

# Matching minds with economics. The effects of pre-university courses and non-stereotyped TikToks to university major choice.\*

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## Abstract

Many countries face the problem of high numbers of first year college dropouts, which represents a big opportunity cost to students and misallocated resources from universities. This leads policy makers and education institutions to find alternative to better match students with their major choices. We discuss a theoretical framework on the influence of factors such as interest, self-efficacy, outcome-expectation, and stereotypes on academic choice, together with possible channels to their decisions. Moreover, we test this framework and possible channels experimentally, estimating the effect of two interventions on the likelihood of high school pupils studying economics in higher education: (i) the impact of pre-university programs that teach high school students university-level economics; and (ii) the influence of TikTok videos and testimonials showing non-stereotypical career paths economists can take. We find that the effect of the pre-university programs was significantly negative, reducing the likelihood of students choosing economics (-0.22 sd), while the effect of TikToks and testimonials was not different from zero. Heterogeneity analysis shows us that students highly interested in economics did not drop their likelihood to study economics, while the effect of the non-stereotyped videos and testimonials was positive for students that are politically-oriented to the left or that have high socioeconomic status.

*Keywords:* Academic choice, University major choice, Behavioural economics, Social cognitive theory, Stereotypes, Nudging

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## 1. Introduction

The high number of university dropouts (particularly strong for first year students) translates into a high loss of resources to governments and private universities alike, while representing lost opportunities for the students (Kirp, 2019; Schneider & Yin, 2011; Vardishvili, 2020). Evidences from experiments and observational studies shed light to the importance of ability, interest, motivation, and information about program to increase retention rate and degree attainment (Alarcon & Edwards, 2013; DesJardins et al., 2006; Robbins et al., 2009; Slinger et al., 2015; Solberg Nes et al., 2009). To help solve this problem, it becomes imperative to find policies and interventions that help students choose university programs that better match with their interests and abilities, reducing their tendency to dropout. In this context, we discuss a theoretical framework on the influence of factors such as interest, self-efficacy, outcome-expectation, and stereotypes on academic choice, together with possible channels to their decisions. Moreover, we test this framework and possible channels experimentally, estimating the effect of two interventions on the likelihood of high school pupils studying economics in higher education: (i) the impact of pre-university programs that teach high school students university-level economics; and (ii) the influence of TikTok videos and testimonials showing non-stereotypical career paths economists can take.

The direct costs associated with college dropouts is particularly substantial, amounting to billions of dollars in the United States alone, linked to both income and taxes losses (Kelderman, 2010; Kirp, 2019; Schneider & Yin, 2011). The amount of dropouts and the underlying costs can be aggravated in higher education institutions with less selectivity, for instance through open access or open-door academic policy<sup>1</sup> (Brint, 2003; Feldman, 1993; Tresman, 2002), with many countries offering a close to universal access to tertiary education with enrollment levels above 80% (UNESCO, 2020, 2022). In the case of Flanders in Belgium, open access is said to be one of the main reason for the high rate of failures during the first year of tertiary studies (Vossensteyn et al., 2015). Many factors can be associated with higher college dropout rates and low attendance, like lack of financial aid, strong need to work, living far from campus, higher access rate<sup>2</sup>, representation of minority groups, and so on (Billings et al., 2014; Bozick, 2007; Stratton et al., 2008). However, many emotional, cognitive and behavioral factors are also linked with the decision to dropout from one's degree, like low levels of interest, ability, and motivation (Aina et al., 2022; Robbins et al., 2006), which might be reflected to a choice of degree or major that does not match their abilities and characteristics.

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<sup>1</sup>Institutions in which no or few requirements are needed for enrollment, giving a chance to everyone to study (Hendrick et al., 2006)

<sup>2</sup>Still, there exists some opposing results in cases with suppressed demand, like Oppedisano (2011), which found that increasing supply of higher education in poorer regions of Italy (which lacked sufficient supply of higher education before) did not increase dropout rates.

The factors influencing academic and career choice have been an important topic of research in the social choice, education, psychology, and economics literatures. The seminal papers from Lent et al. (1994, 2000) introduced a social cognitive theory on how self-efficacy, expected outcomes, and goals mechanisms can influence career and academic choices. On a similar note, Hall and Chandler (2005) propose the distinction between objective and subjective career success, with the possibility of important life choices being motivated by a perceived 'calling' or 'vocation'. Carlana et al. (2022) investigate the academic choice of students with an immigration background, finding that immigrant students attend vocational high schools more than their peers, but that career counseling and tutoring interventions were able to increase their likelihood to attend technical and academic schools. Wiswall and Zafar (2015) propose a decision model on college major choice, finding that expected earnings and perceived ability are important determinants, while the dominant factor is individual taste. In a similar model, Zafar (2013) find the importance of parents' approval and enjoying coursework as the main determinants to decide a major in both genders, while males are more worried about future financial remuneration than females, with different tastes driving the gender gap. Altmejd et al. (2021) find that older siblings' academic choices can influence the decision of younger ones, but this factor disappears if older sibling dropped out.

One specific factor that can influence academic choices is the existence of stereotypes. For instance, the gender stereotypes' influence to choices is investigated widely: Buser et al. (2014) show a high degree of correlation between competitiveness and the choice for more prestigious academic tracks, and that this personality trait is more present in boys. Current experimental evidence show the importance of role models and non-typical gender roles to academic choice and career outcomes, which can also improve competitiveness (Boneva et al., 2022; Olsson & Martiny, 2018; Palffy et al., 2023; Porter & Serra, 2020). But besides gender stereotypes, there are also career-specific stereotypes threats (i.e. when a stereotyped identity is prominent), which has also found to impact academic choice in the case of ICT (Clayton et al., 2009), for negative stereotypes such as that ICT-professionals do not have many social skills. In different applications, stereotypes were found to impact financial advice, the contribution of ideas, and decisions under risk of loss and uncertainty (Bucher-Koenen et al., 2021; Carr & Steele, 2010; Coffman, 2014).

The example of stereotype threats related to professions is also present for economists. Economists are often associated with being more selfish, greedy rational, more prone to free riding, less willing to cooperate or to give money to charity (Carter & Irons, 1991; Frank et al., 1993; Frey & Meier, 2003; Marwell & Ames, 1981; Van Dalen, 2019). Such types of attributes could be self-selected in the distribution (i.e. people with such traits could be more willing to study economics), or the economic education and profession could promote such traits and behaviours (Bauman & Rose, 2011; Lanteri, 2008; Miller, 1999; Racko, 2019; Wang et al., 2011).

One possibility is that negative attributes associated to a profession or university major would make individuals less willing to choose such academic or professional track.

A particular type of intervention that can be effective to prepare students for tertiary education, while also better matching majors to students' interests, is the application of pre-university or junior college programs to secondary school students. Some pre-university programs focus on being 'enablers' to better prepare students (especially disadvantaged or lacking behind students) to what they will see in the future (Lisciandro & Gibbs, 2016; McPhail, 2015; Nel et al., 2009). But beyond that, such programs can be an important tool to raise awareness and interest to particular majors, providing more information and serving as hands-on experience on how it can feel to study a particular subject in university (Anderson & Gilbride, 2003).

The objectives of this paper are twofold. First, we propose a theoretical framework on how elements such as interest, self-efficacy, outcome-expectation, and stereotypes can impact students' academic choices. Second, we test this framework empirically, by investigate whether we can influence students likelihood to study economics in higher education. For this, we apply a randomized controlled trial with Belgian secondary school students based on two interventions: (i) we test whether pre-university courses (that teach university-level economics classes to high school students) can impact likelihood to choose economics, interest, and self-efficacy; (ii) if informative TikTok videos and life testimonials on non-stereotypical careers in economics can impact their academic choices and their pre-conceived stereotypes about economists.

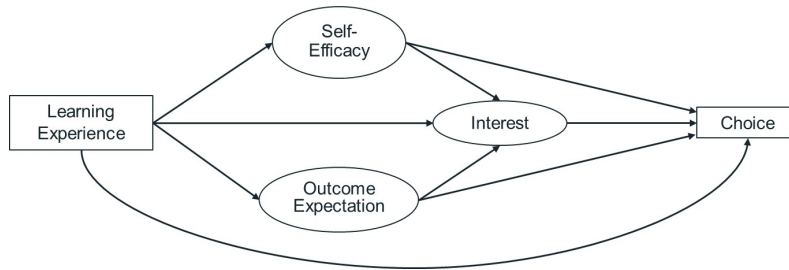
Our paper contributes in the literature in several ways. This is the first study to our knowledge to give experimental evidence on (i) the use of pre-university courses to influence students' major decisions and (ii) the role of professional-linked stereotypes to academic choices. Second, we propose alternative frameworks of Lent et al. (1994), considering also the impact of stereotypes in academic decisions, and the role of possible moderators. Moreover, we present these experimental evidences for a country with an open-door system to enter University, on which improvements in matching students with their right majors are even more timely to reduce costs caused by excessive drop-outs.

