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# Informing students about college: an efficient way to decrease the socio-economic gap in enrollment – Evidence from a randomized field experiment[☆]

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**Abstract**

Although the proportion of students enrolled in college increased in the last decades, students from non-college family backgrounds remain underrepresented in higher education around the world. This study sheds light on whether the provision of information in a randomized controlled trial with more than 1,000 German high school students results in higher college enrollment rates. One year prior to high school graduation, we treated students in randomly selected schools by giving an in-class presentation on the benefits and costs of higher education as well as on possible funding options for college education. We collected data from students prior to the information intervention and followed them for four consecutive years. We find evidence that an information intervention increases students' application as well as their enrollment rates, in particular for students from non-college backgrounds with enrollment intentions prior to treatment. Moreover, treated students persist in college at a similar rate as students in the control group, i.e. they are not more likely to drop out of college. Our results indicate that a low-cost information intervention is an efficient tool to encourage students to translate their college intentions into actual enrollment.

*Keywords:* college enrollment, college benefits, college costs, educational inequality, information, randomized controlled trial
*JEL:* I21, I24, J24

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## 1. Introduction

Investing in human capital, especially continuing with post-secondary education, leads to higher income and other positive life outcomes. Katz and Murphy (1992) are a well-known early example in the economic literature documenting that, compared to vocational training or only high school education, returns to college are high. Moreover, skill-biased technological change (see Acemoglu and Autor, 2011, for an overview) and resulting job polarization (Autor and Dorn, 2013; Goos et al., 2014), have increased demand and returns for high-skilled workers to the extent that investing in college education has become important. This is particularly true in light of demographic changes and shrinking work forces in almost all industrialized societies. Yet, what determines individual decisions to invest in human capital is still not entirely understood. According to standard economic models, individuals invest in their human capital if expected discounted lifetime benefits exceed expected discounted costs (Mincer, 1958; Schultz, 1961; Becker, 1962).

Besides this well-known human capital approach, there is an emerging literature stressing that information deficits prevent students from making an optimal educational choice (for an overview see Damgaard and Nielsen, 2018). Such deficits provide an additional explanation for why some students may be less likely to invest further in education. Initial results from the literature on incomplete information suggest that students underestimate benefits and overestimate costs of college education (among others see Booij et al., 2012; Bettinger et al., 2012; Oreopoulos and Dunn, 2013; Kerr et al., 2015; Wiswall and Zafar, 2015a,b; McGuigan et al., 2016; Bleemer and Zafar, 2018). In particular, this result applies to students from low socio-economic (SES) backgrounds. Given that, on average, these students grow up with less information about college, they have more difficulty in comparing costs and benefits of college education and are therefore less likely to enroll. In light of these background differences, several studies have examined the effectiveness of information provision on students' college transitions (e.g. Oreopoulos and Dunn, 2013; Bettinger and Baker, 2014; Castleman et al., 2014; Kerr et al., 2015; Wiswall and Zafar, 2015a,b; Castleman and Long, 2016; McGuigan et al., 2016; Oreopoulos and Ford, 2016; Carrell and Sacerdote, 2017). However, among these studies, those solely providing information (Oreopoulos and Dunn, 2013; Kerr et al., 2015; McGuigan et al., 2016) find no effects on students' eduational chocie compared to those providing information using text messaging, student coaching, or mentoring as additional support (Bettinger and Baker, 2014; Castleman et al., 2014; Castleman and Long, 2016; Oreopoulos and Ford, 2016; Carrell and Sacerdote, 2017). In sum, results depend on the type of information, the timing of the provision, and on the manner of presentation.

While most of these studies are based in the U.S., where students need to pay tuition fees, in this paper we examine a randomized controlled trial (RCT hereafter) in a non-tuition fee context. To be specific, we analyze whether an information intervention

can increase college enrollment, in particular among students from a non-college family background.[1] With an information workshop in randomly selected schools, we provided students with information based on empirical research regarding benefits, costs, and funding possibilities[2] of college attendance, as well as, on some field- and gender-specific returns.[3] This intervention was implemented one year prior to high school graduation. Essentially, we encourage high school students to enroll in college without meaningfully altering costs or preferences (e.g. Thaler and Sunstein, 2008).

By providing students with information about college, we effectively address three of the distinct behavioral barriers in educational transitions, highlighted amongst others in Lavecchia et al. (2016).[4] These barriers explain why individuals might not invest (enough) in education: A first barrier is a pronounced present-bias. Students who focus too much on the present are more likely to be prone to short-term thinking. Informing students about differences in lifetime earnings might help students to place less emphasis on the present or immediate returns. A second barrier is being routine-driven, summarizing the behavior of students who rely too much on routine. They automatically make decisions by relying on familiar knowledge and decisions through which routines become the default. Contrasting returns to college and returns to a vocational degree might provide students with unfamiliar knowledge necessary to overcome routine options. Thirdly the barrier described as "mistakes due to information-deficits" summarizes a behavior that explicitly follows from misinformation or unawareness. Here suboptimal outcomes occur if students, for example, regard all college programs as unaffordable. In sum, an information intervention may provide greater certainty about future benefits and shift students' attention towards the future thereby offsetting students' tendency to prefer present over future gains. At the same time, it might help to overcome default options shaped by their social environment by raising the awareness of alternative options, i.e. to stop the path-dependency in educational choice. Moreover, an information intervention might also help to avoid misjudged decisions for or against college simply by delivering comprehensive knowledge about costs and benefits of such a decision. In particular, for students with non-college educated parents these three barriers are all related to information deficits and cannot necessarily be viewed as independent of each other.

Although our information intervention is similar to other randomized controlled trials conducted in the economic literature, the majority of these studies looks at effects

[1] In this study we determine students' background based on parental educational qualifications. More specifically, we define students with parents without a college degree as students from non-college backgrounds.

[2] Dynarski and Scott-Clayton (2006) argue that the complexity of the student aid system in the US burdens those with the least ability to pay and undermines re-distributive goals.

[3] In the remaining paper we refer to this particular set of information on benefits, costs, funding possibilities, as well as some field- and gender-specific returns as ***information about college***.

[4] Lavecchia et al. (2016) and more recent Damgaard and Nielsen (2018) discuss potential links between behavioral economics and the economics of education, as RCTs addressing behavioral theory have become more and more frequent in education economics.

in settings with high tuition fees. This might explain why interventions solely based on providing information find no treatment effect compared to studies on application assistance, coaching or mentoring. Yet, this paper sheds light on an informational intervention to increase college enrollment in a country without tuition fees. To the best of our knowledge, the study by Kerr et al. (2015) is the only other study carried out in a tuition free context, namely in Finland. Yet, they focus on major-specific information and the types of courses students apply for and enroll in, rather than on the choice of going to college at all. They find no average impact on applications or enrollment. In contrast to the majority of the existing literature, our study shows an information effect and thus suggests that we should not disregard information interventions as an effective tool to boost college enrollment.

In contrast to previous studies, we are able to follow students over a longer period, namely for five years. This enables us to analyze not only application and enrollment rates, but also students' persistence in college. In total, we analyze data of more than 1,000 students in 27 schools. We find that the information treatment affects students' college application and enrollment: students who participated in the information workshop are 7 percentage points (pp) more likely to apply for college in the year of high school graduation and 10 pp more likely to enroll in college in that same year. Acknowledging that a considerable share of students take a gap year before enrolling in college, we additionally analyze enrollment rates up to one year after high school graduation. In this additional specification, students in the treatment group are 6 pp more likely to enroll in college. All point estimates remain stable across various sensitivity specifications. In addition, we apply the wild cluster bootstrap-t procedure as suggested by Cameron and Miller (2015) to account for the small number of schools (clusters). Compared to other interventions we know if students are still enrolled up to two years after their initial enrollment and estimate if treated students are more or less likely to be still studying. Results indicate that the information workshop positively affects students' persistence in college. We also analyze potential channels of the information interventions. We show that the bundle of information about college, i.e. benefits, costs, and funding options, most likely induces students to enroll in college. Moreover, our back-of-the-envelope cost-benefit calculations show that the increase in college enrollment not only renders net benefits at the individual level but also from a public perspective.

In addition to the overall treatment effects on application and enrollment rates, our study shows that these results are mainly driven by students at the margin. These students are those who prior to the information intervention state that they intend to enroll in college. We argue that these students, who are already interested in college education, are the most responsive group to the information intervention, because they may be more likely to be particularly attentive during the information workshop and thus are more likely to use the information to follow through on their intentions. Evidence for a presumably stronger impact on students with intentions to enroll is found by a previous

study based on earlier waves of the panel we use. Peter and Zambre (2017) show that the information workshop affected students' intentions one year later. This treatment effect mainly works through stabilizing non-college background students' post-secondary educational plans. In other words, this earlier study shows that in response to the information treatment these students are less likely to give up their enrollment intentions in the year of high school graduation. Turning to application and enrollment rates, we find that the information treatment increases application and enrollment rates for marginal students by 11 pp. Taking a closer look at marginal students from non-college backgrounds, enrollment rates within one year after high school graduation even increase by 15 pp.

This result is particularly interesting, since other studies show that students from low socio-economic backgrounds have difficulties translating their intentions into actual college enrollment.[5] Although the transition process after graduating from high school is less complicated in Germany compared to other countries, students from non-college backgrounds are still less likely to translate their college enrollment intentions into actual behavior. Numbers from a representative and nationwide study indicate that a considerable share of students, in particular those from non-college backgrounds, do not translate their enrollment intentions into actual behavior. Students with a college background stating an enrollment intention have a 92% chance to enroll. However, students with a non-college background stating enrollment intention have only a 72% chance to enroll.[6]

Overall, our results show that a low-cost information workshop is a cost-effective way to encourage students to follow through on their educational plans. Moreover, we show that these effects are long lasting. Thus, information interventions should not be discarded as valuable and sound treatments, in particular for students at the margin. We argue that several aspects of the setup of our intervention might explain differences in effects compared with other studies. First, our intervention consisted of an in-class presentation given by a trained person with a concise script. Second, students did not have to engage further by accessing a specific website or reading additional material. Third, a video at the end of the information workshop imprinted the information on students' memory.

In the German context, such an easy-to-administer and low-cost-information treatment is of particular interest as it can help to increase the share of college attendees in particular from non-college backgrounds. Over the past decades, the OECD (2016) has consistently suggested that Germany should increase its share of college attendees

[5]For example, in the U.S. students from non-college backgrounds are more likely to refrain from enrolling in college during the summer period after high school graduation even if they have previously intended to enroll. This so-called "summer melt" indicates that students from low-socio-economic backgrounds are more likely to face obstacles during the admission process at college (e.g. Castleman et al., 2014; Castleman and Page, 2015).

[6]These are own calculations based on data from the German National Education Panel Study (NEPS), see Blossfeld et al. (2011).

as enrollment rates are relatively low in comparison to other industrialized countries. Although, college enrollment rates have indeed increased,[7] the decision to enroll in college is still closely linked to students' family background. The socio-economic gap in college enrollment in Germany is large and persistent since the mid-1990s (Autorengruppe Bildungsberichterstattung, 2016): college-eligible students whose parents have no college degree are around 20 pp less likely to take up college education compared to students with college educated parents. As German politicians aim to close this so-called "education gap" our study shows that targeted information is one effective tool to reach this goal. Other programs, such as student aid, which addresses students' potential financial constraints, or mentoring programs, which provide encouragement and support that students might lack at home, are cost intensive. Moreover, one drawback of such programs is that students need to know about them and actively seek them out; i.e. students need to invest time and effort to gain access and benefit from these programs. This is not the case for the information intervention presented in this paper.

The remainder of the study is structured as follows: Section 2 gives an overview of the relevant institutional context in Germany. Section 3 describes the target sample and the randomized controlled trial, followed by Section 4 with a detailed discussion of the information intervention. Section 5 presents the data and empirical strategy used. In Section 6 our estimation results are reported. This section also includes a discussion about possible channels, shows the robustness of the estimates and provides cost-benefit considerations (see 6.6). Finally Section 7 concludes.

## 2. Institutional context

In Germany, higher education is the responsibility of each federal state. Thus, higher education institutions operate under state-level legislation and receive funding from state and federal government sources. As a result, higher education systems differ across federal states. In contrast, an example of a core national responsibility is the provision of financial student aid (Bundesausbildungsförderungsgesetz, BAföG).

