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Helping Students to Succeed – The Long-Term Effects of Soft Commitments and Reminders

Abstract

To study whether a soft commitment device can help students succeed, we conduct a randomized field experiment and follow a cohort of tertiary students over six years. Students can commit to following their recommended study program structure, and they receive reminders each semester. This easily implementable, low-cost intervention is highly effective: it increases the five-year graduation rate (+15 percentage points) and reduces time to graduation (-0.42 semesters), driven by reduced dropout and an increase in credits obtained per semester. The effects are stronger for suspected procrastinators. A treatment only reminding students to follow the program structure has limited effects.

JEL-Codes: I210, I230, C930, D900, D910.

Keywords: commitment device, reminders, higher education, randomized field experiment.

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1 Introduction

How can we help students to succeed with their studies? This is a policy relevant matter since (i) academic success is crucial for individuals themselves as well as for societies,[1] and (ii) many students fail to graduate or graduation takes longer than scheduled.[2] We test whether we can help students to improve their success on both dimensions, i.e., increase graduation rates and reduce study times, by offering a soft commitment device. The device lets students commit to the officially recommended study plan.

We conducted our intervention with an incoming cohort of a bachelor's degree program. We chose our main treatment – a soft commitment device accompanied by reminders – for the following reasons. First, many students face self-control problems.[3] Our simple theoretical model shows that self-control problems cause students to invest insufficient efforts and that a commitment device can incentivize them to choose higher effort levels. Second, to make sure that many students are willing to commit, the commitment device is soft, i.e., failing to comply with the commitment does not cause material consequences (Bryan et al., 2010). Third, the literature shows that limited attention is often responsible for inaction.[4] This problem is tackled by reminders, which bring the task (fulfilling the committed plan) back to students' minds.

A key feature of our study is the long-run perspective. This is crucial since the ultimate goal of interventions in the educational sector is to improve final outcomes. However, as our theoretical model shows, achieving long-run effects is challenging. First, students' reactions towards an intervention, even one that is successful in the short run, can fade quickly. Second, students' behavior can shift in a direction that counteracts an intervention's effectiveness. For instance, after achieving first successes, students might "rest on their laurels" and reduce their efforts. To evaluate the long-run effectiveness of our intervention, we follow and record the academic progress of each student in the cohort over a time span of six years.

[1] See Hout (2012), Lovenheim & Smith (2023), and Oreopoulos & Petronijevic (2013) for reviews. Recently Case & Deaton (2023) have documented an 8.5-year difference in life expectancy between Americans with and without a four-year college degree by the end of 2021, which is likely due to various direct and indirect effects of education.

[2] In the U.S., the four- and six-year graduation rates among students entering first-time, full-time bachelor's degree programs at 4-year postsecondary institutions in 2014 were only 47 and 64 percent, respectively (see `https://nces.ed.gov/programs/digest/d21/tables/dt21_326.10.asp`, retrieved on November 27, 2023). In 2-year postsecondary institutions, 3-year graduation rates were 32 percent (see `https://nces.ed.gov/programs/digest/d22/tables/dt22_326.20.asp`, retrieved on November 27, 2023). In OECD countries, less than 40% of a starting cohort complete their bachelor's degree within the scheduled study time and three years later around 23% have left tertiary education without obtaining a degree (OECD, 2022).

[3] See, for instance, Wong (2008), Cadena & Keys (2015), or De Paola & Scoppa (2015).

[4] See, for instance, Ericson (2017), Taubinsky (2014), Dean et al. (2017), Altmann & Traxler (2014), and Altmann et al. (2022).

We find that the soft commitment device is highly effective in raising students' success. It increases the five-year graduation rate by 15 pp, reduces dropouts by an imprecisely measured 8 pp, and shortens time to graduation by 0.42 semesters. We also conduct a pure reminder treatment, where students are reminded of the recommended study plan, but cannot commit to it. This treatment increases the five-year graduation rate by 6pp (not statistically significant), which can be entirely explained by lower dropout. Checking for potential negative side effects of the treatments, we find no effect on final GPA for either the commitment or the pure reminders. This shows that treated students do not buy higher graduation rates and shorter time to degree

The long-run perspective also allows us to study the dynamics of the intervention. We find that the effects start to emerge early and accumulate over time. Students in the commitment group obtain around 2.4 credits more in each semester of the regular study duration. Consequently, these students complete the basic study stage (the exams scheduled for the first four semesters) about 0.5 semesters earlier, and subsequently graduate earlier.

Our theoretical model suggests that commitments should be more effective for students prone to procrastination. In the spirit of De Paola & Scoppa (2015), Reuben et al. (2015), Brown & Previtero (2020), and Himmler et al. (2019), we consider students' application dates to university as a proxy for their procrastination tendencies. The idea is that due to the setup of the application process, there should be more procrastinators among late appliers than among early appliers. Consistent with our theoretical model, we find the following effects. First, students in the control group who applied in the second half of the application period drop out more often (by 14.4 pp) and finish their degree 0.67 semesters later than those who applied in the first half. Second, the commitment device increases graduation rates, reduces dropout, and shortens study durations among early and late appliers, but the effects are stronger for late appliers. Remarkably, in the presence of the commitment device, the late appliers graduate as fast and successful as the early applier control group. The commitment device thus completely offsets the negative effect of being a late applier.

The commitment device is not only effective in improving academic success, but also particularly easy to implement. We give students the opportunity to commit during the introductory lectures of their studies. This takes little time and is easy for everyone involved. Moreover, the costs of the commitment device and accompanying reminders amount to less than € 3.50 per student and semester (Table A.1). This is inexpensive, in particular in comparison to other measures that are regularly employed in the educational sector, like hiring additional teaching staff, or student grants.[5]

[5]Nguyen et al. (2019) find in their meta-analysis that an additional $1,000 of grant aid increases on-time degree completion, by about 1.8 pp.

Related literature. Our paper is the first to evaluate the long-run effects of commitment devices on academic outcomes, and we show that such a device can work remarkably well. We thereby contribute to three strands of the literature.

First, we contribute to the literature that studies the design and the effects of commitment devices, particularly in education contexts. The evidence here stems exclusively from short-term interventions. Himmler et al. (2019) provide evidence on the short-run effects of the intervention that we study in this paper. The paper finds that students who commit to the recommended study structure sign up for, take part in, and pass more exams in the first semester of their studies. Our theoretical model shows that it is by no means clear that positive short-term effects will translate into long-term success. Evidence for such fade-outs of intervention effects is, for example, provided by Ashraf et al. (2006a) and Blattman et al. (2020).

Deadlines as commitments are studied by Ariely & Wertenbroch (2002). They provide evidence on the demand for and the effectiveness of deadlines, when students can decide on their distribution over time for different tasks. However, deadlines have also been found to have no effect (Bisin & Hyndman, 2020) or even negative effects (Burger et al., 2011). Baker et al. (2016) and Patterson (2018) study the effects of commitment devices in the context of massive open online courses. Baker et al. allow students to commit to a time when they will watch the course content, but find no effects on short-term course engagement and even negative effects on long-term engagement, persistence, and performance. Patterson lets students limit the time spent on distracting internet activities and finds positive effects on the time spent working on the course and on the final course performance. Robinson et al. (2018) give students the option to commit to improving their in-school conduct by putting money on the line and find a high demand for the commitment, but no effect on later behavior.

Contrary to other domains, no evidence exists in the educational context on the long-run effects of commitment devices.[6] This paper fills the gap by showing that soft commitment devices are a simple and highly effective tool to improve long-run academic achievements. They increase the graduation rate and shorten study duration considerably, especially for students with procrastination tendencies.

Second, we also add to the literature that studies the long-term effects of reminders. Against the backdrop of a literature which finds reminders to be largely ineffective in raising academic performance persistently (Castleman & Meyer, 2020; Oreopoulos & Petronijevic,

[6]Outside the educational sector, some papers have shown long-run effectiveness of commitment devices (e.g., Kaur et al., 2015; Giné et al., 2010; Royer et al., 2015), while others (e.g., Ashraf et al., 2006a) have shown no long-run effects.

2018; Patterson, 2018), our results indicate that repeatedly reminding students about upcoming tasks throughout the course of their studies might increase their long-run academic achievement, especially when they are prone to procrastination. However, the effects are weaker than those of commitment, and they are imprecisely estimated.

Third, we contribute to the literature on behavioral interventions in higher education.[7] Measures such as goal setting (Chase et al., 2013; Clark et al., 2020; Morisano et al., 2010), commitment devices (Ariely & Wertenbroch, 2002; Himmler et al., 2019; Patterson, 2018), exam sign-ups by default (Behlen et al., in press), or relative performance feedback (Brade et al., 2022; Dobrescu et al., 2021; Tran & Zeckhauser, 2012) have been found to positively affect student performance in the short-run. Studies investigating the long-term effects of behavioral interventions on academic achievements are scarce. Azmat et al. (2019) study a relative feedback intervention and find null effects on long-term academic success. Kim et al. (2022) report no overall effects of growth mindset and "belonging" interventions over four years. Brade et al. (2023) show that providing long-run relative performance feedback reduces time to degree. Oreopoulos & Petronijevic (2023) test several low-touch interventions which lasted up to three years and find no performance increases.

2 Model

We start by providing a simple model to guide the analysis of short- and long-run commitment effects. A related and less detailed model is analyzed in the earlier companion paper Himmler et al. (2019), where the short-run effects of commitment are studied.

2.1 Baseline model

Consider a set of students $\{1,...,n\}$ in semester t. At the first stage of the semester, student $i \in \{1,...,n\}$ decides how much study effort $e_{t,i} \in \{0,1\}$ she wants to invest into a particular subject of study, where $e_{t,i} = 1$ means that she invests effort and $e_{t,i} = 0$ that she invests no effort. Her effort costs are $\chi_i(e_{t,i})$. We normalize $\chi_i(0) = 0$ and write $\chi_i(1) =: c_i$, where $c_i > 0$. At the second stage, the student decides whether to take the scheduled exam, $w_{t,i} = 1$, or not, $w_{t,i} = 0$.[8] If she takes the exam, she either succeeds (i.e., passes the exam), $y_{t,i} = 1$, or fails, $y_{t,i} = 0$. The outcomes are associated with a reward $R_{t,i}(\mathcal{H}_{t,i}) > 0$ if she succeeds and a loss $L_{t,i}(\mathcal{H}_{t,i}) < 0$ if she fails, where $\mathcal{H}_{t,i}$ denotes student i's study history until semester t.

[7] Damgaard & Nielsen (2018), Koch et al. (2015), Lavecchia et al. (2016), and Leaver (2016) provide reviews on the behavioral economics of education.

[8] The results do not change if students first have to decide whether to take the exam or not and then decide how much effort to invest in studying.

If she does not take the exam, she neither experiences a reward, nor a loss, and her payoff is normalized to zero. The student's effort determines the probability distribution over the outcomes. Formally, if she takes the exam, the probability of success is

$$\text{prob}_{t,i}\left(y_{t,i}=1 \middle| w_{t,i}=1, e_{t,i}\right) = \begin{cases} \bar{p}_{t,i} & \text{for } e_{t,i}=1, \\ \underline{p}_{t,i} & \text{for } e_{t,i}=0, \end{cases} \tag{1}$$

where $0 \leq \underline{p}_{t,i} < \bar{p}_{t,i} \leq 1$. We suppose that $\bar{p}_{t,i} R_{t,i}(\mathcal{H}_{t,i}) + (1-\bar{p}_i) L_{t,i}(\mathcal{H}_{t,i}) > 0$ and $\underline{p}_i R_{t,i}(\mathcal{H}_{t,i}) + (1-\underline{p}_i) L_{t,i}(\mathcal{H}_{t,i}) < 0$, such that the student optimally takes the exam if she has invested effort and does not take the exam if she has not invested effort.

Since students have to study before the exam and thus also before the outcome is realized, their intertemporal preferences are important. Following Laibson (1997), O'Donoghue & Rabin (1999), and many others, we use the $\beta-\delta$ model to allow for time-inconsistent and present-biased preferences. If student i wants to take the exam, her expected discounted utility when deciding on her study effort is

$$\begin{aligned} u_{t,i}(w_{t,i}=1, e_{t,i}) = \beta_i \delta_i^{\tau} \big[&\text{prob}_{t,i}\left(y_{t,i}=1 | w_{t,i}=1, e_{t,i}\right) R_{t,i}(\mathcal{H}_{t,i}) \\ &+ \left(1-\text{prob}_i\left(y_{t,i}=1 | w_{t,i}=1, e_{t,i}\right)\right) L_{t,i}(\mathcal{H}_{t,i}) \big] - \chi_i(e_{t,i}), \end{aligned} \tag{2}$$

where $\tau > 0$ is the time distance between the effort investment and the outcome, $\delta_i \in (0,1]$ the long-run discount factor, and $\beta_i \in (0,1]$ the present-bias parameter. Because taking the exam is only optimal if the student invests effort, we can simplify (2) to

$$u_{t,i}(w_{t,i}=1) = \beta_i \delta_i^{\tau} \left[\bar{p}_{t,i} R_{t,i}(\mathcal{H}_{t,i}) + \left(1-\bar{p}_{t,i}\right) L_{t,i}(\mathcal{H}_{t,i})\right] - c_i. \tag{3}$$

In contrast, if she does not want to take the exam, her expected discounted utility is

$$u_{t,i}(w_{t,i}=0, e_{t,i}) = \beta_i \delta_i^{\tau} 0 - \chi(e_{t,i}). \tag{4}$$

Since she optimally does not invest effort in this case, (4) simplifies to

$$u_{t,i}(w_{t,i}=0) = 0. \tag{5}$$

Comparing (3) and (5) yields that she decides to study and take the exam if and only if[9]

$$\beta_i \geq \bar{\beta}_{t,i}(\mathcal{H}_{t,i}) := \frac{c_i}{\delta_i^{\tau}\left[\bar{p}_{t,i} R_{t,i}(\cdot) + \left(1-\bar{p}_{t,i}\right) L_{t,i}(\cdot)\right]}. \tag{6}$$

The student is thus more eager to study and take the exam if her preferences are time-

[9] As a tie-breaking rule, we suppose that the student takes the exam in case of indifference.

consistent, $\beta_i = 1$, rather than time-inconsistent, $\beta_i < 1$. Time-inconsistent preferences can thus discourage the student from studying and taking the exam.[10]

2.2 Commitment device

To incorporate the commitment device in the model, let student i experience an additional payoff (or forgone loss) of $Z_{t,i} > 0$ if she takes the exam. The idea is that if the student signs the agreement, her reference point is to take the exam. She experiences satisfaction if she succeeds with her plan, whereas she suffers dissatisfaction if she fails to follow the plan.[11] With a commitment device, the student thus studies and takes the exam if and only if

$$\beta_i \geq \bar{\beta}_{t,i}^{\text{commit.}}(\mathcal{H}_{t,i}) \coloneqq \frac{c_i}{\delta_i^{\tau}\left[\bar{p}_{t,i} R_{t,i}(\mathcal{H}_{t,i}) + (1-\bar{p}_{t,i})\, L_{t,i}(\mathcal{H}_{t,i}) + Z_{t,i}\right]}. \tag{7}$$

From (6) and (7), we see that the student is incentivised to invest effort by the associated expected payoffs. Formally, the total incentives (TINC) the student faces are

$$\text{TINC}_{t,i}^{\text{no commit.}}(\mathcal{H}_{t,i}) \coloneqq \bar{p}_{t,i} R_{t,i}(\mathcal{H}_{t,i}) + (1-\bar{p}_{t,i})\, L_{t,i}(\mathcal{H}_{t,i}) \tag{8}$$

in case of no commitment, while they are

$$\text{TINC}_{t,i}^{\text{commit.}}(\mathcal{H}_{t,i}) \coloneqq \bar{p}_{t,i} R_{t,i}(\mathcal{H}_{t,i}) + (1-\bar{p}_{t,i})\, L_{t,i}(\mathcal{H}_{t,i}) + Z_{t,i} \tag{9}$$

in case of commitment. From (8) and (9) we directly see that, all else equal, students have higher total incentives with commitment than without. Formally, for all $\mathcal{H}_{t,i}$,

$$\text{TINC}_{t,i}^{\text{no commit.}}(\mathcal{H}_{t,i}) < \text{TINC}_{t,i}^{\text{commit.}}(\mathcal{H}_{t,i}). \tag{10}$$

Together with (6) and (7), this implies that, all else equal, the commitment device at least weakly increases a student's study effort and willingness to take the exam. We thus expect that at the beginning of students' studies, where study histories are identical, the commitment device has a positive effect on students' academic success.