This paper is organized as follows. Second chapter discuss the proposed theoretical framework. Chapter three presents the experimental design and methods. Following chapter shows the main results and analysis of the paper. Finally, last chapter presents the discussion.

## **2. Theoretical framework**

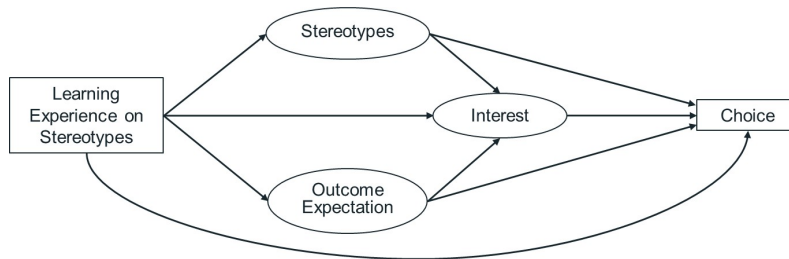
Lent et al. (1994) provide a social cognitive theory on how self-efficacy, outcome expectations, and goals mechanics could influence career and academic choices. Self-efficacy is seen as "people's judgements of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986), responding to questions like 'can I do this?'. While self-efficacy is related to capabilities, outcome expectations comes from personal beliefs

about probable response outcomes (e.g. 'if I do this, what will happen?'), including physical (e.g. monetary), social (e.g. peers approval), and self-evaluative (e.g. personal satisfaction) outcomes. Goals are represented by the ability of individuals to symbolically determine the anticipated outcomes they aspire to achieve in the future, helping people organize and guide their behaviour. Under Lent et al. (1994)'s framework, self-efficacy and outcome expectations would affect idiosyncratic interest, that would then affect choice goals and actual choices. Moreover, particular experiences and learning exposures can lead to changes in initial levels of the aforementioned variables and the choice of a person.



**Figure 1.** Causal framework on the effect of learning experiences to choice.

We simplify the framework focusing on the effects of learning experiences to choice in general (e.g. not separating choice goals from choice actions), focusing on the effect of learning experiences and similar interventions. A direct acyclic graph (DAG) of this framework can be seen in Figure 1. We assume that the learning experience might affect interest directly, since someone's self-efficacy or outcome expectations about the future might not change, but the person's interest about a particular choice might have changed (e.g. sense of novelty or idiosyncratic preferences change that lead to higher interest). Moreover, the learning experience itself is assumed to have a direct effect to choice, since a pleasant (or unpleasant) learning experience might lead to a difference in choice independently of affecting other variables.



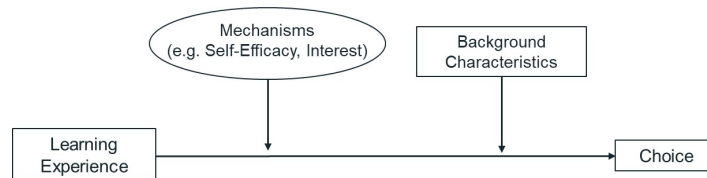
**Figure 2.** Causal framework on the effect of learning experiences on stereotypes to choice.

More specifically, the existence of career-linked stereotypes can also affect academic and career choices. This factor can lead to either a positive view about the profession (e.g. certain professions may be perceived to have a prestige, or to have a higher probability of economic success), or to professions linked to negative stereotyped traits and characteristics (e.g. such professionals being selfish, prone to corruption, or anti-social), changing how desirable a profession or major

can be.

The first mechanism that can explain the role of stereotypes to academic choice is stereotype priming (Blair & Banaji, 1996), in which a certain group or profession is automatically associated with certain traits and characteristics, with this automatic process leading to difference in judgement and decisions, including career related choices (Rudman & Phelan, 2010). The psychology’s theory of backlash can be another mechanism on how stereotypes may influence choice (Rudman, 1998), for example, women and non-white students might feel less encouraged to pursue careers or majors in which most role models are white males, to avoid suffering backlash for this non-stereotypical behaviour (Rudman et al., 2012). Moreover, if a career is associated with a bad trait (e.g. greed, anti-social), individuals might be less inclined in choosing certain major if they do not see themselves having such characteristics, avoiding negative social pressure this way (Krezel & Krezel, 2017). Porter and Umbach (2006) note that political orientation appear as one of the main predictors of university major choice, which can likely influence how career stereotypes are perceived.

Considering the role of stereotypes, we propose a new framework related to learning experiences focusing on non-stereotypical messages, and how they can affect choices. This framework is observed in the DAG from Figure 2. First, we assume that learning about ‘anti-establishment’ opinions about a career or an academic major might directly affect stereotypes or how positively (or negatively) they are perceived. This learning experience can have an effect to choice mediated by stereotypes (since new perceptions about stereotypes can impact the choice). Still, changes in stereotypes may also lead to changes in outcome expectations (considering some stereotypes are related to income and job experience) and interest (new perceptions about stereotypes can give a more negative or positive view about the considered choice), which would indirectly affect choice. Moreover, as in the general framework case, the learning experience centred in stereotypes could have a direct effect on its own, since it might not shift pre-conceived stereotypes (or if they are viewed as positive or negative) nor other variables, but instead the experience itself can be impactful enough to change choices.



**Figure 3.** Causal framework on the effect of learning experiences to choice with moderation effect.

The simplified frameworks do not mean that other elements do not play a role in choice. For instance, as the case from Lent et al. (1994)’s framework, socioeconomic status and background characteristics can affect the effectiveness of learning experiences. Moreover, we assume such background characteristics can also impact pre-existing levels of self-efficacy, outcome expecta-

tion and interest. Although not being the focus of this study, the results of someone’s choice (e.g. performance domains and attainments) would reinforce the cycle, serving as new learning experience and motivating new choices, as proposed by Lent et al. (1994). Besides this, we do not consider the causal link from self-efficacy to outcome expectation for simplification, although we recognize it can possibly exist and be strong (e.g. by feeling more capable of following a certain academic or career path, this may lead to better outcome expectations).

Another possibility, is that learning experiences do not change the initial levels of self-efficacy, outcome expectation, interest, and stereotypes. Instead, the initial levels of such mechanisms, in addition to a person’s environment and characteristics, would work as moderators, affecting the intensity or the direction of the learning experience, this is plotted in Figure 3. This could happen for two reason: (i) because the initial conditions might be considerably difficult to be affected, (ii) since the same learning experience could have a drastic different impact depending on the person. For instance, knowing that a certain career has a big likelihood to earn a big wage (e.g. becoming an executive for an oil company), but that will probably impact the society or the environment negatively, would have a positive influence to someone interested in climbing the corporate ladder while having low regard to climate change and others, with the opposite being true for someone with big concerns about climate matters.

### **3. Experimental design and methods**

An experiment was organized with students between 16 and 18 years-old in the last cycle of secondary education in Flanders, the Dutch-speaking region of Belgium, with the focus of influencing academic major choice in tertiary education, consisting on a randomized-controlled trial with two interventions. The first intervention consisted on a pre-university program called "KU Leuven’s Faculty of Economics and Business - Junior College: A virtual tour through Leuven", which introduced secondary school students to university level economics subjects such as investment decisions, income inequality, influence of price shocks on purchasing power, and estimation of annuities for savings and investments. The second intervention was based on Tik-Tok videos and testimonials, presenting to students non-traditional careers economists can work with, especially linked with jobs with a higher social impact, like working as an economist for institutions such as the Red Cross and the WWF.

Those two interventions are designed as unique learning experience interventions, which are intended to influence the academic choice of choosing a major in university through the paths described in Figure 1 and Figure 2. The first intervention (i.e. the pre-university program) is intended to mimic a first experience of a student in the university, which in addition to possibly affecting academic choices directly, could also affect through changing self-efficacy, interest, and outcome expectation, as seen in Figure 1. In the other hand, the second intervention (i.e. anti-stereotypical videos and testimonials) does not focus on learning about economics, but learning

about what you can do as an economist. Since this intervention has the particular focus of affecting the initial stereotypes of individuals, and not students’ self-efficacy towards economics, this path would be closer to what is proposed in Figure 2.