In Germany, students are assigned to different tracks of secondary schooling based on their performance after primary school.[8] The secondary school tracks distinguish vocational and college tracks.[9] Only at college track schools can students earn the *Abitur*, i.e. the qualification that allows students to enroll directly in college in any federal state following high school graduation. Within university track schools, students can attend

[7] In 2005, around 54% of students with a university entrance diploma (*Abitur*) enrolled in college and this share increased to 67% in 2015.

[8] The transition to secondary schooling after six years occurs in three federal states (Berlin, Brandenburg, and Mecklenburg-West Pomerania); in all other federal states children transit to secondary school following the completion of grade four.

[9] Given that the three track system is nearly abolished across all German federal states, the - in former times known school types - *Hauptschule* and *Realschule* are subsumed as vocational track schools, and *Gymnasium* and *gymnasiale Oberstufe* as university track schools.

different school types: (1) general high schools *(Gymnasium)*; (2) comprehensive high schools *(integrierte Sekundarschule)*; or (3) vocational oriented high schools *(berufliches Gymnasium)*. After graduating with the *Abitur*, students either enroll in college or take up vocational education and training (VET). However, around 23% of students graduating with the *Abitur* delay their post-secondary education by one year (Destatis, 2017, number refers to 2015), e.g. by taking a "gap year" to travel, do volunteer work, or complete an internship.

*Admission to post-secondary education:* The admission process differs between college enrollment and VET. On the one hand, students who intend to pursue a VET after high school graduation have to apply, by and large, one year prior to graduation. For students who intend to enroll in college after graduation, on the other hand, the deadline for college applications is in mid-July in the year of high school graduation. Whether students need to apply to college at all depends on the college major and the specific college they want to enroll in. There is a range of study programs in which students can simply enroll at the beginning of the term without having to apply in advance. In principle, students in Germany face no entry restrictions; however, for programs with excess demand, i.e. where colleges are unable to accommodate all interested students, colleges are allowed to enforce (local) entry restrictions.[10]

In case of excess demand, available slots are generally allocated as follows: The largest share of available slots is allocated using a cut-off based on students' final high school GPA (known as *numerus clausus*). Students whose final GPA is below this cut-off are more likely to be accepted than students whose Abitur grade is above the cut-off.[11] Since colleges only set local admission restrictions if the number of applications exceeds available slots, the cut-off is not announced in advance but rather determined retrospectively. Consequently, last year's *numerus clausus*, gives students an indication about their chance to get admitted.

Another fraction of slots is given to those who have gathered the highest number of waiting semesters. Thus, for students who have a higher final high school GPA[12] it may be reasonable to postpone college enrollment to gather waiting semesters. Finally, the remaining slots are distributed based on a mix of these two criteria combined with college-specific selection criteria, for example professional experience or major-specific grades. Overall, admission rules are specific to each higher education institutions and, thus, students face large differences across federal states, institutions, and college majors.

*Higher education institutions:* The landscape of higher education institutions in Germany is rather diverse. In 2016, there were 445 higher education institutions

[10]Admission to study programs is only centrally allocated for the following college majors: medicine, veterinary, dentistry, and pharmacy.

[11]In Germany grades range from 1 "very good" to 6 "insufficient" and *Abitur* grades range from 1.0 to 4.0, with 1.0 being the best GPA.

[12]Remember that *Abitur* grades range from 1.0 to 4.0, with 1.0 being the best GPA.

in Germany (Destatis, 2016b). In general, college education in Germany (at public institutions) is free of charge, with students paying only a small administrative fee each term.[13] Among all higher education institutions approximately 37% are accredited private institutions, which usually charge tuition fees. Yet, the share of students enrolled in private institutions is just around 7.5% (Buschle and Haider, 2016) and, consequently, private institutions play a minor role in providing college education in Germany. Furthermore, higher education institutions can be differentiated into three main types: (1) universities; (2) universities of applied sciences; and (3) colleges for arts and music; with the latter offering study programs for artistic careers in different areas (fine arts, music, theater etc.).[14] Henceforth, we use the terms "university" and "college" interchangeably, thereby referring to all types of higher education institutions.

*College persistence.* For students who have started studying toward a Bachelor's degree in Germany in fall 2010, the average dropout rate across all higher education institutions and majors amounts to 29%. Of these students 63% dropout during the first two semesters, i.e. within the first year of college. Heublein et al. (2017) show that 30 percent of dropouts state *study performance problems* as the key reason for their withdrawal. They either cannot manage the material, bear the pressure to perform, or feel that the performance requirements are too high. Another somewhat weaker motive relates to financial problems during higher education, with 11% reporting that financial constraints or the inability to combine studying with working agreements lead them to withdraw from college. These results emphasize that students in Germany struggle more with adjusting to the academic life and performance requirements than with the financial burden associated with college education.

Given the heterogeneous landscape in Germany due to federal state regulations, this study uses data from one specific federal state, Berlin. Focusing on one federal state in Germany mainly leads back to keeping the costs of the field experiment in acceptable relation to expected results.[15] In addition, concentrating on one federal state also bears the advantage of examining a singular setting, as regulations and college transitions vary across states.

## 3. Experimental set up and target sample

To identify the relevance of information for post-secondary educational choices – in particular among students from non-college family backgrounds – we set up a RCT. The

[13] In 2006, seven out of sixteen federal states introduced tuition fees (around EUR 500 per term), which triggered a lively discussion about fairness in access to university education. However, by 2014 all states had abolished tuition fees.

[14] While curricula in universities typically follow a more theoretical orientation, universities of applied sciences focus on application-oriented study programs that are often offered in close collaboration with companies.

[15] As we describe in Section 4, trained colleagues went to the treatment schools, which was not only time consuming, but also would have been more expensive to implement across Germany.

field experiment was in part motivated by the fact that students whose parents do not have a college degree are less likely to enroll in college, despite being good performers. Figure 1 shows the distributions of high school GPAs for students who enroll in college and those who do not (graduating class of 2014) differentiated by students' socio-economic background.[16] The left hand side of Figure 1 shows that there are many non-college background students among those not enrolling in college who perform equally well as those who enroll in college. The plots suggest that there exists a considerable share of high performing students that could potentially be encouraged to enroll in college.

[Figure 1 about here]

We randomly treated some high schools in Berlin with an in-class presentation on the benefits of higher education as well as on potential financing strategies.[17] The RCT is targeted to high school seniors one year prior to graduation and was conducted as part of a larger project called ***Be****rliner-****Stu****dienberechtigten-****P****anel* (Best Up).[18] Within this larger Best Up-project, a financial constraints hypothesis regarding college transition of non-college background students was also examined (for further information see Ehlert et al., 2017). For this purpose a financial treatment was offered to a very specific and small subgroup of students, namely to those, who at the beginning of their final high school year, reported having the intention to pursue a vocational degree *(N=81)*.[19]

In the Best Up-project we targeted 27 schools that have a large share of students from non-college family backgrounds. There are 137 schools in Berlin where students can earn their *Abitur* (see Section 2 for details on the school system). Out of these 137 Berlin high schools, 33 schools admitting high performing students in grade five are excluded from the target population, since students with a non-college background are underrepresented in these schools. We stratified the remaining 104 schools according to (1) school type; (2) share of population aged 25 and older with low education (ISCED 0-2) per district; (3) cohort size one year prior the *Abitur* exams; (4) share of students with migration background; and (5) share of female students.[20]

[16] We calculated the kernel distributions of students' final GPA using data from the German National Educational Panel Study (NEPS). Final GPA ranges from 1.0 to 4.0 with 1.0 being the best GPA result.

[17] As part of the setup of the randomized controlled trial, we conducted a power analysis to judge the feasibility of the intervention. Taking the full cohorts of 27 schools (clusters), i.e. about 2,500 students of which roughly 75% intend to go to college, as potential sample and assuming a response rate of 60%, the minimum detectable treatment effect is equal to 6 pp (with $\alpha$ equal to 0.05 and $\beta$ equal to 0.20). Factoring in a panel mortality of 20% leads to a necessary minimum detectable treatment effect of 7 pp.

[18] The project was a co-operation between the German Institute for Economic Research (DIW Berlin) and the Berlin Social Science Center (WZB). The Best Up-project was funded by the Einstein Foundation Berlin. For further information on the project see Ehlert et al. (2017). However, in this paper we use an additional wave of the *Berliner- Studienberechtigten-Panel*, which was funded by the German Science Foundation (DFG) as part of another project at DIW Berlin.

[19] To account for this second treatment, we control for these schools with a dummy variable in the estimations.

[20] With the exception of the share of low educated individuals within a district, all variables are measured at the school level. By including district-level information to draw the school sample, the RCT

During January and February 2013, we contacted schools and asked whether they would be willing to participate in a study that aims to gain a better understanding of what type of support students need to choose their post-secondary educational path. After schools had agreed to participate, schools within school types were randomly assigned into treatment and control groups. The final sample consists of nine information treatment schools. After allocating schools into treatment and control groups, we contacted headmasters again to schedule a date for the planned survey of the targeted students. For the nine information treatment schools, we requested an additional hour to conduct the information intervention in-class. A few weeks before the scheduled survey and our visit to the schools, an invitation to participate in the survey was distributed among all students who were on track to take *Abitur exams* the following year (in summer 2014). The cohort size varies across schools. While in the larger high schools up to 170 students were targeted, in the smaller high schools up to 40 students were expected to participate. We visited the majority of schools in May 2013 and some schools in the first two weeks of June 2013, so students in the treatment schools were provided with information one year prior to high school graduation. Visits were typically three school lessons in length[21], two lessons to conduct the baseline survey and two tests to measure students' cognitive competences[22] and one lesson for the intervention. Among the nine information treatment schools, we were unable to conduct the information workshop in one school due to a miscommunication between the headmaster and its teaching staff.[23] We address the non-compliance of this one school in more detail in Section 6.5, where we show that reassigning this school to the control group or implementing a two-stage-least-squares (2SLS) approach, instead of disregarding this school from our sample, does not alter our conclusions.

As described, randomization was performed at the school level. However, our analysis is conducted at the student level. For this reason, we test whether randomization successfully balanced pre-treatment covariates at the individual level. In Table 1 we report control group means and treatment-control differences not just for individual student characteristics but also for a set of variables that relate to students' perception of the costs and benefits of college education.

[Table 1 about here]

setup aimed at oversampling students from lower educated backgrounds. Stratification was implemented using coarsened exact matching (CEM) as proposed by Iacus et al. (2009). Stratification was only used to draw the school sample and played no role in randomization.

[21]In Germany a school lessons lasts 45 minutes.

[22]Students' figural and verbal competencies were measured based on the I-S-T 2000-Test, which is also used in the German Socio-Economic Panel (SOEP) study to assess the cognitive competencies of adolescents (for further information see Ehlert et al., 2017).

[23]Nonetheless it was possible to survey some students in this school.

As can be seen, with the exception of students' migration background,[24] neither the background characteristics, nor the variables relating to beliefs differ significantly between treatment and control group students. Students in the treatment group are not more/less likely than students in the control group to think that the unemployment risk is smaller with a college degree, or that the prospects of finding a well-paid job are higher, or that lifetime income is higher with a college degree than with a vocational degree. Students in the treatment group do also not feel better or worse informed about college education and are not more/less likely to perceive the cost burden of college education as high when compared to control group students. However, we see marginally statistically significant differences between treatment and control groups regarding school type and cognitive test score. Whereby one difference, namely in respect to whether students at vocational oriented high schools (*berufliches Gymnasium*) pursue the so-called "fast track vocational degree" option, reveals a statistically more significant difference.[25] We learned about this option only after conducting the school survey. Therefore, we include a dummy variable indicating the fast track option together with the other marginally statistically significant differences as covariates in our estimations (see also Section 5).

## 4. Information intervention

The information intervention consists of two components: a 20-minute in-class presentation and a 3-minute video. The in-class presentation comprises information on the benefits of college education in comparison to vocational education as well as information on different funding possibilities for college education.

The information intervention comprised visual material to make it more accessible and mainly addressed three topics: labor market returns of college education, costs of college education, and funding options. Regarding labor market returns, we showed students earnings, career perspectives and earnings over the life-cycle always comparing individuals with a college degree to those with a vocational degree – conditional on holding the *Abitur*. Tailoring the information to individuals with *Abitur* and higher educational qualifications provided students with information that is partly not readily available. General numbers on earnings shown in newspapers, documentations or on the web do not distinguish by highest schooling degree. Providing information specifically for students with *Abitur* is important in the German context, as the *Abitur* is a prerequisite for college enrollment, but not necessarily for VET. However, the returns to a vocational degree largely depend on the highest achieved schooling degree, as students with lower secondary schooling degrees are not qualified to apply to all vocational education programs. Apart from comparing

[24] There are slightly more students with migration background in the treatment group.

