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Information Provision and Postgraduate Studies

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This is the first paper to examine experimentally effects of information provision on beliefs about pecuniary and non-pecuniary returns of postgraduate education, enrolment intentions and realized enrolment. We find that our treatment causally affects beliefs measured six months after treatment. The effects on beliefs differ by gender and academic background, and we find that stated enrolment intentions change accordingly; in particular, males adjust significantly downwards their beliefs and intentions to undertake postgraduate studies. This is driven by males upward adjusting earnings expectations with a first degree only. We follow the students further and provide evidence on actual enrolment one and two years after treatment. Taken together, this study highlights the relevance of information provision on pecuniary and non-pecuniary labour market returns for postgraduate study decisions.

INTRODUCTION

Numerous studies in the economic literature document that compared to vocational training or high school education, returns to college education are high, with Katz and Murphy (1992) being a well-known early example. Consequently, the individual decision to enrol in college or not, has been widely studied. Based on quasi-experimental and experimental studies, we know that information, costs and beliefs all play important roles in explaining college decisions.¹ Recently, studies have documented the increasing variance in earnings within the group of college-educated workers, and estimated substantial returns to postgraduate education (Lindley and Machin 2016; Altonji *et al.* 2016). This suggests that not only the initial decisions to enrol in college, but also postgraduate enrolment decisions matter.² Yet comparatively little is known about factors that influence individual decisions to pursue postgraduate education. In a recent study, Boneva *et al.* (2021) show that pecuniary and non-pecuniary factors play a role by using a choice model, but to the best of our knowledge, experimental evidence on factors that affect postgraduate education decisions does not exist.

This study starts to fill this gap by studying effects of information provision about pecuniary and non-pecuniary returns to postgraduate education to undergraduate college students close to completion of their bachelor's degrees, in a randomized controlled trial (RCT). We study effects of our randomized treatment on beliefs about pecuniary and non-pecuniary returns, and how this affects postgraduate enrolment intentions six months later. Moreover, we can provide evidence on realized enrolment in postgraduate education one and two years after treatment.

The treatment consists of information about pecuniary and non-pecuniary returns of postgraduate versus undergraduate degrees in the labour market, based on empirical data of existing employees. The treatment is delivered at the end of an online survey to a randomly selected subgroup of our sample. Note that we present no information on costs and benefits of the student experience as such; our target population already has first-hand experience on these through their undergraduate studies. In this regard, the information set available to

students who decide about postgraduate enrolment differs from the information and decisions about initial college-going at the end of high school. Rather than providing students with information about the student experience, our treatment gives information about pecuniary and non-pecuniary returns on the labour market depending on undergraduate or graduate degrees, of which undergraduate students have no first-hand experience.

The study population was recruited out of an existing experimental panel study that focused on the initial college-going decision of high school students of the 2014 graduation cohort in the Berlin area, Germany (Peter and Zambre 2017; Peter *et al.* 2021). Our focus on the 446 students presumably enrolled in their final years of the undergraduate programme in 2017 resulted in a number of benefits, including access to information on pre-baseline characteristics that were collected in the past. In particular, pre-baseline information on postgraduate enrolment intentions was available, and we used this, together with more background variables, to implement a randomization design based on pairwise matching. Moreover, we believe that the fact that the targeted students have had experiences in a previous panel study might explain the very low rates of attrition in the three follow-up surveys of this experiment.

We use the information collected in the intervention and the three follow-up surveys that we conducted six months, one year and two years after treatment in four steps.

First, we present correlations between postgraduate enrolment intentions and pecuniary and non-pecuniary returns for our control population. This confirms the relevance of both sets of factors, in line with existing research that stresses that non-pecuniary factors matter in addition to—and potentially more than—pecuniary factors for postgraduate education (Boneva *et al.* 2021).

Second, we examine how the treatment has shifted individual beliefs about pecuniary and non-pecuniary returns of postgraduate education. This is interesting both to understand later effects on intentions and enrolment, and also in its own right as it sheds light on belief updating. This is because the treatment consisted of objective information on a range of attributes of jobs—for example, average earnings for different occupations—and so depends not only on existing beliefs but also on how students place themselves in the categories that we have presented. The main finding here is that many students either previously held very accurate beliefs about pecuniary and non-pecuniary differences between graduate and postgraduate jobs, or did not significantly update their beliefs due to our online information intervention. The largest, and statistically significant, updating of beliefs occurs for males, who downward adjust their expected postgraduate earnings premium. This is driven by higher expectations about earnings with a first degree, rather than lower earning expectations with a second degree. We explore reasons for this gender heterogeneity and discuss that it can be related to differences in initial beliefs or differences in updating, that is, processing of the new information.

Third, we examine how the treatment affected postgraduate enrolment intentions stated six months later. Here, we find effects that mirror the effects on belief updating documented above: males are significantly less likely to state the intention to enrol directly for a postgraduate degree following the successful completion of their undergraduate studies. We find further heterogeneity along parental background; however, this is rarely significant at conventional levels of statistical significance.

Fourth and finally, we estimate effects on postgraduate enrolment one and two years after initial treatment. Here, we again find the largest and negative estimates for male students. These estimates are not statistically significant, yet growing in magnitude and almost statistically significant after two years, when more students in our sample completed their undergraduate studies and faced the decision to enrol into a postgraduate programme.

Taken together, we present causal evidence that an information treatment on pecuniary and non-pecuniary returns can have long-run consequences. We show significant effects on enrolment intentions measured six months later, and supportive evidence on enrolment one and two years after treatment. In addition, we document that the treatment has led to a different updating of beliefs of students, with male students significantly downward adjusting expectations of postgraduate wage premia. These differences in belief updating from the same treatment are in line with the heterogeneity in the effects that we document on direct postgraduate study intentions and enrolment. This study therefore has two main contributions. First and foremost, we provide the first causal evidence of the role of information for postgraduate enrolment decisions. Moreover, we document that the heterogeneity that we find in the treatment effect of receiving information is in line with the heterogeneity that we find in belief updating. This means that despite our finding that male students react strongly to our information treatment, and female students do not, this does not imply that males and females place a different importance on information when making decisions. Differences in belief updating and information processing present an alternative explanation to heterogeneity in treatment effects of information treatments.