To operationalize such interventions in the context of our experiment, we divided schools in three experimental arms. Schools in the control group did not receive any pre-university courses, videos nor testimonials during the duration of the experiment<sup>3</sup>. Schools in the first treatment group (called ‘treatment traditional economics’ hence forth) received only the pre-university program, without any videos nor testimonials. The second treatment group (called ‘treatment social economics’ from now on) receive both interventions, including the pre-university programs, the Tik-Tok videos, and testimonials. By having cumulative level of treatments, this allows us to estimate marginal effects to each different intervention. The treatments were randomized at school level using stratified randomization (Bruhn & McKenzie, 2009). An overview of the experimental conditions can be seen in Table 1. Although the treatment groups had different content, they were of similar length (about 4 to 5 class hours). While students in the treatment social economics were watching videos and reading testimonials about non-traditional careers in economics, the other students consumed placebo material with nothing to do with economics (i.e. a Belgian celebrity talking about the city of Leuven).

**Table 1.** Schematic representation of the experimental conditions.

|  | Control | Treat. Trad. Econ. | Treat. Social Econ. |
|--|---------|--------------------|---------------------|
| Pre-university program with introduction to economics in tertiary education  | No      | Yes                | Yes                 |
| Tik-tok videos and testimonials on non-traditional career paths in economics | No      | No                 | Yes                 |

Regarding the timeline of the experiment, it started in October 2022 with the registration of the experiment in the AEA RCT Registry. Until the end of October the schools registered and completed the pre-tests. After this, the schools were randomized by strata. The schools then planned interventions dates between October 27th and February 22nd 2023, answering to the post-tests after the completion of the courses.

The primary outcome measured was the likelihood of pupils studying economics on higher education, which was asked directly to students on a scale from 0 to 100, alongside the likelihood of attending university . Students were also asked about the likelihood of studying their best or second best subject (i.e besides economics) on higher education. A series of independent variables were collected with the goal of estimating the causal frameworks discussed in the previous section. First, economic knowledge was centred on questions measuring students’ proficiency on the topics they learned during the course, alongside economic interest questions about habits and tastes towards economics (e.g. reading the economic news, following financial markets), which

<sup>3</sup>Nonetheless, control schools could still receive the courses after the experiment finished, letting no school left behind.



was formulated in collaboration with the teachers that helped to create the course materials. Self-efficacy score was measured with scales based on Kundu and Ghose (2016), Lent et al. (2016), and May (2009) adapted for the decision of students to study economics. Outcome expectation on study and job outcomes was based on the scale from Betz and Voyten (1997). Economic stereotypes score was measured by a Linkert-scale on how much students associate common stereotypes with economists. Social image was measured by a Linkert-scale based on how positively/negatively students' social circle would evaluate their decision to study economics and on how positively or negatively they evaluate economic stereotypes to be. Political views was estimated by a two-dimensional scale based on Evans et al. (1996), which measures left-right and libertarian-authoritarian values. A self-assessed question on political orientation (from left to right) was also asked to students. Besides the tests of the main outcome variables, pre-existing conditions of students (e.g. grades in math and language, situation of family, previous interest in economics, socioeconomic status) and school (e.g. private/public, region, performance in past standardized tests, funding by student) were also collected.

The main hypothesis is that the first intervention (i.e. pre-university course on what students will learn in higher education economics) will impact economic interest, self-efficacy and outcome expectation. Those variables will then serve as mediating variables, which we expect to increase the likelihood of someone studying economics in higher education. For students that find the course too hard or uninteresting, this effect might be zero or negative. For the second intervention (i.e. videos and testimonies about non-standard jobs in economics), our hypothesis is that this will reduce the amount of negative stereotypes towards studying economics, which can influence the subjective social image of studying economics (e.g. the influence of peers' opinions). Additionally, interests and outcome expectations can also be impacted by an anti-stereotypical learning experience.

The main identification strategy of the paper to overcome the selection problem is the random assignment of experimental arms. Although a few students did not complete the tests, we had full compliance of the intervention, being able to estimate average treatment effects (ATE). The main total effects are estimated using the following OLS:

$$y_{i,s}^1 = \alpha + \beta_1 \text{TradEcon}_s + \beta_2 \text{SocEcon}_s + \sum \beta_3^l X_{i,s} + \epsilon_{1,i,s} \quad (1)$$

With  $y_{i,s}^1$  being the post-treatment outcome variable (i.e., the likelihood of studying economics in higher education).  $\text{TradEcon}_s$  and  $\text{SocEcon}_s$  are dummy variables identifying, respectively, the treatment groups traditional economics and social economics.  $X_{i,s}$  refer to the set of pre-treatment background characteristics related to either the school or the student, including as well the pre-treatment likelihood of studying economics in higher education and the pre-tests results of the surveys about economic knowledge, economic interest, self-efficacy, outcome expectation, social image, and stereotypes. Considering sample imbalances and attrition, we apply Maha-

lanobis Distance Matching (MDM) that approach a fully blocked experiment with a reasonable sample size (Iacus et al., 2011; Rubin, 1980) and Lee (2009)’s bounds respectively that trims the treatment groups proportionally. Considering that multiple hypothesis will be tested, we will use the Benjamini and Hochberg (1995) method to estimate p-values against false positives, which is preferable to the over-conservative Bonferroni test (Haynes, 2013).

To estimate indirect effects, we use causal mediation analysis (Pearl, 2001) following the approach from Imai et al. (2010) and Valeri and VanderWeele (2013). The model tested is seen in Equations 2 and 3:

$$M_i^1(d, X) = \alpha + \beta_4 d_s + \beta_5 X_{i,s} + \epsilon_{2,i,s} \quad (2)$$

$$y_{i,s}^1(d, M, X) = \alpha + \beta_6 d_s + \beta_7 M_i^1 + \beta_8 X_{i,s} + \epsilon_{3,i,s} \quad (3)$$

Where  $d$  is the treatment status (e.g. traditional economics, social economics) and  $M$  refers to the mediator variable. Considering the multiple causal links from the proposed causal pathways in Figures 1 and 2, this model will be estimated with different mediator variables (e.g. self-efficacy, outcome expectation, interest, stereotypes).

In addition to the main outcomes discussed, we have also analysed the heterogeneity of our treatment effects, using interactions effects estimations and difference in pre and post test levels. This was done to investigate the hypothesis of moderation, as seen in Figure 3. Not only socioeconomic characteristics were used to divide the students into groups, but also political orientation, and pre-test scores from the aforementioned independent variables tested also as mediation mechanisms.

## 4. Results

### 4.1. Data and main outcomes

The final sample used in this study consisted of 537 students in 38 schools<sup>4</sup>. Table 2 shows the background characteristics of our sample across the different experimental conditions. We note a substantial number of variables with imbalance (e.g. catholic school, academic track, gender, results is mathematics, secondary school program, family education, siblings, and self political view). Considering this, variables with imbalance will be included as controls and in the matching estimator.

Table 3 presents the pre-test scores across treatment conditions, which include the main outcome variable (i.e. likelihood to study economics in higher education) and the scores used

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<sup>4</sup>With a sample size of 537, a significance level set at 5%, 38 clusters, an estimated intraclass correlation of clusters at 0.01, and considering a power of 80%, the post-hoc power analysis revealed a minimum detectable effect size of 0.28.