[25] This option allows students to continue at school after high school graduation for one more year in order to obtain a vocational degree. This option applies to three vocational schools in our sample and a very small share of students, 44 students out of 1578 (3%), pursue this option.

labor market returns with a college or a vocational degree, the presentation also discussed results on differences in earnings by gender and across fields of study.

Furthermore, the presentation material comprised information regarding different college funding possibilities. We informed students about the three major funding sources in Germany (1) student aid, i.e. *BAföG (Bundesausbildungsförderungsgesetz)*; (2) scholarships; and (3) student jobs. We specifically highlighted the most important repayment regulations of student aid, as many eligible students tend to believe they have to pay back the full amount directly after graduating from college. Whereas in fact only half of the amount received as student aid must be repaid and repayment obligations only start once earnings exceed a certain threshold. Given that the application procedure for *BAföG* is nearly as complex as for the FASFA in the U.S. (Bettinger et al., 2012), we specifically stressed that it is worthwhile to invest the time and effort to fill out the necessary forms. Unlike in many other countries, financing college education through a scholarship is not (yet) very common in Germany. The information workshop aimed not only at raising the awareness for scholarships but also pointed students toward a (at the time) newly established website helping students to find scholarships. Complementary to information about funding we emphasized that no direct costs of university education exist, as students do not have to pay tuition fees (anymore). Moreover, we showed students that average monthly costs of college education equal their living expenses, which have to be financed irrespective of the educational path taken. Figure A.1 in the Appendix show example slides of the material presented in the information workshop.

The discussion of potential channels of the information intervention in Section 6.4 shows that students processed the information from the in-class presentation. Treated students are more likely to rate labor market benefits to be higher with a college degree than with a vocational degree and also feel better informed about funding possibilities.

The information intervention avoids "advertising" college education as being superior; it rather provided research-based information that should support students in making a more informed decision. Compared to McGuigan et al. (2016) and Kerr et al. (2015), we trained two researchers to present our material in front of the class and provided a concise script instead of asking teachers and students counselors to present the information material, who might provide the information with their own interpretation or selection of the material. Consequently, our method of information provision ensures a consistent treatment. The other component of the information workshop was a 3-minute video at the end of the session that summarized the information of the presentation. With this second feature of the intervention, we further guaranteed standardization of treatment. At the same time, the video highlighted the key take-home messages of the presentation in a compact way. We argue that this may indeed be the part of the information workshop capturing students' attention and imprinting the key points on students' memory. Moreover, this short video may have made the information more salient than in

comparable studies providing information (e.g. Oreopoulos and Dunn, 2013; Kerr et al., 2015; McGuigan et al., 2016).

## 5. Data and empirical strategy

We conducted six surveys: one baseline survey and five consecutive surveys that followed students up to four years after treatment. Table 2 summarizes the different survey waves, reports response rates, and the number of observations in each wave. The pre-treatment survey was an in-school paper-and-pencil questionnaire.[26] Taking the full cohort as a reference, we were able to survey 60% of students (N = 1,578) in the schools. The following five surveys were implemented as on-line surveys.[27] Response rates are very stable from the second survey onwards (nearly always above 90%). However, given the change in survey modes between the school and the first follow-up survey, the response rate in the latter equals 70% (N = 1,105).[28] The baseline survey was conducted one year prior to students' high school graduation and the first follow-up survey was implemented 2-3 months later. For the next four years we followed students during the post-secondary educational phase and surveyed them once a year. For the small sixth survey in fall 2017 only the respondents of the last survey conducted within the Best Up project could be contacted (N=981). For this short follow up online survey in summer 2017, students received no incentive, yet the response rate remained comparably high as 720 students participated. This is equal to a response rate of 74%.

[Table 2 about here]

Although attrition rates are comparatively low, especially from the second survey onwards, attrition in our sample is not random. Comparing student characteristics across attritors and non-attritors shows some significant differences (see Table A.1 in the Appendix). However, neither does attrition differ between treatment and control groups, nor do student characteristics influence survey-dropout behavior differently across these groups.[29]

Our analysis focuses on three main outcomes: students' college application, college enrollment in the same year of high school graduation (direct enrollment), and enrollment within one year after high school graduation. Given the German context, measuring students' college application behavior is somewhat difficult (see Section 2 for more details). First, not all study programs require students to apply. In many programs, they can just enroll without any further requirements. Secondly, we only have information on students'

[26] In treatment schools, the survey was conducted directly preceding the information intervention.

[27] The administration of the surveys was carried out by a renowned survey institute (Kantar Public, formerly TNS Infratest Sozialforschung).

[28] Considering the change in the interview mode, this response rate is very high and satisfactory compared to similar RCTs.

[29] Differential attrition was tested using a Chow test.

application behavior in the summer following high school graduation, i.e. applications to start studying in the following winter term (October 2014). Despite these difficulties, the effect on application rates is particularly interesting, because it abstracts from supply side restrictions, i.e. from the fact that some students who wanted to enroll in college are not admitted immediately.

When measuring college enrollment in the German context, the timing of enrollment must be considered, as a considerable share of students does not enroll in college directly after high school graduation. Among all students who graduate with *Abitur*, on average three-quarter enroll in college (Destatis, 2017). For example, looking at high school graduates from 2010, 75% enroll at all, i.e. observed up to 4 years or more after high school graduation. Out of these 75%, 37% enroll in the same year of high school graduation, while 24% delay their enrollment by one year, and only a comparatively small fraction of around 5% postpones college enrollment for two years; the remaining 9% enroll three to six years after high school graduation (Destatis, 2017). Analyzing just enrollment in the year of high school graduation, i.e. *direct enrollment*, likely results in misleading conclusions as many students take a so-called gap year before starting college education. Thus, we also examine *enrollment within one year*, which comprises college enrollments in the year of high school graduation as well as enrollments one year later.

We only include students for whom we have information on their parents' education and their pre-treatment intention to enroll in college. In order to maximize the statistical power, we keep all students for whom we have information on at least one of our outcomes. This leads to variation in the number of observations across our outcome variables. Note, however, that the conclusions remain very similar if we analyze the balanced sample (see Section 6.5).[30] As outlined in Section 3, it was not possible to implement the information workshop in one of the nine randomized information treatment schools. We run all analyses without the students from this particular school. But we address the sensitivity of dealing with this non-compliance in the robustness section verifying that the conclusion remains unaffected.[31] Table 3 provides some descriptive information on students' background characteristics as well as on the three main outcome variables, i.e. students' college application behavior, their actual enrollment in the year of high school graduation or one year later. On average students in the sample were between 18 and 19 years old at the time of the information treatment. Around 60% of the sample is female and has a non-college family background, defined as having no parent (biological or social) with a college degree. Approximately 54% of students have a migration background, 28% attend the general high school *(Gymnasium)*, while 38% attend a comprehensive

[30]Point estimates and statistical significance, however, differ slightly.

[31]In the robustness section, we consider alternative approaches to deal with the non-compliance: First, we follow a two-stage least squares approach and use the original treatment assignment as an instrument for the actual treatment status. Second, we re-assign this particular school to the control group. None of these tests affect our estimates substantially.

high school *(Integrierte Sekundarschule)* and 34% go to a vocational oriented high school *(berufliches Gymnasium)*. On average, students' high school graduation grade (*Abitur* GPA) equals 2.6, which is slightly below the Berlin average *Abitur* GPA of 2.4.[32]

[Table 3 about here]

Regarding our outcomes, around 77% of students state an enrollment intention one year prior to high school graduation, while 57% of students actually apply for college in the summer of high school graduation. Looking at college enrollment: 38% start studying directly after high school graduation, i.e. in the subsequent winter term. This share increases almost to 60% if we consider enrollment rates within one year. Compared to the German average college enrollment rates of a graduating cohort (see above and Destatis, 2017), a smaller share of students in the sample enrolls in college, which is reasonable, since we oversampled students' from non-college backgrounds.

We calculate treatment effects of the information intervention on college application and enrollment using the following specification:

$$y_{is} = \beta_0 + \beta_1 T_s + S_i'\beta_2 + \beta_3 F_s + \beta_4 I_i + X_i'\beta_5 + \epsilon_{is} \tag{1}$$

where $y_{is}$ is one of our three main outcome variables of student $i$ in school $s$. $T_s$ is the treatment indicator such that $\beta_1$ depicts the effect of the information intervention and is the coefficient of interest. $S_i$ is a set of binary variables specifying the type of high school students attended and $I_i$ indicates students' pre-treatment intention to enroll in college. As noted above, given the slight imbalance in few covariates across treatment status at the individual level (see Table 1), we control for these characteristics by including an additional vector, $X_i$, in our estimation equation. $X_i$ comprises gender, parental educational background, migration background, final high school GPA, and the combined score of the cognition tests.[33] We also account for a school specific regulation that offers students a fast track toward a vocational degree.[34] Apart from accounting for the slight imbalance in student characteristics, including these covariates may also increase the precision of our treatment effect estimates (Angrist and Pischke, 2009). Finally, $\varepsilon_{is}$ is the error term.

As mentioned in Section 3, another treatment was implemented within the larger project that addresses a very specific subgroup of students. To account for this, we include a binary variable indicating whether a school was randomized into this second treatment arm ($F_s$). Hence, we only compare students who received the information workshop with

[32]Recall that *Abitur* grades are measured from 1.0 to 4.0, where 1.0 corresponds to the best possible grade.

[33]We deal with missing values on migration background and final high school GPA by replacing these with a constant and including a binary missing value indicator in the estimation.

[34]Some vocational oriented high schools offer students a specific program that enables them to earn a vocational degree if they stay on for one additional year after high school graduation.

students who did not receive any treatment at all. Since randomization is at the school level, error terms are potentially correlated within schools. Finally, we cluster standard errors at the school level, as recommended by Cameron and Miller (2015).

We estimate this model in the overall sample and additionally perform various subgroup analyses for students from non-college backgrounds, students at the margin to enroll in college, and a combination of these two subgroups.

## 6. Results

Before we present the main estimation results, we first provide descriptive evidence on the effects of the information intervention on application and enrollment behavior. Table 4 shows means across treatment status of related outcome variables for the whole sample as well as for two subgroups: students from non-college backgrounds and students with pre-treatment intentions to enroll in college.[35] We consider the latter group of students to be a relevant subgroup for at least two reasons: First, the main aim of the project is to analyze potential policy measures that help students from non-college backgrounds to enroll in college. Second, previous research shows that even though students from disadvantaged backgrounds start out with high educational aspirations, many do not manage to actually pursue these plans. If a low-cost information workshop effectively supports students to maintain their educational plans and translate these plans into actual behavior, such an intervention may be an efficient tool to reduce socio-economic differences in college education. Thus, in the last column in Table 4 we combine both subgroups depicting means for students from non-college backgrounds with a pre-treatment study intention.

[Table 4 about here]

As shown, students in the treatment group are slightly less likely to have a study intention one year prior to high school graduation, i.e. prior to treatment. Nevertheless, looking at students' application and enrollment behavior, Table 4 shows that this negative difference is turned and the differences between treated and control students becomes positive. This provides a first indication that the information workshop indeed motivates students to apply for, and enroll in, college. In the subgroup of students from non-college family backgrounds, the differences in pre-treatment study intentions between treatment and control groups is larger than in the whole sample, but the general pattern remains similar. Application and enrollment rates of students from non-college backgrounds are positively affected by the information workshop. Focusing on students who are at the margin to apply or enroll in college, i.e. those with prior intentions, shows that students in the treatment group are more likely to apply and directly enroll (around 3-4 pp).

[35] Students answered the following question, which translated reads: "Thinking of everything you know today: Which type of education will you most likely pursue after graduating from high school?".