This is not necessarily true in later semesters. The reason is that the study histories may differ between students who could use the commitment device and students who could not use it, precisely because the commitment device may affect students' achievements. The positive direct effect of commitment on students' motivation (caused by the additional payoff/forgone loss $Z_{t,i}$) could thus be counteracted by the indirect effect that treated students may experience a different study history than untreated students and may

[10] Time inconsistency is empirically indeed a major problem among students, as we discuss in Section 3.1.

[11] See Kahneman & Tversky (1979), Tversky & Kahneman (1991), and Kőszegi & Rabin (2006).

thereby be less motivated. Formally, if $\mathcal{H}_{t,i}^{\text{commit.}} \neq \mathcal{H}_{t,i}^{\text{no commit.}}$, the total incentives under commitment, $\text{TINC}_{t,i}^{\text{commit.}}(\mathcal{H}_{t,i}^{\text{commit.}})$, are not necessarily higher than under no commitment, $\text{TINC}_{t,i}^{\text{no commit.}}(\mathcal{H}_{t,i}^{\text{no commit.}})$. This is intuitive: students who are more successful early in their program due to the use of the commitment device may later rest on their laurels and lower their efforts, which could reduce or even completely destroy the long-run effectiveness of the commitment device. Amir & Ariely (2008) provide evidence that individuals exhibit such "complacency effects" following the attainment of subgoals. Hvidman & Sievertsen (2021) exploit a reform-induced recoding of grades. They document that downgraded students perform subsequently better, which hints at a negative relationship between past success and current motivation.

At the same time, one may hope that initial performance gains due to the commitment cause students to become more ambitious and motivated (see, e.g., Bandura 1988 or Spieker & Hinsz 2004). Thus, if students experience success in early semesters, they may increase their expectations in later semesters, which could further motivate them. Formally, in the long-run, it then holds that $\text{TINC}_{t,i}^{\text{commit.}}(\mathcal{H}_{t,i}^{\text{commit.}}) > \text{TINC}_{t,i}^{\text{commit.}}(\mathcal{H}_{t,i}^{\text{no commit.}})$, which by (10) implies that $\text{TINC}_{t,i}^{\text{commit.}}(\mathcal{H}_{t,i}^{\text{commit.}}) > \text{TINC}_{t,i}^{\text{no commit.}}(\mathcal{H}_{t,i}^{\text{no commit.}})$.

A further issue is that the power of the intervention may weaken over time. This can be captured by a diminishing additional payoff/forgone loss, $\partial Z_{t,i}/\partial t < 0$. The total incentives in the different treatments then narrow over time:

$$\frac{\partial\left(\text{TINC}_{t,i}^{\text{commit.}}(\mathcal{H}_{t,i}) - \text{TINC}_{t,i}^{\text{no commit.}}(\mathcal{H}_{t,i})\right)}{\partial t} < 0. \tag{11}$$

Accordingly, students' efforts and their academic achievements per semester should then become more similar across treatments over time.

To summarize, our theoretical model shows that the commitment device can enhance the incentives to invest in study efforts and improve academic success, especially of students with procrastination tendencies.[12] However, achieving long-run effects of commitments is more challenging than achieving short-run effects.

2.3 Pure reminders

We also empirically evaluate a treatment where students receive reminders but cannot commit, thus addressing potential negative effects of limited memory. Ericson (2017) examines the interaction between present bias and limited memory, and shows that individuals with

[12] If the effort costs are moderate, $c_i \leq \delta_i^{\tau}\left[\bar{p}_i R_{t,i}(\cdot) + (1-\bar{p}_{t,i})\, L_{t,i}(\cdot)\right]$, we see from (6) and (7) that the commitment device could only enhance the study activity of time-inconsistent students. If the effort costs are higher, the commitment device could enhance the activity of time-consistent and time-inconsistent students.

procrastination tendencies may fail to set up reminders on their own, even if the gains from doing so are large. External reminders could therefore help these students to organize their studies better and thus improve their academic outcomes. The reminders may be more helpful in later semesters, since semester schedules and tasks tend to become more individualized and complex over time.

3 Experimental design

3.1 Key design challenges

Improving academic outcomes is difficult; see, for instance, the overview and discussion by Oreopoulos (2021). Appropriately designing interventions is therefore crucial. Given that many students face self-control problems,[13] which our model predicts to affect academic success adversely, we decided to offer students a commitment device. The device gives students the opportunity to commit to the recommended structure of their program, and our model conjectures that this can motivate them to invest effort and thereby improve their academic success. We faced several key design challenges.

Take-up rate. The first challenge is to achieve a high rate of participation. In theory, there should be demand for commitment from students with self-control problems, and previous research provides evidence in support.[14] Yet, individuals might be (partially) naive about their present-biasedness (O'Donoghue & Rabin, 1999) and therefore refuse to commit even if this would be optimal (Bryan et al., 2010).[15] This is especially true for hard commitments. In Ashraf et al. (2006b), for example, only 28% of the individuals take up the offered commitment. In Giné et al. (2010) and Royer et al. (2015), take-up rates are even lower, with 11% and 12%, respectively.[16] To ensure that many students are willing to use our commitment device, we opted for a soft commitment device: we clearly communicated – verbally and in written form – that non-compliance, i.e. failing to adhere to the committed plan, has no consequences (other than not receiving credits for exams not taken).

[13] See Ellis & Knaus (1977); Semb et al. (1979); Solomon & Rothblum (1984); Mischel et al. (1989); Duckworth & Seligman (2006); Steel (2007); Wong (2008); Cadena & Keys (2015); De Paola & Scoppa (2015).

[14] See, for instance, Casari (2009); Augenblick et al. (2015); Houser et al. (2018).

[15] Consistent with the idea of partial naiveté, Acland & Levy (2015) and DellaVigna & Malmendier (2006) find that many individuals overpredict their future gym attendance when signing a membership contract. Augenblick & Rabin (2019) provide evidence against substantial sophistication and estimate that no more than 24% of participants understand their present bias. In line with theoretical predictions, John (2020) finds that individuals who are not sophisticated about their self-control issues adopt commitments that are too weak.

[16] Individuals might also decide against commitment because they value flexibility, for example, due to uncertainty about future shocks. The potential trade-off between commitment and flexibility (Amador et al., 2006; Ambrus & Egorov, 2013; Bond & Sigurdsson, 2018), makes it non-trivial to design an optimal commitment device when individuals value both (Galperti, 2015).

Long-term success. The second challenge is to facilitate the long-term success of the intervention. Our commitment device is long-term since it is designed to align with the full duration of the study program, based on the recommended structure of the entire program. Students commit to following this structure at the outset of their studies. However, over time, the salience and impact of the commitment might diminish. Such an erosion may occur due to limited attention, and students may then forget to take certain actions (Taubinsky, 2014), forget to complete a planned task (Ericson, 2017), or narrowly focus attention on a particular set of choices (Dean et al., 2017).[17] Reminders may counteract limited attention and help achieve long-term success by (i) refocusing attention on the decision problem or task, (ii) making specific choices more salient (Ericson, 2017; Karlan et al., 2016; Taubinsky, 2014), or (iii) forming habits (Taubinsky, 2014). Accordingly, we reminded students of their commitment and the upcoming scheduled exams. In order to assess whether any effects of the commitment treatment are driven by the reminders it provides, we also implement a pure reminder treatment. Here, students are reminded of the upcoming scheduled exams, but cannot commit.

3.2 Implementation of the experiment

Institutional background. The field experiment was conducted with an incoming cohort of undergraduate business administration students at a public German university of applied sciences. This setting is representative for a substantial portion of the German higher education system.[18] The bachelor's program where we conduct the intervention is not particularly selective, as indicated by an average final high school GPA of around 2.66 in our sample (see Table 1), compared to an average GPA of 2.46 in Germany in 2013, the year in which our cohort started studying.[19]

The standard duration of the program (i.e., the time to degree when students complete all courses as scheduled) is seven semesters and it encompasses 210 credit points. This is in accordance with the European Credit Transfer and Accumulation System which governs

[17] Students fail to (re-)apply for financial aid (King, 2004) and lack accurate information about the costs and benefits of education (Hoxby & Turner, 2015; McGuigan et al., 2016; Oreopoulos & Dunn, 2013), even though this information is often readily available. Additional evidence comes from health contexts, where forgetting is among the top reasons for failing to adhere to medication prescriptions (MacDonell et al., 2013; Vyankandondera et al., 2013).

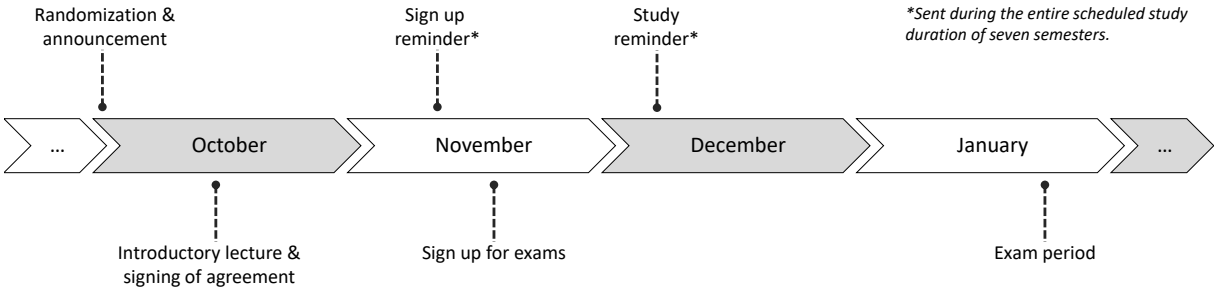
[18] In the study year 2021, around 43% of freshman students enrolled at universities of applied sciences, and in the winter term business administration ranked as the most popular degree program at German universities, accounting for 8.3% of freshman students (Statistisches Bundesamt, 2022).

[19] See `https://www.kmk.org/dokumentation-statistik/statistik/schulstatistik/abiturnoten/archiv-abiturnoten.html`, retrieved on November 27, 2023. In the German system, 1.0 is the best and 4.0 the worst final high school GPA.

and harmonizes the structure of study programs across Europe.[20] According to the recommended study structure, the first four semesters form the *basic study stage*, which consists mainly of compulsory subjects and only few electives (see Figure B.8). As is common at universities of applied sciences, the program includes a mandatory internship scheduled for the fifth semester. In the last two semesters, students specialize in different areas of business administration and write their thesis.

In total, 392 students enrolled in the program and were randomly assigned to the control, pure reminder, and commitment groups. We now explain the experimental design and procedures in more detail (Figure 1 provides an overview of experimental design and timing of events in the first semester).

Figure 1: EXPERIMENTAL DESIGN AND TIMELINE OF EVENTS IN THE FIRST SEMESTER



	Announcement	Introductory lecture	Commitment agreement	Sign up reminder*	Study reminder*
Control; *N=131*	✓	✓			
Pure reminder; *N=132*	✓	✓		✓	✓
Commitment; *N=129*	✓	✓	✓	✓	✓

Randomization. Randomization was carried out before the first semester, using stratification and re-randomization (Morgan & Rubin, 2012). Final high school GPA was used to create four strata within which we re-randomized 30 times, keeping the randomization with the best balancing properties with respect to final high school GPA, age, and gender – the complete set of covariates that were available to us at the time of randomization.[21] We received some additional background characteristics from the student office after the randomization was carried out. Table 1 presents descriptive statistics and balancing properties. The variables are well-balanced across control and treatment groups. In particular, we do not

[20] Universities throughout Europe use this standardized point system, in which a full-time academic year consists of 60 credits. The typical workload for one credit is 25-30 hours of study. See `https://education.ec.europa.eu/education-levels/higher-education/inclusive-and-connected-higher-education/european-credit-transfer-and-accumulation-system`, retrieved on November 27, 2023.

[21] The four strata based on the high school GPA are: $1.0 \leq GPA < 2.0, 2.0 \leq GPA < 2.5, 2.5 \leq GPA < 3.0, 3.0 \leq GPA < 4.0$. The GPA includes passing grades only. The best grade is 1.0, while the lowest passing grade is 4.0.

observe any differences in high school GPA, which is typically a very strong predictor for success in higher education. Overall, only 3 out of the 42 coefficients depicted in the table are significant at the 5%-level, which is close to the expected number of incorrect rejections of the null hypothesis when performing multiple comparisons. The successful randomization can also be seen in the results section, where the estimated coefficients are very robust to the inclusion of control variables.

Table 1: DESCRIPTIVE STATISTICS AND BALANCING PROPERTIES

	(1) Control Mean (Std. Dev.)	(2) Reminder Coefficient (Robust SE)	(3) p-Value	(4) Commitment Coefficient (Robust SE)	(5) p-Value	(6) Reminder− Commitment= 0 (Robust SE)	(7) p-Value
Male[a)]	0.504	−0.049	0.426	0.000	0.999	−0.049	0.425
	(0.502)	(0.061)		(0.061)		(0.061)	
HS GPA[a)]	2.659	0.002	0.927	0.005	0.829	−0.003	0.903
	(0.407)	(0.020)		(0.021)		(0.022)	
Age (first Semester)[a)]	21.718	−0.172	0.699	−0.371	0.388	0.199	0.655
	(3.537)	(0.446)		(0.429)		(0.444)	
Foreigner	0.069	−0.031	0.269	−0.014	0.630	−0.016	0.529
	(0.254)	(0.028)		(0.030)		(0.026)	
Days left in application period	35.832	−4.102	0.193	−2.560	0.415	−1.542	0.623
	(25.829)	(3.149)		(3.137)		(3.133)	
Fresh HS degree	0.534	−0.057	0.354	−0.084	0.169	0.027	0.659
	(0.501)	(0.062)		(0.061)		(0.062)	
HS degree FOS	0.542	−0.042	0.491	0.038	0.529	−0.080	0.185
	(0.500)	(0.061)		(0.061)		(0.060)	
HS degree Abitur	0.412	0.042	0.470	−0.046	0.430	0.088	0.128
	(0.494)	(0.058)		(0.059)		(0.058)	
Other degree	0.046	−0.001	0.984	0.008	0.769	−0.008	0.753
	(0.210)	(0.025)		(0.027)		(0.027)	
HS degree BY	0.626	0.003	0.962	0.001	0.980	0.001	0.982
	(0.486)	(0.060)		(0.060)		(0.060)	
HS degree BW	0.229	−0.009	0.859	−0.112**	0.016	0.103**	0.025
	(0.422)	(0.052)		(0.046)		(0.046)	
HS degree HE	0.061	−0.023	0.386	0.055	0.120	−0.078**	0.018
	(0.240)	(0.027)		(0.035)		(0.033)	
HS degree other state or n.a.	0.084	0.030	0.422	0.056	0.156	−0.026	0.527
	(0.278)	(0.037)		(0.039)		(0.041)	
N	131	132		129			

Notes: [a)] Variables that were used during re-randomization. Column (1) presents the unadjusted control group means and standard deviations of the covariates. Columns (2) and (4) present the estimated coefficients of regressing the covariates on the reminder and the commitment indicators controlling for *strata FE*. Columns (3) and (5) test the null hypothesis of no reminder and commitment effect. Column (6) tests for the equality of the reminder and the commitment indicators. Column (7) presents the corresponding p-Value. Fresh HS degree indicates if the high school degree was obtained immediately before starting the program. HS degree FOS (= Fachhochschulreife) is the secondary school degree from the vocational track. Abitur is the general track degree. BY = Bavaria, BW = Baden-Württemberg, HE = Hesse. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Introductory lecture. The field experiment commences with an introductory lecture in the first week of the first semester. Students received an announcement of this lecture and were encouraged to attend. They were also informed that in the lecture they will receive important information on how to organize their studies. Immediately before the introductory lecture, students picked up a personalized information folder. The front of the folders displayed the number of one of three lecture halls, with each number corresponding to one of the randomly assigned treatments. Helpers made sure that all students entered the hall/treatment they were assigned to.