**Table 2.** Characteristics across experimental groups.

| Variable                              | (1)<br>Control     | (2)<br>Treat Trad Economics | (3)<br>Treat Social Economics | (4)<br>(2) vs (1)    | (5)<br>(3) vs (1)   |
|---------------------------------------|--------------------|-----------------------------|-------------------------------|----------------------|---------------------|
| Catholic school                       | 0.734<br>(0.443)   | 0.580<br>(0.495)            | 0.743<br>(0.438)              | -0.154**<br>(0.052)  | 0.009<br>(0.049)    |
| Academic track                        | 0.769<br>(0.423)   | 0.966<br>(0.182)            | 0.859<br>(0.349)              | 0.197***<br>(0.033)  | 0.089*<br>(0.042)   |
| Dutch spoken at home                  | 0.783<br>(0.414)   | 0.834<br>(0.373)            | 0.864<br>(0.344)              | 0.051<br>(0.042)     | 0.081<br>(0.041)    |
| Sex (male)                            | 0.573<br>(0.496)   | 0.366<br>(0.483)            | 0.461<br>(0.500)              | -0.208***<br>(0.053) | -0.113*<br>(0.055)  |
| Age (17-19)                           | 0.748<br>(0.436)   | 0.727<br>(0.447)            | 0.853<br>(0.355)              | -0.021<br>(0.048)    | 0.105*<br>(0.043)   |
| Results Dutch Previous Year           | 67.420<br>(9.244)  | 68.663<br>(7.668)           | 68.246<br>(6.824)             | 1.244<br>(0.910)     | 0.826<br>(0.879)    |
| Results Mathematics Previous Year     | 61.154<br>(11.725) | 65.693<br>(9.512)           | 65.529<br>(12.111)            | 4.539***<br>(1.141)  | 4.375**<br>(1.321)  |
| <i>Secondary School Study Program</i> |                    |                             |                               |                      |                     |
| Economics                             | 0.867<br>(0.341)   | 0.932<br>(0.253)            | 0.901<br>(0.300)              | 0.065*<br>(0.032)    | 0.033<br>(0.035)    |
| Mathematics                           | 0.077<br>(0.267)   | 0.239<br>(0.428)            | 0.215<br>(0.412)              | 0.162***<br>(0.040)  | 0.138***<br>(0.039) |
| Others                                | 0.133<br>(0.341)   | 0.024<br>(0.155)            | 0.052<br>(0.223)              | -0.108***<br>(0.027) | -0.081**<br>(0.031) |
| Mother Education (High)               | 0.566<br>(0.497)   | 0.678<br>(0.468)            | 0.654<br>(0.477)              | 0.112*<br>(0.052)    | 0.088<br>(0.054)    |
| Father Education (High)               | 0.503<br>(0.502)   | 0.541<br>(0.499)            | 0.571<br>(0.496)              | 0.038<br>(0.055)     | 0.067<br>(0.055)    |
| Books at home (> 70)                  | 0.336<br>(0.474)   | 0.278<br>(0.449)            | 0.293<br>(0.456)              | -0.058<br>(0.050)    | -0.042<br>(0.051)   |
| Siblings (>3)                         | 0.259<br>(0.439)   | 0.098<br>(0.297)            | 0.141<br>(0.349)              | -0.161***<br>(0.039) | -0.117**<br>(0.043) |
| Has a Role Model                      | 0.594<br>(0.493)   | 0.537<br>(0.500)            | 0.539<br>(0.500)              | -0.058<br>(0.054)    | -0.055<br>(0.055)   |
| Know Economists                       | 0.755<br>(0.431)   | 0.800<br>(0.401)            | 0.749<br>(0.435)              | 0.045<br>(0.045)     | -0.007<br>(0.048)   |
| <i>Political View</i>                 |                    |                             |                               |                      |                     |
| Economic Orientation (right)          | 0.544<br>(0.282)   | 0.548<br>(0.271)            | 0.572<br>(0.269)              | 0.004<br>(0.030)     | 0.028<br>(0.030)    |
| Social Orientation (authoritarian)    | 0.474<br>(0.169)   | 0.471<br>(0.163)            | 0.457<br>(0.161)              | -0.002<br>(0.018)    | -0.017<br>(0.018)   |
| Self Political View (right)           | 4.811<br>(1.968)   | 5.093<br>(1.822)            | 5.356<br>(2.018)              | 0.281<br>(0.205)     | 0.545*<br>(0.221)   |

*Note:* values for each of the experimental groups in the columns, with p-values being derived from t-tests of mean-differences between each of the treatment arms (i.e. Traditional Economics and Social Economics) in comparison with the control group.

as mediator variables. Although no pre-treatment imbalance was found in the main outcome variable, we did observe imbalance in other variables, such as for the second best choice, the likelihood of going to university, self-efficacy, social perception of economics, stereotypes associated with economics, and economic knowledge. As in the case of background characteristics, the

**Table 3.** Pre-test scores across experimental groups.

| Variable                                   | (1)<br>Control    | (2)<br>Treat Trad Economics | (3)<br>Treat Social Economics | (4)<br>(2) vs (1)   | (5)<br>(3) vs (1) |
|--|-------------------|-----------------------------|-------------------------------|---------------------|-------------------|
| <i>Higher education choice</i>             |                   |                             |                               |                     |                   |
| Economics                                  | 0.017<br>(0.981)  | 0.006<br>(0.980)            | -0.018<br>(1.039)             | -0.011<br>(0.107)   | -0.035<br>(0.112) |
| Alternative choice                         | -0.127<br>(1.021) | 0.155<br>(0.932)            | -0.071<br>(1.038)             | 0.281**<br>(0.106)  | 0.055<br>(0.114)  |
| University as a goal                       | -0.163<br>(1.192) | 0.035<br>(0.952)            | 0.084<br>(0.877)              | 0.198<br>(0.115)    | 0.247*<br>(0.113) |
| Certainty of academic decision             | 0.062<br>(1.021)  | -0.061<br>(0.979)           | 0.020<br>(1.008)              | -0.123<br>(0.109)   | -0.042<br>(0.112) |
| <i>Higher education alternative choice</i> |                   |                             |                               |                     |                   |
| STEM                                       | -0.007<br>(0.998) | -0.022<br>(0.987)           | 0.029<br>(1.019)              | -0.015<br>(0.108)   | 0.036<br>(0.112)  |
| Law & Social Sciences                      | -0.054<br>(1.004) | -0.017<br>(1.002)           | 0.059<br>(0.996)              | 0.037<br>(0.109)    | 0.114<br>(0.111)  |
| Economic Self-efficacy                     | 0.081<br>(0.996)  | -0.135<br>(0.937)           | 0.084<br>(1.056)              | -0.215*<br>(0.105)  | 0.003<br>(0.114)  |
| Economic Outcome Expectation               | -0.018<br>(1.111) | -0.068<br>(0.860)           | 0.087<br>(1.049)              | -0.049<br>(0.106)   | 0.105<br>(0.119)  |
| Social Perception of Economics             | -0.159<br>(1.127) | 0.070<br>(0.916)            | 0.044<br>(0.978)              | 0.228*<br>(0.110)   | 0.202<br>(0.115)  |
| Stereotypes associated with Economists     | 0.181<br>(1.031)  | -0.124<br>(0.969)           | -0.002<br>(0.994)             | -0.305**<br>(0.108) | -0.183<br>(0.112) |
| Negative view of stereotypes               | -0.171<br>(1.051) | 0.165<br>(0.921)            | -0.049<br>(1.021)             | 0.336**<br>(0.106)  | 0.122<br>(0.114)  |
| Economic Knowledge Score                   | -0.183<br>(0.957) | 0.160<br>(1.075)            | -0.035<br>(0.923)             | 0.342**<br>(0.112)  | 0.148<br>(0.104)  |
| Interest in Economics                      | 0.012<br>(0.960)  | -0.102<br>(1.011)           | 0.101<br>(1.012)              | -0.114<br>(0.108)   | 0.088<br>(0.109)  |

*Note:* values for each of the experimental groups in the columns, with p-values being derived from t-tests of mean-differences between each of the treatment arms (i.e. Traditional Economics and Social Economics) in comparison with the control group.

imbalanced variables will also be used as controls and in the matching estimators. Table 4 on the other hand, presents the scores of the post-test surveys. Here a few of the imbalances found in the pre-tests continue or increase, like the case of the likelihood of choosing an alternative major in higher education, the stereotypes associated with economists, and the economic knowledge score. But one new imbalance appeared after the completion of the course: students in the intervention groups increased the certainty of their choices compared with students in the control, which was stronger in the case for students that also watched the videos and testimonials about non-traditional careers in economics.