Furthermore, looking at enrollment rates within one year, treated students with study intentions prior to the intervention are even more likely to enroll (6 pp). Furthermore, the mean differences between students in treatment and control groups are even larger if we concentrate on students from non-college backgrounds with pre-treatment intentions: In this group around 71% of treated students enroll within one year after high school graduation compared to 64% of control students, i.e. a higher share of treated students enrolls within one year (around 7 pp). Overall, the descriptive evidence provided in Table 4 suggests that our information workshop effectively increase college enrollment.[36]

*6.1. Effects on college application and enrollment*

Our main estimates are shown in Table 5. The first column of Table 5 presents the effect for the whole sample, while in the second and third column we exclusively look at students from non-college backgrounds and students with a pre-treatment study intention, respectively. Finally, in column four, we combine these two groups and consider the effect of the information workshop on students from non-college backgrounds at the margin. Panels A-C indicate our main outcomes, i.e. direct applications, direct enrollments and enrollments within one year after high school graduation. In the overall sample, the information workshop increases the probability to apply for college shortly after high school graduation by 7 pp. The effect is even larger if we consider actual college enrollment in the year of high school graduation (around 10 pp). Examining not only direct transitions but acknowledging that a considerable share of students take a gap year between high school graduation and college enrollment, in Panel C we analyze the effect of the information workshop on college enrollment within one year after high school graduation. The effect decreases to 6 pp and is marginally statistically significant. The reduction in effect size indicates that the information workshop partly encourages students to directly enroll in college and to refrain from delaying their enrollment by a year. Nevertheless, an increase in college enrollment rates of almost 6 pp is a substantial effect. In particular, when compared to the effect sizes of increasing student financial aid on enrollment rates in Germany. In this regard, Steiner and Wrohlich (2012) predict that an increase of 1,000 Euro per year in student financial aid will increase the probability to enroll in college within five years by 2 pp.

[Table 5 about here]

While the overall effect already provides evidence that information provision is an effective tool to increase college enrollment, we are particularly interested in the effects for students from non-college backgrounds. Hence, in column 2, we exclude all students who have at least one college-educated parent. The results in column 2 of Table 5 show

[36] We report these descriptive differences, as they are sizable, albeit they are statistically insignificant, which we mainly attribute to the small sample size.

that, for students from non-college backgrounds, the information workshop increases the probability of directly applying to college by 7 pp and similarly increases the likelihood of enrolling in college in the year of high school graduation by around 8 pp. Panel C further shows that enrollment rates within one year are likewise increased by around 6 pp for these students. However, effects are imprecisely estimated in this subsample, such that statistical significance at conventional levels cannot be established.[37]

Considering the short run results of an earlier study using Best Up-data by Peter and Zambre (2017), who show that the information workshop mostly helps students to maintain their post-secondary educational plans, we additionally look at the likelihood of students at the margin to enroll in college in Table 5. Column 4 shows that, for these marginal students, the information workshop increases the probability to directly apply or enroll in college by around 12 or 13 pp. This effect persists when looking at enrollment rates within one year (11 pp). These estimates show that the information workshop helps students to actually follow through on their enrollment intentions.

In the last column of Table 5 we look at the subgroup of students from non-college family backgrounds with pre-treatment intentions to see how this particular group of students is affected in the long term. Indeed, the estimates indicate that the information workshop increases the probability to enroll in college within one year for these students by around 15 pp. The point estimates of the effect on application and direct enrollment behavior are of similar size (13 / 14 pp) but only marginally statistically significant given the reduced sample size in this subgroup.

In sum, almost all estimates are statistically significant and the size of the effects points toward a substantial economic significance showing that the information intervention affects students' application and enrollment behavior. Our results emphasize that we should not disregard information provision as an effective and low-cost tool to increase college enrollment, especially for students at the margin to enroll.

### *6.2. Effects by academic performance*

While the information workshop aimed at enabling students to make a more informed post-secondary educational choice and not to advertise college enrollment, *per se*, a natural question is whether such an information workshop may, in fact, also encourage students to enroll in college whose academic performance may prevent them from finishing college education. In light of this concern, we examine the effect of the information treatment, distinguishing students by their academic performance in school. We define academic performance based on students' final high school GPA, which is closely related to success in college (e.g. Beattie et al., 2018). Students with a high school GPA that is better or equal to the median GPA of the sample are classified as "higher performing," while

[37] In contrast to the results of Peter and Zambre (2017), who show that the information workshop affects students from different educational backgrounds differently in the short run, the longer run effects of the information workshop do not differ significantly by students' educational background.

students with a final high school GPA worse than the median GPA are classified as "lower performing." Although final high school GPA is measured after treatment, in Table A.2, we show that the information workshop has generally no effect on students' final high school GPA. Thus, using this post-treatment variable to split the sample is of no concern.

[Table 6 about here]

The results presented in Table 6 suggest that the information workshop mostly – but not exclusively – affects college enrollment rates of higher performing students. Treated higher performing students are around 12 pp more likely to enroll in college than comparable students in the control group (see Panel C, column 1). The effects of the information workshop remain similar when looking at higher performing students among those from non-college family backgrounds or those with pre-treatment intentions to enroll. Although we find that, among this latter group, the information workshop also induces lower performing students to apply and enroll in college, we point out that, given the less restrictive college admission process in Germany (see Section 2), in general a considerable share of lower performing students enroll in college, which is also depicted in Figure 1. Nonetheless, if final high school GPA is indeed a valid predictor for students' success in college, these results suggest that a small fraction of treated students may be more likely to drop out college. This concern is addressed in the next section.

### *6.3. Effects on college persistence*

The previous sections show that the information intervention effectively increases students' college enrollment, in particular for those with prior intentions. At the same time, we find some evidence that the workshop also encourages college enrollment among a few lower performing students. Naturally, the question arises if those who enroll in college in response to the information workshop might be, consequently, less likely to persist in college. While we cannot observe whether students graduate from college yet, we know if they are still enrolled up to two years after their initial enrollment. In Table 7, we investigate the effect on study persistence for students who enroll in the year of high school graduation or the year after, i.e. within one year after high school graduation. In Panel A of Table 7, we estimate whether students in the treatment group are still enrolled one year after enrollment, i.e. for two consecutive semesters. Similarly, in Panel B, we analyze whether students are still in college two years after enrollment, i.e. for four consecutive semesters.[38]

[Table 7 about here]

[38]For all students who take a gap year before enrolling in college, this outcome measures persistence one and a half years (and not two full years) after enrollment. This slight difference goes back to the timing of the short follow up survey in summer 2017, which took place in the context of a different project.

Given that our outcomes on study persistence are only defined for students who enroll in college, the sample size clearly decreases, thus reducing statistical power. Nevertheless, we see in Table 7 that treated students are more likely to persist in college than students in the control group: around 5-7 pp in the whole sample (column 1) as well as in the subgroup of non-college background students (column 2). The point estimates for enrollment and persistence suggest that students induced to enroll by the information workshop are certainly not less likely to persist in college than students in the control group; if at all, they are even somewhat more likely to be still studying. When we look at students with pre-treatment study intentions (column 3) and those from non-college family backgrounds with prior intentions (column 4) the same pattern emerges. Overall, the estimates in Table 7 suggest that treated students are slightly more likely to persist in college than students in the control group. Considering that in Germany, most college students tend to drop out within the time frame analyzed in this paper, i.e. during the first two years of their study program (Heublein et al., 2017), it seems reasonable to assume that treated students will earn a college degree as likely as students in the control group.[39]

### *6.4. Channels*

As we have shown that the information intervention affects the college enrollment of students, we now aim at identifying potential channels through which students may have updated their beliefs about benefits and costs and subsequently may have affected their decision to enroll in college. As described above, the information treatment comprises a bundle of topics about college education (see Section 4). Given this bundle of information, we cannot identify exactly which topic or aspect of information is most relevant in explaining the increase in college enrollment rates. By analyzing if the information workshop improved students' knowledge and/or beliefs regarding college returns, cost or funding options, we may, however, shed some light on the potential channels.

In Table 8, we compare control group means and treatment group differences for a set of variables that are related to the information treatment. We start by analyzing students' knowledge about student financial aid *(BAföG)* in Panel A. Students in the treatment group are almost 8 pp more likely to know that only half of the received amount of student aid needs to be repaid. In addition, treated students are 10 pp more likely to know that repayment obligations only start once students are employed and not immediately after college graduation (7 pp). While only these three aspects were emphasized during the information workshop, it is possible that it also led students to gather more information about financial student aid; if so, students in the treatment group would also be better informed about additional aspects of financial students aid that were

[39]The considered time frame for college dropouts refers to students who are enrolled in a Bachelor's program.

not explicitly communicated during the workshop. However, this does not seem to be the case. Students in the treatment group are neither more likely to know that the eligibility for student aid depends on parental income than students in the control group, nor are they more likely to know that repayment obligations are capped at 10,000 EUR and that repayment obligations are reduced if students earn very good grades in college.

In Panel B of Table 8, we compare differences in students' perception regarding the "costs" of college education. As shown, students in the treatment group are 5 pp more likely to feel well informed about college education than students in the control group. Although this difference just misses the threshold for marginal statistical significance (p-value: 0.12), it indicates that treated students feel better informed when compared to students in the control group. In addition, treated students are 13 pp more likely to feel well informed about funding options for college education and 10 pp more likely to agree with the statement that "borrowing money to finance studies is a good investment."

Regarding students' beliefs about the returns to college, in Panel C we consider students' perceived unemployment risk as well as their beliefs about earnings; as in the information workshop, college returns are compared to a vocational degree. Table 8 shows that treated students updated their subjective beliefs in the expected way. Students in the treatment group are significantly more likely to expect their unemployment risk to be lower and their life-time income to be higher with a college degree than with a vocational degree. Additionally, students were asked about their expected earnings at the age of 35 and 50 conditional on earning a) a Master's degree and b) a vocational degree.[40] Based on this information, we calculate students' expected relative earnings premium and compare it across treatment status. Again, treated students are more likely to expect a higher earnings premium for a college degree. Another interesting aspect relates to students' expected earnings over the life cycle. We find that students in the treatment group expect the increase in earnings from age 35 to age 50 to be much larger with a Master's degree than with a vocational degree. However, this difference is not statistically significant.

Finally, in Panel D of Table 8 we analyze some behavioral response that may explain why treated students seem to be somewhat more likely to persist in college. Students in the treatment group are around 8 pp more likely to have applied for financial student aid *(BAföG)* and 2 pp more likely to have applied for a scholarship. While the latter difference points toward a positive effect, it is not statistically significant.

Overall, Table 8 shows that the information intervention provided students with relevant information that changed their knowledge and beliefs about the returns and funding possibilities of college education in such a way that we would indeed expect higher

[40]Students were also asked about their earnings expectations with a Bachelor's degree; however, as the two-tier degree system is still relatively new in Germany, labor market returns of these new degrees are less known. Existing research shows that earnings with a traditional German college degree are more comparable to earnings with a Master's degree, while earnings with a Bachelor's degree are closer to earnings with a vocational degree (Neugebauer and Weiss, 2017).

college enrollment rates among treated students. Further, given that student beliefs not only change in one domain, e.g. regarding returns of college education, but rather in all domains that were addressed in the information workshop, we show that it may in fact be the combination of information that triggers the increase in college enrollment rates among treated students. Boneva and Rauh (2017) provide further evidence that indeed a combination of pecuniary and non-pecuniary information is likely to influence students' educational decisions.

*6.5. Sensitivity analysis*

Table 9 shows the results of our sensitivity analysis. For comparison, we also report the estimates of our main specification. For each of our three main outcome variables, we perform the following robustness tests. First, instead of maximizing statistical power by using all information available, i.e. using the maximum number of observations for each outcome variable, we rerun our estimations using only students for whom we have information on all three outcomes. Second, to account for survey attrition and item non-response, we rerun our estimations using inverse probability weighting. We estimate the probability to be in the analyzed sample using the following student characteristics as predictors: attended high school type, gender, parental educational background, migration background, pre-treatment study intention, combined scores of the cognitions tests, and a binary variable indicating whether the contact information collected in the baseline survey was valid. Third, we account for the small number of clusters (27 schools) by reporting corrected p-values based on the wild cluster bootstrap-t procedure as suggested by Cameron and Miller (2015). The remainder of our robustness tests relate to different approaches to address the one non-compliant school that, despite being randomized into the treatment group, did not receive the treatment due to internal school organizational difficulties on the day when the information workshop was scheduled. While in our main specification we reassign this school to the control group, in Table 9 we apply two alternative approaches. First, we exclude students from this particular school from our sample and rerun our estimations. Second, we implement a two-stage-least-squares (2SLS) approach and use the original treatment assignment (as obtained from randomization) to predict actual treatment status and use the predicted treatment status to estimate the effect of the information workshop. Overall, the results of the robustness analyses show that in some specifications standard errors are rather large, the point estimates remain surprisingly stable across the different specifications. Moreover, the effects of the information workshop are particularly robust to different estimation specification in the subgroup of students who are on the margin of enrolling.