This study is related to the large literature on the role of financial constraints or on the lack or effectiveness of information about actual costs and future monetary returns for college enrolment decisions (see, for example, Dynarski 2002; Dynarski and Scott-Clayton 2006; Bettinger *et al.* 2012; Oreopoulos and Dunn 2013; Wales 2013; Bettinger and Baker 2014; Castleman *et al.* 2014; Kerr *et al.* 2020; Wiswall and Zafar 2015; Castleman and Long 2016; Oreopoulos and Ford 2019; Carrell and Sacerdote 2017; Dynarski *et al.* 2018). In the German context, Peter *et al.* (2021) and Peter and Zambre (2017) study the effects of providing information about returns and financing possibilities for college education to high school students. One key finding is that students of non-academic background, in particular those with intentions to enrol, are more likely to pursue college education if they have received information about its benefits. Moreover, existing literature on individuals' beliefs about returns to educational investment shows that besides pecuniary returns, especially non-pecuniary returns can explain educational decisions (Boneva and Rauh 2017; Belfield *et al.* 2020). This paper differs from this literature because we study postgraduate education decisions. In an important recent paper, Boneva *et al.* (2021) show that both pecuniary and non-pecuniary returns also matter for postgraduate education decisions. We complement this literature by providing first experimental evidence on these, as well as on the role of information.

The remainder of this paper is structured as follows. Section I describes the institutional context and data. In Section II we describe the treatment, randomization and compliance. Section III describes our estimation strategy and outcome variables. Section IV presents the estimates on stated beliefs, enrolment intentions and enrolment. Here, we also provide descriptive evidence on the association between pecuniary and non-pecuniary postgraduate returns and enrolment intentions. Section V concludes.

I. INSTITUTIONAL CONTEXT AND DATA

Institutional context

Almost 20 years after the Bologna Process,³ Germany has a well-established two-tier setting where students first enrol for a bachelor's degree that typically lasts for four years.⁴ Overall, about 60% of bachelor graduates move on to study for an additional two years to earn a master's degree (Spangenberg and Quast 2016). From ten students who continue, almost seven

do the master's programme at the same higher education institution where they earned their bachelor's degree (Fabian *et al.* 2016).⁵ Both percentages are higher for university students compared to those at universities of applied sciences,⁶ which usually offer longer and more practically oriented degrees. Moreover, a higher percentage of students with academically educated parents, and relatively more male students, continue with a master's degree. For these groups the transition rates are between 70% and 80%, while the others have lower rates (50% to 60%). However, the share of 25–34-year-olds with a bachelor's degree in 2019 is 16% in Germany, which is lower than in other countries with a much longer tradition of a two-tier system, such as the UK with 24%. The share of those with a master's degree is 12% in both countries (OECD 2020).

Bachelor's students usually apply for a master's programme in the last term of their studies, which usually lasts for three to four years. Most master's programmes start in the winter term, which means that students have to apply in the early summer before. Most bachelor's students who continue with a master's programme do this without an interruption. Only about 20% perform or plan a transition after a short interruption (Spangenberg and Quast 2016). The main reason for an interruption among university students is an internship: in a survey among bachelor's degree students, this is stated by 36%. The reported main reason among other students is the intention to gain work experience, at 42%. The main reasons for no transition to a master's programme are attractive job offers or intended work experience (Autorengruppe Bildungsberichterstattung 2018). In general, higher education in Germany (at public institutions) is free of charge, with students paying only a small administrative fee each term. There are no fee differences between bachelor's and master's programmes. This does not mean that a master's programme is free of costs, once living costs and opportunity costs are considered.

Although the two-tier system is well established in the higher education system, it is obvious that there is little or no knowledge on the lifelong career prospects of finishing tertiary education with a bachelor's or master's degree in Germany. After 20 years, there are no graduates from bachelor's or master's programmes who have reached retirement age, so there is no empirical evidence on lifetime earnings of these degrees. Thus any empirically based information on non-pecuniary and pecuniary returns of a master's degree is limited to mid-term returns. Even this type of information is relatively new and not widely discussed in public so far. Thus an information treatment on the returns of a bachelor's and master's degree in Germany might be more effective compared to one on other countries with a longer tradition with these two degrees. Furthermore, an effective information treatment ideally has to be placed in a period where the decision is not finalized, but students actively consider whether to transition to a master's programme. Thus for the average student, who starts a master's programme in October and thus has to apply around June, a period of 5–7 months before might be suitable for an information treatment.

Data

A central design feature of this RCT is that we sample the students from a population of students who are likely to pursue postgraduate studies or to enter the labour market after their undergraduate degree. We exploit existing knowledge about students from the *Berliner-Studienberechtigten-Panel* (Best Up) to sample our study population. This panel study provides the necessary target population, as it comprises vast information about students, starting from their enrolment in undergraduate studies until their early intentions of postgraduate enrolment.⁷ The Best Up data contain very detailed information about students of the cohort that graduated from high school either in summer 2014 or one year later. These

students come from a relatively homogeneous environment and are followed from the last year prior to high school graduation (*Abitur* in German) to the first two years of college or vocational training. Although the Best Up data provide us with undergraduate students from the same high school cohort, not all enrol directly in college after high school graduation in 2014. Around 30% of the Best Up participants take a gap year after high school. Thus students in our sample are progressing at different speeds through their undergraduate studies. In addition, the speed varies, because students enrolling in universities of applied sciences take on average one year longer to finish their bachelor's degree due to different programme structures compared to university majors.

In the Best Up data, a majority of students start their final year of undergraduate studies in the winter term that starts in autumn 2017.⁸ Thus around autumn 2018, these students are likely to transit to postgraduate studies or to enter the labour market. Out of the Best Up data, we identify 446 students who are likely to be studying in the winter term 2017 as our target population, of which 371 students (83%) participate in the baseline survey (see Section II for more information about the RCT and the survey).

In Table 1, we provide further descriptive evidence looking at students from the first survey of our study. We show means of all matching (pre-trial) variables as well as baseline study and background characteristics. The sample consists of a majority of students from a non-academic background, who are slightly less likely to enrol in postgraduate degrees.⁹ Students are on average 23 years old and in their fifth semester.¹⁰ This shows that the majority of students in our sample are nearly at the end of their undergraduate degree, as students on average study for 7.2 semesters to complete a bachelor's degree (Autorengruppe Bildungsberichterstattung 2020). As described in the previous subsection, some majors are still organized under the old degree system prior to the change to the two-tier structure. In our sample, about 6% of students are enrolled in such a major. The majority of students (78%) are enrolled in a bachelor's degree. 46% students in our sample intend to enrol directly in postgraduate studies in December 2017 (baseline), and 48% in May 2018 (first follow-up). In December 2018, 26% of those students who participated in the baseline and one-year follow-up of our study ($N = 293$) are enrolled in postgraduate studies. In February 2020, this number has increased to 41% (see the bottom rows in Table 1).

