Equality Index, where the index dimension concerning work classifies Italy at the last position within the EU countries (EIGE, 2021). Moreover, although in Italy females graduate with higher grades have more continuity in their studies (Almalaurea 2022), once entered the labour market, they suffer from horizontal and vertical segregation (sticky floor and glass ceiling).

The gender stereotypes we focus on are both explicit and implicit. Explicit stereotypes are self-reported, conscious beliefs on gender differences in interests, attitudes and abilities in different

[1] Funding from the Gender Stereotypes and Education Gaps in the Economics Field (GSEGEF) FAR 2019 University of Modena and Reggio Emilia Interdisciplinary Research Fund project - is gratefully acknowledged. We are grateful to Professor Carlo Tomasetto for his stimulating comments on the design of the experiment and of the IAT structure and to the role models and the research assistants who participated in the project, as well as to the high school students and the institutes involved in the experiment.

cognitive areas; implicit stereotypes are automatic beliefs about the association between gender and a given field of education (De Gioannis, 2022a; Martin & Dinella, 2001).

The paper contributes to the literature on the determinants of college major choices in four ways: by focusing on Italy; by analysing the preferences of students in a moment when they are mostly close to college major choice; by distinguishing the role of explicit and implicit gender stereotypes on college major choices; by studying the impact of gender stereotypes on college major choice differentiating by gender, with a special focus on the economics field of study.

Our results show a relevant degree of gender stereotypes among students, and – differentiating by gender – females appear to have a higher degree of implicit stereotypes than males. Gender stereotypes have an important effect both on the determinants of the choice of college major and on the college major choice itself. Females with high gender stereotypes feel less confident in themselves and are not attracted by economics and mathematics. At the same time, they are less likely to enrol in economic degrees (preferring humanities careers) and assign less importance to economics for their future academic/professional/everyday life. For males, the effect is the opposite: the higher the degree of stereotype, the higher their level of confidence in economics and mathematics. Choice determinants such as subjective task value and expectation of success are as well differentiated by gender, being strictly correlated with university choices (positively to economics and STEM and negatively to humanities). In addition, the role of choice determinants in enrolment decision-making is higher than the role of ability and skills. As to treatment effects, treated female students appear to increase their awareness concerning college major choice and their propensity for STEM bachelor courses and for finance over marketing within the economics courses. Treated male students appear to be more interested in pursuing higher education instead of looking for a job, are more uncertain about their future field of studies and increase their interest in humanities courses. In the field of economics courses, treated males show a higher propensity for marketing instead of finance when compared to the control group.

The paper is structured as follows. Section 2 reviews the relevant literature. Section 3 describes our field experiment in high schools. Section 4 outlines the sample identification and the data. Section 5 presents the results. Section 6 concludes. The Appendix contains additional figures and tables, together with a specification of how we performed the test for the existence of implicit stereotypes.

2. LITERATURE REVIEW

The determinants of uneven gender distribution across fields of study have been largely analysed in the literature, leading to the conclusion that the factors that influence college major choice are complex and multidimensional (Patnaik et al., 2020). Psychological and cultural factors have a great role in this context and manifest themselves both at home and at school through the negative (explicit and implicit) gender stereotypes proposed by family, teachers, and peers.

Carlana and Corno (2021) show that parents affect the children's field of study either by imposing direct restrictions on their choice sets or by indirectly influencing their behaviour through recommendations, while several additional contributions highlight the role of parents on children's preferences and economic/educational decisions (Doepke et al., 2019; Lizzeri and Siniscalchi, 2008; Giustinelli, 2016). Moreover, the expectancy-value theory (EVT) of academic motivation (Eccles et al., 1983; Jacobs et al., 2005) points out that parents are a major environmental influence on the development of children's self-perception of ability in different academic domains. In particular,

parents' evaluations have been found to affect the association between performance-related indicators (such as teacher's ratings) and children's self-perception of ability (e.g., Frome & Eccles, 1998; Tiedemann, 2000). As regards to the role of teachers, Carlana (2019) and Lavy (2008) provide evidence that teachers' stereotypes induce girls to underperform in math, develop lower self-confidence, and self-select them into less demanding high schools. As to the role of peers, Carlana and Corno (2021) and Booth et al. (2018) show that girls do not choose math to avoid interactions in male-dominated contexts (thus perpetuating gender segregation by avoiding to enroll in a field in which they know they will be rounded by the opposite sex), Shan (2020) adds that the most likely to drop out from math-related fields are the highly skilled female and Astorne-Figari and Speer (2019) point out that students switch to majors where their gender is more represented. In addition, Feld e Zolitz (2022) find evidence that students' educational choices and labour market outcomes are affected by the proportion of female peers, showing that women who are randomly assigned to a higher proportion of female peers in their studies are more likely to choose female-dominated majors (like marketing) and less likely to choose a male-dominated major (like finance).

Together with parents, teachers and peers, also role models have been shown important for college major choices. Indeed, several studies demonstrate the positive impact of female role models on pushing female students through typical male-dominated paths, both directly by affecting their choice (Porter and Serra 2020; Breda et al. 2020) and indirectly by affecting their ability or probability to graduate (Porter and Serra 2020; Carrell et. al. 2020). Redmond et Gutke (2019) demonstrate the effectiveness of one-to-one mentorship relations in supporting females in STEM; Jethwani, et al. (2017) tests the effectiveness of live tutoring from college and graduate students together with site visits/field trips to organizations where female role models showed how they work in generating interest in female students for cybersecurity; Stoeger and al. (2016) prove the effectiveness of the E-mentoring for women in STEM with a female mentor; Merritt et al. (2021) found an increase in science identity among adolescent girls through science workshops where female professionals in STEM talked about how they became interested in STEM.

A related branch of literature such as research in developmental and educational psychology has addressed the issue of choice drivers offering a holistic view of choice determinants, jointly considering dimensions such as motivation, beliefs, values, and goals. In particular, according to Eccles and Wingfield's model (2002), the main determinants of choices (and of performance) are:

i. *Expectations of success* (I can do It?). The expectations of success include both the observed ability and the personal prejudice about one's own abilities. That latter refers to the self-perception of being able to achieve the goal, namely the ability's self-concept. According to the literature, this second component is based on personal perception, and it is a strong determinant of course enrolment and occupational aspirations choice (Bandura 1997, Bandura et al. 2001).

ii. *Subjective task value* (Why do It?). Rokeach M. (1979) defined values as a set of stable and general beliefs about what is desirable, pointing out that beliefs are formed in the individual's basic psychological needs and sense of self and are influenced by societal norms. In other words, the *subjective task value* is a multidimensional construct which includes all dimensions that motivate (engage) individuals by influencing both the attractiveness of some goals and the thought that achieving those goals is something that should be done (Feather 1988, Feather 1992). It contains dimensions such as intrinsic value (I like it), attainment value (it makes me feel accomplished),

utility (I value it important for my future goals (Eccles, 1983)), costs (anxiety, fear of failure, effort) and sense of belonging.

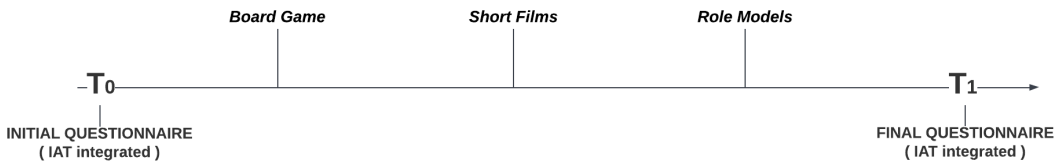
These dimensions are interacting blocks and develop together with the external stimuli which derive from the environment which the individual belongs to and that surround pupils from the very beginning of their lives. These external stimuli can be otherwise defined as "environmental factors" and can be identified with family, teachers, peers, cultural roles and role models. All together these factors contribute to determine pupils' future choices, with the risk of conveying gender stereotypes in the choice of the field of study. The influence of surrounding beliefs, the lack of role models (Carrell et. Al. 2010) and the lack of representation (Porter and Serra 2020) could indeed boost the *self-stereotype* and affect the association between gender and fields. Thereby, perceptions and *stereotypes* can be more relevant than interests and skills in college major choices, potentially distorting both the *expectations of success* and the *subjective tasks value*, and in turn the process that guides students' choices. In conclusion, in line with Eccles and Wingfield (2002)'s model, gender stereotypes would indirectly influence educational choices by biasing expectations of success, perceived usefulness of the course, interest in the subject, identification with the course field and the cost of choosing one course over another.

3. EXPERIMENTAL DESIGN & DESCRIPTION

The project involves students belonging to the last year of high school (fifth-grade classes)[2] in different high schools in the provinces of Modena and Reggio Emilia. The choice to focus on that sample of students is because during that year students must choose whether to enrol on universities and which college majors to choose.

As the best allocation between treated and controls is the one which identifies as a comparison group those who in the absence of the program would have had similar results to those who were exposed to the program (Duflo 2004), classes were separated into the factual and the counterfactual groups considering the institute and the various curricula so that the treated and the control groups were as similar as possible for composition and environment.
Computer-administered questionnaires have been submitted to both treated and not treated groups of students with the time sequence shown in Figure 1. At first, an ex-ante questionnaire was implemented on all students, then the treated participated in three activities (namely and in chronological order: a board game, short films projection and meeting with a role model) while the control attended classes as usual without any change in their timetable, and finally, all pupils fulfilled an ex-post questionnaire.

Figure 1 – Timeline of the field experiment



[2] There is only one exception where a fourth class was included as a counterfactual because it was the one in the institute with the most similar characteristics to the treated one.

The details of the three activities are the following:

- **Board game "Free to Choose"** [time: 90 minutes]**:** students were grouped into small groups (no more than six components) and played a game aimed at changing their self-awareness regarding gender issues and gender stereotypes influencing education and career choices.
  Free to choose is a board game created with the cooperation of six southern European countries (Cyprus, Italy, Portugal, Slovenia and Spain) with funds from the European REC - Rights Equality and Citizenship Programme. Its conceptualisation is based on the scientific evidence arising from the explorative report by Ingellis et al. (2018) which aimed at producing evidence-based knowledge on which to establish the Free to Choose (FtC) project. Moreover, the game won the prestigious recognition of best practice in fighting gender stereotypes from the European Commission at the Information and Networking Meeting of the REC - Rights Equality and Citizenship projects dedicated to women's empowerment and combating gender-based violence (Bruxelles).
  This board game is dedicated to people aged between 16 and 29 in the transition phase of their lives. In the game, points are earned by guessing professions and objects of the respective ones chosen by the participants and associated with a random superhero. The fact that players must guess "without knowing" brings out mental processes full of stereotypes, this is also accentuated by the relaxed environment of the game in which players are free to express themselves. Stereotypes also emerge from the counterpart that needs to be guessed: to give an example, to make people guess positions of power they tend to choose items such as ties rather than heels, which are instead associated with teaching and the cashier profession.
  Hence the role of staff as moderators was very important: they must guide and capture the flow of the stereotypes and let them emerge in the final debriefing: for that reason, they have received specific training and studied deeply the *Trainer Handbook* which contains the guidelines for conducting the game and the debriefing.
- **Short films** from ***Short on Work*** [time: 90 minutes]: students watched and discussed three short films on gender stereotypes.
  Short on Work is an international competition for short videos on the work reality nowadays, conceived and implemented by the Marco Biagi Foundation as part of the PhD program in "Labour, Development and Innovation" at the University of Modena and Reggio Emilia. The purpose of the competition is to promote and collect audio-visual works on labour and to develop an international audio-visual archive on representations of labour today, to be used for educational and research purposes. *Short on Work,* like *Free to Choose*, is also founded on a strong theoretical and methodological framework (Capalbi, 2015). In this archive, many short films are devoted to the relationship between gender and work and the pervasive presence of stereotypes: an overview of which is provided by Capalbi and Piscitelli (2020).
  The activity in the classes used short films as a tool to reflect on the persistence of gender stereotypes and professional typecasting in representations to trigger critical reflection and class debate. Again, also in this session, the role of the staff as moderators is the key factor in the treatment quality.
- **Interactive meeting with female *role model*** [time: 90 minutes]: students were exposed to a direct contact with a female young professional engaged in an economic-financial and/or highly quantitative field who has enjoyed an economic and highly quantitative university career (role model).
  The role model - told students her story (-professional life, personal achievements, academic and educational experience). The expository style was informal and designed for the young audience

and presentations included experiences abroad, early college years, and current work. The selection of the role model is very important because what must emerge from her talk is that she is talented in her work, she loves it and she is comfortable in that environment, and she is happy with her path and her past choice. With the right role models, according to the literature reported in Section 2, female students can potentially overcome the stereotype problem by understanding that quantitative subjects and finance are not exclusively for "men". During the one-hour meeting, the Role Model will tell her story and interact with students by answering their questions.