[Table 9 about here]

*6.6. Cost-Benefit Considerations*

We show that our information workshop increases college enrollment, especially for students with pre-treatment intentions. Thus, assuming students graduate with a degree,

they are shifted toward higher-paying jobs, potentially yielding substantial benefits for individuals and society. Yet, higher college enrollment and graduation rates also induce costs, in particular for the German public, as college education is not financed via tuition fees. Therefore, we provide a back-of-the-envelope cost-benefit consideration in this section and calculate the net benefits from an individual's and a public perspective. We assume a discount rate of 3 percent throughout our calculations.[41] In addition, we provide estimates of the private and public internal rate of return of our information intervention. Considering the public perspective is particularly relevant in a tuition free context as in Germany, an increase in take up of college education induces costs that are covered by the public rather than by students.

*Costs of the information intervention.* Recall that the information intervention consists of a 20-minute in-class presentation held by a trained researcher and a 3-minute video summarizing key points of the intervention. The costs of the information workshop comprise set-up costs as well as implementation costs (see Table A.4 in the Appendix for details). The set-up costs of the intervention, i.e. compiling the information, preparing presentation slides and the video, consist mainly of hours worked by a post-doctoral researcher and research assistants. In order to set up the information workshop, we needed approximately 40 hours worked by a post-doctoral researcher and 40 hours worked by a research assistant. Using the standard hourly wage of a post-doctoral researchers and of research assistants in 2013 and adding overhead costs of 20% (use of computers, office space etc.), the set-up costs of the treatment are equal to 2,233 Euro. The implementation costs comprise the costs associated with giving the information workshop in schools. These consist of two hours worked by the trained researchers, overhead costs and public transportation fees per researcher and school. This amounts to total implementation costs of 657.11 Euro, or around 1.30 Euro per treated student. Hence, total costs of the information intervention equal 2,890 Euro, or 5.90 Euro per treated student.

*Average net benefit from an individual's perspective.* We show that our information workshop increases college enrollment on average by 5.6 pp. Assuming that students induced into college by the information workshop successfully earn a college degree, we consider the discounted average lifetime earnings difference between individuals with and without a college degree as potential benefits. According to administrative data from the German Employment Agency (Schmillen and Stüber, 2014) and based on a stylized educational path,[42] lifetime earnings for individuals with [without] a college degree amount to around 2,319,936 Euro [1,560,831Euro]. Assuming a discount rate of 3 percent, we get an average discounted lifetime earnings difference between individuals with and without a college degree of about 300,638 Euro (see Table 10). Given our treatment effect of 5.6

[41] We discount all values to the year of the information treatment, i.e. one year prior to high school graduation.

[42] We assume that students graduate from high school at age 19 and that earning a college degree takes 5 years. In addition, individuals work until retirement at age 65.

pp and assuming that everybody who does not earn a college degree obtains a vocational degree, we can compare the difference in average discounted lifetime earnings in treatment and control groups.[43] This comparison shows that discounted lifetime earnings per student in the treatment group are on average (potentially) 16,836 Euro higher than in the control group.[44] The internal rate of return (IRR)[45] from an individuals' perspective, i.e. the rate at which the net present value (net benefit) of the information intervention becomes zero, equals 0.19.

[Table 10 about here]

*Average net benefits from a public perspective*: In order to calculate potential public benefits of the information workshop, we consider the average additional income tax revenues and social security contributions associated with the higher average discounted lifetime earnings in the treatment compared to the control group. Based on the current tax system, we assume a tax rate of 42% (this includes social security contributions) (see Table 2.6. Bundesfinanzministerium, 2017, p. 36). This yields (potential) average public benefits of 7,071 Euro.[46]

While increasing the number of college graduates increases tax revenues and social security contributions, it also increases public spending. In Germany, students do not pay tuition fees and the costs of college education are covered by the public. Hence, to arrive at the average net benefits from a public perspective, we must also consider the additional costs induced by higher college enrollment rates. To that end, we first compare the public (discounted) costs for a college degree[47] with the (discounted) costs for a vocational degree (see Table 10).[48] This difference amounts to 23,435 Euro, i.e. each student who obtains a college degree instead of a vocational degree induces additional discounted public costs of 23,435 Euro. Given our treatment effect of 5.6 pp on college enrollment, the additional average discounted public costs per student incurred by higher college enrollment rates are equal to 1,312 Euro. Adding the costs of the information intervention per student, yields an estimate for average discounted public costs of 1,318

[43] In the treatment group 64% of students enroll in college, while this share equals around 58% in the control group. We assume that everybody who does not enroll in college opts for a vocational degree, i.e. 36% in the treatment and 42% in the control group.

[44] Considering that students work about 45 years to earn these net benefits, they earn on average 374 Euro more per year.

[45] The IRR is calculated based on $IRR = \sum_{0}^{t} \frac{(B_t)}{(1+r)^t} - C_t$, where $B$ are the benefits, $C$ the costs and $r$ the discount rate.

[46] Recall, that the difference in average discounted lifetime earnings between treatment and control groups equals 16,836 Euro.

[47] One year of college education costs on average 7,000 Euro per student (see Destatis, 2015). Assuming an average time to degree of five years, the discounted costs of each additional college graduate equals 31,124 Euro.

[48] One year of vocational education induces average costs of 2,800 Euro (see Tables Appendix of Destatis, 2016a, p. 130). Assuming an average time to degree of three years, the discounted costs of each additional vocational graduate equals 7,689 Euro.

Euro. Thus, the average net benefits from a public perspective, i.e. the difference between average public benefits (7,071 Euro) and average public costs (1,318 Euro), equals 5,753 Euro per student. The internal rate of return of our information intervention from a public perspective is equal to 0.04.[49]

To compare our information workshop to other studies, we also calculate the cost-benefit ratio. In our study, the cost-benefit ratio from a student perspective is equal to $r = \frac{B}{C} = \frac{374}{6} = 62$. Carrell and Sacerdote (2017), who look at the treatment effect of a mentoring intervention on college enrollment, obtain a cost-benefit ratio of $r = \frac{B}{C} = \frac{5{,}000}{300} = 17$. Looking at another cost-benefit consideration by Bettinger et al. (2012) to induce college enrollment in the U.S., which spent about $1,100 per student, shows that these programs are effective at increasing education, yet they are also more costly. In other words, an in-class presentation of information about college is more cost effective and efficient than getting students enrolled through mentoring interventions. Even comparing our intervention to an equally inexpensive information intervention by Hoxby and Turner (2013), our estimated effect sizes are twice as high.[50]

## 7. Discussion and Conclusion

Our study aims to identify the longer-term effects of an easy-to-administer and low-cost information intervention. We examine its impact on college application, enrollment and study persistence. Given long lasting socio-economic gaps between students by parental educational background, the question is if such interventions are particularly effective for students from non-college backgrounds. As those students are particularly prone to incomplete or systematically biased information about the costs and benefits of college education this might prevent them from enrolling in college, despite their academic performance or intentions. Thus, this study contributes to the literature on the effects of information provision on college enrollment. Moreover, we add to the strand of the literature that evaluates specific measures to overcome behavioral barriers that prevent students from making optimal educational choices. With our information workshop, we address the present bias of young adults, the inclination toward routine-driven behavior, and information deficits that may result in sub-optimal choices.

We use data from a randomized controlled trial in Germany. Students in randomly selected schools in a total sample of 27 schools received information about the benefits and costs of a college education as well as about funding options. We provided information to students one year prior to their high school graduation. We delivered this information in an in-school information workshop, especially designed for students in college track schools.

[49]The IRR is equal to 0.03 if we assume a discount rate of 5% (instead of 3%).

[50]Recall our treatment costs 6 Euro per student and increases enrollment by about 10 percent; Hoxby and Turner (2013) spend $6 per student to change college choice by around 5 percent.

The results of our study differ from other RCTs about post-secondary education in the economic literature. Among these studies those solely providing information (Oreopoulos and Dunn, 2013; Kerr et al., 2015; McGuigan et al., 2016) find no effects on students' educational choices compared to those providing information using text messaging, student coaching, or mentoring as additional support (Bettinger and Baker, 2014; Castleman et al., 2014; Castleman and Long, 2016; Oreopoulos and Ford, 2016; Carrell and Sacerdote, 2017). In sum, results depend on the type of information, the timing of the provision, and on the manner of presentation (for an overview of different studies see Lavecchia et al., 2016; Damgaard and Nielsen, 2018). In contrast, our study shows that we should not discard information interventions as an effective tool to boost college enrollment. We think the difference in findings closely links to the setup of our intervention. Our intervention consisted of an in-class presentation and a 3-minute video at the end of the information workshop. In particular, the video may have imprinted the information on students' memory. Furthermore, we provided students with a mix of information about college education instead of focusing on one specific domain, e.g. costs or benefits. Since our RCT was conducted in a tuition free context, financial barriers are less likely to prevent students from college enrollment and, hence, improving students' level of information may be more effective. Given that the literature has deviated slightly from information provision to mentoring interventions as a more intensive treatment, we provide evidence that an easy-to-administer and low-cost in-class intervention can have a long lasting impact on high school students and their educational choice, in particular for those from non-college family backgrounds and those with intentions to enroll.

Our results indicate that the information intervention affects application and enrollment rates: Treated students are more likely to apply and enroll in college – 7pp and 6 pp respectively. Our estimates suggest that, for the group of students that stated an intention to enroll in college prior to treatment, the information intervention increases the probability to apply and enroll in college even more, by about 12-13 pp. This is a substantial increase compared to other findings in the German context, predicting that an increase in financial aid by 1,000 Euro, for instance, only leads to a relatively low increase (2 pp) in college enrollment (considering an enrollment window of five years after graduation) (see Steiner and Wrohlich, 2012). It is also a substantial increase compared to the effects of the few other international studies evaluating the effects of information provision – that mostly find no average effects at all. Overall, our results show that a low-cost information workshop is successful at encouraging students to follow through on their educational plans. The effects are even larger when targeting students at the margin. Thus, the treatment effects might be even higher if one were to put effort into identifying students at the margin beforehand.

Further, only very few studies are able to follow students from an information intervention in school up to college enrollment and further. To the best of our knowledge, no other study, so far, has been able to accompany students beyond enrollment. We

followed up on students four years after treatment and are therefore able to analyze students' study persistence. In the context of an information intervention, it is particularly important to test whether we encourage students to enroll in college only for them to drop out later. We show, however, that treated students do not have higher dropout rates. On the contrary, our results indicate an increase in college persistence. In the light of other German studies (for example Heublein et al., 2017) showing that dropout rates are highest at the very beginning of studying, we argue that – given the time frame of our analyses – treated students in our RCT are likely to successfully graduate from college. Thus, we expect that the information intervention will also result in higher earnings for treated students. However, for now, this remains a hypothesis, as we will only be able to test this starting in 2020, when the majority of Bachelor's students who participated in the information workshop graduate from college.[51]

Given the very low costs of our intervention, our information workshop could be easily scaled to a larger, if not, nationwide context without needing any further adaptations. Regarding the content of the information workshop, we show that it is most likely the mix of information triggering an increase in college enrollment rates. In other words, instead of providing only domain-specific information, i.e. information on the costs *or* the benefits *or* financing possibilities of college education, it may be the combination of information that has an effect on students' behavior. Thus, our work could be seen as starting point for other researchers to test and compare different options to design and present information about college to high school students in more detail.

As in all RCTs the question remains whether and to what extent we can extend our findings to other settings. Since the effects of our information intervention are strongest for students with prior intentions to enroll in college, and since this is a group that can be find in all high schools, there is no reason to assume that such a workshop would not have similar effects in any other college track high school. Thus, we consider the potential to increase college enrollment through a large-scale information intervention to be high, in fact, much higher than for cost-intensive mentoring programs or other time-intensive interventions that are likely to last for a longer period and have to run more frequently compared to a school-based workshop within a typical class hour. At least this reasoning holds in a tuition-free setting. Furthermore, we are well aware that the effect of our intervention is not likely to occur just in any other regional setting. We argue that our findings could most likely be corroborated in other major cities in Germany, i.e. Munich, Cologne, Frankfurt or Hamburg, and in other European cities in tuition free countries. Given the literature showing that distance to college matters for the probability to enroll (see for Germany Spiess and Wrohlich, 2010), the results of

[51] After students have made their transition into the labor market, we plan to combine the RCT data, via record-linkage, with German administrative data comprising information on average earnings. This will allow us to estimate whether returns to college differ.

our intervention may be different in more rural areas. Despite these regional differences, however, the level of information about college education of students in our sample is similar to the overall German average.[52] Based on a German wide representative sample, we can show that in all federal states in Germany different domains of information are significantly correlated with students' enrollment choice. It is shown that students, who already feel better informed about the financing options of college and who perceive costs as less restrictive, are significantly more likely to enroll in college (for more details, see Table A.3 in the Appendix). Thus, these results indicate that informing students about college education may be an effective tool to increase college enrollment in Germany as a whole. Overall, we argue that the presented information intervention is likely to be generalizable in a context similar to the one of Germany.