A first comparison of our initial target sample with a nationwide representative study already shows that students are fairly comparable—in terms of age, final GPA, and intentions to enrol in postgraduate studies—to the average German student (see Table A1 in the Online Appendix).¹¹ Students from the NEPS SC4 cohort also graduated from high school in 2014, and 50% come from a non-academic background—that is, they are first generation students—compared to 59% in our baseline sample. In the NEPS SC5 cohort, students were sampled in the winter term 2010/11 at German universities and universities of applied sciences. In this sample, 63% of students are first generation students, and 83% are enrolled in a bachelor's programme, compared to 78% in our baseline sample (see Table A1 in the Online Appendix).

II. DETAILS OF INTERVENTION

We conducted five online surveys to accompany bachelor's students from the Best Up panel at the transition to postgraduate studies or the labour market. In the baseline survey in December 2017/January 2018, we routed students according to their treatment status, and presented to those in the treatment group a series of screens with information about realized pecuniary and non-pecuniary returns on the labour market differentiated by college degree.

TABLE 1
DESCRIPTIVE STATISTICS

Variable	Mean	SD	N
<i>Matching variables (pre-inquiry)</i>			
General intention	0.771	0.421	371
Best Up treatment group	0.305	0.461	371
Female	0.623	0.485	371
Pre-inquiry enrolment	0.865	0.342	371
GPA (categorical)	1.911	0.795	371
<i>Baseline covariates</i>			
Direct transition	0.461	0.499	371
General intention	0.768	0.423	371
Non-academic background	0.589	0.493	365
Migration background	0.467	0.500	368
Age (June 2018)	23.442	0.945	371
High school (Gymnasium)	0.302	0.460	371
Integrated comprehensive school	0.369	0.483	371
Vocational high school	0.329	0.470	371
GPA	2.327	0.593	335
Degree: not enrolled	0.102	0.304	371
Degree: bachelor	0.779	0.415	371
Degree: staatsexamen/diplom	0.057	0.231	371
Degree: master	0.046	0.209	371
Degree: art/n.a.	0.016	0.126	371
Total semesters enrolled	5.466	1.837	356
<i>First follow-up</i>			
University	0.464	0.499	371
Applied university	0.259	0.439	371
Lehramt (teaching)	0.097	0.296	371
Subject: Law, Business, Social Science	0.310	0.463	371
Subject: Natural Science, Engineering	0.253	0.436	371
Subject: Other	0.173	0.378	371
Direct transition	0.478	0.500	322
General intention	0.739	0.440	322
<i>Second follow-up</i>			
Postgraduate enrolment	0.256	0.437	293
<i>Third follow-up</i>			
Postgraduate enrolment	0.408	0.492	311

Notes

Source: Berliner-Studienberechtigten-Panel, 2013–20.

Treatment

The information treatment consists of an online learning module that informed students about different aspects relevant to the postgraduate decision.¹² The learning module comprised visual and audio information and addressed three topics: realized pecuniary and non-pecuniary labour market returns by college degree—for example, earning levels and differentials for different occupations and sectors—and funding options for postgraduate studies.¹³

In this online survey, the presented information allowed students to place themselves and to update their beliefs about their individual returns. Students were shown informative graphs with explanatory text and helpful audio explanation transporting the depicted information.

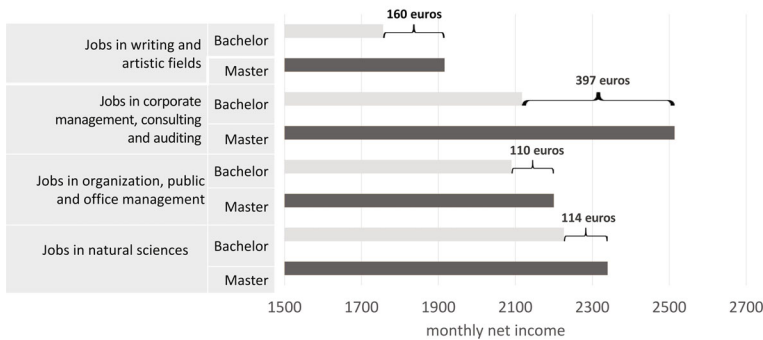
After each information slide, students were asked to answer a comprehensive question about the previous screen. Students could not continue to the next screen without listening to the audio file and without answering the short comprehensive question. However, students could go back to the previous screen. Forcing answers to the questions in this way ensures that students had looked at the material and processed the visualized information. It is otherwise very difficult to know for certain that students looked at the information with online or handout-based provision compared to information provided in person (see, for example, Oreopoulos and Dunn 2013; Peter and Zambre 2017).

Moreover, we presented information about a range of non-pecuniary labour market returns depending on degree (bachelor’s versus master’s), such as the likelihood of working in a highly-skilled occupation.

In Figure 1, we show two examples of the visual information that students received in the online learning module.¹⁴ The diagram at the top of Figure 1 presents a pecuniary example of realized labour market returns by college degree type, whereas the bottom diagram depicts a non-pecuniary example, namely the probability of working in highly-skilled occupations.

For all measures depicting pecuniary returns examples, we used data from the Microcensus (*Mikrozensus* in German).¹⁵ The measures for the non-pecuniary examples were

Master's graduates earn more in every occupational group



Master's graduates are more likely to work in highly-skilled occupations

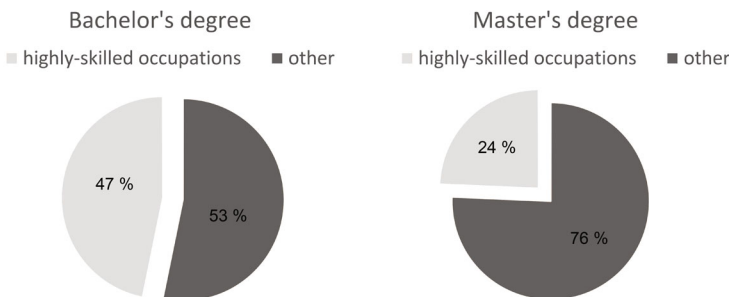


FIGURE 1. Example slides from the online information module. *Notes:* This figure provides examples of the slides used in the online information module, and shows two out of ten illustrative screens. The top diagram shows income by field of education and degree type, and the bottom diagram shows the share of people working in a highly-skilled occupation by degree type. Both slides are translated from German. Examples of the original screens seen by students are included in Section B of the Online Appendix.

constructed using another large nationwide household survey, the German Socio-Economic Panel Study (SOEP).¹⁶ Using large representative datasets to construct the measures for the treatment allowed us to tailor the information to students close to the end of their bachelor's degree, and to provide students with information that was not widely available. Numbers on realized labour market returns are not widely available in newspapers or on the web for different college degree types, given that the two-tier system is still young.