The activities took place in the class environment and were mainly conducted by the same people except for the interaction with the female role model. The staff who delivered the interventions in the classes were gender-balanced and consisted of a PhD student in "Labour, Development and Innovation" and a research fellow at the Interdepartmental Center on Digital Humanities, University of Modena and Reggio Emilia (DHMORE). Random events[3] cause class meetings to sometimes be held virtually or to be subject to variations in the staff and a descriptive table of the final implementation can be found in table A4 in the Annexes.
Control students, on the other hand, continued to attend school without any change in their timetable. To avoid interference in the outcome, none of the students is aware that it is involved in a project aimed at deconstructing gender stereotypes. They believe that they are participating in a generic orientation project.

Slots for the administration of the questionnaires were agreed upon in advance with the teachers as part of the activity and usually took place on the same day as the treated class and its corresponding counterfactual class.[4] The completion of the questionnaire in the classroom was very important to us for the accuracy and quality of the data, for the following reasons:

- fewer misunderstandings about question compilation due to the presence of staff and professors
- more effort and concentration from the students
- little interference from the external environment, same surroundings and device for all respondents in both pre and post questionnaires
- fewer missing data due to pupils did not actually do the exercise at home.

The first three points gain high importance, especially for the IAT exercise, meanwhile the latter with high probability would lead to biased data collection where missing values are related to the characteristics of the respondents[5] (MAR=missing at random).

[3] Random events are mainly linked to health problems and the pandemic situation.
[4] In some cases - happened that one or both questionnaires couldn't take place exactly the same day but we constrained teachers in selecting an alternative day in a very limited time span.
[5] It is reasonable to assume that the students who do not return the questionnaire are: the least diligent, the most careless, those with poorer family circumstances (no device), etc.

4. DATA

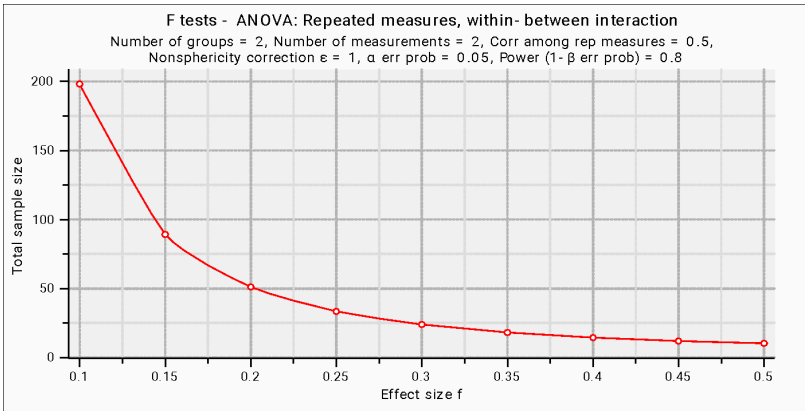
4.1 Sample identification

4.1.1 Sample size: ex-ante calculation

Before conducting the experiment, a statistical power analysis was performed to verify the minimum number of students required to generate significant results. We performed a sample size estimation, using the GPower software (GPower 3.1). The software offers five types of statistical analysis and - according to our needs - we focus on the '*priori'* one in which sample size N is computed as a function of power level $1 - \beta$, significance level α, and the to-be detected population effect size.
Then we select the ANOVA (repeated measures, within-between interaction) test as we are conducting a pre-post analysis.
And finally, by following Cohen's (1988) criteria we set the expected effect size at 0.1[6] the power level at 0.8 and the alpha at 0.05.
Figure 2a reports, as an output of GPower, the minimum number of observations required with our parameters and setting. The sample size needed to detect a small effect that consists of at least 200 students (Actual power =0.8036) between treated and controls. Assuming equidistribution between treated and control optimizes data availability, the final sample consists of at least 100 treated and 100 control.
Considering this as the minimum numerosity and assuming the physiological interferences that characterise these experiments (attrition, missed take up[7], incorrect questionnaire fulfilments and the mismatch between presences in pre and post surveys) we opt for including in our experiment at least 11 class treated and 11 controls. So, we planned to include at least around 400 students depending on class numerosity; this sample also allows for a higher level of precision: as Figure 2b shows, a sample of nearly 300 students would allow for an alpha of 0.01 instead of 0.05.

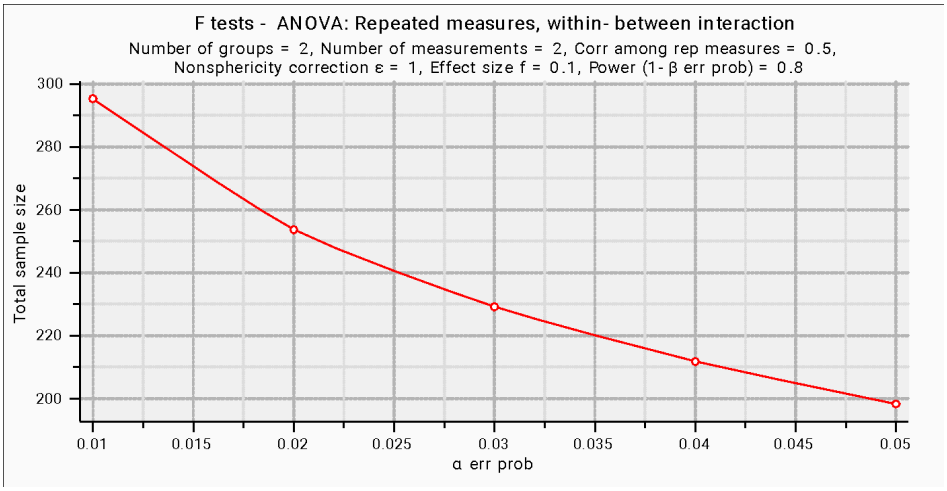
[6] Which is the size suggested for an expected small effect.
[7] As the experiment took place in classes during the official hour of lesson this condition could verify only with absences: is not so reliable to assume that a student is in class without participating. Supply treatment by classes also make impossible crossover effects.

Figure 2a – Required sample size for different effect sizes



Source: Authors' computation using GPower software.

Figure 2b – Required sample size for different alpha



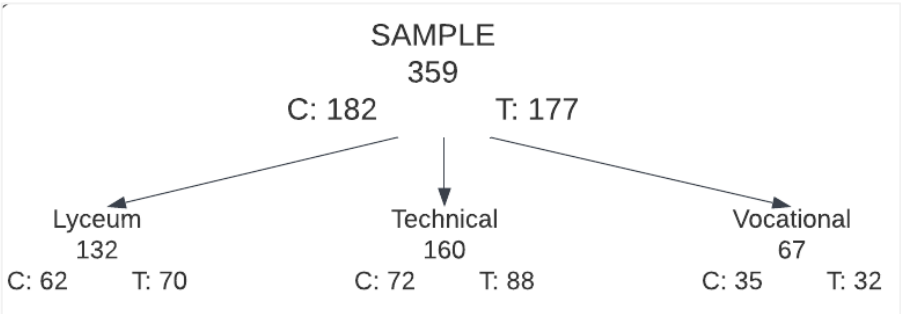
Source: Authors' computation using GPower software.

4.1.2 Sample size: final collected sample

The final sample consisted of 26 classes covering 6 schools and comprising 532 students. In the sample, 13 classes (273 students) were treated and 13 (259 students) were used as a control. We succeeded in merging 366 students (meanwhile for 98 of them we get only the first survey and for 75 only the second one).[8] Of the 366 merged data, 182 were controls and 184 were treated and among these latter 146 attends all the meetings of the treatment meanwhile 177 attended at least 2 out of 3 meetings. We decided to omit from the final sample all treated who participated in only 1 out of 3 meetings, so our final sample is composed of 359 pupils between controls and treated who had participated in at least 2 out of 3 meetings. Our final sample, represented in figure 3, includes 132 Lyceum students (36.8%), 159 technical students (44.6%) and 67 vocational students (18.7%).

[8] The sum of the three is 539 which is slightly higher than 532 this is since maybe some students were present both at the pre and the post surveys, but we couldn't aggregate their responses due to omitted, incorrect, or undecipherable merges codes.

Figure 3 – Sample specification



Source: Authors' computation on acquired data.

We use self-acquired primary data which were collected mainly by submitting students a questionnaire before and after the treatment. The questionnaire was developed in Qualtrics[9] after careful reflections on the most crucial information required for the evaluation of the experiment and a deep exploration of the literature. We used the latter both to extract some commonly used and scientifically validated questions and as inspiration to create queries customised to our case.
The same questions were submitted twice in the pre-survey and the post-survey with the aim of creating a panel database; the only exceptions were variables invariant over time (such as demographics and parents' information) which were asked only once in the pre-questionnaire and queries on project satisfaction which could be asked exclusively in the post and only for treated.
The questionnaire includes questions on demographics, skills, attitudes, beliefs, stereotypes, inclination toward economics, university choice intentions and drivers of the latter.
Moreover, we integrate the collected data with some information on the class composition: the number of students and the percentage of females, hours of math and economics, gender of the Math and Economics teacher, whether the class was already involved in activities aimed to diminish gender stereotypes and how much the professors seemed to be involved and believe in the project (this last piece of information was gathered by submitting to the staff and those who had direct dealings with professors a short questionnaire).

In Section 4.2 we provide further insight into the main dimensions considered.

4.2 Variables definition

UNIVERSITY TRACK (or work) INTEREST
The major choice is our main outcome of interest: we ask students how likely they are to take 15 different paths after high school. Among this set of options, the first one was to go to work and the other 14 concerned different university paths. For each alternative, the answer options range from 1 (*Extremely Unlikely*) to 5 (*Extremely Likely*). Moreover, we also ask them about their certainty concerning their future (how confident they feel about what they declare in the 15 paths).

STEREOTYPES
The problem with measuring explicit stereotypes is that people may not want to reveal their thoughts (social desirability), or they are not fully aware (conscious) of their feelings.

[9] https://www.qualtrics.com/it/ .

So, we decided to measure students' stereotypes both implicitly (*Dscore*) and explicitly (*ExplicitStereotypeSchool* and *ExplicitSterereotypeFamily*).
The explicit stereotype is measured regarding the female-economics association both at school (Tomasetto, Mirisola, Galdi and Cadinu 2015) and in the household[10] environments.
To measure implicit stereotypes, we rely on the most widespread measure of the strength of stereotypical associations (De Gioannis 2022b) the Implicit Association Test (IAT) developed by social psychologists (Greenwald et al., 1998). This test, besides being widely applied by social psychologists, has also spread to economists, especially for research on gender (Carlana and Corno 2021, Carlana 2019, Tomasetto 2015) and cultural background (Corno 2018) divergences. Its strength is its ability to detect biases that operate at the unconscious level (or that respondents do not want to disclose) by measuring the reaction rate. The reaction time is measured by submitting participants to a categorization task in which they are asked to place as faster as possible on the left or on the right side stimuli belonging to four categories. In our case, as we are interested in the association between gender and fields, the categories are Masculine names (target A), Feminine names (target B), Economics and finance subjects (attribute A) and Humanistic subjects (attribute B).
The higher (or lower) rate of target and attribute placement may reveal how strongly an individual associates subject domains to gender and thus the presence of stereotypes.