The lecture and information folder gave students an overview of what was expected of them in the first four semesters (the basic study stage), and advised them to stick to the officially recommended exam schedule. The introductory lecture and the corresponding information folder were identical for the control and the reminder group (see Figures B.1 to B.3). The folder of the commitment group contained the same information material, and additionally two unsigned copies of an agreement (see Figure B.5). Students were offered to voluntarily sign the agreement during the introductory lecture, thereby committing to the officially recommended exam schedule. Students who signed the agreement kept one copy and turned in the second. To clearly communicate the soft nature of the commitment, both verbally in the lecture and in writing in the information folder, it was emphasized that the agreement is non-binding and that failure to comply imposes no further consequences other than those from the official examination regulations (see Figure B.4). All 115 of the 129 students in the commitment group who participated in the introductory lecture signed the agreement,[22] which demonstrates a very high willingness to use soft commitments in this setting.[23]

Exam sign-up reminders. As is typical for German universities, students attend courses without having to enroll in them. Instead, they sign up for the exams they want to take.[24] In each semester there is a two-week period, during which students sign up for exams online. The official study plan recommends taking exams worth 30 credits in most semesters, but students can sign up for fewer or more exams.

In each semester during the regular study duration of seven semesters, students in the commitment group received a letter shortly before the sign-up period that reminded them to sign up for the recommended exams. For students who signed the agreement, these letters also included a reminder of their commitment (Figure B.7). The letters in the pure reminder group are the same, except that they make no reference to commitments, since students in this group could not commit (Figure B.6).

From the second semester onward, the letters in both groups contained a second page (Figure B.8). It listed the exams students should have already passed and the exams they should take in the current semester according to the study plan. We placed check boxes next

[22] In the reminder group 17 of 132 students, and in the control group 16 of 131 students did not show up. Throughout the paper, we report intention to treat effects (ITT). The treatment effects on the treated can be calculated by using randomized assignment as an instrumental variable. We do not report these estimates here, but from the participation numbers above, one can see that the treatment effects of reminder and commitment will be 11% to 15% larger than the respective ITT effects (depending on the specification).

[23] The in-class setting may have caused some students to feel pressure to sign, and demand for commitment may thus be higher in our environment than in other settings. However, the university subsequently did not receive any complaints from students.

[24] It is possible to take part in an exam without having attended the course, although this is not recommended.

to the exam list so that students could track their progress.

Study reminders. Around one month before the start of the exam period, students in the reminder and the commitment groups received another letter, which again emphasized the study plan and advised to start preparing for the exams (Figures B.9 and B.10). In the commitment group, the letter again referred to the commitment students made and we enclosed a copy of their signed agreement. The letters also contained a page with the recommended exam schedule for the past and the current semesters. Both the exam signup reminders and the study reminders were sent in all seven semesters of the regular study duration.[25]

4 Empirical strategy

To analyze the long-run effects of the intervention, we use administrative data, which was provided by the university after the twelfth semester. Our data therefore span the six years following the start of the treatments.[26] The primary outcomes are the graduation rate and the dropout rate[27], as well as the number of semesters students take to graduate. Unless explicitly stated differently, we provide the ITT effects from OLS estimations that compare the outcomes of the control group with the outcomes of the reminder and the commitment groups.

The baseline specification is

$$Y_i^k = \alpha_0 + \alpha_1 Reminder_i + \alpha_2 Commitment_i + \mathbf{s_i}\boldsymbol{\alpha_3} + \varepsilon_i, \tag{12}$$

where Y_i^k denotes the level of outcome k for individual i. $Reminder_i$ and $Commitment_i$ are indicators for being randomized into these treatment groups. The vector $\mathbf{s_i}$ includes strata fixed effects which control for the random assignment of treatment and control units within blocks. Strata are defined by the final high school GPA.

In a second specification, we add a vector $\mathbf{x_i}$ with additional covariates:

$$Y_i^k = \alpha_0 + \alpha_1 Reminder_i + \alpha_2 Commitment_i + \mathbf{s_i}\boldsymbol{\alpha_3} + \mathbf{x_i}\boldsymbol{\alpha_4} + \varepsilon_i. \tag{13}$$

The vector $\mathbf{x_i}$ includes all covariates that were used for re-randomization, i.e., final high school GPA, age, and a dummy for being male. It also contains individual characteristics that were made available to us after the randomization: an indicator for being a foreign stu-

[25] Students who were not present at the introductory lecture did not receive any letters.

[26] Our observation period ends before the start of the Covid-19 pandemic.

[27] We have also classified as dropouts those students who were randomized but did not commence their studies in the first semester.

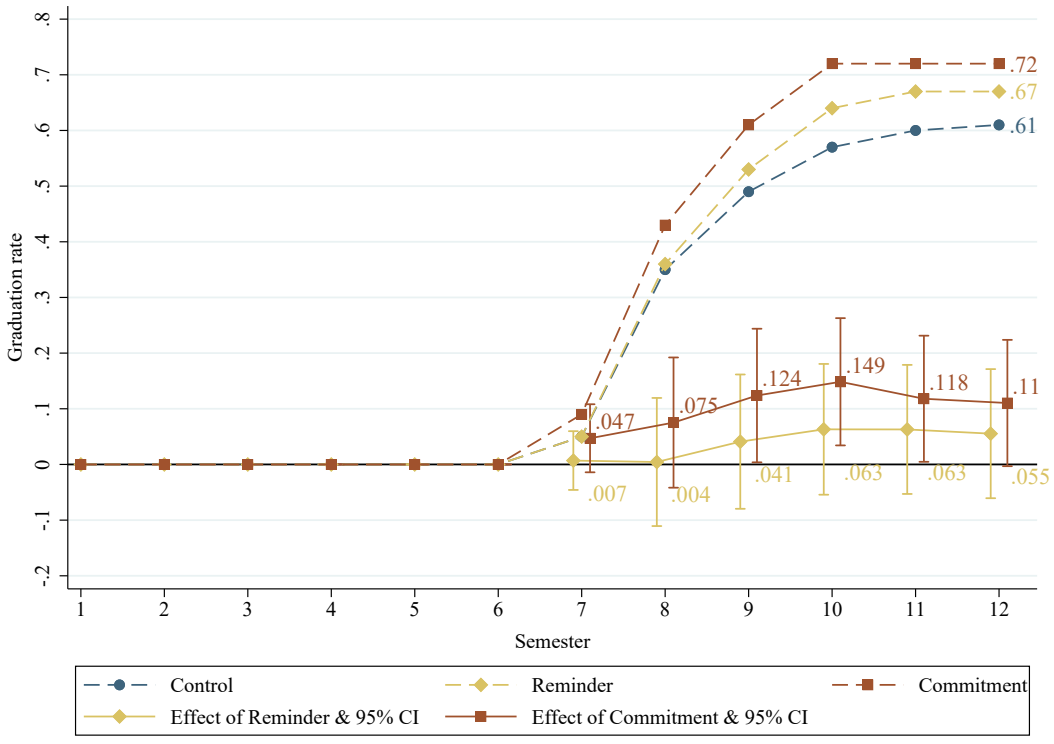
dent, the number of days left in the application period when applying to the study program, a dummy for having obtained the high school degree immediately before starting the program ("fresh" degree), dummies for the type of the high school degree (*Abitur* or *other* degree; the reference group has a degree from a *Fachoberschule*), dummies for originating from the federal states of Baden-Württemberg, Hesse, or another state (the reference group is Bavaria).

5 Results

5.1 Primary outcomes: long-term effects on academic achievements

Degree attainment. Figure 2 depicts graduation rates for the three experimental groups over time (dashed lines) and treatment effects with 95% confidence intervals based on Equation (12) from the seventh semester onward. In the control group, only around 5% of the students manage to obtain their degree in the regular study duration of seven semesters, implying substantial room for improvement.

Figure 2: TREATMENT EFFECTS ON GRADUATION RATES



Notes: Dashed lines depict the unadjusted mean of the graduation rate. Coefficients based on OLS regressions with strata fixed effects estimated separately for each semester. *Outcome variable:* indicates if a student graduated before or in the respective semester. The 95% confidence intervals are based on robust standard errors.

From the seventh semester onward, we observe students graduating, and from this point on, students in the commitment group are more likely to have graduated than the controls.

Table 2: TREATMENT EFFECTS ON GRADUATION RATES

Semester	7th		8th		9th		10th		11th		12th	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Reminder	0.007	0.013	0.004	0.002	0.041	0.039	0.063	0.072	0.063	0.072	0.055	0.064
	(0.027)	(0.028)	(0.059)	(0.057)	(0.061)	(0.059)	(0.060)	(0.058)	(0.059)	(0.057)	(0.059)	(0.057)
Commitment	0.047	0.048	0.075	0.076	0.124**	0.133**	0.149**	0.165***	0.118**	0.125**	0.110*	0.118**
	(0.031)	(0.033)	(0.059)	(0.059)	(0.061)	(0.059)	(0.058)	(0.056)	(0.058)	(0.056)	(0.058)	(0.56)
Strata	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Covariates	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
N	392	392	392	392	392	392	392	392	392	392	392	392
Control mean	0.05	0.05	0.35	0.35	0.49	0.49	0.57	0.57	0.60	0.60	0.61	0.61

Notes: The coefficients for each semester are from separate regressions. *Outcome variable:* indicates if a student graduated before or in the respective semester; *strata:* HS GPA strata FE; *covariates:* HS GPA, age, male dummy, foreigner dummy, application date (days left), fresh HS degree dummy, HS degree Abitur dummy, other degree dummy, HS degree in BW dummy, HS degree in HE dummy, HS degree in other state dummy. Robust standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

By the end of the twelfth semester, 61% of the control group have graduated with a degree, whereas 72% in the commitment group have done so. As can be seen in Figure A.1, all of the remaining 28% in the commitment group and 36 of the remaining 39% in control have dropped out, i.e., 3% in control are still studying (we evaluate effects on dropout behavior later).

The estimates for the differences in graduation rates based on Equation (12) are shown in Figure 2 and Table 2. In the seventh semester the effect of commitment is 4.7 pp ($p = 0.131$), and it subsequently steadily increases. The tenth semester is an important mark, as by the end of this semester all students in the commitment group have either graduated (72%) or dropped out of the program (28%). The commitment group is thus "complete", and we can evaluate how the other groups fare against this benchmark. In the control group only 57%, have graduated at this point, and the treatment effect therefore peaks in this semester at 14.9 pp ($p = 0.011$).

In the two following semesters, the gap between the two groups shrinks slightly to 11.0 pp ($p = 0.057$), as some students in the control group still manage to graduate, whereas no more changes are possible in the commitment group. Table 2 shows that the estimates are robust to the inclusion of covariates.

The pure reminder treatment does not increase graduation rates to the same extent. Students in this group only start graduating at higher rates than the controls from the ninth semester onward and we observe the biggest difference in comparison to controls in the tenth semester with 6.3 pp ($p = 0.291$); see Figure 2 and Table 2.

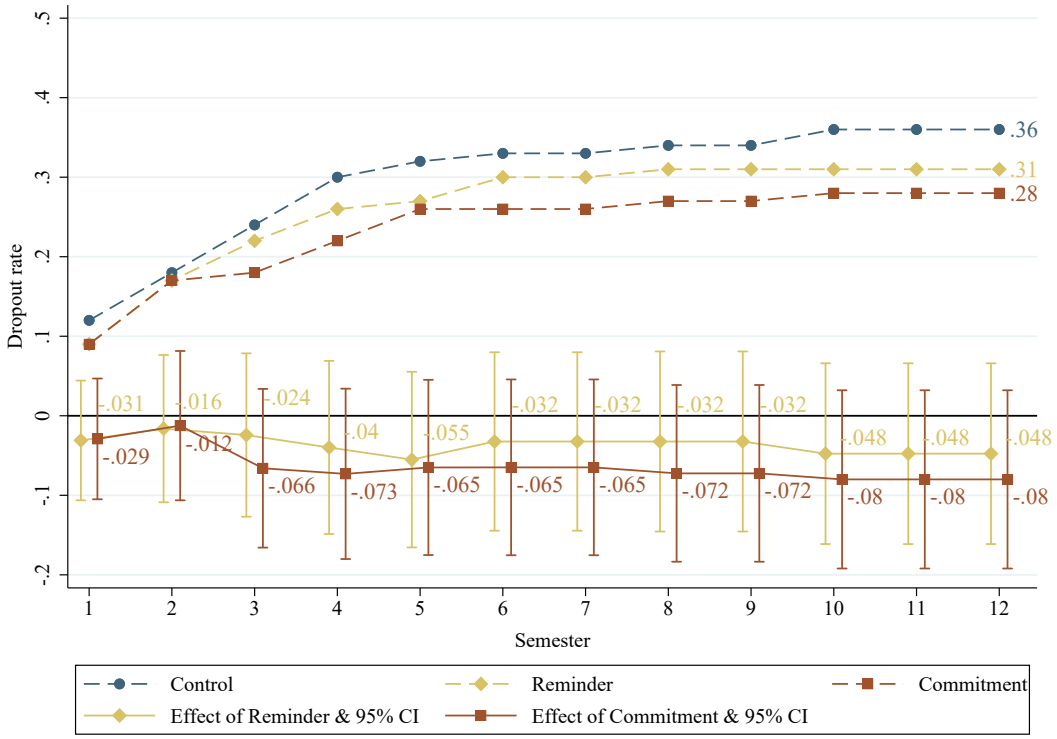
These results provide first evidence that a commitment device is able to elicit large gains in long-term academic attainment. Such effects can be plausibly explained by our theoretical model in Section 2, which emphasizes the motivational role of commitment. The (imprecisely estimated) effects in the reminder group tentatively suggest that pure reminders,

while not as effective as the commitment device, might still be beneficial for long-run academic achievement.

The positive effects on five-year graduation rates raise the question of how they come about. Do they arise from students dropping out at lower rates, from students graduating faster, or a combination of the two?

Dropout behavior. Figure 3 shows the dropout behavior in the three experimental groups over the course of the twelve semesters. The dashed lines indicate the share of students in each group that dropped out of the study program before or in the respective semester. In addition, the figure depicts coefficients and corresponding 95% confidence intervals from estimating Equation (12) separately for each semester.

Figure 3: TREATMENT EFFECTS ON DROPOUT RATES



Notes: Dashed lines depict the unadjusted mean of the dropout rate. Coefficients based on OLS regressions with strata fixed effects estimated separately for each semester. *Outcome variable:* indicates if a student dropped out of the study program before or in the respective semester. The 95% confidence intervals are based on robust standard errors.