We further informed students about different funding sources for postgraduate education in Germany, and highlighted, for example, that students can also apply for student aid (*BAföG*, or *Bundesausbildungsförderungsgesetz*) for a master's degree, as many eligible students tend to believe that the support covers only the first degree. Section B of the Online Appendix comprises example screenshots of visual material shown in the online learning module.

Implementation, timing of intervention

We implemented in total five online surveys, which were optimized to smartphones, tablets and computers for easy access to participation. In a first very short pre-trial survey, we assessed how many students would still be studying in the winter term 2017. This pre-trial survey took place from August to September 2017 (see Figure A1 in the Online Appendix). The following four online surveys took place from December 2017 to January 2018, from May to June 2018, from December 2018 to January 2019, and in February 2020. From the pre-trial survey in autumn 2017, we received a target population of 446 potential students still studying for their bachelor's degree in the winter term 2017. Out of these 446 students, response rates in all three trial surveys are very high and always lie clearly above 80% (see number of participants per survey in Figure A1 in the Online Appendix).¹⁷

The baseline survey in December 2017/January 2018 was conducted about 7–8 months before final year students would typically graduate with an undergraduate degree. At the end of this first online survey, treated students were routed to the online learning module (see also the previous subsection). The first follow-up survey was 6 months later, in May/June 2018. With this first follow-up, we were able to measure students' intentions to enrol in postgraduate studies. These intentions measured up to 6 months after the first survey are comparatively long-run intentions and most likely coincide for the majority of students with their application process for postgraduate studies. The second follow-up survey was conducted 12 months after treatment in December 2018. With this second follow-up, we asked students about their actual enrolment. By the winter term 2018, we expected most students to have graduated from their undergraduate studies and to have enrolled directly in a master's programme. As our data from 12 months after treatment show, this second follow-up was still a little too early to detect the full effect on actual enrolment, as students are still more likely to be enrolled in undergraduate programmes and less likely to be enrolled in postgraduate studies. For this reason, an additional follow-up was conducted in February 2020, where postgraduate enrolment rates were much higher (see Table 1).

Randomization and compliance

The randomization of students into treatment and control groups was implemented using pairwise matching. Bruhn and McKenzie (2009) show that in small samples, methods other than pure randomization can improve the degree of balance among relevant pre-treatment characteristics and follow-up outcomes. Pairwise matching allowed us to balance treatment and control students matching on many variables predictive of the outcome variables, thereby increasing the efficiency and power of the hypothesis testing. We applied the greedy pairwise

matching algorithm mentioned and provided by Bruhn and McKenzie (2009). Since we utilize data from the Best Up panel, we had enough information and time to perform randomization using matching techniques, as information—about, for example, pre-trial postgraduate intentions, GPA from high school graduation, or gender—was already available. Pairwise matching using baseline characteristics would not have been feasible, as the treatment took place immediately after the baseline data collection. After having selected ‘statistical twins’ based on a rich set of pre-treatment characteristics, we randomized participants in each pair into treatment and control groups.

Table 2 shows the balancing of covariates in the pre-trial survey (August/September 2017) and the baseline survey (December 2017/January 2018). We separately regress balancing variables on a treatment group dummy to calculate raw treatment group differences. To account for the *ex ante* balance approach, we further regress balancing variables on a treatment group dummy and pair fixed effects, dropping all the observations from incomplete pairs. The actual difference between treatment and control group means is not statistically significant for

TABLE 2
BALANCE IN BASELINE AND PRE-TRIAL COVARIATES

	Full sample			Pair fixed effects	
	Control group mean	Treatment group difference	<i>N</i>	Treatment group difference	<i>N</i>
<i>Matching variables (pre-inquiry)</i>					
General intention	0.784	−0.026	371	−0.019	310
Best Up treatment group	0.308	−0.007	371	−0.026**	310
Female	0.627	−0.009	371	0.000	310
Pre-inquiry enrolment	0.870	−0.010	371	−0.006	310
GPA (categorical)	1.908	0.006	371	−0.013	310
<i>Enrolment intentions (baseline)</i>					
Direct transition	0.449	0.024	371	0.039	310
General intention	0.757	0.023	371	0.006	310
<i>Background (baseline)</i>					
Non-academic background	0.575	0.029	365	0.066	302
Migration background	0.404	0.125**	368	0.112**	304
Age (June 2018)	23.403	0.079	371	0.135	310
High school (Gymnasium)	0.286	0.031	371	−0.006	310
Integrated comprehensive school	0.405	−0.072	371	−0.077	310
Vocational high school	0.308	0.041	371	0.084	310
GPA	2.319	0.017	335	0.010	268
<i>Enrolment (baseline)</i>					
Degree: not enrolled	0.114	−0.022	371	−0.019	310
Degree: bachelor	0.757	0.044	371	0.052	310
Degree: staatsexamen/diplom	0.054	0.005	371	−0.013	310
Degree: master	0.054	−0.016	371	−0.013	310
Degree: art/n.a.	0.022	−0.011	371	−0.006	310
Total semesters enrolled	5.474	−0.016	356	0.104	288

Notes

Treatment group differences using pair fixed effects are based on a regression with pair fixed effects omitting observations from incomplete pairs.

Source: Berliner-Studienberechtigten-Panel, 2013–18.

*, **, *** indicate $p < 0.1$, $p < 0.05$, $p < 0.01$, respectively.

the pairwise matching variables and the variables on intentions, enrolment and background characteristics. Yet a statistically significant higher share of treated students has a migration background. The same picture emerges for the treatment group differences controlling for pair fixed effects.

The attrition rate is never significantly related to the treatment, and equals 11.9% in the control group at the first follow-up, 19.5% at the second follow-up, and 14.6% at the third follow-up. Attrition is also not related to most matching variables and important predictors of postgraduate enrolment intentions in the treatment and control groups. Although attrition is small and does not differ between treatment and control groups, we see a small statistically significant difference between male and female participants (see Table A2 in the Online Appendix). Females are less likely to drop out at the second follow-up. While this does not imply that treatment effect estimates are biased, we acknowledge that it might limit representativeness of our estimates for our baseline sample. We therefore also run separate regressions for females and males in the analysis below.

III. EMPIRICAL ANALYSIS

Estimation specification

The main model for the estimation of treatment effects is

$$(1) \quad Y_i^{\text{post}} = \alpha + \delta T_i + \gamma W_i + \beta X_i + \varepsilon_i,$$

where Y_i^{post} is the post-treatment outcome of student i , and T_i is a binary treatment group indicator. In our main specification, we control for variables used for pairwise matching W_i to account for the randomization procedure. In addition, we control for a set of baseline characteristics X_i to improve power (direct and general enrolment intentions and postgraduate enrolment at baseline).