We present the main results in Table 5, in which all background characteristics and pre-test score levels are used as controls, moreover, we match on unbalanced variables using Mahalanobis distance weights. Panel A shows the main interest variable (i.e. the likelihood of choosing economics in higher education) as outcome variable, which shows that following pre-university courses led to a significant average treatment effect (ATE) of  $-0.22$  sd. As such, on average

**Table 4.** Post-test scores across experimental groups.

| Variable                                   | (1)<br>Control    | (2)<br>Treat Trad Economics | (3)<br>Treat Social Economics | (4)<br>(2) vs (1)    | (5)<br>(3) vs (1)   |
|--|-------------------|-----------------------------|-------------------------------|----------------------|---------------------|
| <i>Higher education choice</i>             |                   |                             |                               |                      |                     |
| Economics                                  | 0.046<br>(0.903)  | -0.147<br>(1.083)           | -0.031<br>(1.159)             | -0.193<br>(0.110)    | -0.078<br>(0.117)   |
| Alternative choice                         | -0.116<br>(1.045) | 0.281<br>(1.060)            | -0.092<br>(1.205)             | 0.398***<br>(0.115)  | 0.025<br>(0.126)    |
| University as a goal                       | 2.031<br>(1.768)  | 2.227<br>(1.545)            | 2.214<br>(1.561)              | 0.197<br>(0.179)     | 0.184<br>(0.183)    |
| Certainty of academic decision             | -0.441<br>(2.393) | 0.212<br>(2.495)            | 0.703<br>(2.458)              | 0.653*<br>(0.267)    | 1.144***<br>(0.269) |
| <i>Higher education alternative choice</i> |                   |                             |                               |                      |                     |
| STEM                                       | -1.277<br>(1.955) | -1.270<br>(1.959)           | -1.383<br>(1.864)             | 0.007<br>(0.213)     | -0.106<br>(0.211)   |
| Law & Social Sciences                      | 0.464<br>(2.491)  | 0.406<br>(2.492)            | 0.572<br>(2.478)              | -0.058<br>(0.271)    | 0.108<br>(0.275)    |
| Economic Self-efficacy                     | 0.729<br>(0.491)  | 0.617<br>(0.571)            | 0.641<br>(0.608)              | -0.112<br>(0.059)    | -0.089<br>(0.062)   |
| Economic Outcome Expectation               | 1.079<br>(0.620)  | 1.019<br>(0.627)            | 1.078<br>(0.589)              | -0.060<br>(0.068)    | -0.001<br>(0.067)   |
| Social Perception of Economics             | 1.523<br>(0.840)  | 1.558<br>(0.800)            | 1.637<br>(0.820)              | 0.035<br>(0.089)     | 0.114<br>(0.092)    |
| Stereotypes associated with Economists     | -0.530<br>(1.071) | -0.963<br>(1.027)           | -0.780<br>(0.971)             | -0.433***<br>(0.114) | -0.249*<br>(0.112)  |
| Negative view of stereotypes               | 1.299<br>(0.964)  | 1.506<br>(0.932)            | 1.392<br>(0.895)              | 0.207*<br>(0.103)    | 0.092<br>(0.102)    |
| Economic Knowledge Score                   | -0.324<br>(0.880) | 0.746<br>(1.103)            | 0.230<br>(0.993)              | 1.070***<br>(0.111)  | 0.554***<br>(0.105) |
| Interest in Economics                      | 0.896<br>(1.299)  | 0.770<br>(1.330)            | 0.854<br>(1.431)              | -0.125<br>(0.144)    | -0.042<br>(0.152)   |

*Note:* values for each of the experimental groups in the columns, with p-values being derived from t-tests of mean-differences between each of the treatment arms (i.e. Traditional Economics and Social Economics) in comparison with the control group.

students considering studying economics or with doubts regarding their university choice, felt less inclined of selecting economics as first choice after participating in the pre-university courses. Regarding the social economics intervention (i.e. the non-stereotyped tik-tok videos and testimonials) had no significant effect in changing the likelihood to study economics.

Panels B and C from Table 5 show additional dependent variables of interest regarding university choice. Using chance to go to university as outcome variable from Panel B, we see that none of the two interventions had a significant effect of changing this decision. This can be reasoned by a highly left-skewed distribution of desire to attend university, with more than 80% of pupils showing a high interest to go to higher education. Panel C shows the certainty of academic choice as outcome. Here we find that the pre-university courses were highly effective to increase the certainty of their higher education choice, with students feeling almost 1 full standard devi-

**Table 5.** Estimated ATEs and Lee bounds of main outcome variables.

| Specification   | Mahalanobis<br>Matching | Lower Bound                | Upper Bound               | Trimming proportion |
|---|-------------------------|----------------------------|---------------------------|---------------------|
| Panel A: Chance to study econ. in university as outcome |                         |                            |                           |                     |
| Treat. Trad. Econ.                                      | -0.223*<br>(0.071)      | -0.651<br>[-1.998, 0.696]  | 0.347<br>[-1.167, 1.861]  | 23.2%               |
| Treat. Social Econ.                                     | 0.115<br>(0.094)        | -1.301<br>[-2.412, -0.191] | -0.020<br>[-1.089, 1.049] | 32.1%               |
| N   | 537                     |                            |                           |                     |
| R <sup>2</sup>  | 0.655                   |                            |                           |                     |
| F   | 2278.00                 |                            |                           |                     |
| Panel B: Chance to go to university as outcome          |                         |                            |                           |                     |
| Treat. Trad. Econ.                                      | 0.140<br>(0.064)        | -0.541<br>[-1.864, 0.782]  | 0.720<br>[-0.568, 2.008]  | 23.2%               |
| Treat. Social Econ.                                     | -0.120<br>(0.077)       | -1.612<br>[-3.105, -0.118] | -0.588<br>[-2.256, 1.080] | 32.1%               |
| N   | 537                     |                            |                           |                     |
| R <sup>2</sup>  | 0.408                   |                            |                           |                     |
| F   | 58.29                   |                            |                           |                     |
| Panel C: Certainty of academic choice as outcome        |                         |                            |                           |                     |
| Treat. Trad. Econ.                                      | 0.991*<br>(0.323)       | 0.297<br>[-2.409, 3.004]   | 1.799<br>[-0.830, 4.428]  | 23.2%               |
| Treat. Social Econ.                                     | 0.012<br>(0.462)        | -0.594<br>[-3.125, 1.937]  | 1.747<br>[-1.306, 4.800]  | 32.1%               |
| N   | 537                     |                            |                           |                     |
| R <sup>2</sup>  | 0.300                   |                            |                           |                     |
| F   | 70.10                   |                            |                           |                     |

*Note:* Lower and upper bounds coefficients are the Lee (2009)'s bounds estimations for the required trimming rate in comparison with control conditions. Treatments are constructed as cumulative dummy variables, indicating 1 if followed a certain intervention, and 0 otherwise. Numbers in brackets are the 95% confidence intervals. The Mahalanobis Distance Matching estimated coefficients are in terms of standard deviations of the outcome variable. Clustered standard errors in parentheses. \*  $p \leq .05$  \*\*  $p \leq .01$  \*\*\*  $p \leq .001$ , which are corrected for multiple hypothesis testing using the Benjamini and Hochberg (1995) method. Estimation controls for all pre-test observed characteristics presented in Tables 2 and 3.

ation more confident of their academic future in comparison to the control group. Nonetheless, students that also followed the tik-toks intervention had no different effect in comparison to students that only followed the pre-university courses. Considering difference in attrition levels, we also ran Lee (2009)'s bounds, with trimming proportions between 23 and 32%. Fortunately, all of our estimated ATEs fitted inside either the point estimates of the lower and upper bounds or within their confidence intervals.

#### 4.2. Mechanisms

In Table 6 we test the mechanisms behind Figures 1 and 2, this is done firstly by testing those variables as the main outcomes (i.e. to test if our interventions were able to change the initial observed levels of the mechanisms). Then, the significant effects will be estimated using causal mediation analysis. Panel A shows self-efficacy as outcome, which demonstrates that none of our interventions were able to change self-efficacy. The same was observed in Panel B for outcome expectation as outcome variable, without any significant change. Thus, results

from Panels A and B go against the hypothesis formulated in Figure 1 inspired on Lent et al. (1994), which indicates that our pre-university courses were unable to be effective interventions to change self-efficacy and outcome expectations. Panel C tests the hypothesis from Figure 2, using stereotypes as outcome, which indicates that none of the interventions (not even the one with a particular focus on showing that economists can also work with socially relevant work) were successful in changing pre-conceived stereotypes about economists. An addition modification to the framework from Lent et al. (1994), seen in Figures 1 and 2, is that interest is not only a mechanism that leads higher self-efficacy and outcome expectation to a different academic choice, but can also be changed directly through a learning experience (i.e. a pleasing experience can increase interest on its own). In Panel D we test this with interest as outcome, which again suggests no significant difference in interest about economics after participating in the courses. Although none of our mechanisms was affected by the interventions, we ran a causal mediation analysis to check if possible indirect effects could still arise, this is shown in Appendix B

We repeated the Lee (2009)'s bounds estimation from Table 5 to account for variations in attrition rates, but here using the investigated mechanisms as outcomes. Again, all of our estimated ATEs fell within either the point estimates of the lower and upper bounds or within their corresponding confidence intervals.