It is obvious that our intervention cannot address all issues leading to inequalities in higher education and hence, we think it is important to, at least, mention some other aspects that are likely to interact with those observed in this study. A very important factor explaining educational choices are parents, as indicated above. Instead of targeting students with different parental backgrounds, it could be another option to address parents directly. Parents with vocational degrees are likely to be prone to informational biases when it comes to college education and the associated returns. Moreover parental preferences predict children's educational choices, as shown by Woelfel and Heineck (2012) for Germany. Moreover, self-reported parental investment decisions in their children's education correlate with beliefs about the productivity of these investments (Boneva and Rauh, 2018). This suggests that parents without a college degree might not aspire to college education for their children because they worry that with a college degree their children might alienate from their family's identity (Akerlof and Kranton, 2002). Similarly, parental educational aspiration gaps by socio-economic background might emerge from differences in expected benefits of college education or its costs (Belfield et al., 2016; Lergetporer et al., 2018). Thus, another approach to close the socio-economic gap in college enrollment could be to inform parents about the costs and benefits of college education.[53] Still, even if we assume a strong influence of parental knowledge or approval of their children's educational choices, a comparable information workshop for parents would be far more costly to arrange. In addition, we argue that such an approach would likely result in a smaller long lasting information effect if any at all. Adult children might be less likely to rely completely on their parents in educational decisions and, thus, any potential effects of changes in parental beliefs will be less effective. Nevertheless, it remains an open question of whether an informational intervention for parents could be a supplementary possibility to reduce inequalities in college enrollment.

[52]See Table A.3 in the Appendix, and for a descriptive comparison between the Best Up sample and the NEPS sample (see also Ehlert et al., 2017, Table 3, p. 34).

[53]In various regions in Germany parents are informed when it comes to vocational education and training (see for example Bryant et al., 2006; Boockmann et al., 2017).

In addition, it is equally important to understand how schools, colleges, or other governmental institutions can provide better support to students from non-college family backgrounds in order to make use of all existing human potential. Considering the evidence on the impact of early interventions (e.g. Cunha et al., 2006; Cunha and Heckman, 2007), which suggests that it is more efficient to intervene earlier, our study shows that one year prior to high school graduation is not too late to reduce the socio-economic gap in higher education.

In conclusion, we show how an information workshop at school may be an effective policy measure to increase the efficient use of human capital resources, which is especially important in countries with a shrinking labor force. Furthermore, our findings provide evidence how socio-economic differences in college enrollment decrease by providing students with objective and relevant information. Such a tailored low-cost information workshop is indeed an effective tool to encourage students, in particular at the margin, to translate their intentions into actual college enrollment. In addition, we show in our back-of-the-envelope calculations that the increase in college enrollment not only renders net benefits at the individual level but also from a public perspective. The latter is important considering that our intervention takes place in a tuition free country, where an increase in college enrollment rates also leads to a substantial increase in public expenditure in post-secondary education.

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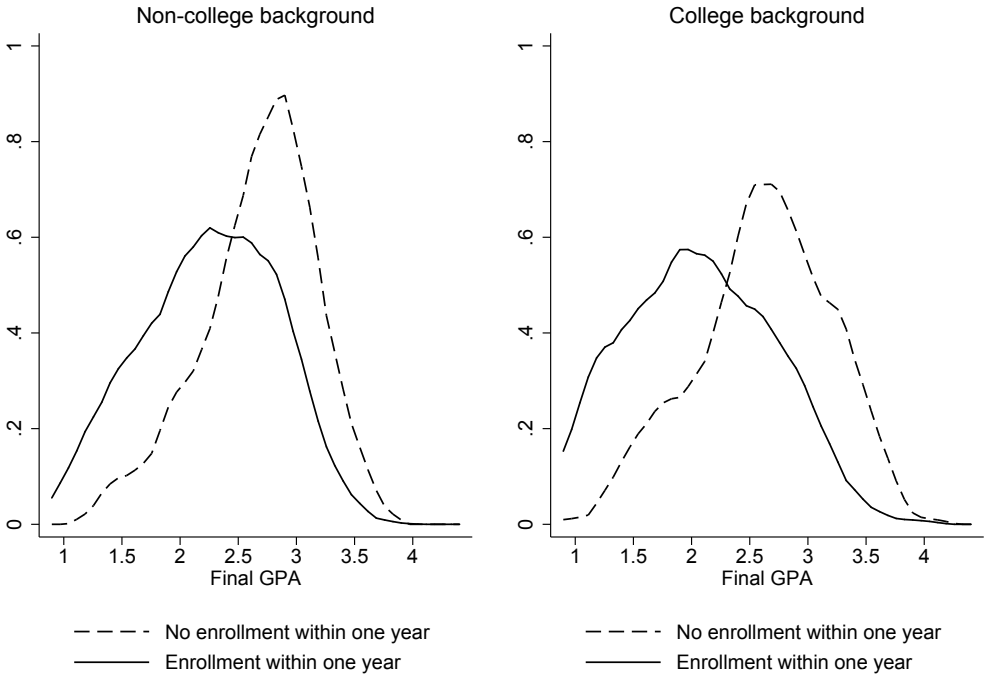
## Tables

Table 1: Covariate balance by treatment status

| | Full sample | | | |
|---|---|---|---|---|
| | Control Group Mean | Treatment Group Mean | Diff. | p-value |
| Int. college enrollment (t0) | 0.777 | 0.748 | -0.029 | 0.208 |
| **Background characteristics:** | | | | |
| Age (at baseline) | 18.553 | 18.497 | -0.056 | 0.322 |
| Female | 0.571 | 0.562 | -0.009 | 0.746 |
| Migration background | 0.518 | 0.564 | 0.046* | 0.094 |
| Non-college fam. backgr. | 0.613 | 0.618 | 0.005 | 0.850 |
| **School type:** | | | | |
| School type I (Gym.) | 0.297 | 0.262 | -0.035 | 0.152 |
| School type II (Gesamtschule) | 0.366 | 0.411 | 0.044* | 0.095 |
| School type III (berufl.Gym.) | 0.336 | 0.327 | -0.009 | 0.730 |
| Fast track to vocational degree[1] | 0.017 | 0.051 | 0.033*** | 0.000 |
| **Performance and skills** | | | | |
| German Grade | 8.580 | 8.446 | -0.134 | 0.311 |
| Math Grade | 7.714 | 7.860 | 0.146 | 0.392 |
| Score on cognition tests (0-40) | 20.198 | 20.623 | 0.426* | 0.094 |
| **Beliefs about costs and returns** | | | | |
| Unemp.risk smaller | 0.392 | 0.385 | -0.007 | 0.798 |
| Prosp. for well paid job higher | 0.702 | 0.704 | 0.002 | 0.929 |
| Life time inc. higher | 0.623 | 0.622 | -0.001 | 0.970 |
| Feeling well informed about coll.edu. | 0.336 | 0.361 | 0.025 | 0.330 |
| Perceived cost burden high | 0.377 | 0.406 | 0.029 | 0.281 |
| N | 1086 | 492 | | |
| N (total) | 1578 | | | |

*Notes:* This table presents control group means and treatment-control differences based on a two-sided t-test. [1]The so-called "fast track vocational degree" option allows students at vocational high schools (*berufliches Gymnasium*) to continue at school after high school graduation for one more year in order to earn a vocational degree. This option applies to three vocational schools in our sample and a very small share of students, 44 students out of 1578 (3%). Source: *Berliner-Studienberechtigten-Panel*, wave 1. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Figure 1: Final high school GPA and college enrollment




*Source:* Data from the National Educational Panel Study (NEPS): Starting Cohort 4, 10.5157/NEPS:SC4:9.1.0., own calculations. From 2008 to 2013, NEPS data was collected as part of the Framework Program for the Promotion of Empirical Educational Research (BMBF). As of 2014, NEPS is carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in cooperation with a nationwide network.

Table 2: Survey overview

| Year | 2013 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|
| Survey mode | PAPI | CAWI | CAWI | CAWI | CAWI | CAWI |
| Response rate | 60% | 70% | 96% | 96% | 95% | 74% |
| Time in relation to high school graduation | 1 year before | 9-10 months before | shortly after | 1 year later | 2 years later | 3 years later |
| Time passed since info workshop | 0 | 2-3 months | 1 year | 2 years | 3 years | 4 years |
| N | 1578 | 1105 | 1062 | 1020 | 972 | 720 |

*Notes:* PAPI: Paper and Pencil Interview (in school); CAWI: Computer Assisted Web Interview. In contrast to the first five surveys, in the sixth survey in 2017 students did not receive any incentives to participate.

Table 3: Descriptive statistics

| | All | Non-college family background |
|---|---|---|
| **Background characteristics:** | | |
| Female | 0.57 | 0.60 |
| Migration background | 0.53 | 0.57 |
| Non-college fam. backgr. | 0.62 | 1.00 |
| **School type:** | | |
| School type I (Gym.) | 0.29 | 0.28 |
| School type II (Gesamtschule) | 0.38 | 0.37 |
| School type III (berufl.Gym.) | 0.33 | 0.35 |
| **Performance and skills** | | |
| Final high school grade | 2.54 | 2.61 |
| Score on cognition tests (0-40) | 20.40 | 19.85 |
| **Outcome related:** | | |
| Pre-treatment study intention | 0.77 | 0.73 |
| Applied for college in 2014 | 0.57 | 0.55 |
| Enrolled in college in winter 2014 | 0.38 | 0.37 |
| Enrolled within one year after high school graduation | 0.59 | 0.56 |
| N | 1518 | 934 |

*Notes:* This table presents summary statistics for the whole sample as well as for the subsample of students from non-academic backgrounds. The number of observations may vary across variables. Source: *Berliner-Studienberechtigten-Panel*, wave 1-5. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table 4: Outcome variables: Means across treatment status

| | All | | Non-college family background | | With study intention | | Non-coll. with study int. | |
|---|---|---|---|---|---|---|---|---|
| | CG | TG diff | CG | TG diff | CG | TG diff | CG | TG diff |
| Pre-treatment intention | 77.8 | -2.7 | 74.1 | -4.7 | 100.0 | 0.0 | 100.0 | 0.0 |
| Direct application | 56.7 | 0.6 | 54.8 | 1.7 | 63.0 | 2.6 | 61.9 | 4.3 |
| Direct enrollment | 37.5 | 1.9 | 36.9 | 0.3 | 42.9 | 4.0 | 43.4 | 4.1 |
| Enrollment within 1 year | 58.4 | 1.0 | 56.6 | -0.3 | 65.3 | 5.8 | 64.4 | 6.8 |

*Notes:* This table reports control group means and treatment-control differences for different subgroups based on a two-sided t-test. Control group is abbreviated as CG and the treatment-control differences as TG diff. Source: *Berliner-Studienberechtigten-Panel*, wave 1-5. * $p<0.1$, ** $p<0.05$, *** $p<0.01$. Without the non-compliant school.