As shown by Bruhn and McKenzie (2009), the most accurate way to account for the randomization procedure is to run a regression on the treatment group indicator and pair fixed effects. Otherwise, standard error estimates tend to be overly conservative. However, this leads to the omission of observations from pairs with only one follow-up observation. As this lowers the effective sample size—particularly for subgroup analyses—we control for matching variables W_i instead. In Table A3 of the Online Appendix, we show that our main results are robust to using different sets of control variables. In Table A8 of the Online Appendix, we provide evidence that our results are robust to using only complete randomization pairs and randomization-inference-based p -values (Young 2019).

Outcome variables and effect heterogeneity

A first set of outcome variables consists of students' beliefs about pecuniary and non-pecuniary labour market returns by degree type. We asked students to rate the answers to the following question:¹⁸ 'Please think about the time in the near future when you are 30–35 years old. Further assume that you are working full-time then. Certain aspects of your life might depend on whether you graduated with a bachelor's degree or with a master's degree. How likely do you think that you will ...'. We provided students with the following five pecuniary and non-pecuniary aspects for both bachelor's and master's degrees, and asked to rate these on a Likert-type scale from 1 (very unlikely) to 7 (very likely): (1) to earn above average income;¹⁹ (2) to do intellectually challenging work; (3) to be able to combine work and family life; (4) to work in a highly-skilled job or with managerial responsibility;

(5) that parents are satisfied with their job.²⁰ Table A10 of the Online Appendix shows how students on average rate these five dimensions for each degree type. For example, students on average rate the probability to work in a highly-skilled job or with managerial responsibility as 4.1 with a bachelor's degree, and 5.5 with a master's degree.²¹ We construct the perceived postgraduate return measures as the difference in perceived probabilities between master's and bachelor's degrees.

The second set of outcome variables comprises students' *intentions* to pursue postgraduate studies and their *actual enrolment* in master's programmes. Given the German context, measuring students' postgraduate application behaviour is somewhat difficult, similar to measuring undergraduate application (see Peter *et al.* (2021) for a discussion regarding bachelor's programmes). Not all study programmes require students to apply. In many programmes, they can just enrol without any further requirements. We therefore focus in particular on students' intentions to enrol *directly* after obtaining a bachelor's degree. We measure postgraduate enrolment intentions using a binary variable measuring *direct* transition intentions. We define *direct intentions* as intending to enrol in a postgraduate programme immediately after completion of a bachelor's programme. We code students to whom the question does not apply due to permanent study termination as 0, and students already enrolled into a postgraduate or five-year programme as 1.

Enrolment in postgraduate studies is defined for students who completed their bachelor's degree and are enrolled in a master's programme at the second follow-up survey. They are coded as 1, and the bachelor's graduates no longer enrolled in higher education, at either universities or universities of applied sciences, are coded as 0. As the scope for finding effects 12 months after treatment is limited if students progress more slowly through their studies than the population average, we conducted an additional follow-up survey two years after the treatment. This is particularly important for non-academic background students, who are less likely to enrol directly in postgraduate studies (see the first subsection of Section I).

Besides a potential deferral of enrolment, non-academic students might differ in their beliefs about labour market returns to a postgraduate degree compared to students from an environment where college returns are observable (see Boneva and Rauh 2017). In addition, the effects might also vary by gender. Studies show that the expected returns to a bachelor's or master's degree differ for male and female students (see, for example, Reuben *et al.* 2017; Zambre 2018). Due to a relatively large number of missing observations for students' fields of study, and the observed distribution over the different subjects (see also Table 1), we are not able to estimate effects by fields of study without getting sample sizes that are too small. But we run our main regression with study subject fixed effects as a robustness check.

IV. RESULTS

Beliefs about pecuniary and non-pecuniary returns

In order to elicit students' beliefs about different returns for either bachelor's or master's degrees, we asked them to rate five pecuniary and non-pecuniary aspects separately for each degree type on a Likert-type scale from 1 to 7 (see the final subsection of Section III for more details). In the following, we show associations between postgraduate enrolment intentions and a range of pecuniary and non-pecuniary return factors for the control group at the first follow-up. Table 3 presents estimates of a new regression equation in each column, with differing sets of covariates. Column (1) shows that the perceived probability to earn an above-average income is significantly correlated with intentions to study a master's degree. Columns (2)–(5) introduce the non-pecuniary factors. Interestingly, parental satisfaction with job does not matter, possibly because these bachelor's students are already somewhat detached from

TABLE 3
ASSOCIATIONS OF ENROLMENT INTENTIONS AND PERCEIVED RETURN

	Dependent variable: direct transition intention						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Pecuniary aspect</i>							
Above-average income	0.14*** (0.04)					0.10** (0.05)	0.10** (0.04)
<i>Non-pecuniary aspects</i>							
Intellectually challenging work		0.10** (0.04)				0.07* (0.04)	0.10** (0.05)
Work–life balance			0.10** (0.05)			0.03 (0.04)	0.10** (0.05)
Highly-skilled/managerial				0.08** (0.04)		0.03 (0.04)	0.10** (0.04)
Parents satisfied with job					0.01 (0.05)	–0.09 (0.06)	
Non-pecuniary return index							0.10* (0.06)
<i>Other</i>							
Age (June 2018)	–0.05 (0.04)	–0.05 (0.05)	–0.06 (0.05)	–0.03 (0.04)	–0.05 (0.05)	–0.05 (0.04)	–0.04 (0.04)
Female	–0.23*** (0.08)	–0.24*** (0.08)	–0.19** (0.09)	–0.22*** (0.08)	–0.22** (0.09)	–0.23*** (0.08)	–0.23*** (0.08)
Migration background	0.17** (0.08)	0.18** (0.08)	0.14* (0.08)	0.17** (0.08)	0.16* (0.08)	0.19** (0.08)	0.18** (0.08)
Non-academic family background	–0.08 (0.08)	–0.06 (0.08)	–0.08 (0.08)	–0.09 (0.08)	–0.08 (0.08)	–0.07 (0.08)	–0.07 (0.08)
<i>F-test (p-value): Joint significance of return measures</i>							
Constant	1.74* (0.99)	1.69 (1.08)	1.95* (1.11)	1.42 (1.02)	1.76 (1.09)	1.73* (1.02)	1.61 (0.98)
<i>N</i>	147	147	147	147	147	147	147

Notes

This table shows the effects of stepwise OLS regressions for direct transition intentions on perceived pecuniary and non-pecuniary returns. Dependent variable and return measures are from the first follow-up survey (6 months after treatment). Regressions are based on control group only. Robust standard errors in parentheses.