SUBJECTIVE TASK-VALUE
Within this dimension, being multidimensional, we used a wide and diverse range of indicators. We used the reduced scale (adapted to the financial-economic domain) of Good *et al* (2012) for the Sense of belonging containing the subscales acceptance (*SenseofbelongingIndex1*) and membership (*SenseofbelongingIndex2*).
As intrinsic values, we use two variables aimed at assessing how much students like math (*Like_maths)* and/or economics (*Like_economics*).
We also ask how much they consider Economics, Maths, Statistics and Finance important for their personal fulfilment, their future academic achievement and professional fulfilment as an indicator of utility (other goals) in the following tables these variables correspond namely to *ImpoEconomyforLife , ImpoEconomyforAcademic* and *ImpoEconomyforProfession*.
We also included possible costs (*cost*) that individuals might perceive with some questions from PISA (concerning that math lessons could be difficult, nervousness for solving math assignments or problems, feeling that they cannot solve a math problem and fear of getting low math grades).

EXPECTATIONS OF SUCCESS
In our model, expectations of success are based on two components: the observed ability and the own prejudice about their abilities. For the first (*MeasuredAbility*), we simply used grade point average in maths and – if available – economics. We determine the latter (*AbilitySelfConcept*) with a set of questions from PISA 2012 in which students report if they are good at math, if they get good grades or feel talented in math like "In my maths class, I understand even the most difficult work".
We also integrate with the overconfidence (*Overconfidence_maths* and *Overconfidence_economics*) variable which is computed by comparing their observed ability and their declared one. According to the literature, this second component based on personal perception is a strong determinant of course enrollment and occupational aspirations choice (Bandura 1997, Bandura et al. 2001).

[10] Items were inspired by the ISTAT (2011) survey on discrimination by gender.

ENVIRONMENTAL FACTORS

In addition to class fixed effects with information on peers and professors, we collect a set of family background variables.

Family background: Family factors play a fundamental role in choices and abilities, even more so than the school itself (Bottazzi e Lusardi 2020). For both parents, we collected: their place of birth, level and field of study. We also collected information on the care and time both parents devote to the student. The latter includes items such as the time spent by parents having dinner with their children, asking them how things are going at school, shows interest in their children's future and their feeling. As income proxies, we collect the work they do, their contract type, home assets (together with study assets) and the number of books at home.

The questionnaire also includes an exhaustive battery of questions about what the students feel is more important in their choice (all environmental factors, abilities, interests, works, etc… are included). The summary statistics of student and family characteristics are reported in Table 1.

Student characteristics: Gender, age, whether they have ever repeated a grade or more, place of birth and years in the Emilia Romagna region.

4.3 Descriptive statistics

Table 1 – Summary statistics for the main covariates

Variable	Obs	Mean	Std. Dev.	Min	Max
Student observable characteristics					
Female	359	0.67	0.47	0	1
age	359	19.19	0.57	18	22
YearsInEmiliaRomagna	359	18.02	3.26	2	22
RepetedClass	358	0.19	0.39	0	1
North	359	0.86	0.35	0	1
Family background					
Mother_North	359	0.50	0.50	0	1
Father_North	359	0.49	0.50	0	1
Mother_North	359	0.50	0.50	0	1
Father_North	359	0.49	0.50	0	1
Mother_Elementarymiddle	359	0.3	0.46	0	1
Father_Elementarymiddle	359	0.41	0.49	0	1
Mother_Highschool	359	0.43	0.50	0	1
Father_Highschool	359	0.38	0.48	0	1
[1] *Mother_Lyceumh*	359	0.09	0.28	0	1
Father_Lyceumh	359	0.08	0.27	0	1
Mother_Lyceums	359	0.02	0.14	0	1
Father_Lyceums	359	0.03	0.16	0	1

Mother_Technical	359	0.21	0.41	0	1
Father_Technical	359	0.19	0.39	0	1
Mother_Vocational	359	0.08	0.26	0	1
Father_Vocational	359	0.07	0.25	0	1
Mother_Universitymore	359	0.19	0.39	0	1
Father_Universitymore	359	0.12	0.33	0	1
[2] *Mother_Eco*	359	0.01	0.12	0	1
Mother_Stem	359	0.01	0.12	0	1
Mother_Hum	359	0.10	0.3	0	1
Father_Eco	359	0.02	0.13	0	1
Father_Stem	359	0.03	0.16	0	1
Father_Hum	359	0.04	0.20	0	1
Mother_Notemployed	359	0.03	0.17	0	1
Mother_Housewife	359	0.15	0.36	0	1
Father_Notemployed	359	0.05	0.22	0	1
Mother_Empl1 [3]	359	0.26	0.44	0	1
Father_Empl1 [3]	359	0.36	0.48	0	1
Mother_Empl2	359	0.42	0.49	0	1
Father_Empl2	359	0.23	0.42	0	1
Mother_Empl3	359	0.04	0.19	0	1
Father_Empl3	359	0.12	0.32	0	1
Mother_Empl4	359	0.07	0.25	0	1
Father_Empl4	359	0.18	0.39	0	1
MumCare	358	4.09	0.95	1	5
DadCare	358	3.55	1.2	1	5
WellnessHome[4]	359	5.4	0.88	0	6
WellnessStudy[5]	359	4.73	.67	0	5
Bookathome0to10	359	0.11	0.31	0	1
Bookathome11to25	359	0.14	0.34	0	1
Bookathome26to100	359	0.31	0.46	0	1
Bookathome100more	359	0.35	0.48	0	1
School environment					
Lyceum	359	0.37	0.48	0	1
Technical	359	0.45	0.5	0	1
Vocational	359	0.19	0.39	0	1
classSize	359	21.01	3.48	13	26
ShareFemale	359	59.78	25.67	11.11	94.12
FemaleTeacher	359	0.77	0.42	0	1
TeacherBeliefInTheProject	359	7.06	1.69	4.67	10

TeacherMotivateStudent	359	6.63	2.21	3	10
TeacherEngagement	359	6.83	2.01	3	10
TimeSpan	359	11.18	4.59	-2	18
Hmath	359	16.13	1.6	12	17
Heco	359	20.28	12.49	0	33

Note: The sum of the percentages of the complementary variables (such as education and occupation of parents, book at home, etc..) could be lower than 100% as students have the possibility to answer "I don't know".

[1] High school specification: the sum of mum (or dad) specification percentages returns the mum (or dad) percentages with a high school diploma.

[2] University specification: most relevant group selection (dichotomies that only consider degrees in the humanities, STEM or economics).

[3] Work specification: for both parents are four dummies variables which indicate a labour status which increases with the number (further details on categories are included in the table A3 in the annexes.

[4] WellnessHome: continuous variable ranging from 0 to 6 indicating the possession of some basic "home assets" as dishwasher, fridge, oven, etc..

[5] WellnessStudy: continuous variable ranging from 0 to 5 indicating the possession of some "study assets" like PC, dictionary, internet connection, room and a table intended for study.

The sample consists of 67% females, this partly dictated by decision-making choices related to the nature of the intervention that led us to exclude classes with few (or no) girls.

Students were mainly born in Northern Italy (85%) but, for their parents, this percentage falls below 50 per cent: around 30% came from Southern or Central Italy and the remaining 20 per cent emigrated from abroad.

Regarding the family background: parents' educational qualification is mainly concentrated in middle school diploma (30% of mothers and 40% of fathers) and high school diploma (40% of mothers and 37% of fathers). Confirming that, even in the previous generation, mothers are the more educated ones.

The same is found for the university degree which is possessed by 19% of mothers compared to 12% of fathers. Gender distribution across fields of study shows that, even for the previous generation, there were gender imbalances among the various areas (women engaged in highly mathematical fields were only $\frac{1}{3}$ of those engaged in humanities fields while for fathers the same ratio is $\frac{3}{2}$). The percentage of unemployed mothers exceeds 18% compared to only 5% for fathers, moreover fathers' not working status is mainly due to retirement (and associated with a pension) while that of mothers is related to being housewife. Within employed parents, households mothers are concentrated at the lowest levels of employment and the percentage of fathers in the highest one is about three times that of mothers. Finally, there are parental differences also in the time and attention devoted to children: care variables show that, taking fathers as a basis, mothers have 15% more care (time spent together, talking, worrying about students' feelings and their future) for their children.

This family background snapshot - in line with expectations, and the Italian context - is a fertile ground for implicit stereotypes: students are born and grow up in a context that becomes 'normal' for them but which, as we can see, is far from being gender-balanced. It is not a negligible influence as the home environment has a strong influence on students' decisions, more than the school environment (Bottazzi Lusuardi 2020).

5. RESULTS

5.1 Gender differences in major choice determinants

Table 2 allows analysing of the differences by gender in the variables that reveal stereotypes of field choice and degree of confidence in the different fields. As can be seen, by the observed average and statistically significant differences among them, female students are more likely to have higher implicit stereotypes[11] as revealed by IAT (Dscore) while, at the start of the experiment, they show lower explicit stereotypes revealed by two variables that refer to the school and to the family environment. However, there does not appear to be a statistically significant difference by gender in math or economics enjoyment nor in the ability self-concept. On the other hand, male students assign higher importance to economics in life and have lower psychological costs (fear to get low grades in math, nervousness and|or helplessness and|or anxiety) in addressing subjects with higher math content. Moreover, males tend to be more overconfident than female students regarding math and economics.

Table 2 – Gender comparison on major choices determinants AT T=0

	(1) FEMALE		(2) MALE		(3) T-TEST ($\bar{x}_m - \bar{x}_f$)	
	mean	sd	mean	sd	b	t
Dscore	0.41	0.40	0.17	0.39	-0.24***	(-5.39)
ExplicitStereotypeSchool	2.21	1.17	2.80	1.27	0.59***	(4.20)
ExplicitSterereotypeFamily	1.37	0.69	2.55	1.26	1.17***	(9.43)
MeasuredAbility	7.32	1.20	6.73	1.16	-0.59***	(-4.49)
AbilitySelfConcept	2.39	0.75	2.45	0.74	0.06	(0.70)
Like_maths	3.29	1.67	3.47	1.56	0.17	(0.95)
Like_economics	3.46	1.61	3.82	1.54	0.36	(1.73)
ImpoEconomyforLife[1a]	2.94	1.34	3.24	1.19	0.30*	(2.16)
ImpoEconomyforAccademy[1b]	2.85	1.35	2.94	1.18	0.09	(0.61)
ImpoEconomyforProfession[1c]	3.17	1.40	3.49	1.19	0.32*	(2.22)
Cost	2.62	0.77	2.25	0.68	-0.37***	(-4.58)
SenseofbelongingIndex1 [2a]	4.59	1.23	5.08	1.12	0.49***	(3.75)
SenseofbelongingIndex2 [2b]	3.82	1.75	4.45	1.67	0.63**	(3.29)
Overconfidence_maths	0.19	0.39	0.31	0.46	0.12*	(2.36)
Overconfidence_economics	0.14	0.34	0.26	0.44	0.13**	(2.76)
N	242		117		359	

Notes: Because these variables change over time and may be affected by treatment, we report values at the first survey (T_0) before the start of the project).

[11] This is in line with previous research with a similar setting [De Gioannis 2022a].