In all three groups, the majority of dropouts occur in the first four semesters, and the dropout rates in the commitment and the reminder group are lower than in control from the third and fourth semesters onward, respectively. By the end of the twelfth semester, 36% of students in the control group dropped out of the study program. In the commitment group, the dropout rate is 8 pp lower ($p = 0.161$), and for students who receive pure reminders it is

4.8 pp lower (p = 0.410); see Column (1) of Table 4. Including the covariates in Column (2) slightly changes the coefficients to 8.6 pp (p = 0.125) and 6.2 pp (p = 0.274).

While none of the reported effects on dropout in Figure 3 and Table 4 are statistically significant at conventional levels, they are of sizable magnitude, implying a 13.3% (reminder) and 22.2% (commitment) reduction relative to control. For the reminder group, the dropout effect accounts for almost the entire effect on graduation. For the commitment group, after the tenth semester, the dropouts explain 50% of the effect on graduation.[28]

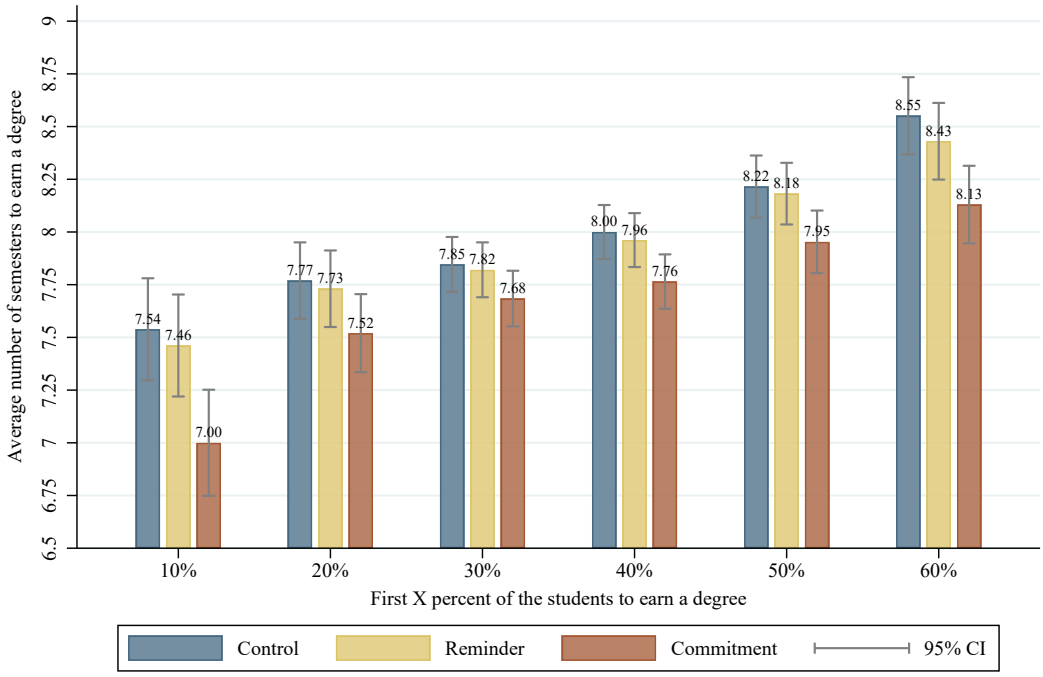
Time to degree. The pattern of effects on graduation already shows that students in the commitment group not only graduate at a higher rate than the controls, but they also do so at a faster pace. Quantifying the effect on time to degree is, however, complicated by the fact that it is only observed for students who have graduated. While we observe time to degree for all graduates in the commitment group (all students have either graduated or dropped out), for the other two groups the time to degree for the 3% of the students who are still studying is unknown (see Figure A.1). Nevertheless, under plausible assumptions, we can estimate time to degree effects. We propose two different methods, both of which lead to qualitatively and quantitatively similar results.

(a) Comparing the observable parts of the time to degree distribution. We first employ an approach in the spirit of Weiss et al. (2019). The idea is to compare the parts of the time to degree distribution that are observed in all groups. This is a valid and insightful comparison, as any remaining students who will still manage to graduate, will by definition have a longer time to degree than students who have already graduated. For students who dropped out, the comparison makes the plausible assumption that they will either also have a longer time to obtain a degree or will never graduate. Thus, for all three experimental groups the "fastest" or first X% of degree earners are already observed, where X% is the share of students who graduated with a degree by the end of the twelfth semester. With 62%, the control group has the lowest share of graduates after twelve semesters, and we will therefore only look at time to degree among the fastest 62% of graduates in the treatment groups.

Figure 4 depicts the average time to degree for the first 10 to 60% of degree earners, separately by treatment status. First, the figure shows that the commitment device reduces the time to degree across the entire distribution. The largest differences are observed for the first 10% of degree earners, for whom it reduces time to degree by 0.54 semesters (p = 0.004) compared to controls (7.00 vs 7.54 semesters). For the first 60% of degree earners, it reduces time to degree by 0.42 semesters (p = 0.002) compared to controls (8.13 vs 8.55 semesters).

[28] Note that as long as not all students have either graduated or dropped out, the graduation effect will not reflect the absolute value of the dropout effect.

Figure 4: AVERAGE TIME TO DEGREE



Notes: Average semesters to earn a degree is calculated as the average number of semesters it took the first X percent of students to earn their degree. The highest depicted X percent is chosen based on the experimental group with the lowest graduation rate after twelve semesters. The 95% confidence intervals are based on robust standard errors from unadjusted OLS regressions.

Second, the pure reminder treatment does not have any effects on average time to degree along the entire distribution. This is consistent with our earlier findings that the effects of the reminder on graduation rates observed in Figure 2 are only driven by reduced dropout (and not by faster graduation).

Overall, this evidence further substantiates that the commitment device not only increases the number of students who graduate, but also enables students to graduate faster.

(b) Simulating time to (any) degree for dropouts. Dropouts may go on to pursue and obtain a degree at another university. Our administrative data includes information on whether dropouts are planning to enroll at another university. 23.4% of control, 19.5% of reminder, and 30.56% of commitment dropouts at the time of their dropout stated that they plan to study at another university. This suggests that less than a third of the dropouts will pursue another degree and commitment group dropouts are more likely to do so. If students who pursue another degree are equally likely to obtain that degree across the treatment groups, this implies that the commitment effects on obtaining *any* degree (defined as including degrees obtained from another university after dropout) are even larger than our previous estimates suggest. We will, however, not rely on this data. The reason is that we cannot rule out that some dropouts start studying at other universities without indication in the administrative data. For simplicity, and as it presents the most conservative case, in the following time

to degree simulations we assume that all students who drop out go on to obtain a degree at another university.

Table 3: TREATMENT EFFECTS ON TIME TO DEGREE – SIMULATION ANALYSES

	Assumption I		*Assumption II*	
	(1)	(2)	(3)	(4)
Control				
Median time to degree	9.385		9.134	
95% interval	[9.123, 9.654]		[8.962, 9.322]	
99% interval	[9.038, 9.742]		[8.911, 9.382]	
Reminder				
Median effect	-0.056	-0.009	-0.001	0.048
95% interval	[-0.410, 0.309]	[-0.368, 0.359]	[-0.248, 0.255]	[-0.202, 0.305]
99% interval	[-0.520, 0.425]	[-0.478, 0.475]	[-0.326, 0.334]	[-0.287, 0.384]
Commitment				
Median effect	-0.457	-0.432	-0.459	-0.449
95% interval	[-0.812, -0.099]	[-0.790, -0.065]	[-0.705, -0.215]	[-0.703,-0.205]
99% interval	[-0.923, 0.000]	[-0.915, 0.047]	[-0.785, -0.136]	[-0.789,-0.117]
Strata	yes	yes	yes	yes
Covariates	no	yes	no	yes
N	392	392	392	392

Notes: The table reports the median average time to degree estimate in the control group, the medians of the treatment effect estimates for the reminder and the commitment group, and intervals from the 2.5th (0.5th) to the 97.5th (99.5th) percentile of the respective estimates, which are recovered from 10,000 iterations of the following procedure. For students who are still enrolled after the twelfth semester, time to degree is set to thirteen semesters. For all students who drop out, it is assumed that they subsequently earn a degree at another institution, and their total time to graduation is hence the sum of the time until dropout and the time until they obtain the new degree. Under *Assumption I*, we assume that dropouts go on to obtain any degree at another university. To simulate this, we randomly draw in each of the 10,000 iterations from the time to degree distribution for all German university degrees in 2019, provided by the Federal Statistical Office (Statistisches Bundesamt, 2020). Under *Assumption II*, we assume that dropouts go on to obtain a business or economics degree, which allows them to transfer credits. To account for this, we reduce the time to degree at the new university by their study progress before dropping out, but we assume that it takes them at least one semester at the new university to obtain their degree. To calculate the progress in semesters, we divide the number of obtained credits at dropout by 30, which – in accordance with the ECTS – is the supposed course load of one semester. As data source, we again use data from the Federal Statistical Office for all of Germany in 2019 (Statistisches Bundesamt, 2020). *Strata:* HS GPA strata FE; *covariates:* HS GPA, age, male dummy, foreigner dummy, application date (days left), fresh HS degree dummy, HS degree Abitur dummy, other degree dummy, HS degree in BW dummy, HS degree in HE dummy, HS degree in other state dummy.

We use the following procedure to simulate the time at which dropouts obtain a degree. (i) For dropouts, we impute the time to degree by randomly drawing values from the time to degree distributions for all university degrees obtained in Germany in 2019; data provided by the Federal Statistical Office (Statistisches Bundesamt, 2020).[29] This is conservative if students who have a history of dropout tend to be slower in obtaining their degree than average students. (ii) For students who are still enrolled in the program, we make the most conservative assumption that they obtain their degree in the next (thirteenth) semester. Using the imputed time to degree as the outcome, we then estimate treatment effects based on Equations (12) and (13). We repeat this process 10,000 times and recover the treatment effect coefficients from each iteration.

[29]We use data from 2019 as this is the most recent data available before the outbreak of the Covid-19 pandemic.

We use two different assumptions for the time to degree of dropouts: Under *Assumption I*, we use the time to degree distribution of all study programs in Germany in 2019. Since this distribution includes master's programs, which usually take less time than bachelor's degrees, this will also work against the commitment effects. As most study programs are unrelated to business studies, we assume that students are unable to transfer obtained credits to their new program.

Under *Assumption II*, we use the time to degree distribution of business and economics programs only. We assume that students can transfer their credits and reduce the study duration drawn from the distribution by the study progress at the time of dropout (assuming that it takes students at least one semester at the new university to graduate).[30] [31]

Table 3 reports the median estimates of all iterations as well as intervals from the 2.5th (0.5th) to the 97.5th (99.5th) percentile of the respective estimates. The top row shows that the median average time to degree estimate in the control group is 9.39 and 9.13 semesters for *Assumptions I* and *II*. In line with the results presented above, we find no evidence that students in the reminder group obtain their degrees faster (see middle rows). The commitment device, on the other hand, reduces time to degree by 0.43 to 0.46 semesters under *Assumption I* (bottom rows, Columns 1 and 2) and by 0.45 to 0.46 semesters under *Assumption II* (bottom rows, Columns 3 and 4). Both estimates are thus very close to the effect on time to degree that we estimated among the first 60% of degree earners (0.42 semesters).

Taken together, these results provide compelling evidence that even in the very conservative scenario in which all dropouts manage to complete a degree at another university, the commitment device shortens the time to graduation by 0.42 to 0.46 semesters. In other words: almost every other student graduates a semester earlier with the commitment than they would without the commitment.

5.2 Secondary outcome: potential side effects on GPA

Reduced time to graduation could come at the cost of worse grades, e.g., if students spend less time per course because they now take more courses. Any such effects would have to be weighed against the beneficial effects of higher graduation rates and reduced time to degree. Table 4 shows the treatment effects on final GPA. The estimates in Column (3) indicate that

[30] We calculate the study progress at dropout by dividing the number of obtained credits by the 30 credits course load of one semester stipulated by the European Credit Transfer and Accumulation System.

[31] The three simplifying assumptions we make should work against finding treatment effects: (i) all dropouts going on to pursue another degree; (ii) students being able to study any degree, even graduate programs that take less time, (iii) students can transfer all credits that they have previously obtained. In particular, assumptions (ii) and (iii) reduce the time to the next degree, and – as there are more dropouts in the control group – the controls will "benefit" more from this reduction in time to degree.

students in the reminder group have a final GPA that is 0.051 grade points worse ($p = 0.342$) compared to controls (the best grade is 1.0, the worst grade is 4.0). For students in the commitment group, the final GPA is 0.052 grade points better ($p = 0.382$). Adding covariates in Column (4) leaves those estimates largely unchanged.

Table 4: TREATMENT EFFECTS ON TWELFTH SEMESTER DROPOUT RATE AND FINAL GPA

			Final GPA			
	Dropout		OLS		IPW	IPWRA
	(1)	(2)	(3)	(4)	(5)	(6)
Reminder	−0.048	−0.062	0.051	0.074	0.090*	0.070
	(0.058)	(0.057)	(0.054)	(0.049)	(0.049)	(0.047)
Commitment	−0.080	−0.086	−0.052	−0.039	−0.025	−0.043
	(0.057)	(0.056)	(0.059)	(0.057)	(0.055)	(0.055)
Strata	yes	yes	yes	yes	see notes	
Covariates	no	yes	no	yes	see notes	
N	392	392	261	261	261	261
Control mean	0.36	0.36	2.20	2.20	2.18	2.19
(Std. deviation)	(0.48)	(0.48)	(0.40)	(0.40)	-	-

Notes: Dropout: indicates if a student dropped out of the study program before or in the twelfth semester; *final GPA:* only includes students who obtained a degree by the end of the twelfth semester; includes passing grades only; highest passing grade is 1.0, lowest passing grade is 4.0; *strata:* HS GPA strata FE; *covariates:* HS GPA, age, male dummy, foreigner dummy, application date (days left), fresh HS degree dummy, HS degree Abitur dummy, other degree dummy, HS degree in BW dummy, HS degree in HE dummy, HS degree in other state dummy; *IPW:* Inverse probability weighting using the strata and covariates to predict treatment assignment among students who obtain a degree by the end of the twelfth semester. *IPWRA:* inverse-probability-weighted regression adjustment, using the strata and covariates for the regression adjustment. Robust standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

One caveat is that the estimates could be affected by a selection bias due to the different graduation rates across treatment arms. To address this, in Column (5), we employ inverse probability weights to reweight observations according to their treatment assignment probability. In Column (6), we extend on this by also performing regression adjustments, giving the estimates the double-robust property.[32] Inverse probability weighting alone increases the negative effect of the reminder on GPA to 0.090 grade points ($p = 0.067$) and reduces the positive effect of the commitment device to 0.025 ($p = 0.646$). Additionally, performing regression adjustment produces roughly the same estimates as the OLS specification with all controls in Column (4).

Another caveat is that we do not observe the final GPA for students who are still studying. In Table A.2, we include those students and replace the unobserved final GPA with their GPA from the end of the twelfth semester. Doing so keeps the estimates for the reminder letter mostly unchanged. For the commitment group, if anything, it increases the positive effects.

[32] That is, the IPWRA estimator is consistent if either the treatment status prediction model or the weighted regression model for the treatment-specific predicted outcomes is correctly specified (Wooldridge, 2010).

Overall, these estimates provide no evidence that the soft commitment device leads to a worse final GPA. This is important because it means that the positive effects on the primary outcomes graduation rate, dropout, and time to degree can be interpreted as net gains. For the reminder on the other hand, the estimates imply that the beneficial effects might come at the cost of a slightly worse final GPA, although these estimates are not precise.