Table 5: Effects of the information intervention on application and enrollment: Main results

| | All | Non-college background | With study intention | Non-coll. with int. |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| **Panel A: Direct application** | | | | |
| Info. effect | 0.072** | 0.065 | 0.117*** | 0.127* |
| | (0.032) | (0.045) | (0.042) | (0.069) |
| N | 1011 | 636 | 774 | 459 |
| **Panel B: Direct enrollment** | | | | |
| Info. effect | 0.098** | 0.077* | 0.132** | 0.137* |
| | (0.039) | (0.044) | (0.050) | (0.068) |
| N | 1055 | 651 | 815 | 473 |
| **Panel C: Enrollment within 1 year** | | | | |
| Info. effect | 0.056* | 0.055 | 0.110*** | 0.147** |
| | (0.032) | (0.046) | (0.036) | (0.058) |
| N | 1060 | 655 | 819 | 476 |

*Notes:* This table reports the effects of the information workshop on different outcomes as indicated by the the different panels. All estimates are based on Eq. 1 and include the full set of control variables as described in Section 5. Standard errors are clustered at the school level. Source: *Berliner-Studienberechtigten-Panel*, wave 1-5. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table 6: Effects of the information intervention by students' academic performance

| | Higher performing students | | | Lower performing students | | |
|---|---|---|---|---|---|---|
| | All | Non-college family background | With study intention | All | Non-college family background | With study intention |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: Direct application** | | | | | | |
| Info. effect | 0.107** | 0.155* | 0.138** | 0.040 | 0.004 | 0.104 |
| | (0.051) | (0.077) | (0.058) | (0.056) | (0.056) | (0.072) |
| N | 497 | 287 | 430 | 442 | 300 | 299 |
| **Panel B: Direct enrollment** | | | | | | |
| Info. effect | 0.120** | 0.112 | 0.134** | 0.077* | 0.027 | 0.149** |
| | (0.052) | (0.067) | (0.056) | (0.044) | (0.044) | (0.065) |
| N | 540 | 311 | 470 | 455 | 301 | 309 |
| **Panel C: Enrollment within 1 year** | | | | | | |
| Info. effect | 0.117** | 0.138* | 0.129** | 0.015 | -0.016 | 0.138** |
| | (0.056) | (0.070) | (0.047) | (0.051) | (0.067) | (0.058) |
| N | 541 | 312 | 471 | 458 | 303 | 312 |

*Notes:* This tables reports the effects of the information workshop on different outcomes as indicated by the different panels for higher and lower performing students, respectively. Students' academic performance is defined based on their final high school GPA, i.e. students whose grades are better than the median grade are classified as higher performing, while students whose grades are worse than the median are classified as lower performing students. All estimates are based on Eq. 1 and include the full set of control variables as described in Section 5. Source: *Berliner-Studienberechtigten-Panel*, wave 1-5. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table 7: Effects of the information intervention on students' study persistence

| | All | Non-college family background | With study intention | Non-coll. with int. |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| **Panel A: Still studying after one year** | | | | |
| Info. effect | 0.045 | 0.047 | 0.034 | 0.003 |
| | (0.038) | (0.048) | (0.037) | (0.043) |
| N | 530 | 315 | 464 | 266 |
| **Panel B: Still studying after two years**[1] | | | | |
| Info. effect | 0.067 | 0.070 | 0.052 | 0.020 |
| | (0.067) | (0.077) | (0.065) | (0.072) |
| N | 442 | 260 | 384 | 216 |

*Notes:* This tables reports the effects of the information intervention on students' persistence at college, which is measured conditional on enrollment within one year after high school graduation. All estimates are based on Eq. 1 and include the full set of control variables as described in Section 5. Standard errors are clustered at the school level. [1]For all students who take a gap year before enrolling in college, this outcome measures persistence one and a half years (and not two full years) after enrollment. Source: *Berliner-Studienberechtigten-Panel*, wave 1-6. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table 8: Channels: On what information did students update their beliefs?

| | Control Group Mean | Treatment Group Diff. | p-value (of Diff.) | N |
|---|---|---|---|---|
| **Panel A: Knowledge on public student aid** | | | | |
| BAfoeG: repay half | 0.542 | 0.076** | 0.030 | 935 |
| BAfoeG: repay if job | 0.408 | 0.100*** | 0.004 | 932 |
| BAfoeG: starting repayment | 0.309 | 0.071** | 0.033 | 932 |
| BAfoeG: eligibility depends on parental income | 0.814 | -0.006 | 0.821 | 940 |
| BAfoeG: max. amount to be repayed | 0.166 | 0.021 | 0.433 | 919 |
| BAfoeG: repay less with very good grades | 0.218 | -0.019 | 0.522 | 929 |
| **Panel B: Costs** | | | | |
| Feeling well informed about college | 0.440 | 0.053 | 0.120 | 981 |
| Feeling well informed about financing options | 0.348 | 0.132*** | 0.000 | 956 |
| Borrowing money to finance studies is a good investment | 0.325 | 0.101*** | 0.003 | 944 |
| **Panel C: Returns** | | | | |
| Unemp.risk smaller | 0.327 | 0.112*** | 0.001 | 962 |
| Life time inc. higher | 0.631 | 0.117*** | 0.000 | 936 |
| Rel.inc.prem. M.A. vs. Voc. (ratio) | 1.845 | 0.179* | 0.051 | 705 |
| Inc. increase age 35 to 50 (M.A. vs. Voc.) | 508.501 | 534.879 | 0.251 | 686 |
| **Panel D: Behavioral responses** | | | | |
| Applied for BAfoeG | 0.526 | 0.084* | 0.054 | 593 |
| Applied for scholarship | 0.072 | 0.022 | 0.348 | 604 |

*Notes:* This table presents control group means and treatment-control differences based on a two-sided t-test. Means (mostly) indicate the share of students whose answers are in accordance with the statement in the left column. Source: *Berliner-Studienberechtigten-Panel*, wave 1-3. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table 9: Sensitivity analysis

| | Main | | Balanced sample | | Inverse probability weights | | Corrected p-values | | Excluding non-compliant school | | 2SLS approach | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Panel A: All** | | | | | | | | | | | | |
| Direct application | 0.072** | | 0.050 | | 0.065* | | 0.072** | | 0.074** | | 0.075** | |
| | (0.032) | [1011] | (0.031) | [916] | (0.034) | [1011] | *p: 0.038* | [1011] | (0.034) | [989] | (0.035) | [1011] |
| Direct enrollment | 0.098** | | 0.095** | | 0.086** | | 0.098** | | 0.085** | | 0.073* | |
| | (0.039) | [1055] | (0.040) | [916] | (0.040) | [1055] | *p: 0.028* | [1055] | (0.039) | [1035] | (0.042) | [1055] |
| Enrollment within 1 year | 0.056* | | 0.054* | | 0.049 | | 0.056 | | 0.052 | | 0.047 | |
| | (0.032) | [1060] | (0.031) | [916] | (0.034) | [1060] | *p: 0.14* | [1060] | (0.033) | [1040] | (0.033) | [1060] |
| **Panel B: Non-college family background** | | | | | | | | | | | | |
| Direct application | 0.065 | | 0.046 | | 0.059 | | 0.065 | | 0.061 | | 0.058 | |
| | (0.045) | [636] | (0.045) | [567] | (0.047) | [636] | *p: 0.198* | [636] | (0.047) | [628] | (0.047) | [636] |
| Direct enrollment | 0.077* | | 0.053 | | 0.069 | | 0.077 | | 0.069 | | 0.062 | |
| | (0.044) | [651] | (0.045) | [567] | (0.047) | [651] | *p: 0.122* | [651] | (0.044) | [644] | (0.045) | [651] |
| Enrollment within 1 year | 0.055 | | 0.038 | | 0.050 | | 0.055 | | 0.049 | | 0.044 | |
| | (0.046) | [655] | (0.054) | [567] | (0.047) | [655] | *p: 0.284* | [655] | (0.046) | [648] | (0.046) | [655] |
| **Panel C: With study intention** | | | | | | | | | | | | |
| Direct application | 0.117*** | | 0.090** | | 0.110** | | 0.117** | | 0.118** | | 0.119** | |
| | (0.042) | [774] | (0.043) | [702] | (0.043) | [774] | *p: 0.012* | [774] | (0.045) | [754] | (0.047) | [774] |
| Direct enrollment | 0.132** | | 0.131** | | 0.121** | | 0.132** | | 0.114** | | 0.097* | |
| | (0.050) | [815] | (0.054) | [702] | (0.051) | [815] | *p: 0.026* | [815] | (0.050) | [797] | (0.054) | [815] |
| Enrollment within 1 year | 0.110*** | | 0.119*** | | 0.106** | | 0.110** | | 0.101*** | | 0.093** | |
| | (0.036) | [819] | (0.035) | [702] | (0.039) | [819] | *p: 0.026* | [819] | (0.036) | [801] | (0.037) | [819] |
| **Panel D: Non-college family background with study intention** | | | | | | | | | | | | |
| Direct application | 0.127* | | 0.102 | | 0.127* | | 0.127* | | 0.120 | | 0.117 | |
| | (0.069) | [459] | (0.070) | [407] | (0.068) | [459] | *p: 0.100* | [459] | (0.072) | [452] | (0.072) | [459] |
| Direct enrollment | 0.137* | | 0.113 | | 0.131* | | 0.137* | | 0.123* | | 0.111 | |
| | (0.068) | [473] | (0.075) | [407] | (0.072) | [473] | *p: 0.098* | [473] | (0.069) | [467] | (0.070) | [473] |
| Enrollment within 1 year | 0.147** | | 0.138* | | 0.148** | | 0.147** | | 0.138** | | 0.131** | |
| | (0.058) | [476] | (0.068) | [407] | (0.059) | [476] | *p: 0.044* | [476] | (0.059) | [470] | (0.060) | [476] |

*Notes:* This table reports various robustness tests of the effect of the information workshop on our three main outcomes. Standard errors in parentheses are clustered at the school level. The number of observations are shown in brackets. Source: *Berliner-Studienberechtigten-Panel*, wave 1-5. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table 10: Cost-benefit consideration: Overview of private and public cost and benefits (in EUR)

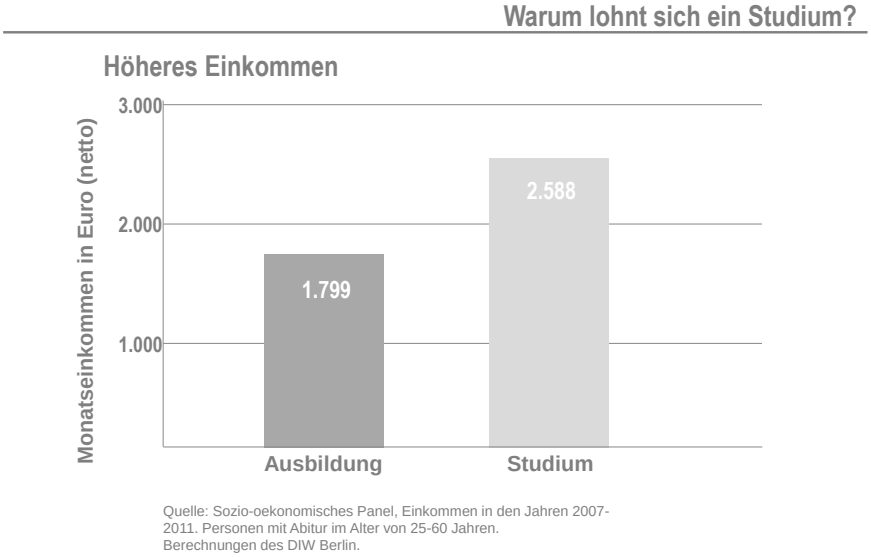
| | Average per individual between 20 and 60 years old | | | | | |
|---|---|---|---|---|---|---|
| | with college degree | without college degree | Difference | Treatment group | Control group | Difference |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: Individual's perspective** | | | | | | |
| Average lifetime earnings | 2.319.936 | 1.560.831 | 759.105,00 | | | |
| Discounted lifetime earnings | 1,063,066 | 762,428 | 300,638 | 954,836 | 938,001 | 16,836 |
| ***Net benefits*** | | | | | | ***16,836*** |
| **Panel B: Public perspective** | | | | | | |
| Tax revenue and social security | 446,488 | 320,220 | 126,268 | 401,031 | 393,960 | 7,071 |
| Post-secondary education costs | 31,124 | 7,689 | 23,435 | 22,688 | 21,376 | 1,312 |
| Intervention workshop costs | | | | | | 6 |
| ***Net benefits*** | | | | | | ***5,753*** |

*Notes:* This table summarizes our cost-benefit calculations from an individual's and a public perspective. In Panel A, we compare average (discounted) lifetime earnings with a college and vocational degree (columns 1-3). We assume a discount rate of 3%. In Panel B, we compare tax revenues and social security to public costs associated with the different degrees (columns 1-3). Using our overall treatment effect on enrollment rates within one year, i.e. 5.6 pp, we calculate average discounted lifetime earnings/tax revenue and social security contributions/public costs per student in the treatment and control groups (columns 4-5) and show the difference in column 6.