[1]*This set of variables correspond to students' rate from 1 (Not important) to 5 (Very important) at the following question:*
How important do you think economics, mathematics, statistics, finance are for your future prospects? [1a] *future personal fulfilment (of yourself as a person and in everyday life);* [1b]*future academic achievement (at university);* [1c]*future professional fulfilment (working career)*
[2]*Composite indexes are based on a set of continuous variables ranging from 1 "low sense of belonging to financial-economic community" to 8 "high sense of belonging to financial-economic community"* [2a] *subscale acceptance;* [2b]*subscale membership.*

Implicit and explicit stereotypes

Table 3 shows the correlation between the implicit stereotype (Dscore, column 1), the explicit ones (in the family (2) and school environment (3)) and other choices drivers together with the enrolment propensity for finance, marketing, stem and humanistic fields.

As we can see from the first two rows of column 1 in both panels of the table, regardless of gender, the implicit and explicit stereotypes do not correlate. This result is common knowledge in social psychology: in fact, the IAT test is used exactly to gather more accurate information through answers which are not biased by scarce awareness and|or social desirability. In fact, as shown by panel A (female) in columns (2) and (3) the correlation between choices determinants and preferences is basically absent, meanwhile, the IAT results exhibit a very strong correlation with most of them. Those results are in line with Carlana and Corno (2021) who found a positive correlation between the IAT and the choice of the field, but they didn't find the same between IAT and the explicit stereotypes and neither between the explicit and the math choice.

On the other hand, males – in panel B – show a correlation between implicit stereotypes, some determinants and enrolment intention. Our thought is that they actually were more transparent in (or conscious of) their explicit revelation. Recalling the results of table 2: meanwhile, females had a high implicit stereotype and a low explicit one, males returned more constant averages in the two types of stereotypes. Moreover, in table 3 panel B shows a higher male correlation (which is also nearly significant: p-value not reported = 0.11) between the explicit and the implicit (school) stereotypes.

Moreover, as expected, it is very interesting to state that the stereotype interacts with the main dimensions and outcomes in opposite ways depending on gender (positive relationship for males and negative for females). This is because suffering from stereotypes means associating females with humanistic subjects and males with economical and mathematical ones, so stereotypes affect self-confidence and beliefs in the opposite ways depending on one's gender. It derives, as can be seen from Panel A of Table 3, that a girl who suffers from high stereotypes rejects the numerical field: having low self-confidence, feeling it is less important, stating that likes it less, avoiding enrolment in business degrees and preferring humanities degrees. On the other hand, males (panel B) who possess stereotypes tend to enrol more in economics fields and perceive lower difficulties and they consider economics more important.

Table 3 – CORRELATION between implicit and explicit stereotypes and major choice determinants

	(1) *Dscore*	*(2)* *EXP[ ]SCHOOL*	*(3)* *EXP[ ]FAMILY*
PANEL A - FEMALE			
ExplicitStereotypeSchool	0.08		
ExplicitSterereotypeFamily	-0.03		
MeasuredAbility	-0.06	-0.18**	-0.10
AbilitySelfConcept	-0.07	-0.12	0.01
Liike_maths	-0.15*	-0.07	0.10
Like_economics	-0.25**	-0.12	0.02
ImpoEconomyforlife	-0.20**	-0.07	0.06
ImpoEconomyforAcademy	-0.26***	-0.07	0.08
ImpoEconomyforProfession	-0.29***	-0.06	0.16*
Cost	-0.02	0.11	0.02
SenseofbelongingIndex1	-0.20**	-0.03	0.12
SenseofbelongingIndex2	-0.15*	-0.02	-0.01
Overconfidence_maths	-0.10	-0.01	0.03
Overconfidence_economics	-0.22***	-0.07	0.07
Finance[1]	-0.25***	-0.11	-0.01
Marketing[1]	-0.26***	-0.14*	-0.09
STEM[1]	-0.14*	-0.05	0.11
Humanistic[1]	0.14*	0.11	-0.08
PANEL B - MALE			
ExplicitStereotypeSchool	0.11		
ExplicitSterereotypeFamily	-0.08		
MeasuredAbility	0.02	0.12	-0.11
AbilitySelfConcept	0.18	0.17	-0.12
Liike_maths	-0.01	0.10	0.03
Like_economics	0.09	0.19	0.00
ImpoEconomyforlife	0.20*	0.19*	0.16
ImpoEconomyforAcademy	0.22*	0.11	-0.15
ImpoEconomyforProfession	0.18*	0.18*	0.07
Cost	-0.19*	-0.16	0.14
SenseofbelongingIndex1	0.13	0.29**	-0.01
SenseofbelongingIndex2	0.08	0.31***	0.12
Overconfidence_maths	-0.04	0.11	-0.03
Overconfidence_economics	0.08	0.19*	0.11
Finance[1]	0.31***	0.35***	0.06

Marketing[1]	0.29**	0.31***	0.09
STEM[1]	0.17	0.01	0.01
Humanistic[1]	-0.04	-0.00	-0.13

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes:

[1] *likelihood of enrolling in this specific field*

The expectation of success: ability and ability self-concept

Table 4 – Gender differences in ability

Gender	Overall[1]	Maths	History	Italian	Economics	English	Philosophy
Male	7.18	6.67	7.10	6.98	6.69	7.08	7.04
Female	7.61	7.32	7.43	7.46	7.29	7.50	7.33

[1] *Overall is not the average of the grades shown, but the overall mark on the school report.*

Despite indicators in table 4 show that females outperform men in each dimension (economics and mathematics included), female overconfidence in math and economics is scarce and extremely lower than the male one ($Pr_{(|T| > |t|)} < 0.01$) condition that does not occur for subjects such as English, history, and Italian where both genders have similar self-confidence values. Moreover, females tend to disagree with self-praising and self-confident phrases such as *"In my maths class, I understand even the most difficult work"* ($Pr_{(|T| > |t|)} < 0.05$) or "*I learn mathematic quickly"* ($Pr_{(|T| > |t|)} < 0.01$).

Subjective task value

As for reported literature, this dimension is composed of reasons that motivate (engage) individuals. Falls among these intrinsic motivations is the enjoyment of the subject and the extrinsic one which consists of the perceived utility in studying it.

Table 2, shows that - even though girls have lower scores - there are no significant gender differences in how much students like math (*Like_maths*) and economics (*Like_economics*). The same condition occurs in the answers to the question "I have always believed that mathematics is one of my favourite subjects" inspired by PISA questionnaire. Regarding extrinsic motivation, there are significant differences in favour of males on the thought that economics is important for life and profession (respectively *ImpoEconomyforLife* and *ImpoEconomyforProfession* in table 2) and no statistical difference in the perceived utility of economics for the academic life although, again, females show a lower score.

Another dimension falling under the subjective task value is the composite index of the sense of belonging which is significatively higher in males for both sub-dimensions: acceptance (*SenseofbelongingIndex1*) and, even more, membership (*SenseofbelongingIndex2*).

Last but not least, costs are another important component which affects the subjective task values in a negative way: the higher the fear of the subject and the perception of inadequacy, the lower the motivation toward that pathway. Once again, from table 2, we see females in a disadvantaged condition with significative higher costs. As the composite index (*cost*) all the cost sub-variables show high gender differences. The greatest ones are related to anxiety: the rate of females in the statement *"I am very nervous when I must do a math assignment"* and *"I am very nervous when I*

must solve a maths problem" are respectively 19.2% and 22% higher than the males one both with a $Pr_{(|T| > |t|)} = 0.000$.

5.2 Relationship between choice determinants and enrolment intention

The dimensions introduced in table 2 and analysed so far have shown a strong gender disparity, even though the observed abilities are equal if not even favourable to females. The purpose of Table 5 is to investigate how these determinants influence the propension to enrol in a finance (column 1), marketing (column 2), STEM (column 3) or humanities (column 4) degree.

Table 5 – Correlation between choices determinants and major choice preferences

	(1) FINANCE	(2) MARKETING	(3) STEM	(4) HUMANISTIC
PANEL A - FEMALE				
MeasuredAbility	0.25***	0.23***	0.29***	-0.08
AbilitySelfConcept	0.25***	0.22***	0.35***	-0.21**
Liike_maths	0.28***	0.27***	0.41***	-0.23***
Like_economics	0.67***	0.62***	0.35***	-0.29***
ImpoEconomyforlife	0.43***	0.37***	0.31***	-0.23***
ImpoEconomyforAcademy	0.52***	0.53***	0.38***	-0.14*
ImpoEconomyforProfession	0.51***	0.55***	0.39***	-0.24***
Cost	-0.12	-0.07	-0.28***	0.09
SenseofbelongingIndex1	0.41***	0.41***	0.31***	-0.13*
SenseofbelongingIndex2	0.54***	0.50***	0.36***	-0.09
Overconfidence_maths	0.18**	0.12	0.17**	-0.11
Overconfidence_economics	0.35***	0.31***	0.18**	-0.03
PANEL B - MALE				
MeasuredAbility	0.20*	0.18	0.18	-0.10
AbilitySelfConcept	0.22*	0.20*	0.39***	-0.05
Liike_maths	0.15	0.13	0.47***	0.02
Like_economics	0.63***	0.53***	0.31**	0.18
ImpoEconomyforlife	0.40***	0.36***	0.16	-0.11
ImpoEconomyforAcademy	0.55***	0.54***	0.40***	-0.03
ImpoEconomyforProfession	0.46***	0.48***	0.31***	-0.14
Cost	-0.14	-0.15	-0.19*	0.03
SenseofbelongingIndex1	0.41***	0.36***	0.12	-0.04
SenseofbelongingIndex2	0.42***	0.35***	-0.01	-0.08
Overconfidence_maths	0.02	0.01	0.32***	0.06
Overconfidence_economics	0.39***	0.38***	0.33***	0.12

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: stereotypes are omitted because the relationship is already reported in table 3.

For both genders, there is evidence that the dimension selected as choice determinants have significant relationships with the propensity to enrol in different university courses. In fact, consistently with the literature analysed, enrolment decision-making does not appear to be simply a matter of ability and skill. Indeed, the correlation between measured ability and choices shows the lowest values for both sexes becoming of low or zero significance for the male subsample.

For females - Panel A - the stronger relationship with the chosen path is given by how much they like the subject of economics (correlation with the likelihood of enrolment in economics highly significant and greater than 0.6) or maths (highest correlation between all determinants with the STEM enrolment likelihood). Females who are inclined to enrol in economics degrees are also those who consider economics to be more important for their academic and working future and life in general and the ones who feel to belong to the financial-economics community (SenseofbelongingIndexes). Overconfidence in economic capabilities is also important for economic enrolment and has a correlation with this latter greater than the actual ability itself. On the other hand, female overconfidence in maths has a lower correlation; which disappears for the marketing degree (which has a lower quantitative content) but is still consistent for the finance and STEM degree.

Surprisingly, despite the expected sign, the costs -which for girls are an emerging problem- do not correlate significantly with the propensity of enrolment in economics. It is possible to explain this evidence by considering that the cost index was built on variables concerning exclusively the math dimension. In fact, we can see that for the propensity to enrol in STEM degrees this component comes to be as important and significant as the ability itself.

Furthermore, in the female sub-sample, the selected determinants correlate satisfactorily well also with the probability of enrolment in humanities degrees. The appreciation of economic-mathematical subjects, the perception of one's own abilities and the importance given to economic subjects: all have a negative and highly significant relationship with enrolment in humanities.

For males (panel B), the math component seems to be less relevant in the intention of enrolment in economics as there is no correlation between it and both the overconfidence and appreciation of math. On the other hand, these latter are very important for the propensity to enrol in STEM. The relationship between the remaining determinants and enrolment in economics does not diverge from the results seen in the female subsample. Conversely, the relationship between determinants and the propensity toward a humanistic path (column 4) strongly deviates from female evidence.