5.3 Explaining dynamics: intermediate measures of academic achievement

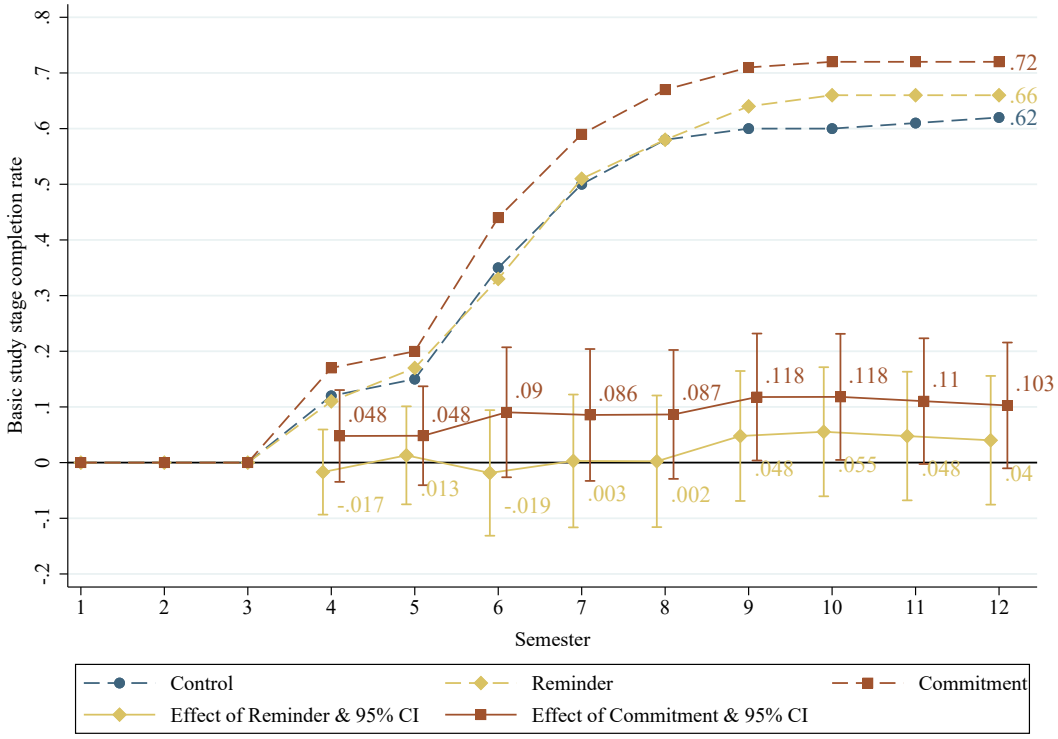
How do the long-term effects on academic achievements come about? To answer this question, we now investigate the dynamics of the treatment effects. We show how the treatments affect completion of the basic study stage and credit accumulation over time.

Basic study stage completion. The basic study stage encompasses all courses scheduled for the first four semesters, and it totals 120 credit points (see Figure B.8). Completion of the basic study stage is a particularly interesting outcome, as almost all courses of this stage are mandatory. This rules out the possibility that treated students select into less challenging electives (which might lead to faster graduation). In addition, while students generally committed to following the study plan in order to successfully graduate, the commitment also stated that "in particular, I will take the exams according to the 'Exam plan for successful studies'. This plan initially only displayed the scheduled exams of the basic study stage (see Figures B.2 and B.5; it was in later semesters updated to include the exams scheduled beyond the basic study stage, see Figure B.8).

The dashed lines in Figure 5 indicate for each treatment the shares of students who completed the basic study stage before or in the respective semester. The figure also shows coefficients and 95% confidence intervals from estimating Equation (12) separately for each semester. In the control group 12.2% complete the basic study stage by the end of the fourth semester. After the fifth semester, the share increases sharply. By the end of the eighth semester, 58.8% have completed this stage (recall that by then more than 30% have dropped out, i.e., only about 10% of those in the starting cohort who are still enrolled have not completed the basic stage at this point).

We find that preceding their earlier graduation, students in the commitment group already complete this key part of their studies earlier. By the end of the fourth semester, students in the commitment group are 4.8 pp ($p = 0.254$) more likely to have completed the basic study stage and the gap widens in subsequent semesters. Figure A.2 shows that the first 60% of students in the commitment group who complete the basic study stage do so 0.48 semesters ($p = 0.023$) earlier than their control counterparts (5.65 vs 6.13 semesters). By

Figure 5: TREATMENT EFFECTS ON BASIC STUDY STAGE COMPLETION



Notes: Dashed lines depict the unadjusted mean of the basic study stage completion rate. Coefficients based on OLS regressions with strata fixed effects estimated separately for each semester. *Outcome variable:* indicates if a student completed the basic study stage before or in the respective semester. 95% confidence intervals are based on robust standard errors.

the end of the basic study stage, students in the commitment group have therefore already generated a considerable advantage. This is plausible, since, as explained above, students initially committed to following the study plan for this stage of the study program in particular.

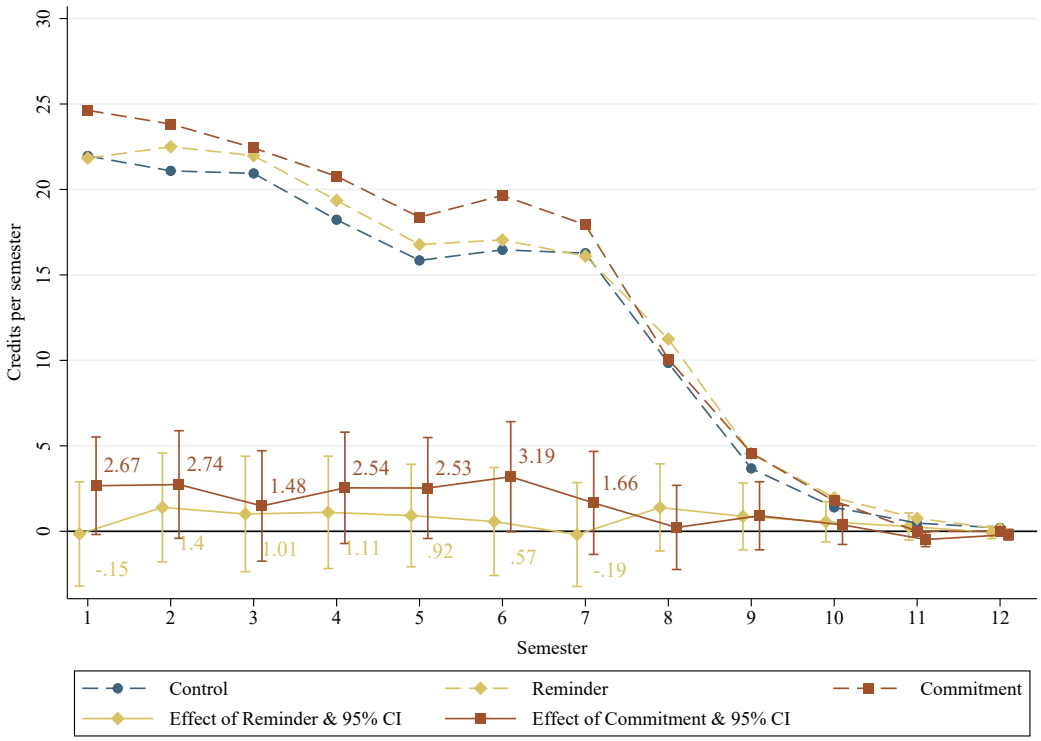
For students in the reminder group, we only find an imprecisely estimated increase in the completion rate from the ninth semester onward, driven by reduced dropout.

Credit accumulation. Figure 6 displays the number of credits each of three experimental groups on average obtain in each semester and the treatment effects based on Equation (12). During the regular study duration of seven semesters, students in the commitment group consistently earn about 2.5 credits more per semester. This is confirmed by Column (1) in Table 5, which shows pooled estimates for the effects on credit accumulation during the regular study duration. Students in the commitment group earn on average 2.4 credits more per semester compared to students in the control group (p = 0.080; 21.1 vs 18.7 credits per semester). Adding covariates in Column (2) increases the effect to 2.76 credits (p = 0.039). Thus, we find no evidence for a possible "rest on laurels effect". Instead, our results indicate that the commitment has a persistent and long-lasting effect on students' achievements. The

findings suggest that students' success in early semesters motivates them to increase their efforts also in later semesters; see the discussion of the theoretical model in Section 2. Because large shares of students start to graduate from the eighth semester onward, and since graduates can no longer obtain additional credits, the gap shrinks to zero in the semesters after the regular study duration.

For the students in the pure reminder group, both Figure 6 and Table 5 provide only little evidence of increased credit accumulation. The estimates are imprecise, but they indicate that students in this group may earn between 0.67 to 0.97 credits more per semester. This is in line with the observation that these students do not graduate faster.

Figure 6: TREATMENT EFFECTS ON CREDITS PER SEMESTER



Notes: Dashed lines depict the unadjusted mean of the credits per semester. Coefficients based on OLS regressions with strata fixed effects estimated separately for each semester. *Outcome variable:* credits per semester. 95% confidence intervals are based on robust standard errors.

A caveat of this analysis of the effects on credit points is that it includes students who are no longer enrolled in the program. While this has the advantage of keeping the initial sample unchanged and thus the estimates unbiased, the estimates can be influenced by differences in dropout behavior. It is therefore interesting to investigate the credits earned conditional on still being enrolled at the beginning of the respective semester. Columns (3) and (4) in Table 5 provide the estimates of the effects on average credits per semester during the regular study duration. Conditional on still being enrolled at the beginning of the semester, students in the commitment group earn 1.68 credits ($p = 0.029$) more in each semester than the con-

Table 5: TREATMENT EFFECTS ON CREDITS PER SEMESTER DURING THE SCHEDULED STUDY DURATION

	Unconditional		Conditional			
	OLS		OLS		IPW	IPWRA
	(1)	(2)	(3)	(4)	(5)	(6)
Reminder	0.667	0.971	−0.142	0.017	0.004	0.270
	(1.378)	(1.338)	(0.832)	(0.830)	(0.775)	(0.793)
Commitment	2.401*	2.762**	1.678**	1.923**	1.902***	2.008***
	(1.367)	(1.334)	(0.765)	(0.750)	(0.715)	(0.718)
Strata	yes	yes	yes	yes	see notes	
Covariates	no	yes	no	yes	see notes	
N	2744	2744	2245	2245	2245	2245
Control mean	18.69	18.69	23.60	23.60	23.57	23.33
(Std. deviation)	(13.49)	(13.49)	(10.66)	(10.66)	-	-

Notes: The scheduled study duration spans the first seven semesters. Estimates from pooled OLS estimations. For each semester, the conditional estimates include only students who are still enrolled at the beginning of that semester. *Outcome variable:* credits per semester; *strata:* HS GPA strata FE; *covariates:* HS GPA, age, male dummy, foreigner dummy, application date (days left), fresh HS degree dummy, HS degree Abitur dummy, other degree dummy, HS degree in BW dummy, HS degree in HE dummy, HS degree in other state dummy. *IPW:* Inverse probability weighting using the strata and covariates to predict treatment assignment in each semester among students who are still enrolled at the beginning of the semester. *IPWRA:* inverse-probability-weighted regression adjustment, using the strata and covariates for the regression adjustment. Robust standard errors clustered at the student level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

trols (23.6). Including all covariates increases the coefficient to 1.92 credits ($p = 0.011$). For the pure reminder, the estimated effects are close to zero, consistent with the finding that the reminder does not lower time to graduation. Since the conditional estimates are based on a selected sample, in Columns (5) and (6), we use inverse probability weighting and inverse probability weighting in combination with regression adjustment. The commitment effects are very similar to the OLS estimates with all covariates in Column (4).

Overall, the results show that students in the commitment group accumulate more credits per semester during the entire regular study duration. This is the main dynamic behind the substantial reduction in time to degree and the large effects on the graduation rate.

5.4 Effect heterogeneity: procrastination and academic achievements

Identifying procrastinators. Our theoretical model suggests that the effects of reminders and commitment can vary between individuals with and without a tendency to procrastinate. We follow the reasoning in Brown & Previtero (2020), De Paola & Scoppa (2015), Reuben et al. (2015) and Himmler et al. (2019), all of which argue that administrative information on the timing of observed choices can be used to identify procrastinators. The observed behavior we use as a proxy for procrastination tendencies is students' choice of application date to university. In almost all German schools, the application period for university programs with admission restrictions runs from the beginning of May to mid-July. Students can apply

to multiple schools or programs, and submit their application at any time in the application period. Admission letters are sent after the application period closes. Students therefore have no incentive to apply particularly early or late in the application period, and late appliers are not students who have already been rejected by another program (this may be the case in the U.S. system, for example). Under the plausible assumption that procrastinators are more likely to apply towards the end of the application period than time-consistent individuals, we can hence use the application date as a proxy for procrastination tendencies.

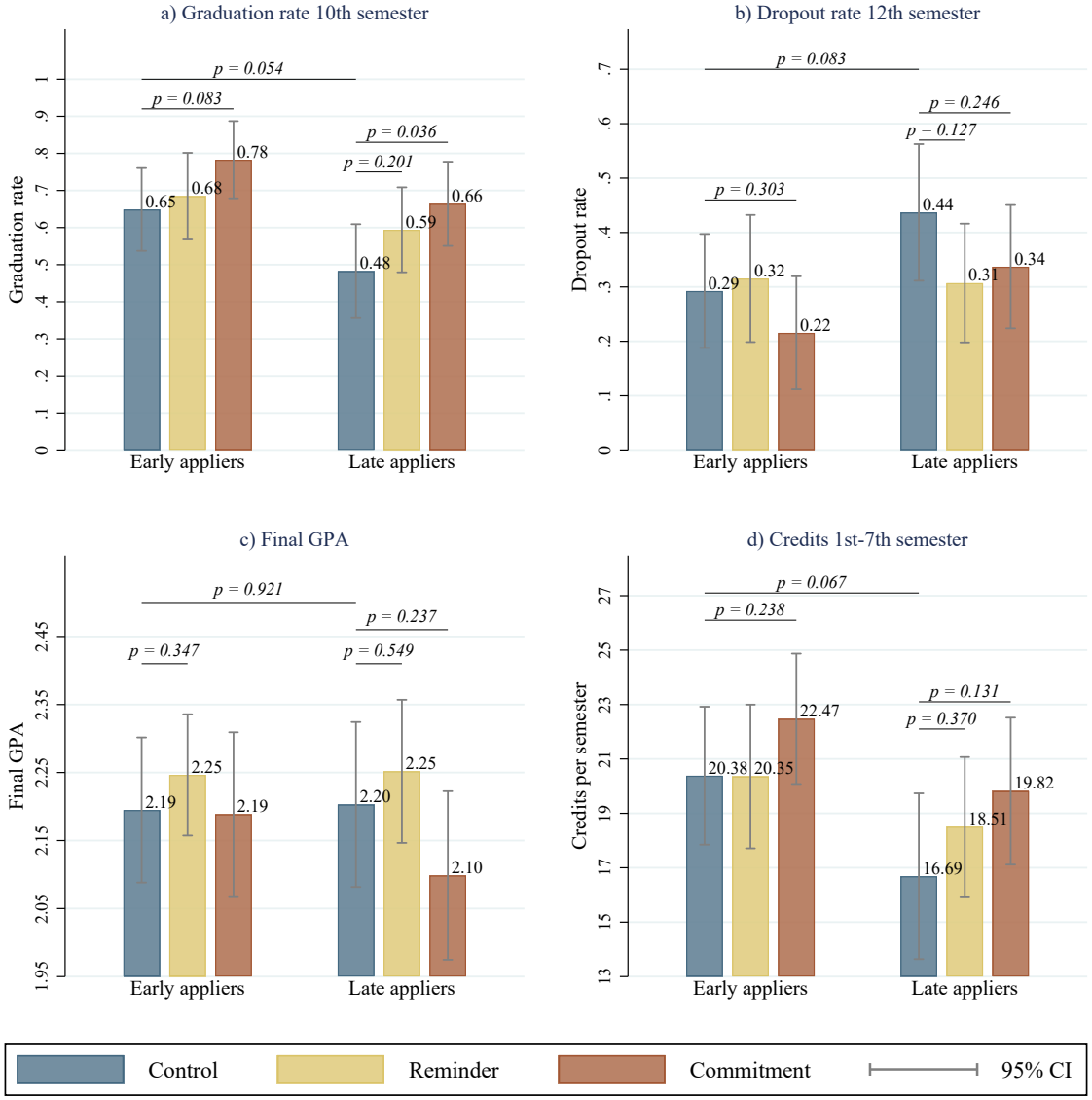
Using procrastination measures based on real observed high stakes decisions such as the university application has two main advantages. First, unlike survey responses, they are not prone to systematic measurement error, or bias introduced by (a) individuals who are (partially) naive about their procrastination, and (b) respondents answering in socially desirable ways. Second, information on the timing of decisions is often available in administrative data, whereas other measures of procrastination typically are unavailable.