#### *4.3. Heterogeneity analysis*

In this subsection we explore the possibility of the alternative hypothesis from Figure 3, in which the background characteristics and the aforementioned mechanisms (e.g. self-efficacy, outcome expectations, interest) can modify the size or the direction of the effect from our interventions through moderation. This hypothesis is tested by adding these variables as interaction to our treatment variables. Additionally, we also present the pre and post test levels of the likelihood to study economics in higher education by subgroups based on these characteristics and mechanisms, which allow us to visualize how those subgroups are deciding.

We start this analysis with self-assessed political orientation. Table 7 shows the pre and post-test levels of chance to study economics in higher education by political orientation. Although students identified with the right political spectrum had a slightly higher likelihood to choose economics (e.g. 55% face to 50% from left-leaning students during pre-tests), this difference was not significant neither before nor after the intervention. In Table 8 we test the moderation of self-assessed political view. We see that there is no significant treatment effect difference coming from following the pre-university course among different political orientation. Nonetheless, we identify the first moderation coming from the interaction of the second intervention with self-identifying as politically left-wing, with an ATE from watching the Tik-Toks and testimonials that is 0.35 sd higher to left-leaning students in comparison to other political orientations. This can possibly be attributed to most themes regarding social and environmental issues being often associated to left political parties. As such, the left-wing students may find these themes important, thus,

**Table 6.** Estimated ATEs and Lee bounds of mechanisms as outcomes.

| Specification                           | Mahalanobis Matching | Lower Bound                | Upper Bound               | Trimming proportion |
|---|----------------------|----------------------------|---------------------------|---------------------|
| Panel A: Self-efficacy as outcome       |                      |                            |                           |                     |
| Treat. Trad. Econ.                      | -0.107<br>(0.054)    | -0.651<br>[-1.998, 0.696]  | 0.347<br>[-1.167, 1.861]  | 23.2%               |
| Treat. Social Econ.                     | -0.025<br>(0.060)    | -1.301<br>[-2.412, -0.191] | -0.020<br>[-1.089, 1.049] | 32.1%               |
| N                                       | 537                  |                            |                           |                     |
| R <sup>2</sup>                          | 0.424                |                            |                           |                     |
| F                                       | 687.75               |                            |                           |                     |
| Panel B: Outcome expectation as outcome |                      |                            |                           |                     |
| Treat. Trad. Econ.                      | -0.102<br>(0.058)    | -0.541<br>[-1.864, 0.782]  | 0.720<br>[-0.568, 2.008]  | 23.2%               |
| Treat. Social Econ.                     | 0.017<br>(0.073)     | -1.612<br>[-3.105, -0.118] | -0.588<br>[-2.256, 1.080] | 32.1%               |
| N                                       | 537                  |                            |                           |                     |
| R <sup>2</sup>                          | 0.383                |                            |                           |                     |
| F                                       | 42.73                |                            |                           |                     |
| Panel C: Econ. stereotypes as outcome   |                      |                            |                           |                     |
| Treat. Trad. Econ.                      | -0.191<br>(0.100)    | 0.297<br>[-2.409, 3.004]   | 1.799<br>[-0.830, 4.428]  | 23.2%               |
| Treat. Social Econ.                     | 0.107<br>(0.103)     | -0.594<br>[-3.125, 1.937]  | 1.747<br>[-1.306, 4.800]  | 32.1%               |
| N                                       | 537                  |                            |                           |                     |
| R <sup>2</sup>                          | 0.400                |                            |                           |                     |
| F                                       | 409.68               |                            |                           |                     |
| Panel D: Interest in econ. as outcome   |                      |                            |                           |                     |
| Treat. Trad. Econ.                      | -0.063<br>(0.114)    | 0.297<br>[-2.409, 3.004]   | 1.799<br>[-0.830, 4.428]  | 23.2%               |
| Treat. Social Econ.                     | -0.017<br>(0.118)    | -0.594<br>[-3.125, 1.937]  | 1.747<br>[-1.306, 4.800]  | 32.1%               |
| N                                       | 537                  |                            |                           |                     |
| R <sup>2</sup>                          | 0.525                |                            |                           |                     |
| F                                       | 786.74               |                            |                           |                     |

*Note:* Lower and upper bounds coefficients are the Lee (2009)'s bounds estimations for the required trimming rate in comparison with control conditions. Treatments are constructed as cumulative dummy variables, indicating 1 if followed a certain intervention, and 0 otherwise. Numbers in brackets are the 95% confidence intervals. The Mahalanobis Distance Matching estimated coefficients are in terms of standard deviations of the outcome variable. Clustered standard errors in parentheses. \*  $p \leq .05$  \*\*  $p \leq .01$  \*\*\*  $p \leq .001$ , which are corrected for multiple hypothesis testing using the Benjamini and Hochberg (1995) method. Estimation controls for all pre-test observed characteristics presented in Tables 2 and 3.

**Table 7.** Pre and post-test likelihood of choosing economics in higher education by self-assessed political orientation.

|                 | (1)<br>Left (self-assessed) | (2)<br>Right (self-assessed) | (3)<br>(2) vs (1) |
|-----------------|-----------------------------|------------------------------|-------------------|
| Pre-test level  | 0.50<br>(0.030)             | 0.55<br>(0.026)              | 0.05<br>(0.039)   |
| Post-test level | 0.49<br>(0.030)             | 0.52<br>(0.028)              | 0.03<br>(0.041)   |



**Table 8.** Estimated ATEs and Moderation effects of self-assessed political view using chance to study economics in university as outcome.

|                            | (1)  |
|----------------------------|--|
|                            | Political view (self-assessed) as moderation |
| Treat. Trad. Econ.         | -0.186*                                      |
|                            | (0.063)                                      |
| Treat. Social Econ.        | 0.052  |
|                            | (0.106)                                      |
| Treat. Trad. Econ. * Left  | -0.201                                       |
|                            | (0.112)                                      |
| Treat. Social Econ. * Left | 0.354 *                                      |
|                            | (0.119)                                      |
| N                          | 537  |
| $R^2$                      | 0.657  |
| F                          | 9695.60                                      |

*Note:* Lower and upper bounds coefficients are the Lee (2009)'s bounds estimations for the required trimming rate in comparison with control conditions. Treatments are constructed as cumulative dummy variables, indicating 1 if followed a certain intervention, and 0 otherwise. Numbers in brackets are the 95% confidence intervals. The Mahalanobis Distance Matching estimated coefficients are in terms of standard deviations of the outcome variable. Clustered standard errors in parentheses. \*  $p \leq .05$  \*\*  $p \leq .01$  \*\*\*  $p \leq .001$ , which are corrected for multiple hypothesis testing using the Benjamini and Hochberg (1995) method. Estimation controls for all pre-test observed characteristics presented in Tables 2 and 3.

they feel more inclined to study economics in higher education after learning the positive impact (both socially and environmentally) that many economists bring to the society.

**Table 9.** Pre and post-test likelihood of choosing economics in higher education by economical self-efficacy and outcome expectation.

|                 | (1)               | (2)                | (3)        | (4)                   | (5)                    | (6)        |
|-----------------|-------------------|--------------------|------------|-----------------------|------------------------|------------|
|                 | Low Self-Efficacy | High Self-Efficacy | (2) vs (1) | Low Outc. Expectation | High Outc. Expectation | (5) vs (4) |
| Pre-test level  | 0.32              | 0.68               | 0.36***    | 0.36                  | 0.68                   | 0.32***    |
|                 | (0.021)           | (0.017)            | (0.027)    | (0.023)               | (0.021)                | (0.031)    |
| Post-test level | 0.32              | 0.66               | 0.34***    | 0.36                  | 0.65                   | 0.30***    |
|                 | (0.023)           | (0.018)            | (0.029)    | (0.023)               | (0.023)                | (0.033)    |

In Table 9 we repeat the results from Table 7, but using self-efficacy and outcome expectations to divide into sub-groups. The levels of academic choice are very much in line with Lent et al. (1994)'s framework, since students with either high self-efficacy or high outcome expectation have a considerably higher chance (a difference of at least 30 percentage points) to enrol in higher education with economics as a major in comparison to lower levels of these measures. Now turning to the moderation analysis from Table 10, we see that the degree of self-efficacy makes no difference to the size of the treatment effects, since the interaction elements are close to zero. For the case of high outcome expectation, although observing a sizeable marginal decrease of 0.25 sd in the ATE of following the pre-university courses, and an increase of 0.37 sd in the ATE of the non-stereotyped Tik-Toks intervention in comparison to lower levels of outcome

expectation, those effects are no longer significant after applying the Benjamini and Hochberg (1995) adjustments for multiple hypothesis testing. Nonetheless, we do not reject the possibility that larger sample sizes could generate a more precise estimation of this. A possible explanation on these sizeable differences due to higher outcome expectations come in two directions. First, students with higher outcome expectations are more inclined to choose economics in higher education in the first place (as seen in Table 9), but by following an economics course with a high level of difficulty (since it has university level content, in comparison to the usual secondary education level) they may feel their future expected outcomes (forecasted before the intervention) become less probable, thus evaluating a higher education major in economics as less desirable in consequence. Second, by following the Tik-Toks and testimonials intervention, students with a high economics outcome expectation but with a low desire to study economics (e.g. due to a low willingness to become a banker) may start thinking that economics can be a valuable academic choice after learning about the different socially relevant career paths available for economists.