None of the dimensions analysed seems to be linked to the male choices in the humanistic field. Even though determinants are purpose-built to study enrolments in economics degree courses, the complete absence of a relationship with the humanistic degree is an unexpected and relevant fact: given the complementary nature of the two types of fields of study, it is plausible to assume the presence of an inverse relationship.

From this table, it is not possible to explain what drives young males toward the humanities, but it does not seem to be related to ability, nor of appreciation or usefulness.

5.3 Treatment effects

Change in choice of the majors

Figure 4a shows, for treated and controls (vertical axes), the *shift* in the probability of enrolment in different fields (horizontal axes). The latter is derived by the pre-post difference of the average score in the respective choice's intention.

Males treated -compared to control- have a lower increase of their certainty with respect to their future choices (green pipe): from the beginning males show high confidence about their decision, but it seems that, by participating in the project, they have begun to re-examine themselves. the most interesting result in the treated males is precisely the decrease in the propensity to work after high school (whereas the controls show an increase in this variable over time). Finally, they decrease the desire to enrol in finance and increase the propensity toward humanities and marketing degrees. Turning now to female students in figure 4b treated girls show greater awareness (green pipe) than female students in the control group. Almost no differences in the propensity to go to work can be observed in the two groups it slightly decreases in both. The results for the fields of study are interesting and positive: in fact, two cross trends in treated and control groups can be noted. The first concerns economics, where there is a switch between finance (which is a highly quantitative course) and marketing controls; females in the control group seem to be more oriented toward marketing and treated toward finance. The second regards the STEM and humanities degrees: in fact, while there is no substantial difference in the propensity for humanities degrees, the propensity for STEM degrees is much stronger for the girls treated and shows an increase that even surpasses the humanities degrees' likelihood.

Figure 4a – Temporal shift in choice: from T_0 to T_1

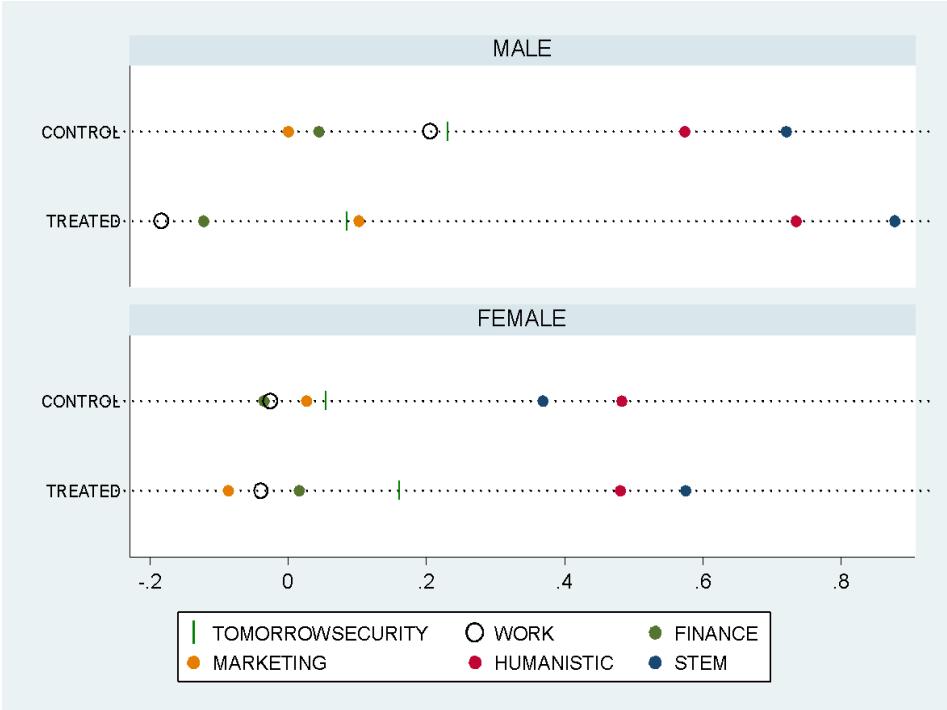


Figure 4b – Temporal shift in choice: from T_0 to T_1 - SchoolType details

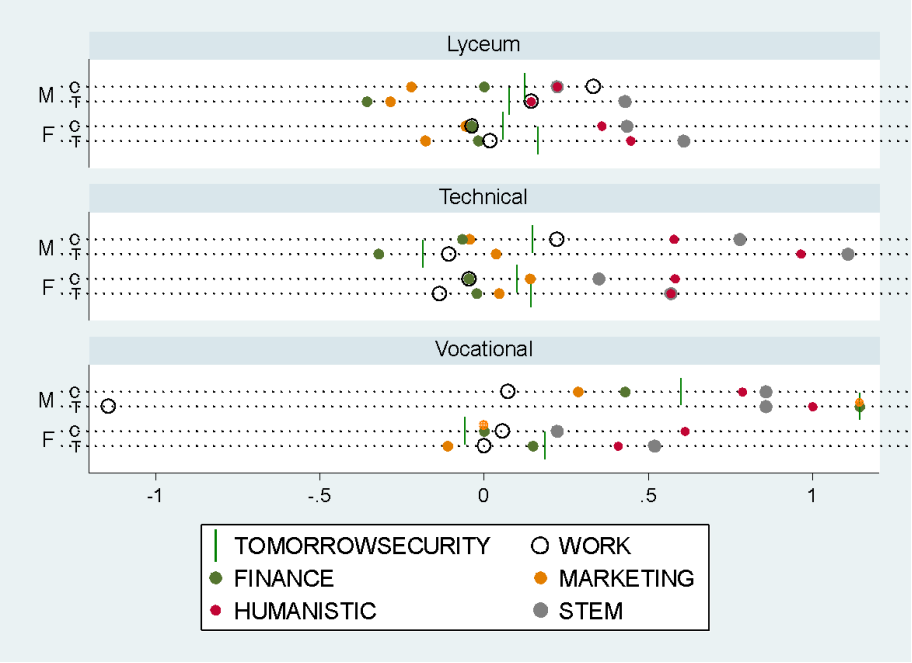


Figure 4b offers further insight by splitting the analysis by school type (Lyceum, Technical, Professional). It is discernible how shifting in choices are heterogeneous according to the typology of the institute: Lyceum students show more restrained displacements; this could be due to the fact that perhaps in high school they already have more solidly rooted ideas: perhaps more confidence, more organisation, an approach that leads them to make decisions in advance, etc…Students from technical and professional high schools, indeed, seem to have a more malleable mind: both treated and controls show more pronounced changes in their choices, suggesting that the decision-making process is still open and evolving.

Treated male students in technical institutes highly increase their propensity towards humanities fields if compared with the counterfactuals and females increase the one towards STEM with the same intensity as humanities: situations which do not occur for their counterfactual. In technical institutes both males and females treated groups show a decrease in their work intentions, especially if compared with the control groups.

The first peculiarity of students in vocational institutes is that both genders, when treated, have a higher increase in their confidence in their future with respect to counterfactual. Another remarkable change is in male orientation toward work: meanwhile the counterfactual remains stable around zero (no change in their tendency) the one of treated suffers a huge decrease (-1.14, which is nearly to 30% of the maximum possible shift from "extremely likely" to "extremely unlikely"). Treated males also show a great increase in their propensity towards humanities, but the biggest one is towards economics (both marketing and finance). The evidence on males makes us assume that they

perceived this external intervention as a strong stimulus that got them involved and made them consider other options besides work. Girls attending vocational high schools, on the other hand, show the same positive trend as the sample as a whole, but with a major emphasis.

Figure 5 – Insight in Work likelihood: treated and control in T_0 and T_1 - schoolType details

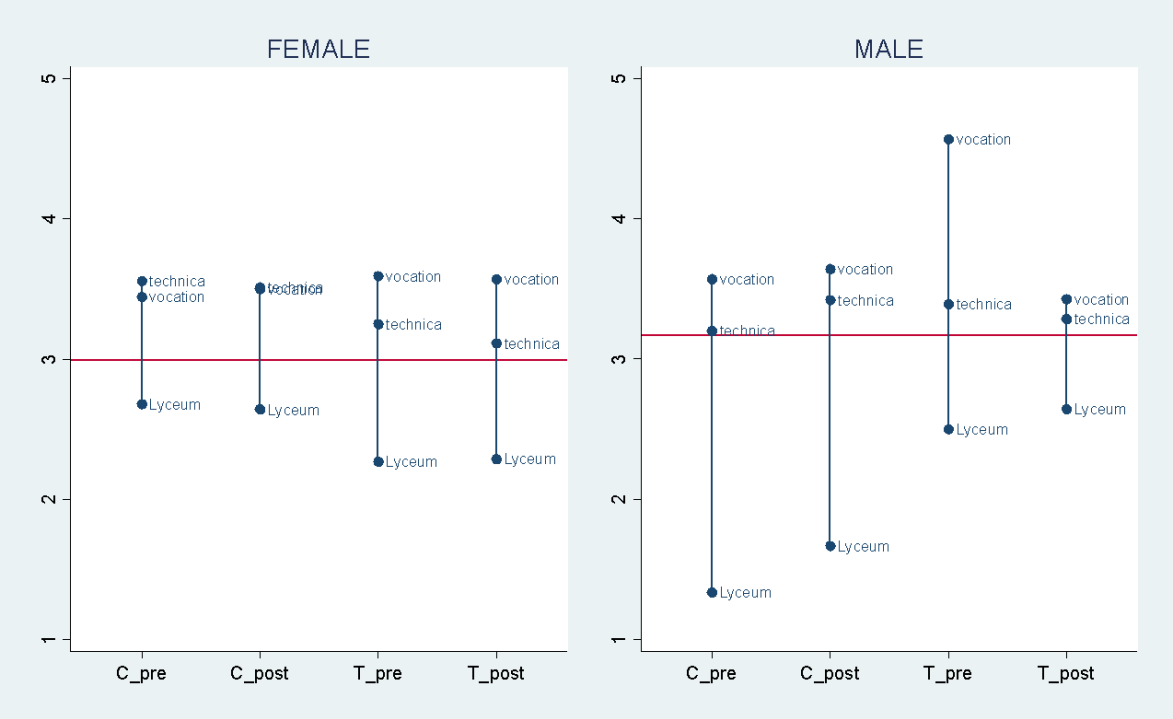


Figure 5 reports a focus on the propensity to work by the typology of the institute. On the left, we have the female subsample and on the right the male one. On the horizontal axes there is the control group in the survey at T0 (C_pre) and at T1 (C_post) and the treated one before (T_pre) and after treatment (T_post), while on the vertical axis it shows the propensity to go to work where 1 corresponds to "extremely unlikely" and 5 "extremely likely".

As expected, the lyceum is always placed at the bottom of each subsample and vocational schools are almost always at the top. On average (red line) males are slightly more likely to go to work than females (except for the lyceum control group where a very low male propensity to work can be seen). Females who participated in the project did not experience significant changes in their propensity to work, but we can see a slight decrease for the students of technical and a substantial stability in the ones attending vocational high schools while female students in the control groups attending vocational high school show a modest increase in the propensity to work.

The effects on males (shown in the right side of the figure) are more noticeable, at first treated in vocational high schools show a big drop in the propensity to work with regards to their control counterparts whose propensity to work remains almost stable. Also, the treated group attending technical high schools shows a decrease in the probability of working while their control counterpart shows an increase in the propensity to work. Finally, there is a small increase in the treated male students attending Lyceum, but this is still lower than that shown by the control group.

Satisfaction/engagement

We also ask directly to students in the treated group their subjective thoughts about the project and every single session.