The distribution of the application dates in the application period of our cohort is depicted in Figure A.3. We define as "late appliers" those individuals who applied after the median application date. While not all late appliers are necessarily procrastinators, those students who are procrastinating will have a higher probability of applying late. Late applications should thus disproportionately often come from procrastinators.

Late applier performance. We observe that in the absence of treatment, late appliers' academic achievements are substantially lower than those of early appliers. Panel a) in Figure 7 and Column (1) in Table A.3 show that students in the control group who apply early are 16.6 pp ($p = 0.054$) more likely to have graduated by the end of the tenth semester compared to students who apply late (estimates for the other semesters are reported in Table A.4). Column (2) of Table A.3 provides evidence that this gap between early and late appliers is robust to the inclusion of covariates (14.6 pp; $p = 0.092$). As Panel b) of Figure 7 shows, early appliers are also 14.4 pp (0.083) less likely to drop out. Additionally, they obtain on average 3.7 credits ($p = 0.067$) more than late appliers in each semester of the scheduled study duration (Panel d). In Figure 8, we visualize time to degree separately for the two subgroups: among late appliers, it takes the first 50% on average 8.70 semesters to earn their degree, while the first 50% among early appliers only take 8.03 semesters to graduate. The final GPA appears to be the only performance dimension on which early appliers do not outperform students who apply late (see Panel c) of Figure 7).

Commitment. Consistent with the notion that commitment devices are particularly effective for procrastinators (see the theoretical model in Section 2), we find that commitment increases the tenth-semester graduation rate of late appliers by 18.2 pp ($p = 0.036$) to 66%,

Figure 7: TREATMENT EFFECTS BY APPLICATION DATE

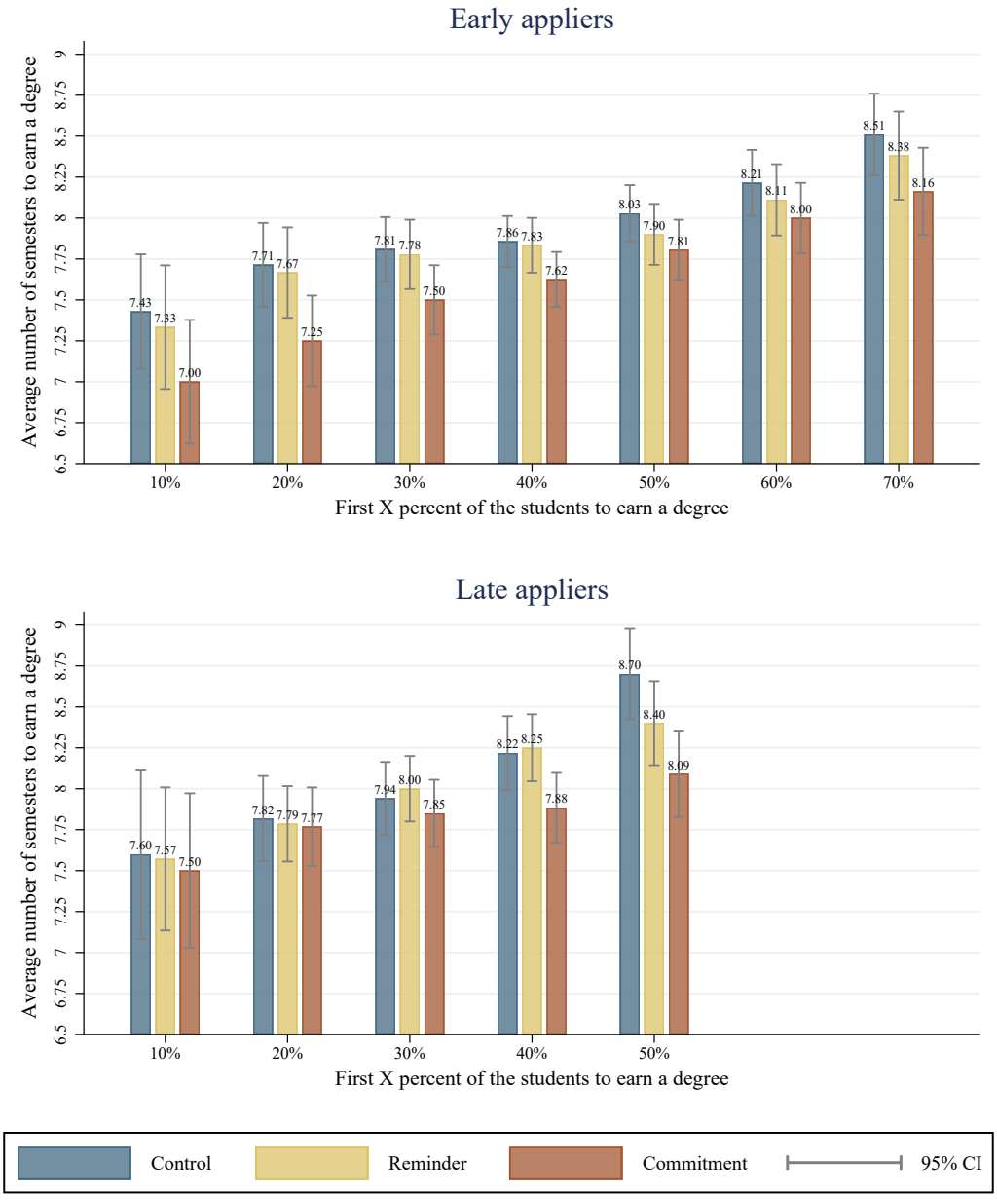


Notes: Early and late appliers are defined by splitting the sample at the median application date (see Figure A.3). *Degree 10th semester:* indicates if a student graduated before or in the tenth semester; *dropout 12th semester:* indicates if a student dropped out of the study program before or in the twelfth semester; *final GPA:* only includes students who have obtained a degree by the end of the twelfth semester; includes passing grades only; highest passing grade is 1.0, lowest passing grade is 4.0; *credits 1st-7th semester:* credits per semester during the scheduled study duration of seven semesters. All panels show linear predictions based on OLS regressions with strata fixed effects (pooled OLS is used for Panel d). The 95% confidence intervals are based on robust standard errors (clustered at the student level in Panel d). Estimates are also reported in Table A.3.

which is practically identical to the 65% rate of early appliers in the control group (Panel a) in Figure 7). The commitment device thus completely offsets the negative effect of being a late applier on graduation rates. The effects on the other outcomes are estimated less precisely, but point in the same direction. The commitment device reduces dropout by the end of the twelfth semester for late appliers by 10 pp ($p = 0.246$; Panel b) to 34%, versus 29% for the early appliers in control. It also increases the number of credits obtained by late appliers per semester during the regular study duration by 3.1 ($p = 0.131$, Panel d) to 19.82, versus

20.38 for the early appliers in control. Accordingly, time to graduation among late appliers is reduced by 0.61 semesters (p = 0.002) among the first 50% who earn a degree (see bottom panel of Figure 8). Finally, if anything, the commitment improves the final GPA of late appliers by 0.10 (p = 0.237).

Figure 8: AVERAGE TIME TO DEGREE – BY APPLICATION DATE



Notes: Early and late appliers are defined by splitting the sample at the median application date (see Figure A.3). The average semester to earn a degree is calculated as the average number of semesters it took the first X percent of students to earn their degree. The highest depicted X percent is chosen based on the experimental group with the lowest graduation rate after twelve semesters. The 95% confidence intervals are based on robust standard errors from unadjusted OLS regressions.

We find that the commitment is also somewhat effective for early appliers, but – con-

sistent with the theoretical model – to a lesser extent.[33] The graduation rate in the tenth semester is increased by 13.4 pp ($p = 0.083$), the twelfth-semester dropout rate is decreased by 7.7 pp ($p = 0.303$), the number of obtained credits is increased by 2.1 credits ($p = 0.238$), and among the first 70% to earn a degree, time to graduation is reduced by 0.35 semesters ($p = 0.062$, see top panel in Figure 8). While most of the effects for early appliers are not estimated precisely, they are still sizable from a practical perspective.

Pure reminders. We find evidence that the pure reminders are able to offset some of the disadvantages that late appliers face (see Figure 7): they increase the graduation rate in the tenth semester by 11.1 pp ($p = 0.201$; Panel a), reduce the twelfth-semester dropout rate by 13 pp ($p = 0.127$; Panel b), increase credits per semester during the first seven semesters by about 1.8 ($p = 0.370$; Panel d), and reduce time to graduation among the first 50% of degree earners by about 0.3 semesters ($p = 0.118$, see Figure 8). These effects for late appliers are in agreement with the literature, which argues that reminders can be of help to individuals with time-inconsistent preferences.[34] In comparison with the commitment effects for late appliers, the effects of the pure reminder on credits and tenth-semester graduation rate for the late appliers are smaller (and not statistically significant, although the coefficient magnitudes are relevant from a policy perspective). We find little evidence for effects on final GPA. For early appliers, the pure reminder letters have no effect.

Summary. Commitment has large positive effects for the late appliers on all dimensions. In particular it greatly increases their graduation rate while strongly reducing their time to degree, bringing both indicators on par with the early appliers in control. We also see some performance increases for the early appliers, which is what the theoretical model predicts when effort costs are high. Early applier effects manifest in increased graduation rate and faster graduation, but the effects are smaller than for late appliers. For the reminders, it is worth repeating that there are no statistically significant full sample effects, and even for the late appliers there are no statistically significant effects. Overall, and in line with theory, this suggests that the commitment adds a crucial component in helping students to succeed.

[33] The model shows that the commitment device can also spawn motivational effects for non-procrastinators, and via this channel increase the performance of early appliers; see Footnote 12.

[34] As discussed in Section 2, Ericson (2017) shows that while time-consistent individuals set up their own reminders to deal with limited memory, those with present-biased preferences may procrastinate on setting reminders. In our context, this means that procrastinators may start learning for the exams too late and too little and that this problem can be mitigated by external reminders.

6 Conclusion

Educational outcomes are very important, yet typically hard to change. This paper shows that soft commitments are a low-cost policy instrument with large and long-lasting effects. Following an entire cohort of students in higher education over six years, our analysis reveals that the commitment device increases the graduation rate by 15 pp and shortens time to graduation by 0.42 semesters, without adverse effects on grades. The mechanism driving these effects is a reduction in dropouts by 8 pp and an increase of credits obtained per semester by roughly 2.5.

Using observed data on choice of application date as a proxy for procrastination tendencies, we find that the commitment device is particularly helpful for students prone to procrastination. This is important since these students suffer from high dropouts and long study times. In fact, our commitment device enables late appliers to graduate at the same rate and as quickly as early appliers. It thus completely offsets the disadvantage these students face.

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Appendices

A Additional tables and figures

Table A.1: SUMMARY OF COST (IN EUROS)

Cost calculation for commitment device (cohort of 400)		
Student assistant	(7 semesters*40 hours per semester*€13.00)	€3,640.00
Introductory lecture		
Printing of information folders	(400 students*€2.30)	€920.00
Printing of information folder content	(5 pages*400 students*€0.10)	€200.00
Transparent envelopes	(400 students*€0.10)	€40.00
Reminders		
Printing of letters	(7 semesters*4 pages*400 students*€0.10)	€1,120.00
Envelopes	(7 semesters*2 letters*400 students*€0.02)	€112.00
Postage	(7 semesters*2 letters*400 students*€0.63)	€3,528.00
Total cost per semester		€1,365.71
Cost per student per semester		**€3.41**

Notes: This table summarizes the cost of the measure in Euros, in total and per student (for a cohort of 400). The postage in this table is the average postage paid during the intervention.

Table A.2: TREATMENT EFFECTS ON FINAL GPA – ROBUSTNESS

	OLS		IPW	IPWRA
	(1)	(2)	(3)	(4)
Reminder	0.047	0.070	0.082*	0.062
	(0.056)	(0.049)	(0.049)	(0.047)
Commitment	−0.079	−0.061	−0.040	−0.064
	(0.061)	(0.057)	(0.054)	(0.054)
Strata	yes	yes	see notes	
Covariates	no	yes	see notes	
N	268	268	268	268
Control Mean	2.22	2.22	2.20	2.22
(SD)	(0.43)	(0.43)	-	-

Notes: Only includes students who have obtained a degree by the end of the twelfth semester or who are still enrolled. *Outcome variable:* final GPA, including passing grades only; highest passing grade is 1.0, lowest passing grade is 4.0; for students who are still enrolled the final GPA is set to the GPA at the end of the twelfth semester; *strata:* HS GPA strata FE; *covariates:* HS GPA, age, male dummy, foreigner dummy, application date (days left), fresh HS degree dummy, HS degree Abitur dummy, other degree dummy, HS degree in BW dummy, HS degree in HE dummy, HS degree in other state dummy; *IPW:* Inverse probability weighting using the strata and covariates to predict treatment assignment among students who obtain a degree by the end of the twelfth semester or who are still enrolled. *IPWRA:* inverse-probability-weighted regression adjustment, using the strata and covariates for the regression adjustment. Robust standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.3: TREATMENT EFFECTS BY APPLICATION DATE

	Degree 10th sem.		Dropout 12th sem.		Final GPA		Credits 1st-7th sem.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Early applier	0.166*	0.146*	−0.144*	−0.110	−0.008	−0.008	3.697*	3.145
	(0.086)	(0.086)	(0.083)	(0.084)	(0.082)	(0.078)	(2.016)	(2.018)
Reminder	0.111	0.112	−0.130	−0.128	0.049	0.055	1.820	1.898
	(0.087)	(0.085)	(0.085)	(0.084)	(0.081)	(0.079)	(2.028)	(2.009)
Rem.*early app.	−0.076	−0.084	0.153	0.142	0.003	0.034	−1.849	−2.004
	(0.119)	(0.117)	(0.116)	(0.114)	(0.107)	(0.102)	(2.735)	(2.678)
Rem.+Rem.*early app.	0.036	0.029	0.023	0.013	0.052	0.088	−0.030	−0.106
	(0.082)	(0.080)	(0.079)	(0.077)	(0.070)	(0.063)	(1.850)	(1.780)
Commitment	0.182**	0.187**	−0.100	−0.090	−0.104	−0.114	3.129	3.232
	(0.086)	(0.082)	(0.086)	(0.084)	(0.088)	(0.088)	(2.066)	(1.977)
Com.*early app.	−0.047	−0.040	0.023	0.002	0.098	0.138	−1.039	−0.871
	(0.116)	(0.114)	(0.114)	(0.113)	(0.121)	(0.113)	(2.721)	(2.637)
Com.+Com.*early app.	0.134*	0.147*	−0.077	−0.087	−0.006	0.024	2.091	2.361
	(0.077)	(0.079)	(0.075)	(0.076)	(0.081)	(0.073)	(1.767)	(1.789)
Strata	yes	yes	yes	yes	yes	yes	yes	yes
Covariates	no	yes	no	yes	no	yes	no	yes
N	392	392	392	392	264	264	2744	2744