**Table 10.** Estimated ATEs and Moderation effects of self-efficacy and outcome expectation using chance to study economics in university as outcome.

|                               | (1)<br>Self-Efficacy (SE) as moderation | (2)<br>Outcome Expectation (OE) as moderation |
|-------------------------------|---|---|
| Treat. Trad. Econ.            | -0.226*<br>(0.086)                      | -0.165*<br>(0.063)                            |
| Treat. Social Econ.           | 0.086<br>(0.140)                        | 0.018<br>(0.105)                              |
| Treat. Trad. Econ. * High SE  | 0.010<br>(0.090)                        |   |
| Treat. Social Econ. * High SE | 0.065<br>(0.171)                        |   |
| Treat. Trad. Econ. * High OE  |   | -0.253<br>(0.131)                             |
| Treat. Social Econ. * High OE |   | 0.366<br>(0.162)                              |
| N                             | 537                                     | 537   |
| R <sup>2</sup>                | 0.655                                   | 0.658   |
| F                             | 4257.89                                 | 1056.02                                       |

*Note:* Lower and upper bounds coefficients are the Lee (2009)'s bounds estimations for the required trimming rate in comparison with control conditions. Treatments are constructed as cumulative dummy variables, indicating 1 if followed a certain intervention, and 0 otherwise. Numbers in brackets are the 95% confidence intervals. The Mahalanobis Distance Matching estimated coefficients are in terms of standard deviations of the outcome variable. Clustered standard errors in parentheses. \*  $p \leq .05$  \*\*  $p \leq .01$  \*\*\*  $p \leq .001$ , which are corrected for multiple hypothesis testing using the Benjamini and Hochberg (1995) method. Estimation controls for all pre-test observed characteristics presented in Tables 2 and 3.

Now we focus on the impact of interest in economics to the size and direction of our treatment effects. As expected, Table 11 shows that students with a higher interest in economics estimate the likelihood to study economics in higher education to be higher (about 16% higher). Table 12 indicates that while students with a lower interest in economics feel less inclined to study economics after the pre-university course (as seen in the baseline ATE of -0.33 sd), this effect is significantly greater to highly interested students (0.21 sd), which gets closer to a zero

**Table 11.** Pre and post-test likelihood of choosing economics in higher education by interest in economics.

|                 | (1)          | (2)           | (3)        |
|-----------------|--------------|---------------|------------|
|                 | Low Interest | High Interest | (2) vs (1) |
| Pre-test level  | 0.45         | 0.62          | 0.17***    |
|                 | (0.017)      | (0.016)       | (0.023)    |
| Post-test level | 0.44         | 0.60          | 0.16***    |
|                 | (0.018)      | (0.017)       | (0.025)    |

**Table 12.** Estimated ATEs and Moderation effects of interest in economics using chance to study economics in university as outcome.

|                                     | (1)                                 |
|-------------------------------------|-------------------------------------|
|                                     | Interest in economics as moderation |
| Treat. Trad. Econ.                  | -0.326***                           |
|                                     | (0.075)                             |
| Treat. Social Econ.                 | 0.184                               |
|                                     | (0.121)                             |
| Treat. Trad. Econ. * High interest  | 0.213*                              |
|                                     | (0.086)                             |
| Treat. Social Econ. * High interest | -0.150                              |
|                                     | (0.110)                             |
| N                                   | 537                                 |
| R <sup>2</sup>                      | 0.657                               |
| F                                   | 1498.47                             |

*Note:* Lower and upper bounds coefficients are the Lee (2009)'s bounds estimations for the required trimming rate in comparison with control conditions. Treatments are constructed as cumulative dummy variables, indicating 1 if followed a certain intervention, and 0 otherwise. Numbers in brackets are the 95% confidence intervals. The Mahalanobis Distance Matching estimated coefficients are in terms of standard deviations of the outcome variable. Clustered standard errors in parentheses. \*  $p \leq .05$  \*\*  $p \leq .01$  \*\*\*  $p \leq .001$ , which are corrected for multiple hypothesis testing using the Benjamini and Hochberg (1995) method. Estimation controls for all pre-test observed characteristics presented in Tables 2 and 3.

impact. While students with a lower interest are negatively impacted, these results suggest that students with a high interest in economics are more inclined to maintain this interest and their initial higher likelihood to study economics. In other words, even after completing a course in a higher level of difficulty, the academic choice is maintained if initial interest is high.

**Table 13.** Pre and post-test likelihood of choosing economics in higher education by how difficult was the course and by economic knowledge.

|                 | (1)               | (2)               | (3)        | (4)                 | (5)                  | (6)        |
|-----------------|-------------------|-------------------|------------|---------------------|----------------------|------------|
|                 | Found course easy | Found course hard | (2) vs (1) | Low econ. knowledge | High econ. knowledge | (5) vs (4) |
| Pre-test level  | 0.57              | 0.50              | -0.07**    | 0.49                | 0.53                 | 0.04       |
|                 | (0.020)           | (0.021)           | (0.029)    | (0.028)             | (0.029)              | (0.040)    |
| Post-test level | 0.57              | 0.45              | -0.12***   | 0.47                | 0.53                 | 0.06       |
|                 | (0.023)           | (0.022)           | (0.031)    | (0.028)             | (0.031)              | (0.042)    |

Here we focus on the moderation from (i) how students identify the difficulty of the course; and (ii) the level of economic knowledge attained after the course. In Table 13 we observe that

**Table 14.** Estimated ATEs and Moderation effects of difficulty during course and economic knowledge using chance to study economics in university as outcome.

|                                   | (1)  | (2)                                       |
|-----------------------------------|--|---|
|                                   | Difficulty in course (Diff.) as moderation | Economic knowledge (Eknow.) as moderation |
| Treat. Trad. Econ.                | -0.342*                                    | -0.239*                                   |
|                                   | (0.113)                                    | (0.081)                                   |
| Treat. Social Econ.               | 0.173                                      | 0.104                                     |
|                                   | (0.121)                                    | (0.108)                                   |
| Treat. Trad. Econ. * Low Diff.    | 0.234*                                     |   |
|                                   | (0.108)                                    |   |
| Treat. Social Econ. * Low Diff.   | -0.106                                     |   |
|                                   | (0.139)                                    |   |
| Treat. Trad. Econ. * High Eknow.  |  | 0.039                                     |
|                                   |  | (0.097)                                   |
| Treat. Social Econ. * High Eknow. |  | 0.141                                     |
|                                   |  | (0.190)                                   |
| N                                 | 537  | 537                                       |
| R <sup>2</sup>                    | 0.659                                      | 0.656                                     |
| F                                 | 10882.85                                   | 2852.77                                   |

*Note:* Lower and upper bounds coefficients are the Lee (2009)'s bounds estimations for the required trimming rate in comparison with control conditions. Treatments are constructed as cumulative dummy variables, indicating 1 if followed a certain intervention, and 0 otherwise. Numbers in brackets are the 95% confidence intervals. The Mahalanobis Distance Matching estimated coefficients are in terms of standard deviations of the outcome variable. Clustered standard errors in parentheses. \*  $p \leq .05$  \*\*  $p \leq .01$  \*\*\*  $p \leq .001$ , which are corrected for multiple hypothesis testing using the Benjamini and Hochberg (1995) method. Estimation controls for all pre-test observed characteristics presented in Tables 2 and 3.

students that found the pre-university courses to be easy had a likelihood considerably higher than their peers that had a hard time doing the course already during the pre-test, but that this difference got even larger after the interventions (from 7 to 12 percentage points). Although possibly related to how difficult the course was evaluated by the students, the level of economic knowledge attained after the intervention displayed independence from the likelihood to study economics in higher education. In a very similar way to the case of interest from Table 12, here in Table 14 we see that students that had no problems completing the course had an ATE after attending pre-university courses that was 0.23 sd higher in comparison to students that found the course to be harder. This difference was not observed when testing economic knowledge as moderator, since the value of the interactions was close to zero. A possible interpretation to those conflicting results, is that subjectively finding a course to be 'easy' can be linked to (i) mastering the subject (evidenced by achieving a great knowledge or good grade) and (ii) enjoying the content (i.e. demonstrating interest for it). As the economic knowledge showed no result in modifying the effect of the treatment, the mechanism behind the moderating effect of finding the course to be easy can instead be attributed to high interest in economics (as seen in Table 12).