A positive common opinion emerged, especially for girls who appear to be the most satisfied about the project and those who on average rate the meetings the highest.

Very few participants (less than 7%) declare that they were unhappy to get involved in the project, and this percentage falls below 4% for the female population.

For each of the three sessions (board game, short film and role model) students are called to rate from one to five (the higher the score the more positive the answer) the following four questions:

1. Do you like it?
2. Do you think that the activity you have just done has changed your beliefs and perceptions? (belief1)
3. Do you think that the activity you have just done will influence your choice of university? (belief2)
4. Do you think the activity has changed your view of yourself in the world of work? (belief3)
5. In general, how useful do you consider it?

Table 6 reports average scores by gender: generally, positive opinions emerged, especially for girls who are the ones who enjoyed the activities most and found them more useful.

The activities were highly appreciated (like), especially the board game, which is very close to the maximum score of 5. Of the five-dimension observed, the second one which -for all the activities- gets the highest score is the perceived utility.

The role model meeting got the highest scores in all dimensions concerning perceived usefulness and influence. The t-test comparison reveals significant gender differences in the role model utility (p-value <0.05) and appreciation, but this result seems to be driven by a high female rate rather than a low male engagement.

In fact, despite the role model speech being the only activity targeting uniquely females, we get pleasantly impressed by discovering that males not only like it but also feel it was the most useful one and the one that most shape their perceptions, future choices and self-view at work.

Table 6 – Satisfaction

	Like	Belief1	Belief2	Belief3	Utility
Free to Choose					
Male	4.29	2.44	2.00	2.07	2.35
Female	4.36	2.54	2.02	2.41	2.60
Short on Work					
Male	3.39	2.71	2.00	2.22	2.76
Female	3.74	2.68	2.08	2.51	2.92
Role Model					
Male	3.42	2.78	2.53	2.40	2.89
Female	3.79	2.68	2.52	2.60	3.21

Figure 6 - Satisfaction and outcome

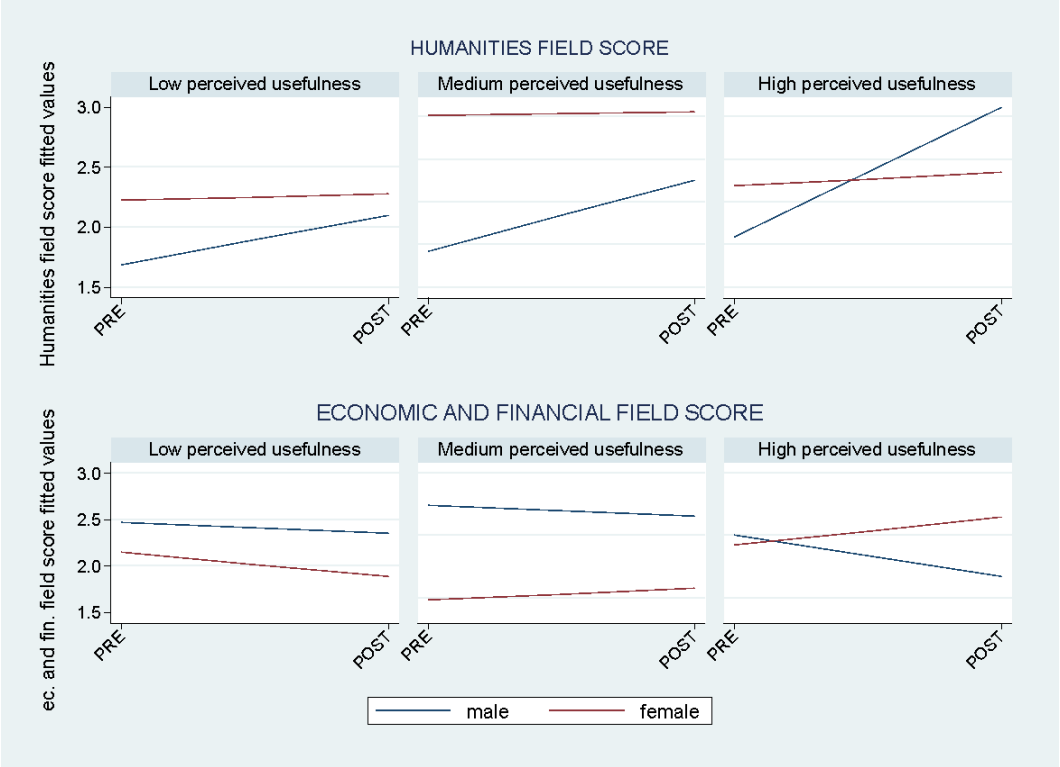


Figure 6 illustrates by gender and survey time (*pre* and *post*) the fitted values of the propensity to enrol in a humanities field (above) and in the financial economics one (below). The analysis is conducted on treated which are divided into three subgroups according to personal perception of the project's utility.

At first, it is important to point out that the starting conditions (pre) were not homogeneous in terms of perceived usefulness: girls who found the project most helpful had a greater initial propensity towards financial economics as well as a lower one towards humanities and, on the other side, males show exactly the opposite. Slopes in red and blue lines show changes over time.

The upper side of the tables suggests that female students who participated in the project maintained their inclination toward humanistic subjects basically unchanged, while males in all groups report a higher propensity towards humanities degrees with the highest increase for those who found the project more useful.

The lower side of the figure shows that both males and females who perceive the project as not very useful slightly decrease their interest in a finance degree, while there is a positive reversal for females who find the project moderately useful and, finally, trends became more pronounced for those who found the project very useful.

Our findings would seem to show that the students who believe the most in the project are also the ones who show the higher starting conditions toward the "*not expected field*" and have the greatest changes.

Among students who perceive the project as very useful, there has been a real reversal: male propensity towards humanities exceeds female propensity (upper part of figure 6) and the female tendency toward finance outnumbers the males' one (lower part of figure 6). The idea -coming from

the starting condition – is that this particular sub-group is exactly the one formed by male and female students who would like to place themselves outside the *"stereotype box"*, feel more represented by the project, more involved and ultimately freer in their choices. So, we might see the switch in high perceived usefulness as a reallocation, closer to an optimal point, where there is a better match between choice and personal abilities and interests.

6. CONCLUSIONS

In this paper, we have analyzed the determinants of college major choices with a gender perspective, with the aim of investigating to what extent students in their last year of high school are entrenched by gender stereotypes in their choice of whether to carry on with their studies or to look for a job or, having chosen to pursue a tertiary education, how their college major choices are affected by a number of different factors including explicit and implicit gender stereotypes.

For these purposes, a field experiment has been carried out in a set of high schools in Italy, a country where the gender gap in employment at the disadvantage of women is higher than the EU-27 average and with a high level of employment segregation by gender. The experiment has been conducted in two districts of the Emilia Romagna region (Modena and Reggio Emilia), where female labour supply is sensibly higher than on average in Italy, but - where the labour market shows signs of employment segregation and inequalities in time allocation by gender.

The family background snapshot of our sample matches this scenario. The majority of mothers have undertaken humanistic studies, spend more time with their children, have lower-paid jobs or are housewives; on the contrary, the majority of fathers have scientific backgrounds and better-paid jobs (even if they hold on average a lower-level of education). Within the high schools of our sample, the composition of the classes is unbalanced by gender, with a large concentration of females in less quantitative courses, and vice versa for males. In line with the literature, this evidence has non-negligible implications for our experiment: environmental factors (such as school and family context) play a determining role in self-perception and choices. Therefore, students cannot be "neutral" in their choices, having already distorted beliefs that have been forming since their birth within their family and during their studies.

Our descriptive statistics show that the choice of the type of high school (lyceum, technical or vocational) is not the only bias that keeps girls away from subjects such as economics and mathematics: female students consider economics to be less important for their daily life and profession, have a lower "sense of belonging to the field" and are less confident in their abilities in mathematics and economics. Furthermore, female students perceive a very high cost in tackling math tasks compared to male students (fear of getting low marks in math, nervousness and helplessness or anxiety). Concerning gender stereotypes, female students show a level of implicit stereotyping that is more than double that of male students (while their level of explicit stereotypes is very low). In particular, females with a high level of implicit gender stereotypes feel less confident in themselves and are not attracted by economics and mathematics. At the same time, they are less likely to enrol in economic degrees (preferring humanities careers). For males, the effect is the opposite: the higher the degree of stereotype, the higher their level of confidence in economics and mathematics.

Within our experiment, the treated group has been involved in a set of activities aimed at contrasting gender stereotypes (role models, board game, short films presentation), while the control group

attended classes as usual without any change in their timetable. A descriptive analysis shows that female students - compared to the control group of female students - increase their awareness, and their propensity for STEM bachelor courses and show an increased preference for finance over marketing within the class of economics courses.
Our project also had a non-trivial impact on males. Treated male students appear to be more interested in pursuing higher education instead of looking for a job, are more uncertain about their future field of studies and increase their interest in humanities courses. In the field of economics courses, treated males show a higher propensity for marketing instead of finance when compared to the control group. Female students' explicit gender stereotypes increase after the experiment (from a very low level at the beginning). This could mean that our experiment has made female students more aware or freer to express themselves, or both. The same cannot be said for females' implicit gender stereotypes, which undergo only marginal variations. This result is not entirely unexpected, as implicit stereotypes are an inner construct that has developed throughout students' life and the time span of our experiment is too low to expect to obtain large impacts in this dimension. Satisfaction statistics reveal that for students - regardless of gender- the meeting with the female role models is the most useful and engaging among all proposed activities.
Although a careful investigation of the impact of the chosen activities on gender stereotypes and on college major choice would have required observing students along a longer time span than that of our experiment, our preliminary analysis has demonstrated that changes have occurred in the degree of (explicit and implicit) gender stereotypes, in the choice about enrolling in a university and in the choice about the field of study.
Further research on collected students' microdata includes the estimation of multivariate models to test the impact of the different determinants on college major choices, on students' confidence in their abilities and on college major choice itself.
Other extensions of our analysis leading to collect new microdata would be to measure teachers' and parents' gender stereotypes to test their impact and replicate the experiment in different areas of the country to test the impact of cultural factors and household models.

Since our microdata show that gender differences in parents' characteristics - are reflected in the gender distribution by type of high school attended and in the observable gender stereotypes that in turn affect college major choices, a relevant policy implication of our study would be to address gender inequalities in family background variables, within this perspective, the inclusion of gender equality as one of the three cross-cutting priorities in the Italian Recovery and Resilience Plan (Italian Government, 2021) can, if properly implemented, reduce the observed inequalities, though its impact could be observable only in the medium run. More specifically, policies addressing gender inequalities in high school and college major choices such as Summer Camp dedicated to girls to improve their skills in ICT or awareness programmes to reduce the impact of stereotypes on career and education choices should be promoted at the national, regional and local level (European Commission, 2021). In this regard, in the country analysed in this study, the Recovery and Resilience Plan includes a specific measure to improve STEM skills among female high school students (Italian Government, 2021, p.39), while at regional and local levels different measures to encourage choices of college majors free from gender stereotypes are detected (amongst them 'Digital girls', a summer camp for female students attending last years of high school to improve their ICT skills) (European Commission, 2021).

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APPENDIX 1

IAT for gender and field of study

a. How IAT works

The test measures mental association by looking at the speed of stimuli classification.

Stimuli belong to two pairs of categories which are formed on opposite hemispheres: table 1 reported the categories and stimuli that we chose (Female vs Male) and (Eco-fin vs Humanistic).

Classification is done by placing stimuli to the right[12] or left[13] depending on the category they belong to and the exercise request.

The setting and implementation (next paragraph) of the IAT that we adopt are inspired by Carpenter et. al. 2019, who, in addition to building a free IAT software, tested its validity with three different experiments. The test consists of 7 blocks in which there are stimuli belonging to the four different categories; the task is to classify them as faster as possible while avoiding mistakes.