Source: Berliner-Studienberechtigten-Panel, 2013–18.

*, **, *** indicate $p < 0.1$, $p < 0.05$, $p < 0.01$, respectively.

their parental background.²² All other factors are significant predictors in the association between non-pecuniary beliefs and direct enrolment intentions. Next, in column (6) we estimate jointly the associations between perceived pecuniary and non-pecuniary returns, and enrolment intentions. Last, but not least, in column (7) we combine the non-pecuniary factors into a preference-weighted index of non-pecuniary returns.²³ As before, and in line with the existing literature, we find that these two measures of perceptions of pecuniary and non-pecuniary returns matter (Boneva and Rauh 2017; Belfield *et al.* 2020).

Causal effects on perceived returns

In Figure 2, we show treatment effects on students' beliefs about pecuniary and non-pecuniary postgraduate returns. The upper panel shows the overall effect for the preferred specification,

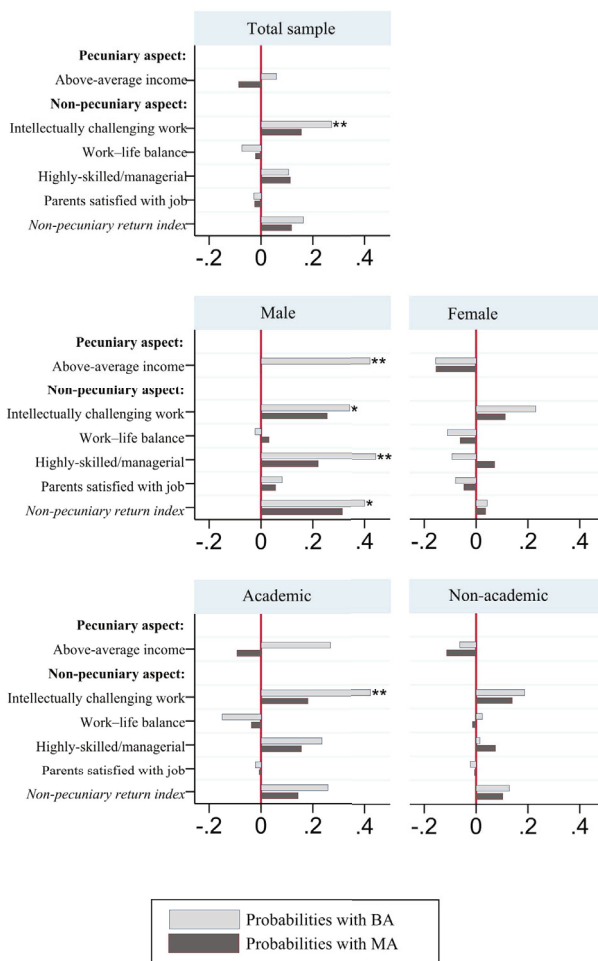


FIGURE 2. Treatment effects on standardized perceived probabilities with a bachelor's degree only and with a master's degree. *Notes:* All outcome measures taken at first follow-up (6 months after treatment), standardized using the control group. This figure shows treatment effects from a regression of the outcome measure on a treatment group indicator, also controlling for matching variables (see Table 2), direct and general enrolment intentions, and postgraduate enrolment at baseline. Source: Berliner-Studienberechtigten-Panel, 2013–18. *, **, *** indicate $p < 0.1$, $p < 0.05$, $p < 0.01$, respectively.

the middle panel shows effects by gender, and the bottom panel shows effects by academic background.²⁴ The rows in the diagrams in Figure 2 list the results for the one pecuniary return measure ('Above-average income') and the four non-pecuniary return measures and their summary index, as described in the final subsection of Section III and the previous subsection.

Figure 2 shows that treated students increase their beliefs about a bachelor's degree 6 months after treatment (see also Table A9 of the Online Appendix). Treated students mainly update their beliefs about monetary returns with an undergraduate degree, but also increase the returns to a bachelor's degree regarding non-pecuniary returns, such as 'to do more intellectually challenging work' and 'to work in a highly-skilled job'. In particular, treated male students and students with at least one parent with a university degree increase their pecuniary beliefs about a bachelor's degree, making a master's degree relatively less attractive. The differences in the distribution of perceived probabilities of males (see Figure A2 of the Online Appendix) show that post-treatment males are more likely to report probabilities above 4 on the Likert scale, in particular for earning above average income with a BA. Similar updating cannot be observed for females (see Figure A3 of the Online Appendix).²⁵

Returning to the standardized impacts, treated male students increase their belief 'to earn above average income' when having a bachelor's degree by 0.42 standard deviations. This leads to a similar decrease in the difference between both degrees (−0.42 points—see also the third column in Table A9 of the Online Appendix). Students from an academic background also adjust significantly their beliefs about monetary returns of a bachelor's degree. Similar to male treated students, the difference between the beliefs by degree decreases significantly, by 0.36 points.

Female students and students from non-academic backgrounds do not update significantly their beliefs about either degree due to the information treatment. In addition, we show the absolute levels of perceived returns in the control group in Table A10 of the Online Appendix and distributions of perceived probabilities for the treatment and control group in Figures A2 and A3 of the Online Appendix. Males and females in the control group have fairly similar perceptions of bachelor's and master's degrees, in particular when plotting expected earnings by degree type and gender in the control group in comparison to realized net monthly earnings of full-time workers from the German Microcensus (see Figure A4 of the Online Appendix).²⁶ Yet untreated males tend to assess bachelor's degrees somewhat worse than untreated females, which can be seen as suggestive evidence that males are more likely to underestimate the returns to a bachelor's degree; but these differences are hardly statistically significant. This pattern is not observed for students from academic versus non-academic backgrounds.

Looking at preferences about pecuniary and non-pecuniary returns, Table A11 of the Online Appendix shows that for male students, it is slightly more important to earn above-average income, doing intellectually challenging work and working in highly-skilled jobs, than for female students; whereas female students place higher values on the work–life balance aspect. Yet only the gender differences regarding work–life balance and to work in a highly-skilled job are statistically significant. The information treatment provided more information on aspects that are particularly important to men, which is one potential explanation for the gender differences in treatment effects on perceived returns. This conclusion is also supported by the literature from several disciplines, which points towards gender differences in work values or career preferences. Women have been found to attach higher value to things not covered in this information treatment than men, such as enjoying the work at their jobs, helping others, and interacting with people (Busch-Heizmann 2015; Diekmann *et al.* 2010; Lippa 2005; Weisgram and Bigler 2006; Weisgram *et al.* 2011; Zafar 2013).