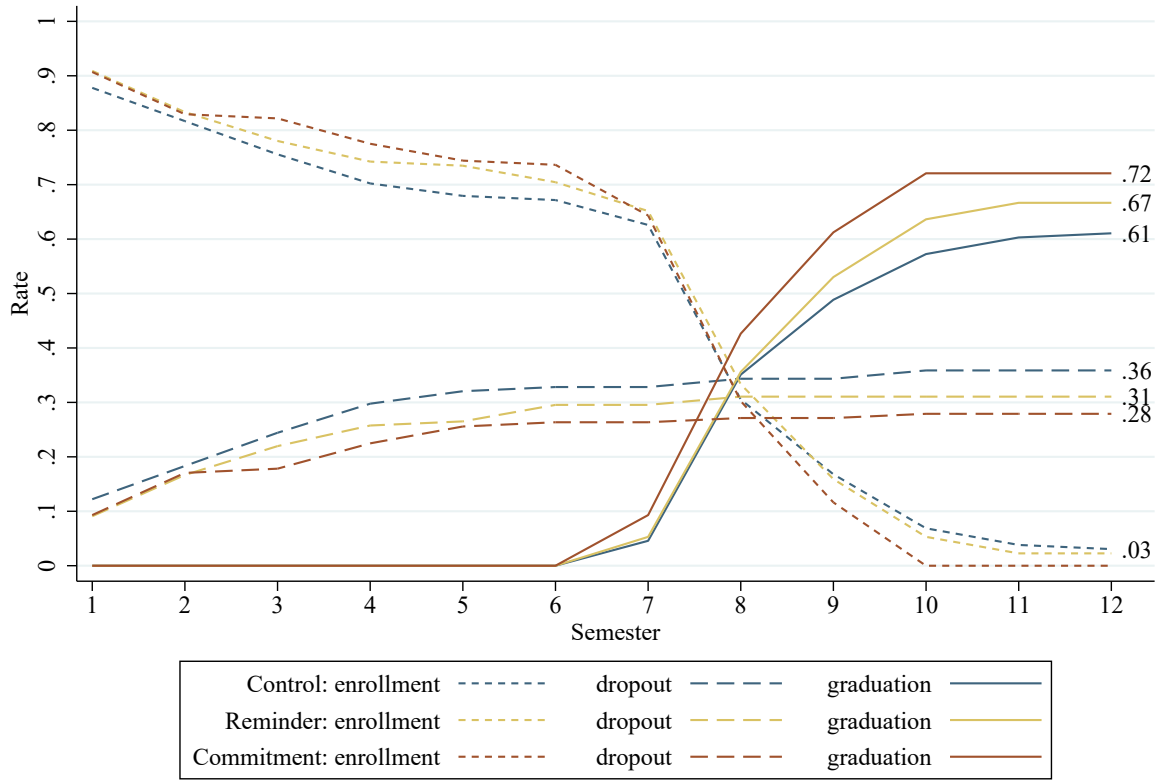
Notes: Degree 10th semester: indicates if a student graduated before or in the tenth semester; *dropout 12th semester:* indicates if a student dropped out of the study program before or in the twelfth semester; *final GPA:* only includes students who have obtained a degree by the end of the twelfth semester; includes passing grades only; highest passing grade is 1.0, lowest passing grade is 4.0; *credits 1st-7th semester:* credits per semester during the scheduled study duration of seven semesters; estimates from pooled OLS estimations; *strata:* HS GPA strata FE; *covariates:* HS GPA, age, male dummy, foreigner dummy, fresh HS degree dummy, HS degree Abitur dummy, other degree dummy, HS degree in BW dummy, HS degree in HE dummy, HS degree in other state dummy. Robust standard errors in parentheses (clustered at the student level in Columns 7 and 8). * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.4: TREATMENT EFFECTS ON GRADUATION RATES BY APPLICATION DATE

Semester	7th		8th		9th		10th		11th		12th	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Early applier	0.013	0.018	0.129	0.092	0.165*	0.144*	0.166*	0.146*	0.163*	0.134	0.148*	0.119
	(0.037)	(0.038)	(0.083)	(0.082)	(0.087)	(0.086)	(0.086)	(0.086)	(0.085)	(0.085)	(0.085)	(0.086)
Reminder	0.009	0.017	−0.019	−0.034	0.097	0.097	0.111	0.112	0.135	0.133	0.119	0.117
	(0.032)	(0.033)	(0.078)	(0.078)	(0.086)	(0.083)	(0.087)	(0.085)	(0.086)	(0.085)	(0.086)	(0.085)
Rem.*early app.	−0.001	−0.011	0.072	0.068	−0.092	−0.120	−0.076	−0.084	−0.128	−0.129	−0.112	−0.114
	(0.055)	(0.054)	(0.116)	(0.117)	(0.123)	(0.120)	(0.119)	(0.117)	(0.118)	(0.116)	(0.118)	(0.116)
Rem.+Rem.*early app.	0.007	0.005	0.054	0.034	0.005	−0.024	0.036	0.029	0.008	0.003	0.007	0.003
	(0.044)	(0.043)	(0.086)	(0.086)	(0.087)	(0.086)	(0.082)	(0.080)	(0.081)	(0.078)	(0.081)	(0.078)
Commitment	0.013	0.014	0.135	0.117	0.162*	0.165*	0.182**	0.187**	0.148*	0.141*	0.132	0.126
	(0.034)	(0.035)	(0.084)	(0.082)	(0.087)	(0.083)	(0.086)	(0.082)	(0.086)	(0.083)	(0.086)	(0.083)
Com.*early app.	0.073	0.070	−0.107	−0.089	−0.057	−0.058	−0.047	−0.040	−0.042	−0.028	−0.026	−0.012
	(0.060)	(0.062)	(0.119)	(0.118)	(0.122)	(0.119)	(0.116)	(0.114)	(0.115)	(0.114)	(0.115)	(0.114)
Com.+Com.*early app.	0.086*	0.084	0.027	0.029	0.104	0.107	0.134*	0.147*	0.106	0.113	0.106	0.113
	(0.051)	(0.053)	(0.085)	(0.085)	(0.085)	(0.085)	(0.077)	(0.079)	(0.076)	(0.077)	(0.076)	(0.077)
Strata	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Covariates	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
N	392	392	392	392	392	392	392	392	392	392	392	392
Control mean late app.	0.03	0.03	0.27	0.27	0.38	0.38	0.47	0.47	0.50	0.50	0.52	0.52
Control mean early app.	0.06	0.06	0.42	0.42	0.58	0.58	0.66	0.66	0.69	0.69	0.69	0.69

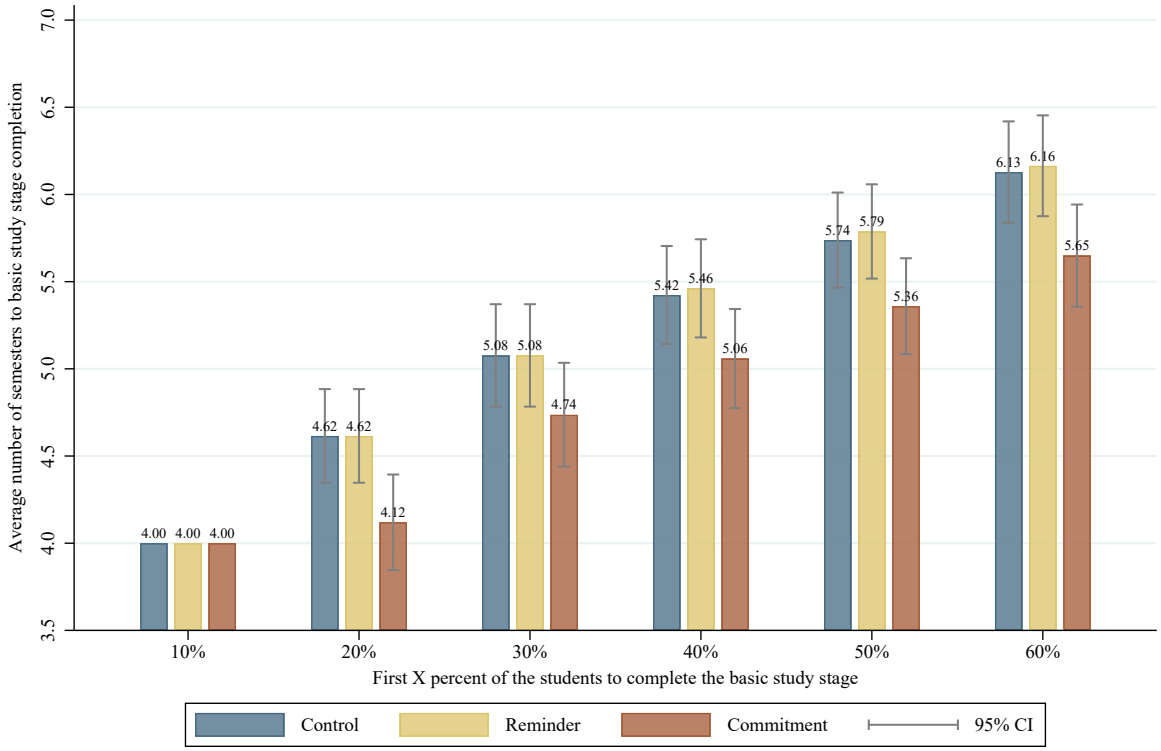
Notes: The coefficients for each semester are from separate regressions. *Outcome variable:* indicates if a student graduated before or in the respective semester; *strata:* HS GPA strata FE; *covariates:* HS GPA, age, male dummy, foreigner dummy, fresh HS degree dummy, HS degree Abitur dummy, other degree dummy, HS degree in BW dummy, HS degree in HE dummy, HS degree in other state dummy. Robust standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Figure A.1: ENROLLMENT, DROPOUT, AND GRADUATION RATES OVER TIME



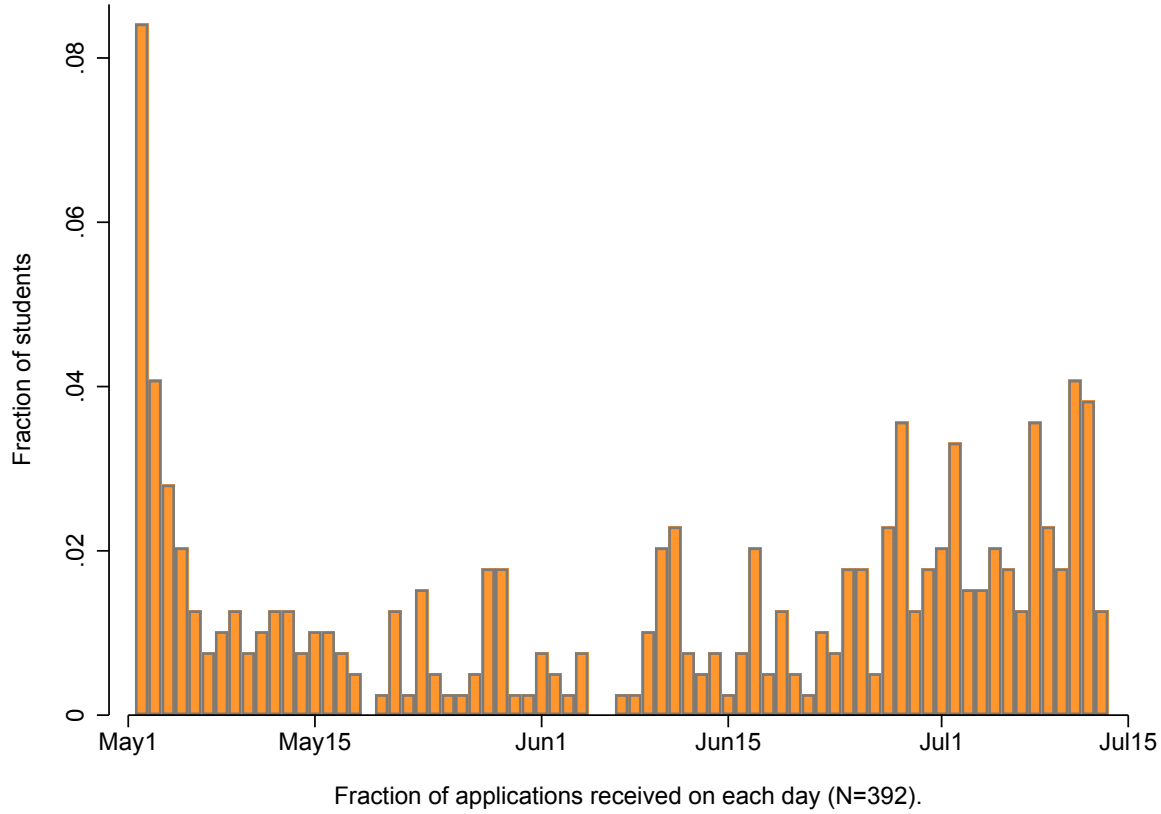
Notes: The figure shows the raw enrollment, dropout, and graduation rates over time by treatment status.

Figure A.2: AVERAGE TIME TO BASIC STUDY STAGE COMPLETION



Notes: Average semesters to complete the basic study stage is calculated as the average number of semesters it took the first X percent of students to complete the basic study stage. The highest depicted X percent is chosen based on the experimental group with the lowest basic study stage completion rate after twelve semesters. The 95% confidence intervals are based on robust standard errors from unadjusted OLS regressions.

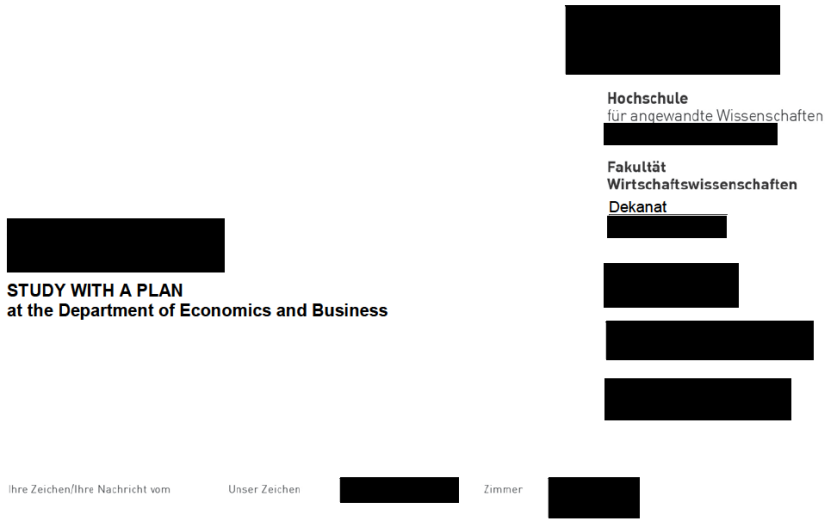
Figure A.3: DISTRIBUTION OF APPLICATION DATES



Notes: Application dates of the incoming Business Administration students. The application period was May 2 to July 12.