Blocks 1, 2 and 5 are practice blocks in which appear only names (target A and B) or subjects (attribute A and B), meanwhile blocks 3,4,6,7 are combined in the sense that appears both people's names and subjects. Half of the 4 blocks require working on *"compatible tasks"* by classifying male & economics and finance on one side and female and humanistic on the other. Meanwhile, in the remaining blocks, the pairs are reversed: male & humanistic stored on one side and female and economics and finance on the other "*incompatible tasks"*.

This setting is repeated four times in which categories have different orders and places (table 2), and **only one** of the four permutations is randomly assigned to each respondent. According to Nosek et al., 2005 this randomised permutation – aimed at counterbalancing the left/right starting positions of targets and attributes - allows for more precise estimates as is proved that the order of task (blocks) matters in IAT performance (Greenwald & Nosek, 2001).

The data originating from the reply in blocks 3,4,6,7 are used to compute standardised differences scores (Dscore)[14] in IAT, indicating in which condition (compatible vs. incompatible) participants were faster. Is reliable to assume (and was proved) that a person suffering from stereotype is quicker to perform the compatible task and has more difficulty in the incompatible one: since he mentally associates females with the humanistic hemisphere and boys with the economic one. The Dscore is positive (Dscore > 0) for people who are faster at compatible tasks revealing the presence of stereotypes while a negative one (Dscore < 0) discloses the opposite mental association (female associated with economics and finance and male with humanities).

The index we get is a relative measure: that means that we cannot disclose if females are associated with the humanistic field and males with the economic one in an absolute sense. Instead, we can keep which gender is seen relatively closer to the economics/humanistic hemisphere at the implicit level.

[12] By pressing the "I" key on the keyboard.
[13] By pressing the "E" key on the keyboard.
[14] The Dscore calculation follows Greenwald et al. (2003).

Table A1- IAT stimuli

Categories	**Stimuli**
Masculine names (target A)	Luca, Federico, Matteo, Alberto, Davide, Alessandro.
Feminine names (target B)	Anna, Martina, Laura, Giulia, Erica, Alessia
Economics and finance (attribute A)	Economics, finance, calculus, statistics, mathematics, algebra, formulas, equations).
Humanistic (attribute B)	literature, Italian, history, philosophy, art, pedagogy, languages

Table A2- IAT blocks

Block	**Compatible First [Target A on Right with Pos]**		**Incompatible First [Target A on Right with Neg]**		**Compatible First [Target A on Left with Pos]**		**Incompatible First [Target A on Left with Neg]**	
	Right	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**
1	F	M	F	M	M	F	M	F
2	H	E	E	H	E	H	H	E
3	F+H	M+E	F+E	M+H	M+E	F+H	M+H	F+E
4	F+H	M+E	F+E	M+H	M+E	F+H	M+H	F+E
5	M	F	M	F	F	M	F	M
6	M+H	F+E	M+E	F+H	F+E	M+H	F+H	M+E
7	M+H	F+E	M+E	F+H	F+E	M+H	F+H	M+E

Notes:
M: stands for Masculine names (target A) *F: stands for Feminine names (target B)*
E: stands for Economics and Finance (attribute A) *H: stands for Humanistic (attribute B)*

b. How we implemented it

The typology and fineness of the information to be collected (such as milliseconds reaction times) implies the need for a computer to administer the questionnaire and a well-reasoned procedure to implement it. The latter is because common online survey tools are unable to detect sensitive measures of reaction time.

For this, we use the software developed by Carpenter et. al. 2019: authors created an open-source tool (IATgen[15]) which could be easily customized to research needs and returns Qualtrics-compatible output: this is a great advantage as it allows the IAT test to be conducted directly within a longer questionnaire and thus permits linking it to any other desired respondent information.

Out procedure is detailed in the following steps.

At first, we select our stimuli after delving into literature (Carlana 2019), consulting with professor Carlo Tomasetto and conducting a pilot survey[16] on students of the Department of Economics Marco

[15] http://iatgen.org/

[16] In the pilot survey we subjected students to a prototype of the IAT, but with a larger pool of options (namely Economics, Finance, Calculus, Statistics, Mathematics, Algebra, Formulas and Equations as economics and finance stimuli & Humanities, Italian, Literature, History, Philosophy, Art, Pedagogy, Languages as humanistic stimuli). Following we explicitly ask them to evaluate all these options from 1 (= highly humanistic domain) to 10 (=highly economics domain) To check that the stimuli chosen are truly perceived by pupils as belonging to the two hemispheres (economics and humanities) and select those that are sensed as most representative.

Biagi of the University of Modena and Reggio Emilia and of the Department of Psychology Renzo Canestrari of the University of Bologna.
Then, we insert the chosen stimuli in the IATgen interface grouped into the four categories (two targets and two attributes) and download the IAT test in the QSF format, which could be imported directly into paid Qualtrics account.
But before importing it, through HTML codes, we carefully translated into Italian the instruction of the test that appears to users. This is a crucial point of our implementation because it is not suggested to make any changes to the test once in Qualtrics because the data collection will get corrupted[17].
The questionnaire begins with a barrier that verifies the device used and excludes those who do not have a keyboard because they are unable to conduct the IAT, follows with randomization that assigns an IAT permutation to each respondent, and ends with all other questions related to our covariates of interest.
Finally, we test the questionnaire to be sure that everything works, and that data are stored correctly and could be imported into IATgen.

c. Data cleaning and imputation of missing values

We have 10 missing in the score in the Implicit Association Test: missingness is imposed by the software and arises when it detects that the test was done without diligence and effort. Namely following the procedure firstly reported by Greenwald et. al., 2003 and resumed in Lane et al., 2007 (p. 92). Are scored as missing trials too slow (over 10,000 ms) and trials in which participants place more than 10% of the stimuli faster than 300 ms.
So, we cannot rely upon the missing values in the IATest to be completely random (MCAR) but, instead, related to the characteristics of the respondents (MAR) as the low motivation of respondents to carry out the exercise or a deficit in understanding it.

[17] This is particularly insidious since the error is initially invisible (the questionnaire works correctly as the data collection and storage), damages arise only once the data are reimported into IATgen.

APPENDIX 2

Description of the main variables in the data set

Table A3- Description of the main variables

VARIABLE	DEFINITION
Dependent variables	
Finance Marketing STEM Humanistic Work	Continuous variables, ranging from 1 "Extremely Unlikely" to 5 "Extremely Likely", which show how likely students are to take the following pathways: *Finance:* enrol in economics and finance degree. *Marketing:* enrol in economics and marketing degree. *STEM:* enrol in a "*hard STEM degree*", namely math or statistics or physics or chemistry or engineering or architecture and urban planning. *Humanistic:* enrol in a humanistic degree, namely political science, sociology, law, philosophy, languages, pedagogy and psychology. *Work:* go to work. For composite groups, the variable is the average between all options.
Student observable characteristics	
Female	Binary variable taking value 1 if female, 0 if male.
Age	continuous variable calculated as the difference between the year of the testing (2022) and the student's birth.
YearsInEmiliaRomagna	continuous variable indicating the years passed in the Emilia Romagna region. This variable coincides with the age of the students who were born in the region.
North	Binary variables taking value 1 for students born in North[18] of Italy and 0 for students from the rest of Italy or abroad.
RepetedClass	Binary variables taking value 1 for students have ever repeated a grade or more
Environmental Factors	
Family Background	
Mother_North	Binary variables taking value 1 if the student's mother was born in the North of Italy and 0 for mothers from the rest of Italy or abroad.
Mother' Level Of Study: Mother_Elementarymiddle Mother_Highschool Mother_Universitymore	Binary variables represent the mother's education level. *ElementaryMiddle* takes value 1 if the mother completed no more than lower secondary school, *highSchool* takes value 1 if she went to high

[18] We define North as the ITC and ITH NUTS1 (Nomenclature of Territorial Units for Statistics) codes of Italy. Namely Piemonte, Valle D'Aosta, Liguria and Lombardia for ITC NUTS1 (North West Italy) and Trentino Alto Adige, Veneto, Friuli Venezia Giulia, Emilia Romagna for ITH NUTS1 (North East Italy).

	school, *universityMore* takes value 1 whether he attended a bachelor's, master's or doctoral degree course.
Mother Education. High School Spec: Mother_Humanisticlyceum Mother_Scientificlyceum Mother_Technical Mother_Vocational	Set of binary variables specifying the nature of the *high school* attended by the mother. The four dummies respectively have value 1 whether the mum attended a humanistic Lyceum (*Mother_Humanisticlyceum*) , a scientific lyceum (*Mother_Scientificlyceum*), a technical school (*Mother_Technical*) or a vocational school (*Mother_Vocationa*l) and 0 otherwise (others levels of study).
Mother Degree: Mother_ECO Mother_STEM Mother_HUM	Set of binary variables specifying the nature of the *degree course* attended by the mother. The three dummies respectively have value 1 whether the mum attended a humanistic degree (*MOTHER_HUM*), a economics degree (*MOTHER_ECO*), a stem degree (*MOTHER_STEM*) and 0 otherwise (others levels of study or "neutral" degree field do not strictly enter in humanities, economics or stem).
Mother Work: Mother_Housewife Mother_Notemployed Mother_Empl1 Mother_Empl2 Mother_Empl3 Mother_Empl4	Binary variables representing the mother's current employment status. *MOTHER_housewife* takes value 1 if the mother is a housemaker. *MOTHER_notEmplyed* takes value 1 if the mother doesn't work. The other dichotomies indicate a labour status which increases with the number, namely: *MOTHER_empl1* takes value 1 for: blue collar, atypical worker (as a term-contract worker, an occasional collaborator etc...) and low-paying jobs (waiter, school janitor, gardener, social worker, cleaner, bartender, caregiver …) *MOTHER_empl2* takes value 1 for employee, teacher, nurse, physiotherapist or for the self-employed worker as a trader, shopkeeper or artisan. *MOTHER_empl3* takes value 1 for freelance professionals (as a lawyer, commercialist, etc..), university professor, headmaster. *MOTHER_empl4* takes value 1 for middle manager, doctor, surgeon, partner and or owner of a company.
Father_North	Binary variables taking value 1 if the student's Father was born in the North of Italy and 0 for fathers from the rest of Italy or abroad.
Father' Level Of Study: Father_Elementarymiddle Father_Highschool Father_Universitymore	Binary variables represent the father's education level. *ElementaryMiddle* takes value 1 if the father completed no more than lower secondary school, *highSchool* takes value 1 if she went to high school, *universityMore* takes value 1 whether he attended a bachelor's, master's or doctoral degree course.
Father Ed. High School Spec: Father_Humanisticlyceum Father_Scientificlyceums Father_Technical Father_Vocational	Set of binary variables specifying the nature of the *high school* attended by the father. The four dummies respectively have value 1 whether the Dad attended a humanistic Lyceum (*Father_Humanisticlyceum*) , a scientific lyceum (*Father_Scientificlyceums*), a technical school (*FATHER_Technical*)

	or a vocational school (*FATHER_Vocational*) and 0 otherwise (others levels of study).
Father Degree: Father_ECO Father_STEM Father_HUM	Set of binary variables specifying the nature of the *degree course* attended by the father. The three dummies respectively have value 1 whether the Dad attended a humanistic degree (*FATHER_HUM*), a economics degree (*FATHER_ECO*), a stem degree (*FATHER_STEM*) and 0 otherwise (others levels of study or "neutral" degree field do not strictly enter in humanities, economics or stem).
Father Work: Father_Notemployed Father_Empl1 Father_Empl2 Father_Empl3 Father_Empl4	Binary variables representing the father's current employment status. *FATHER_notEmplyed* takes value 1 if the father doesn't work (there are no fathers housemaker in the sample). The other dichotomies indicate a labour status which increases with the number, namely: *FATHER_empl1* takes value 1 for: blue collar, atypical worker (as a term-contract worker, an occasional collaborator etc...) and low-paying jobs (waiter, school janitor, gardener, social worker, cleaner, bartender, caregiver …) *FATHER_empl2* takes value 1 for employee, teacher, nurse, physiotherapist or for self-employed worker as a trader, shopkeeper or artisan. *FATHER_empl3* takes value 1 for freelance professionals (as a lawyer, commercialist, etc..), university professor, headmaster. *FATHER_empl4* takes value 1 for the middle manager, doctor, surgeon, partner and or owner of a company.
MumCare	Continuous variable ranging from 1 "never" to 5 "several times a month" reporting the time and attention that the mother devotes to the student (including speaking about his future, the importance of school and asking how things are going in the institute. Composite index inspired by PISA 2015.
DadCare	Continuous variable ranging from 1 "never" to 5 "several times a month" report the time and attention that the father devotes to the student (including speaking about his future, the importance of school and asking how things are going in the institute. Composite index inspired by PISA 2015.
WellnessStudy	Continuous variable ranging from 0 to 5 indicating the possession of some "study assets" like a PC, dictionary, internet connection, room and a table intended for study. Composite index inspired by PISA 2012.
WellnessHome	Continuous ranging from 0 to 6 indicating the possession of some basic "home assets" as dishwasher, fridge, oven, etc... Composite index inspired by PISA 2012.
I.Bookathomenomissing	Categorical variable indicating the estimated number of books at home. Inspired by PISA 2012.