To summarize the effects on perceived returns, the most significant finding is that males expect higher BA returns. In principle, such gender heterogeneity could reflect underlying differences in baseline beliefs, that is, that males correct their beliefs post-treatment; or alternatively, gender differences in updating could explain the heterogeneity in the effect. Given that we fail to document systematic differences in expectations, in particular with respect to earnings, based on male and female control group students, we believe that this result is most likely explained by differential processing of information. Interestingly, among the few studies that analyse belief updating after an information intervention is the study by Kerr *et al.* (2020), and similar to our results on postgraduate decisions, they find evidence only for men adjusting their beliefs after the intervention.

Note that we asked the students again in the second and third follow-ups, taking place 12 and about 26 months after our information treatment, respectively. In both, we do not find any evidence for causal long-term effects of our intervention on perceived returns, highlighting the importance of timing in relation to when actual enrolment decisions are taken.²⁷

Effects on direct enrolment intentions

In Table 4, we first present treatment effects on students' intentions to enrol into a postgraduate programme measured 6 months after the treatment, that is, in the first follow-up survey. Column (1) shows the overall effect, columns (2) and (3) show effects differentiated by gender, and columns (4) and (5) show effects differentiated by students' academic backgrounds. We estimate all effects in Table 4 controlling for matching variables, direct enrolment intentions and postgraduate enrolment prior to treatment (at baseline).

Table 4 shows that students' direct enrolment intentions decrease by 0.042 in the overall sample (see column (1)). Compared to students in the control group, where 50% intend to enrol directly in postgraduate studies, treated students are 4 percentage points less likely to pursue a master's degree directly after graduating from their bachelor's degree. Looking at the treatment effect separately by gender shows that this reduction in intentions is driven by male students. Treated male students are 16 percentage points less likely to intend to enrol in postgraduate studies after the treatment (see column (3)). Considering that enrolment intentions of males in the control group are 26 percentage points higher than those of females, the treatment led to a reduction in the gender gap of enrolment intentions. This effect mirrors the effects found in Figure 2, as treated male students increase their belief of pecuniary returns to a bachelor's degree. We also estimate the treatment effects separately by academic background, and continuing generation students are also less likely to intend to enrol directly in master's programmes by 5 percentage points.

All effects on direct intention to enrol in postgraduate studies are statistically insignificant at conventional levels, apart from the effects on male students. Yet the size of the overall effect is not small. We also studied the frequency of upward and downward changes in direct transition intentions between baseline and the first follow-up (Table A7 of the Online Appendix). No significant effect of the intervention on the frequency of observed changes in enrolment intentions is found, and the point estimate is close to zero. The intervention has reduced the number of upward changes and increased the number of downward changes by similar amounts—again, not statistically significant—which leads to a net effect very close to zero.

While the results presented above refer to our preferred specification, we also provide results for five alternative control variable specifications in Tables A3–A6 of the Online Appendix. The first result shows that the mean difference in the outcome between

TABLE 4
TREATMENT EFFECTS ON POSTGRADUATE ENROLMENT INTENTIONS AND ENROLMENT

	Total sample (1)	Female (2)	Male (3)	Non-academic (4)	Academic (5)
<i>(1) Follow-up (after 6 months): direct transition intentions</i>					
Treatment effect	-0.042 (0.041)	0.026 (0.050)	-0.156** (0.077)	-0.003 (0.059)	-0.053 (0.060)
Control group mean	0.497	0.404	0.661	0.457	0.567
N	322	206	116	189	130
<i>(2) Follow-up (after 1 year): postgraduate enrolment</i>					
Treatment effect	-0.043 (0.042)	-0.042 (0.052)	-0.063 (0.074)	-0.026 (0.056)	-0.039 (0.073)
Control group mean	0.282	0.273	0.300	0.276	0.305
N	293	192	101	176	112
<i>(3) Follow-up (after 2 years): postgraduate enrolment</i>					
Treatment effect	-0.058 (0.047)	-0.029 (0.060)	-0.124 (0.079)	-0.034 (0.060)	-0.014 (0.082)
Control group mean	0.437	0.408	0.483	0.421	0.475
N	311	192	119	187	120
<i>(2 or 3) Follow-up (within 2 years): postgraduate enrolment</i>					
Treatment effect	-0.035 (0.045)	-0.001 (0.057)	-0.105 (0.075)	-0.027 (0.058)	-0.004 (0.078)
Control group mean	0.408	0.373	0.469	0.404	0.431
N	344	216	128	203	136
Pair fixed effects	No	No	No	No	No
Controls: Matching variables	Yes	Yes	Yes	Yes	Yes
Controls: Enrolment intentions	Yes	Yes	Yes	Yes	Yes
Controls: Background	No	No	No	No	No
Controls: Study subject	No	No	No	No	No

Notes

All regressions control for matching variables (see Table 2) and direct and general enrolment intentions and postgraduate enrolment at baseline. We deal with missing information in control variables by setting these variables to a constant value and including a binary variable indicating missing values in control variables. Robust standard errors in parentheses.

Source: Berliner-Studienberechtigten-Panel, 2013–20.

*, **, *** indicate $p < 0.1$, $p < 0.05$, $p < 0.01$, respectively.

treatment and control group is -0.038 points. To control for finite sample imbalances, we gradually add sets of control variables to the regression. Controlling for baseline enrolment intentions and enrolment on top of the matching variables lowers standard errors considerably, and increases the effect size to about -0.042 . In a next step, we add background characteristics—for example, controlling for the finite-sample imbalance in migration background—with negligible changes in point estimates and standard errors. Finally, we also control for three groups of study subjects. Again, this leads to only negligible changes in the results.

When accounting for randomization pair dummies in Table A8 of the Online Appendix, as suggested by Bruhn and McKenzie (2009), estimates and standard errors change only slightly. We further show that traditional standard errors and standard errors based on randomization inference, following the approach by Young (2019), are almost the same.

Effects on actual postgraduate enrolment

In Table 4, we also present results on the last of our main outcomes and look at treatment effects on actual postgraduate enrolment one and two years after the information treatment. Unlike the results on postgraduate enrolment intentions, these results are likely to be very dependent on the exact timing of the intervention. Initially, when the intervention was planned, it was assumed that a large share of students were likely to complete their undergraduate degree between the first and second follow-ups. Yet, as the control group mean for postgraduate enrolment at the second follow-up shows, a relatively small share of students already and directly transitioned to postgraduate studies (28.2%). One year after the baseline survey, the majority of students are still enrolled in an undergraduate programme; for example, because they started studying later, they are more likely to be enrolled in programmes of universities of applied sciences, to have switched majors, or need longer than the population average for other reasons.²⁸ Yet while the enrolment shares are still fairly low, there is a clear correlation between enrolment intentions and actual enrolment. Of the control group students who did not report direct enrolment intentions at baseline, only 6% were enrolled in a master's programme after one year, while among those who reported direct enrolment intentions, the share is 37%. After two years, the respective shares are 21% and 53%. The correlation shows that expecting a link between impacts on intentions and enrolment is justified.