Finally, our attention is directed towards socioeconomic status (SES) and education from mother as possible moderators. As in the case from Table 2, we note that the amount of books at home is used as proxy for SES. Table 15 reveals that, initially (i.e. during pre-tests), both students with a lower SES and students whose mothers have lower education tend to have a

**Table 15.** Pre and post-test likelihood of choosing economics in higher education by socio economic status (quantity of books) and education of mother.

|                 | (1)             | (2)             | (3)              | (4)              | (5)               | (6)              |
|-----------------|-----------------|-----------------|------------------|------------------|-------------------|------------------|
|                 | Low SES         | High SES        | (2) vs (1)       | Mother low educ. | Mother high educ. | (5) vs (4)       |
| Pre-test level  | 0.59<br>(0.019) | 0.52<br>(0.024) | 0.06*<br>(0.030) | 0.58<br>(0.024)  | 0.51<br>(0.015)   | 0.07*<br>(0.029) |
| Post-test level | 0.55<br>(0.021) | 0.53<br>(0.025) | 0.02<br>(0.032)  | 0.56<br>(0.025)  | 0.50<br>(0.017)   | 0.05<br>(0.031)  |

**Table 16.** Estimated ATEs and Moderation effects of socio economic status and education of mother using chance to study economics in university as outcome.

|                                    | (1)                                       | (2)   |
|------------------------------------|---|---|
|                                    | Socio economic status (SES) as moderation | Education of mother (Edmoth.) as moderation |
| Treat. Trad. Econ.                 | -0.148<br>(0.065)                         | -0.184<br>(0.137)                           |
| Treat. Social Econ.                | -0.062<br>(0.103)                         | -0.043<br>(0.159)                           |
| Treat. Trad. Econ. * High SES.     | -0.294***<br>(0.069)                      |   |
| Treat. Social Econ. * High SES.    | 0.628 ***<br>(0.146)                      |   |
| Treat. Trad. Econ. * High Edmoth.  |   | -0.049<br>(0.153)                           |
| Treat. Social Econ. * High Edmoth. |   | 0.235<br>(0.172)                            |
| N                                  | 537                                       | 537   |
| R <sup>2</sup>                     | 0.665                                     | 0.656                                       |
| F                                  | 1972.64                                   | 2403.77                                     |

*Note:* Lower and upper bounds coefficients are the Lee (2009)'s bounds estimations for the required trimming rate in comparison with control conditions. Treatments are constructed as cumulative dummy variables, indicating 1 if followed a certain intervention, and 0 otherwise. Numbers in brackets are the 95% confidence intervals. The Mahalanobis Distance Matching estimated coefficients are in terms of standard deviations of the outcome variable. Clustered standard errors in parentheses. \* p ≤ .05 \*\* p ≤ .01 \*\*\* p ≤ .001, which are corrected for multiple hypothesis testing using the Benjamini and Hochberg (1995) method. Estimation controls for all pre-test observed characteristics presented in Tables 2 and 3.

slightly higher likelihood of choosing economics as preferred major in college (between 6 to 7 percentage points difference), but that this difference becomes insignificant during post-tests. Table 16 points out that socioeconomic status can have a moderating effect for both interventions (i.e. the pre-university courses and the non-stereotyped videos). We see that while higher SES students are more negatively impacted by attending the courses (-0.29 sd), they encountered a very positive impact of watching the Tik-Toks and testimonials about non-typical careers for economists (0.63 sd). This shows that high SES students are less resilient to difficult subjects (we see that the effect of attending the pre-university course was not significant for low SES pupils), but they are considerably more interested in social and environmental themes in comparison to their peers. The same difference was not observed when dividing students by the education of the mother, since the moderating effects turned out to be not significant. Considering our measure for SES (i.e. books at home) is just a proxy, we see that it can actually measure two

different things: (i) the purchasing power level of the family (i.e. how many books the family can afford); and (ii) the importance of seeking information and education (i.e. how many books would actually be read). Since the level of education from the mother was insignificant as moderator, we can argue that the stronger moderating mechanism behind the two measures of SES is the purchasing power.

## 5. Discussion

The big number of dropouts in higher education represents a big misallocation of resources and efforts to education institutions, governments, and students alike, being linked (among others) to non-optimal choices from students. In the present study, we brought both theoretical and experimental evidence on how learning experiences about an academic course (tested in the format of pre-university courses interventions) and learning experiences about career-linked stereotypes (evaluated in the format of non-stereotyped Tik-Tok videos and testimonials) could be able to improve academic choices, using the major of economics as example. By showing an university experience as real as it can be, students felt 0.22 sd less likely to enrol in university with economics as a major after completing an university level course. The effectiveness of their new academic choice was measured based on the certainty of their choice, which increased in 0.99 sd. The non-stereotyped videos and testimonials had no significant impact to the average student.

Inspired by the work of Lent et al. (1994), we formulated and tested three possible causal frameworks in which learning experiences can affect academic choices. In the first (the closest to Lent et al. (1994)'s original framework), both self-efficacy and outcome expectation would serve as mediator mechanisms to impact choices, but we modified the original framework by including interest as a possible indirect effect and including a possible direct causal link between the learning experience and choice. The second causal framework focused on the impact of learning experiences on stereotypes, which in addition to outcome expectation and interest, included stereotypes as a possible mediator to impact choice. Finally, the third framework assumed that none of the aforementioned mechanisms would work as a mediator, but instead, that these variables (in addition to background characteristics) could impact the size or the direction of the learning experience effects as moderators.

While testing these frameworks, we noted that our interventions were not able to significantly change the initial levels of no mechanisms, which brings confronting evidence to the first two frameworks. The third framework was tested using heterogeneity analysis with interaction dummies. We note that high interest and low difficulty in the course (mostly driven by interest, since economic knowledge acquired played no role) were significant positive moderators of the pre-university courses, with the total effect being close to zero. This shows that students with a high level of interest in economics, or that have a good aptitude to complete difficult courses maintained their likelihood to study economics. The opposite was true for high socioeconomic

status (SES), which served as a negative moderator. This indicates that high SES pupils are less resilient to difficult course work, while low SES students had a treatment effect that was not different from zero, showing a higher resiliency.

Although having a null effect to the average student, the non-stereotyped videos were strong interventions to particular subgroups. Students with either high SES or that self-identified with the left political spectrum had a positive significant moderation effect, increasing the likelihood to study economics after watching the videos and testimonials. This illustrates that students from the left-wing or from more financially stable families are more interested in socially and environmentally relevant themes.

We present a few possible policy applications of our results. This study shows that pre-university courses can be effective tools to discourage students with low interest or aptitude (which may be likely to drop-out) from enrolling in a poorly matched academic course, working as a type of 'sludge' or anti-nudge to these students. Instead, such students can then choose a more optimal choice that better fits their interests and abilities. But the design of this particular course should be made with care depending of the objectives of the intervention. For instance, if the objective is to increase the number of enrolments in a major that has many free spots available, then this pre-university course should not be too difficult nor uninteresting, otherwise the effect can be the opposite of what is expected. Moreover, the heterogeneity analysis regarding our second intervention (i.e. non-stereotyped Tik-Toks and testimonials), showed that targeted information treatments can be effective nudges to particular sub-groups, while being ineffective to others (in this case, only sub-groups interested in social and environmental themes were influenced). As such, knowing the desires and interests of different sub-groups of students can help policy makers to design similar interventions, making certain majors or career paths more attractive to specific target audiences.

Nonetheless, our paper has a few limitations, which also opens a road map for new research. First, our experiment suffered from a limited sample size of 537 students. This is planned to be partially improved, since a second trial of our experiment is currently going, thus we expect our sample size to be increased. Second, while we were able to ask students directly for their expectations regarding academic choice, we still did not observe their actual choices, nor their academic records and dropout rate after one year of higher education. Third, both of our interventions had a shorter duration, which limits the possibilities of stronger effects, especially to variables that can be hard to change, like self-efficacy, stereotypes and interest. Future research efforts shall be directed in testing our findings with different majors, target groups, with more intense interventions, and especially with a longer observation period to estimate long lasting effects.

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