School Environment	
Type Of School: Lyceum Technical Vocational	Binary variables corresponding to the three main Italian tracks of upper secondary schools: Lyceums, Technical, and Vocational.
ClassSize	Continuous variable representing the number of pupils in the classroom.
ShareFemale	Continuous variable equal to the percentage of females in the class[19].
FemaleTeacher	Binary variable indicating whether students have a female maths or economics teacher.
TeacherBeliefInTheProject	Continuous variable which is reported the mean of the staff's evaluation about how much they feel professors believe in the usefulness of the project. In your opinion, did ***school X***'s professor(s) believe in the usefulness of the project?
TeacherMotivateStudent	Continuous variable which is reported the mean of the staff's evaluation about how much they feel professors make their classes get involved in the project. In your opinion, how motivated was(were) ***school X***'s professor(s) to make his(their)class(es) get involved in the project?
TeacherEngagement	Continuous variable reporting the mean of the staff's evaluation about how much they feel professors satisfy to participate in the project. how satisfied/happy you felt ***school X***'s professor(s) was(where) that his(their)class(es) was participating in the project?
OnlineRoleModel	Binary variable equal to 1 if the role model activity was conducted online.
OnlineShort	Binary variable equal to 1 if the short film projection activity was conducted online.
School	Binary variables corresponding to the six schools participating in the projects.
Class	Binary variables corresponding to the classes participating in the projects.
TimeSpan	Continuous variable indicating the number of days between the first and second questionnaires.
Hmath	Sum of weekly math hours in the curriculum (first through fifth grades)
Heco	Sum of weekly economy hours in the curriculum (first through fifth grades)
Choices Determinants	
Stereotype	
Dscore	Continuous variable indicating the Implicit stereotype (composite index based on the Iat test results). The variables range from -1.04 to + 1.26.

[19] The percentage was computed on respondents to the pre questionnaire (93% of the total number of participants), so could slightly differ from the real one.

	Positive values indicate a positive mental association between female&humanistic and male&finance/economy, neutral values reflect the absence of stereotypes and negative values the opposite mental association (male&humanistic and female&finance/economy).
ExplicitstereotypeSchool	Continuous variables ranging from 1 "no stereotype" to 6 "high stereotype" indicating the female-economy explicit association at school. (composite index)
ExplicitstereotypeFamily	Continuous variables ranging from 1 "no stereotype" to 6 "high stereotype" indicating the female-economy explicit association in the household. (composite index)
Expectation Of Success	
MeasuredAbility	Continuous variable ranging from 4 to 10 correspond to the average grades in math and economics took by students at the end of the fourth grade.
AbilitySelfConcept	Continuous variable ranging from 1 "low self-confidence in math" to 6 high "high self-confidence in math". The variable is composed of dimensions like the student agreement with the following statements "I am not good at math (reversed)", "I get good grades in mathematics", "I learn mathematics quickly", "In my maths class, I understand even the most difficult work". Composite index built on some items extrapolated from a battery of PISA questions. (Alpha subindex pre-aggregation = Scale reliability coefficient: 0.84)
Overconfidence_Math	Binary variable equal to one whether teens have a perception that they are better at math than what their actual grade reveals and zero otherwise.
Overconfidence_Economy	Binary variable equal to one whether teens have a perception that they are better at economy than what their actual grade reveals and zero otherwise.
Subjective Tasks Value	
Like_Maths	Continuous variable ranging from 1 to 6 indicating how much students like the math subjects.
Like_Economics	Continuous variable ranging from 1 to 6 indicating how much students like the economy subjects. Even if this variable is highly predictive and correlated with the choice of the field of study we cannot use it in regression because
ImpoeconomyForLife	Continuous variable ranging from 1 "not important" to 5 "extremely important" which corresponds to how important students perceive the economy to be for their life.
ImpoeconomyForAccademy	Continuous variable ranging from 1 "not important" to 5 "extremely important" which corresponds to how important students perceive the economy to be for their academic future.

ImpoeconomyForProfession	Continuous variable ranging from 1 “not important” to 5 “extremely important” which corresponds to how important students perceive the economy to be for their professional future.
Cost	Continuous variable ranging from 1 “low perceived cost” to 6 “high perceived cost” (we mean as costs feelings such as fear to get low grades in math, nervousness and|or helpless and|or anxiety in solving math problems and exercises) . Composite index built on some items extrapolated from a battery of PISA questions.
Senseofbelongingindex1 Senseofbelongingindex2	Continuous variable ranging from 1 “low sense of belonging to financial-economic community” to 8 “high sense of belonging to financial-economic community” The variables included in the index explore the feeling of the student (who is asked to imagine him/herself in an economics and finance class) S[…]x1 - subscale acceptance: I feel like an outsider/accepted/ respected/disregarded/valued/ neglected/appreciated. S[…]x2 - subscale membership: I feel a member of the economy and finance world/ that I belong to the economy and finance community/ in connection with the economy and finance community. Composite index inspired on the reduced scale (and adapted to the financial-economic domain) of Good et all 2012.

Table A4 – Treatment, details on heterogeneity

INSTITUTE	CLASS(ES)	FREE TO CHOOSE	SHORT ON WORK	ROLE MODEL
Vocational1	5CP	**Date**: 25/11/2021 **Mode:** presence **Staff:** Staff1[1]. ; Staff2[2]	**Date:** 27/11/2021 **Mode:** presence **Staff:** Staff1 ; Staff2	**Date**: 02/12/2021 **Mode:** presence **Staff:** Staff1 ; Staff2 **Role model:** Role model1[3]
Vocational2a	5A	**Date**: 25/11/2021 **Mode:** presence **Staff:** Staff1 ; Staff2	**Date:** 02/12/2021 **Mode:** presence **Staff:** Staff1 ; Staff2	**Date**: 09/12/2022 **Mode:** Role model online, students and staff in class. **Staff:** Staff1; Staff2; Staff3 [2] **Role model:** Role model2 [4]
Lyceum1	5A ES 5B ES	**Date**: 29/11/2021 **Mode:** presence **Staff:** Staff1 ; Staff2	**Date:** 01/12/2021 **Mode:** Staff online, students in class. **Staff:** Staff1 ; Staff2	**Date**: 04/12/2021 **Mode:** presence **Staff:** Staff3 **Role model:** Role model3 [5]
Technical1a	5A AFM 5B AFM	**Date**: 17/01/2022 **Mode:** presence **Staff:** Staff1; Staff2	**Date:** 20/01/2022 **Mode:** presence **Staff:** Staff1; Staff4 [2]	**Date**: 22/01/2022 **Mode:** presence **Staff:** Staff3 **Role model:** Role model4 [6]
Technical1a	5F SIA	**Date**: 17/01/2022 **Mode:** presence **Staff:** Staff1; Staff2;	**Date:** 20/01/2022 **Mode:** presence **Staff:** Staff3 ; Staff4	**Date**: 22/01/2022 **Mode:** presence **Staff:** Staff3 **Role model:** Role model4
Technical1b	5H RIM 5L RIM	**Date**: 18/01/2022 **Mode:** presence **Staff:**	**Date:** 25/01/2022 **Mode:** presence **Staff:** Staff1 ; Staff5[2]	**Date**: 29/01/2022 **Mode:** Role model online, students and staff in class. **Staff:** Staff2 **Role model:** Role model5 [7]
Vocational2b	5M	**Date**: 24/01/2022 **Mode:** presence **Staff:** Staff2; Staff1	**Date:** 01/02/2022 **Mode:** presence **Staff:** Staff1 ; Staff2	**Date**: 04/02/2022 **Mode:** presence **Staff:** Role model online, students and Staff2 in class. **Role model:** Role model6 [8]

continued on the next page

INSTITUTE	CLASS(ES)	FREE TO CHOOSE	SHORT ON WORK	ROLE MODEL
Lyceum2	5B CLAS	**Date**: 27/01/2022 **Mode:** presence **Staff:** Staff1	**Date**: 03/02/2022 **Mode:** presence **Staff:** Staff1; Staff4	**Date**: 12/02/2022 **Mode:** presence **Staff:** Staff1 **Role model:** Role model7 [9]
Lyceum2 (due to the Pandemic issue -for this class- "Free to Choose" and "Short on Work" were inverted in the implementation timeline)	5A LING	**Date**: 03/02/2022 **Mode:** presence (due to Pandemic issue "Free to Choose" came after "Short on Work") **Staff:** Staff2	**Date**: 27/01/2022 **Mode:** online with students at home (due to Pandemic issue Short on Work") came before "Free to Choose") **Staff:** Staff2	**Date**: 12/02/2022 **Mode:** presence **Staff:** Staff1 **Role model:** Role model7
Technical2	5B RIM	**Date**: 10/01/2022 **Mode:** presence **Staff:** Staff3; Staff2	**Date:** 19/01/2022 **Mode:** online with students at home **Staff:** Staff1	**Date**: 28/01/2022 **Mode:** presence **Staff:** Staff1 **Role model:** Role model1

[1] Research fellow at DHMore (Interdepartmental Center on Digital Humanities, University of Modena and Reggio Emilia).

[2] PhD student in Labour, Development and Innovation at Department of Economics Marco Biagi and Economic Policy Foundation.

[3] PhD student in Labour, Development and Innovation at Department of Economics Marco Biagi and Economic Policy Foundation, ex-worker in the finance section of Prometeia. Master's degree in Economics and Finance at Marco Biagi Department of Economics.

[4] Research Assistant at the Department of Communication and Economics, University of Modena & Reggio Emilia. PhD's degree in Labour Relations at Department of Economics Marco Biagi and Economic Policy Foundation.

[5] Economist in the finance section of Prometeia. Master's degree in Economics and Public Policies at Marco Biagi Department of Economics.

[6] Data and analysis manager of the Job Pricing observatory. PhD's degree in Economics and business at the University of Cagliari.

[7] Associate Professor in Political Economy SECS/P01. PhD's degree in Economics at London School of Economics and Political Science.

[8] Senior economist in the finance section of Prometeia. Master's degree in Economic and Social Sciences at Bocconi university.

[9] Operating assistant in a financial advisory firm of Banca Fideuram. Master's degree in Labour Relations at Marco Biagi Department of Economics