Treated students are 4 percentage points less likely to be enrolled in postgraduate studies in the winter term 2018. This translates into a reduction in enrolment by 15% compared to the control group. While not negligible in size, effects on actual enrolment after one year shown in Table 4 are far from being statistically significant.

While the pattern from the previous findings—stronger effects on males and students from academic family background—is visible one year after the treatment, the impact on actual postgraduate enrolment of men becomes visible only after two years, where the effect is much more pronounced (−12.4 percentage points), yet still not statistically significant at conventional levels (p -value 0.12).

In the last part of Table 4, we also look at the two last follow-ups jointly to see if pooling the sample increases statistical power. But no relevant differences in standard errors can be observed. Here, the outcome is defined as being enrolled in a postgraduate programme at least once during the one- and two-year follow-ups.

V. CONCLUSION

This is the first study to present estimates for effects of information provision on beliefs about postgraduate returns, enrolment intentions and realized enrolment. We show that students updated significantly their beliefs about postgraduate returns half a year later. In particular, males downward adjust expectations regarding the postgraduate premium. Moreover, we document corresponding changes in enrolment intentions six months after treatment, and we provide suggestive evidence that the effects of information on intention materialized into differences in realized postgraduate enrolment two years after initial treatment.

These results are important as they document that information frictions exist even for students already enrolled in undergraduate degrees. Moreover, the online treatment could be scaled up at low cost.

On the other hand, we show that only groups of students for whom we find significant effects of the treatment on beliefs also show significant reactions in our enrolment measures. This highlights a general difficulty in providing systematic information about the role of beliefs in an experimental setup where research is bound in the analysis by the ethical requirement to present only truthful information to the students. One implication is that

effects of information can be estimated only for groups where significant belief updating takes place. Our setting is fortuitous in this context, since the two-tier system, while well established at the university level, was still quite novel for the labour market. As a consequence, little information on long-run postgraduate earnings premia of older cohorts could be observed, thus providing a setting that gives scope for updating to take place. RCTs on the role of information for belief updating and postgraduate decisions as a result have particularly high demands on sample size to shed light on heterogeneity on the role of information, which requires significant belief updating across groups.

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ENDNOTES

1. See detailed literature review below.
2. Note that we use 'postgraduate education' in the European sense, i.e. including master's degrees, which are called 'graduate education' in the USA.
3. The Bologna Process has created the European Higher Education Area. The Bologna declaration was signed by education ministers from 29 European countries in 1999.
4. Before the Bologna Process in the 2000s, Germany had a system of longer single-tier degrees.
5. In the sample on which we base our analysis, 64% of master's students continue at the same higher education institution. Moreover, 76% continue their studies in the same city.
6. While curricula in universities typically follow a more theoretical orientation, universities of applied sciences focus on application-oriented study programmes that are often offered in close collaboration with companies.
7. For further information on the Best Up study and data, see Ehlert *et al.* (2017), Peter and Zambre (2017) and Peter *et al.* (2021).
8. See also Figure A1 in the Online Appendix for more information on the stylized timeline to an undergraduate degree in Germany in relation to our trial timeline.
9. A student is considered to come from a non-academic parental background if neither of their parents holds a college degree.
10. In Germany, one year of college is divided into two terms, called semesters.
11. We compare our sample to two so-called starting cohorts of the National Educational Panel Study (NEPS), SC4 and SC5 (for more information, see Blossfeld *et al.* 2011).
12. The study has been approved by an IRB; for more information, see the AEA RCT registry entry at <https://doi.org/10.1257/rct.2446-2.0> (accessed 6 February 2022).
13. The online survey was programmed and administered by a survey institute (Kantar Public) to ensure a professional interaction with survey participants. Students were invited via email to participate in an online survey providing them with an individual link. The link worked with smartphones, tablets and PCs, as the online survey was mobile-ready.
14. Examples of programmed screens as seen by students are included in the Online Appendix.
15. The Microcensus is an annual household survey providing nationwide representative statistics on the population and the labour market in Germany. It surveys 1% of the population in Germany.
16. The SOEP has been carried out since 1984, and in 2017 more than 30,000 individuals in approximately 17,000 households participated in (see Wagner *et al.* 2007).
17. Compared to other response rates of similar RCTs, this response rate is very high and satisfactory.
18. See Section C of the Online Appendix for the full German and English versions of the questions.
19. In this question, 'average income' refers to the average gross wage of all German full-time workers.
20. We use these particular categories to elicit students' beliefs, as they have been shown to matter by Boneva and Rauh (2017), which allows us to compare our findings to the emerging literature on pecuniary and non-pecuniary returns and educational choices.

21. Table A10 of the Online Appendix shows mean values for the control group only, as well as standard deviations and differences between groups. For reporting treatment effects on perceived probabilities, standardized variables are used to make results easier to interpret.
22. This finding is different to that of Boneva *et al.* (2021), who find a large and statistically significant effect for parental support. However, it might be possible that they measure another aspect of parental support.
23. Students were asked to rate the importance of each category on a scale from 1 (not important at all) to 5 (very important). We constructed the non-pecuniary return index by weighting each of the four non-pecuniary return measures with the relative importance reported by the respective student.
24. The estimates are also summarized in table format in Table A9 of the Online Appendix, which includes regressions on the difference between probabilities with a bachelor's and master's degree.
25. For the exact phrasing of the original question in German, as well as the English translation, see Section C of the Online Appendix.
26. Male students expect to earn on average nearly 800 euros more than the realized net monthly earnings of male bachelor graduates (see Figure A4 of the Online Appendix). Looking at a master's degree, the difference between expected and realized earnings is even higher for male students in the control. Males expect to earn approximately 3700 euros compared to actual earnings of 2354 euros.
27. In the second and third follow-ups, we also asked participants for expected min, mean and max earnings. Using these measures, we confirm the finding that effects have faded after 12 months.
28. See Figure A1 of the Online Appendix for a stylized visualization of times for a bachelor's degree and the application period for master's programmes.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

A Supplementary Material

B Material of the information treatment

C Survey question on students' beliefs about pecuniary and non-pecuniary returns (follow-up)