## Appendix: Additional figures and tables

Figure A.1: Examples of slides used in the information treatment

(a) Earnings by degree




(b) Earnings by majors and occupations

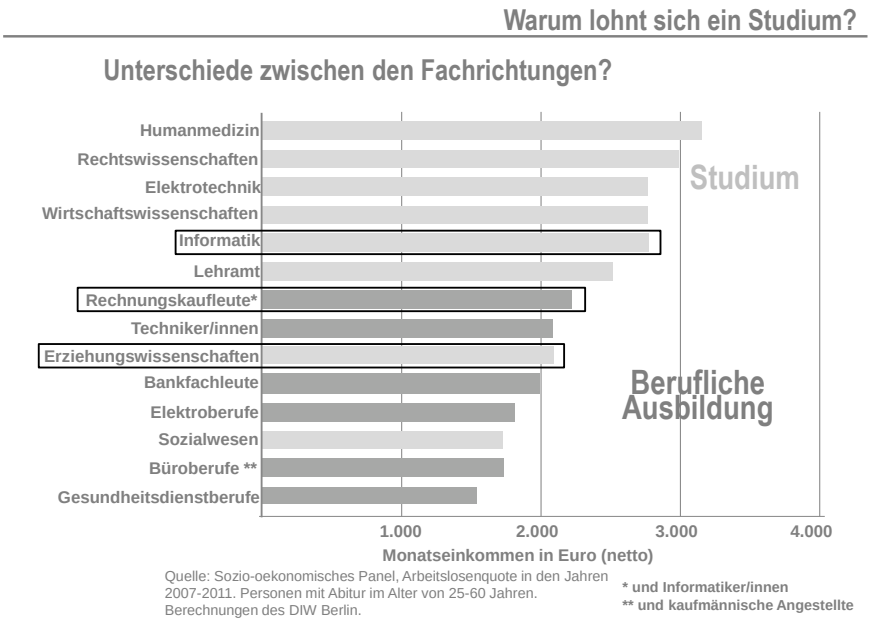
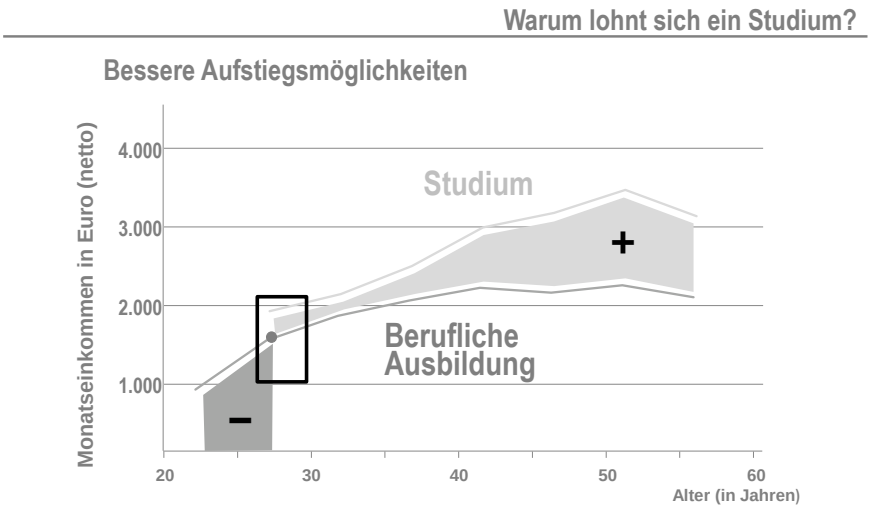
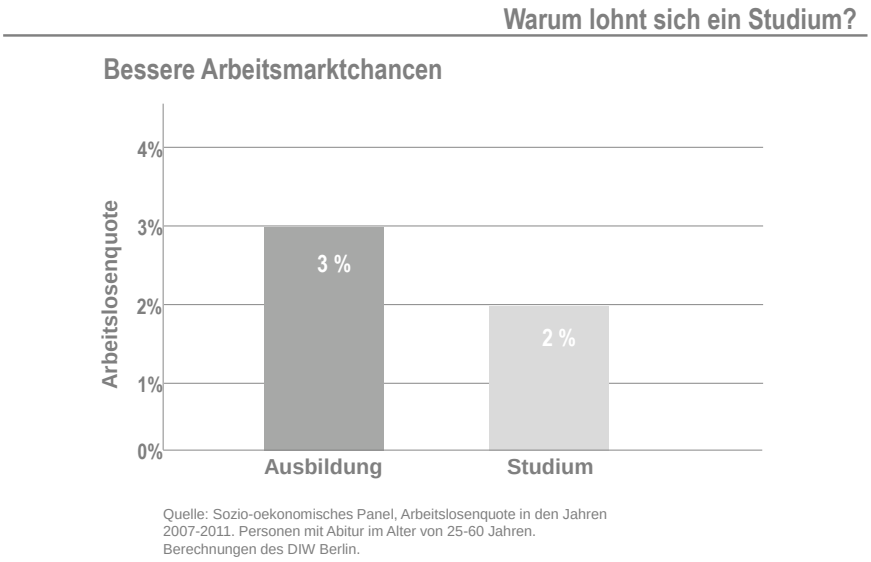


Figure A.1: Examples of slides used in the information treatment (continued)

(c) Lifetime earnings by degree




(d) Unemployment risk by degree




Note: This figure provides examples of the slides used in the information treatment and shows four of ten illustrative slides used in the in-class presentation. The first sub-figure (a) shows the difference in average earnings between individuals with a university degree *(Studium)* and a vocational degree *(Ausbildung)*. The second one (b) depicts earnings differences across different university majors and occupations in vocational education. Sub-figure (c) shows a comparison of lifetime earnings with a university degree and a vocational degree, while in the last sub-figure (d) the unemployment rate for individuals with a university degree and a vocational degree are depicted. The comparison is always drawn for individuals conditional on having earned the college entrance diploma (*Abitur*).

Table A.1: Comparing attritors and non-attritors

| | Direct application sample | | Direct enrollment sample | | Enrollment within 1 year sample | |
|---|---|---|---|---|---|---|
| | Attritors | Non-attritors Diff. | Attritors | Non-attritors Diff. | Attritors | Non-attritors Diff. |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Treatment Group | 0.315 | -0.008 | 0.313 | -0.003 | 0.312 | -0.001 |
| Int. college enrollment (t0) | 0.766 | 0.007 | 0.773 | -0.014 | 0.773 | -0.015 |
| **Background characteristics:** | | | | | | |
| Age (at baseline) | 18.458 | 0.222*** | 18.452 | 0.259*** | 18.455 | 0.253*** |
| Female | 0.595 | -0.078*** | 0.602 | -0.105*** | 0.603 | -0.109*** |
| Migration background | 0.510 | 0.063** | 0.497 | 0.110*** | 0.498 | 0.106*** |
| Non-college fam. backgr. | 0.629 | -0.042 | 0.617 | -0.009 | 0.618 | -0.011 |
| **School type:** | | | | | | |
| School type I (Gym.) | 0.303 | -0.045* | 0.293 | -0.019 | 0.293 | -0.021 |
| School type II (Gesamtschule) | 0.357 | 0.064** | 0.373 | 0.020 | 0.375 | 0.017 |
| School type III (berufl.Gym.) | 0.340 | -0.019 | 0.334 | -0.001 | 0.332 | 0.004 |
| Fast track to vocational degree | 0.041 | -0.035*** | 0.038 | -0.030*** | 0.038 | -0.030*** |
| **Performance and skills** | | | | | | |
| German Grade | 8.640 | -0.289** | 8.690 | -0.471*** | 8.692 | -0.480*** |
| Math Grade | 7.994 | -0.663*** | 8.025 | -0.824*** | 8.017 | -0.808*** |
| Score on cognition tests (0-40) | 20.712 | -1.076*** | 20.900 | -1.743*** | 20.897 | -1.750*** |
| **Beliefs about costs and returns** | | | | | | |
| Unemp.risk smaller | 0.389 | 0.004 | 0.391 | -0.001 | 0.391 | -0.002 |
| Prosp. for well paid job higher | 0.693 | 0.026 | 0.700 | 0.006 | 0.701 | 0.004 |
| Life time inc. higher | 0.626 | -0.010 | 0.635 | -0.039 | 0.637 | -0.044* |
| Feeling well informed about coll.edu. | 0.354 | -0.030 | 0.353 | -0.029 | 0.352 | -0.028 |
| Perceived cost burden high | 0.408 | -0.061** | 0.399 | -0.039 | 0.398 | -0.036 |
| N | 567 | 1011 | 523 | 1055 | 518 | 1060 |

*Notes:* This table compares student characteristics across attritors and non-attritors for each estimation sample based on a two-sided t-test. Students for whom we do not observe the outcome of interest are counted as attritors. Source: *Berliner-Studienberechtigten-Panel*, wave 1. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table A.2: Effects of the information intervention on students final high school GPA

| | All | Non-college family background | With study intention | Non-coll with study intention |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Info. effect | 0.058 | 0.058 | 0.049 | 0.039 |
| | (0.076) | (0.077) | (0.085) | (0.089) |
| N | 1074 | 667 | 841 | 493 |

*Notes:* Academic performance is measured by the final high school grade, which ranges from one (best grade) to four (worst grade) in Germany. Source: *Berliner-Studienberechtigten-Panel*, wave 1-5. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table A.3: Predicting college enrollment within one year with student characteristics and beliefs about college using data from the NEPS

| | College enrollment within one year | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| **Student characteristics**: | | | | | |
| Final high school GPA *(Abitur)* | -0.22*** | -0.22*** | -0.23*** | -0.21*** | -0.21*** |
| | (0.01) | (0.01) | (0.02) | (0.02) | (0.02) |
| Female | | -0.06*** | -0.05*** | -0.06*** | -0.06** |
| | | (0.02) | (0.02) | (0.02) | (0.03) |
| Migration background | | 0.06*** | 0.04* | 0.04 | 0.08* |
| | | (0.02) | (0.03) | (0.03) | (0.04) |
| Parental college background | | | 0.02 | 0.02 | 0.03 |
| | | | (0.02) | (0.02) | (0.03) |
| Attending general high school *(Gymnasium)* | | | | 0.18*** | 0.20 |
| | | | | (0.06) | (0.13) |
| Friends with study intention | | | | 0.03*** | 0.02 |
| | | | | (0.01) | (0.01) |
| **Beliefs about college education**: | | | | | |
| Feeling well-informed | | | | | 0.01 |
| | | | | | (0.02) |
| Not informed about financing options | | | | | 0.17*** |
| | | | | | (0.03) |
| Perceived cost burden high | | | | | -0.04*** |
| | | | | | (0.02) |
| Prospectives for well-paid job higher | | | | | 0.05 |
| | | | | | (0.03) |
| Unemployment risk smaller | | | | | 0.04 |
| | | | | | (0.03) |
| Difficulties to pay costs for books etc. (direct costs) | | | | | -0.05*** |
| | | | | | (0.02) |
| Perceived income loss high (opportunity costs) | | | | | -0.02 |
| | | | | | (0.02) |
| Adjusted $R^2$ | .088 | .093 | .10 | .11 | .16 |
| N | 2626 | 2540 | 1964 | 1827 | 876 |

*Notes:* This table presents estimates from a linear probability model. In a stepwise procedure, we add variables known to be important predictors of college enrollment. Note that while academic performance is highly relevant for the enrollment decision and has a stable effect across all specifications, it only explains a small share of the overall variation. In specification (5), we add variables capturing students' information level and beliefs about college education. Students, who already feel better informed about the financing options of college or who perceive the cost burden as lower, are significantly more likely to enroll in college. Estimations are based on a sample of *Abitur* graduates from the National Educational Panel Study (NEPS): Starting Cohort Grade 9, doi:10.5157/NEPS:SC4:9.1.1. From 2008 to 2013, NEPS data was collected as part of the Framework Program for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, NEPS is carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in cooperation with a nationwide network. Source: NEPS Data, Data Version SC4: 9.1.0. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table A.4: Set up and implementation costs of the information intervention

| **Type of costs** | **Amount in Euro** |
|---|---|
| **A: Setup costs** | |
| Preparing the presentation (40h worked by a post-doctoral researcher) | 1,275.64 |
| Presentation set up (40h worked by a research assistant) | 585.00 |
| Subtotal | 1,860.64 |
| Overhead costs (using computers etc.) 20% of total costs | 372.13 |
| Total setup cost of intervention | 2,232.77 |
| Total setup cost of intervention per school | 279.10 |
| **B: Implementation costs** | |
| Researcher in school (2 working hours) | 63.78 |
| Overhead costs (using computers etc.) 20% of total costs | 12.76 |
| Public transportation fee (per school) | 5.60 |
| Total cost per treated school | 82.14 |
| Total implementation cost (all eight schools) | 657.11 |
| **Setup cost per student** | 4.54 |
| **Implementation cost per student** | 1.34 |
| **Total workshop cost per student** | 5.87 |

*Notes:* Hourly wages for a post-doctoral researcher equal 31.89 Euro and 14.63 for a research assistant. The marginal cost per student is equal to total implementation cost divided by total number of treated students $\frac{657}{492} = 1.34$ and the setup cost per student, i.e. in this case interpretable as fix cost of the intervention, is equal to the total set up cost divided by total number of treated students $\frac{2232.77}{492} = 4.54$.