B Experimental materials

Figure B.1: COVER LETTER, INTRODUCTORY LECTURE ALL GROUPS (ENGLISH)



[redacted]

Hochschule
für angewandte Wissenschaften
[redacted]

Fakultät
Wirtschaftswissenschaften
Dekanat
[redacted]

[redacted]

STUDY WITH A PLAN
at the Department of Economics and Business

[redacted]

[redacted]

Ihre Zeichen/Ihre Nachricht vom Unser Zeichen [redacted] Zimmer [redacted]

Study with a Plan

Dear Mr/Ms «first name» «last name»,

we are delighted that you have chosen to study Business Administration at our university, and we welcome you in [redacted]. Today we want to introduce to you the program ***Study with a Plan***. As the name gives away, it is aimed at helping you to optimally organize your studies.

To this end you will find on the next page an **Exam Plan**, which will facilitate studying successfully and without overlapping courses during the first four semesters. After the fourth semester, the intern semester marks an important milestone in the course of your studies. ***Study with a Plan*** means that you are **„exam free"** after the fourth semester. Therefore, you can enter **without „obligations"** into your internship in the fifth semester, and the following second study period.

Studying with a plan has a number of additional advantages, which we will point out to you in today's lecture. We hope that this information will assist you in your studies from the start.

In addition you can today give us feedback on your first two weeks at the university. We would appreciate it if you could fill out the attached questionnaire.

We wish you a good and successful start at our department!

With kind regards
Your

Prof. Dr. [redacted]

Vice Dean

Figure B.2: EXAM PLAN, INTRODUCTORY LECTURE ALL GROUPS (ENGLISH)

I. Study with a Plan – Exam plan for successful studies.

	Class	Acronym	Hours	Credit Points (CP)	Passed
1. Semester	Statistik und mathematische Grundlagen	MATH	4	6 CP	☐
	Allgemeine Betriebswirtschaftslehre	ABWL	4	6 CP	☐
	Organisation	ORGA	4	6 CP	☐
	Wirtschaftsprivatrecht	WIPR	4	6 CP	☐
	Buchführung und Bilanzierung	BUBI	4	6 CP	☐
	CP after 1st Semester			Target: 30 CP	Actual: CP
2. Semester	Volkswirtschaftslehre	VOWL	4	6 CP	☐
	Arbeitsrecht	ARBR	4	6 CP	☐
	Personal	PERS	4	6 CP	☐
	Kosten- und Leistungsrechnung	KOLR	4	6 CP	☐
	Steuern	STEU	4	6 CP	☐
	PC Praktikum	PCP	Has to be passed before end of 3rd Semester		☐
	CP after 2nd Semester			Target: 60 CP	Actual: CP
3. Semester	Marketing	MARK	6	6 CP	☐
	Operation Management	OPMG	4	6 CP	☐
	Wirtschaftsinformatik	WINF	4	6 CP	☐
	Finanzierung und Investition	FINI	6	6 CP	☐
	Controlling	CONT	4	6 CP	☐
	Englisch	ENGL	Proof of English proficiency before end of 3rd Sem.		☐
	CP after 3rd Semester			Target: 90 CP	Actual: CP
4. Semester	Angewandte Volkswirtschaftslehre	AVWL	4	6 CP	☐
	Seminar / Planspiel	SEMA/PLSP	4	6 CP	☐
	Anwendung BWL-Methoden	ABWM	4	6 CP	☐
	Wirtschaftsenglisch	WENG	4	6 CP	☐
	Fachbezogene Wahlpflichtfächer	FWPF	4	6 CP	☐
	CP after 4th Semester			Target: 120 CP	Actual: CP

In the rightmost column of this summary you can document your progress in your studies. Check off the exams you have already passed and note the obtained Credit Points. Over the course of your studies this allows you to evaluate whether you are still "on track". If you are, this should motivate you to continue to „Study with a Plan". Otherwise, if needed you can correct your course in time by (re)taking the missing exams.

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Figure B.3: INFO MATERIAL, INTRODUCTORY LECTURE CONTROL AND REMINDER GROUPS (ENGLISH)

III. Information about the Exam Plan for successful studies.

a) Adhering to the study plan – You can do it!

According to the study plan you should expect a workload of 30 Credit Points or 900 hours in every semester (1 CP = 30 hours). This amounts to roughly 45 hours per week over a period of 20 weeks, and it includes the weeks with classes as well as the period of preparing for exams. The workload therefore approximates that of a "regular employee". Under typical circumstances, this is doable!

Accordingly, a 6 CP class comes with a workload of 180 hours, of which 45 hours (15 weeks*3hours class) are reserved for the classes. The remaining 135 hours are your responsibility and are spent independently studying. This corresponds to 6-7 hours per week (assuming 20 weeks including exam preparation). Of course this can only give some rough orientation, and the individual workload can deviate from these numbers.

b) The study plan takes into account the sequence of classes.

Some classes build on other classes, i.e. the lecturers will assume that you have attended introductory classes. This means that certain fundamentals will not be covered again in the more advanced classes.

Some advanced classes (especially in later semesters) can only be taken after certain credit point thresholds have been cleared, or after certain prerequisite exams have been passed. The reason is that only if you have understood the basics these classes can proceed to convey advanced knowledge in an efficient manner.

c) The study plan allows for studying without overlapping classes

Only if you adhere to the study plane it is guaranteed that there will be no overlapping classes. All classes in a specific semester are scheduled in a way that they do not overlap. As soon as you take classes from different semesters, e.g. because you have to retake a class, the times of your classes will almost certainly clash.

d) Plan ahead: core classes.

Core classes are only offered once a year. It is important that you consider this when planning your studies. The best course of action is to adhere to the study plan – the plan makes sure that there will be no lost time, which would ultimately delay your graduation.

Figure B.4: INFO MATERIAL, INTRODUCTORY LECTURE COMMITMENT GROUP, TEXT ADDED TO REMINDER TEXT IN GREY (ENGLISH)

III. Information about the Exam Plan for successful studies.

a) Why a target agreement?

Agreeing on targets is an instrument that is widely used in business contexts. Specifying and confirming goals in writing leads to a higher probability of reaching them. With the attached target agreement you set for yourself the target of "Studying with a Plan". Specifically, this means: with the target agreement you and the department aim at studying successfully, according to the Study Plan.

The agreement is therefore a measure by which you make clear to yourself that you really „take your studies seriously". You get to keep one copy of the agreement for your records, so that you can later bring to mind the targets that you set for yourself when you started your studies. The intention is to motivate yourself to check the progress you are making in your studies against the study plan, evaluate your progress, and take appropriate actions if things are not going as planned.

By signing the agreement you are subject to the same consequences that already arise from the official examination regulations. In this respect, you can only be better off by signing the agreement.

b) Adhering to the study plan – You can do it!

According to the study plan you should expect a workload of 30 Credit Points or 900 hours in every semester (1 CP = 30 hours). This amounts to roughly 45 hours per week over a period of 20 weeks, and it includes the weeks with classes as well as the period of preparing for exams. The workload therefore approximates that of a "regular employee". Under typical circumstances, this is doable!

Accordingly, a 6 CP class comes with a workload of 180 hours, of which 45 hours (15 weeks*3hours class) are reserved for the classes. The remaining 135 hours are your responsibility and are spent independently studying. This corresponds to 6-7 hours per week (assuming 20 weeks including exam preparation). Of course this can only give some rough orientation, and the individual workload can deviate from these numbers.

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Some advanced classes (especially in later semesters) can only be taken after certain credit point thresholds have been cleared, or after certain prerequisite exams have been passed. The reason is that only if you have understood the basics these classes can proceed to convey advanced knowledge in an efficient manner.

d) The study plan allows for studying without overlapping classes

Only if you adhere to the study plane it is guaranteed that there will be no overlapping classes. All classes in a specific semester are scheduled in a way that they do not overlap. As soon as you take classes from different semesters, e.g. because you have to retake a class, the times of your classes will almost certainly clash.

e) Plan ahead: core classes.

Core classes are only offered once a year. It is important that you consider this when planning your studies. The best course of action is to adhere to the study plan – the plan makes sure that there will be no lost time, which would ultimately delay your graduation.

Figure B.5: COMMITMENT AGREEMENT (ENGLISH)

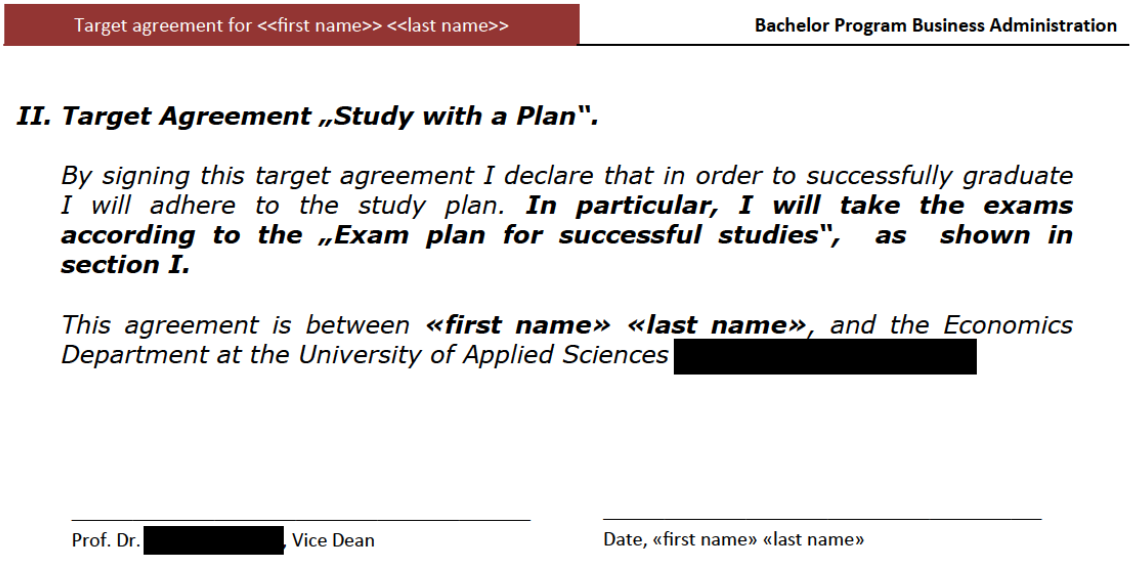


Figure B.6: SIGN-UP LETTER 1ST SEMESTER – REMINDER (ENGLISH)

[redacted]

Hochschule
für angewandte Wissenschaften
[redacted]

Fakultät
Wirtschaftswissenschaften
Dekanat
[redacted]

[redacted]

[redacted]

[redacted]

Hochschule für angewandte Wissenschaften
[redacted]

Herr
«Vorname» «Nachname»
«Strasse»
«PLZ» «Ort»

Ihre Zeichen/Ihre Nachricht vom | Unser Zeichen [redacted] | Zimmer [redacted]

Study with a Plan

Dear Mr/Ms «Last Name»,

surely you remember the introductory lecture to ***Study with a Plan*** which took place in the context of the statistics class. In this lecture you were given important information on how to best organize your studies.

The exam sign-up period for the winter semester is coming up shortly. **In the context of *Study with a Plan* we recommend: In the period from 18.11. - 29.11. please use the university website to sign up for at least the following exams:**

Statistics and Mathematics	MATH
Business Administration	ABWL
Organization	ORGA
Civil law	WIPR
Accounting	BUBI

We hope you enjoy your time at our department and wish you all the best.

Kind regards
Your

Prof. Dr. [redacted], *Vice Dean*

Figure B.7: SIGN-UP LETTER 1ST SEMESTER – COMMITMENT, TEXT ADDED TO REMINDER LETTER IN GREY (ENGLISH)

[redacted]

Hochschule
für angewandte Wissenschaften
[redacted]

Fakultät
Wirtschaftswissenschaften
Dekanat
[redacted]

Hochschule für angewandte Wissenschaften
[redacted]

Frau
«Vorname» «Nachname»
«Strasse»
«PLZ» «Ort»

[redacted]

Ihre Zeichen/Ihre Nachricht vom | Unser Zeichen | Telefon [redacted] | Zimmer [redacted]

Study with a Plan

Dear Mr/Ms «Last Name»,

surely you remember the introductory lecture to ***Study with a Plan*** which took place in the context of the statistics class. In this lecture you were given important information on how to best organize your studies and you have signed a target agreement with us.

The exam sign-up period for the winter semester is coming up shortly. **In the context of *Study with a Plan* we recommend: In the period from 18.11. - 29.11. please use the university website to sign up for at least the following exams:**

Statistics and Mathematics	MATH
Business Administration	ABWL
Organization	ORGA
Civil law	WIPR
Accounting	BUBI

We hope you enjoy your time at our department and wish you all the best.

Kind regards
Your

Prof. Dr. [redacted], *Vice Dean*

Figure B.8: APPENDIX TO SIGN-UP LETTER 7TH SEMESTER – REMINDER AND COMMITMENT (ENGLISH)

I. Curriculum und requirements 1st to 6th semester

Curriculum 1st semester		Passed
Statistics and mathematics	MATH	☐
Business administration	ABWL	☐
Organization	ORGA	☐
Civil law	WIPR	☐
Accounting	BUBI	☐
Total CP (6CP each, target=30CP)	Σ	☐

Curriculum 2nd semester		Passed
Economics	VOWL	☐
Labor law	ARBR	☐
Human resources	PERS	☐
Cost and activity accounting	KOLR	☐
Taxation	STEU	☐
Total CP (6CP each, target=30CP)	Σ	☐

Curriculum 3rd semester		Passed
Marketing	MARK	☐
Operations management	OPMG	☐
Information systems	WINF	☐
Financing and investment	FINI	☐
Controlling	CONT	☐
Total CP (6CP each, target=30CP)	Σ	☐

Requirements after 3rd semester	Attained
72 CP after the 3rd semester	☐
Computer internship completed successfully	☐
Command of English proven	☐

Curriculum 4th semester		Passed
Applied economics	AVWL	☐
Seminar/business game	SEMA/PLSP	☐
Applied business methods	ABWM	☐
Commercial English	WENG	☐
Subject-specific electives	FWPF	☐
Total CP (6CP each, target=30CP)	Σ	☐

Curriculum 5th semester		Passed
Internship[2]	PRAK	☐
Preparation/reflection of internship	PRAV/PRAR	☐
General electives	AWFP	☐
Total CP (22+3+5 CP, target=30CP)	Σ	☐

Curriculum 6th semester		Passed
Business management/ethics	UNTF/UETH	☐
Major 1a	SCHW	☐
Major 2a	SCHW	☐
Total CP (7+10+10 CP, target=27CP)	Σ	☐

II. Curriculum 7th semester

Curriculum 7th semester		Signed Up
Major 1b	SCHW	☐
Major 2b	SCHW	☐
Bachelor seminar	BAGS	☐
Bachelor thesis	BACA	☐
Total CP (10+10+1+12 CP, target=33CP)	Σ	☐

[1] 66 instead of 72 CP from the first three semesters are required if the 3rd semester was not completed at the FHWS.
[2] Requirements for internship: 95 CP, minimum duration of 20 weeks, timely registration.

Figure B.9: STUDY LETTER 1ST SEMESTER – REMINDER (ENGLISH)

[redacted]

Hochschule
für angewandte Wissenschaften
[redacted]

Fakultät
Wirtschaftswissenschaften
Dekanat
[redacted]

[redacted]

[redacted]

[redacted]

Hochschule für angewandte Wissenschaften
[redacted]

Ihre Zeichen/Ihre Nachricht vom | Unser Zeichen | Telefon [redacted] | Zimmer [redacted]

Study with a Plan

Dear Mr/Ms «First Name» «Last Name»,

Christmas and the New Year are just around the corner. We wish you a peaceful time and a happy new year. Enjoy the upcoming holidays with your family and friends. Please also remember that the exam period starts shortly after the turn of the year.

In the context of *Study with a Plan* we recommend that you start the necessary preparations before the Christmas break. The exam plan prescribes that in the first semester you successfully participate in at least the following exams:

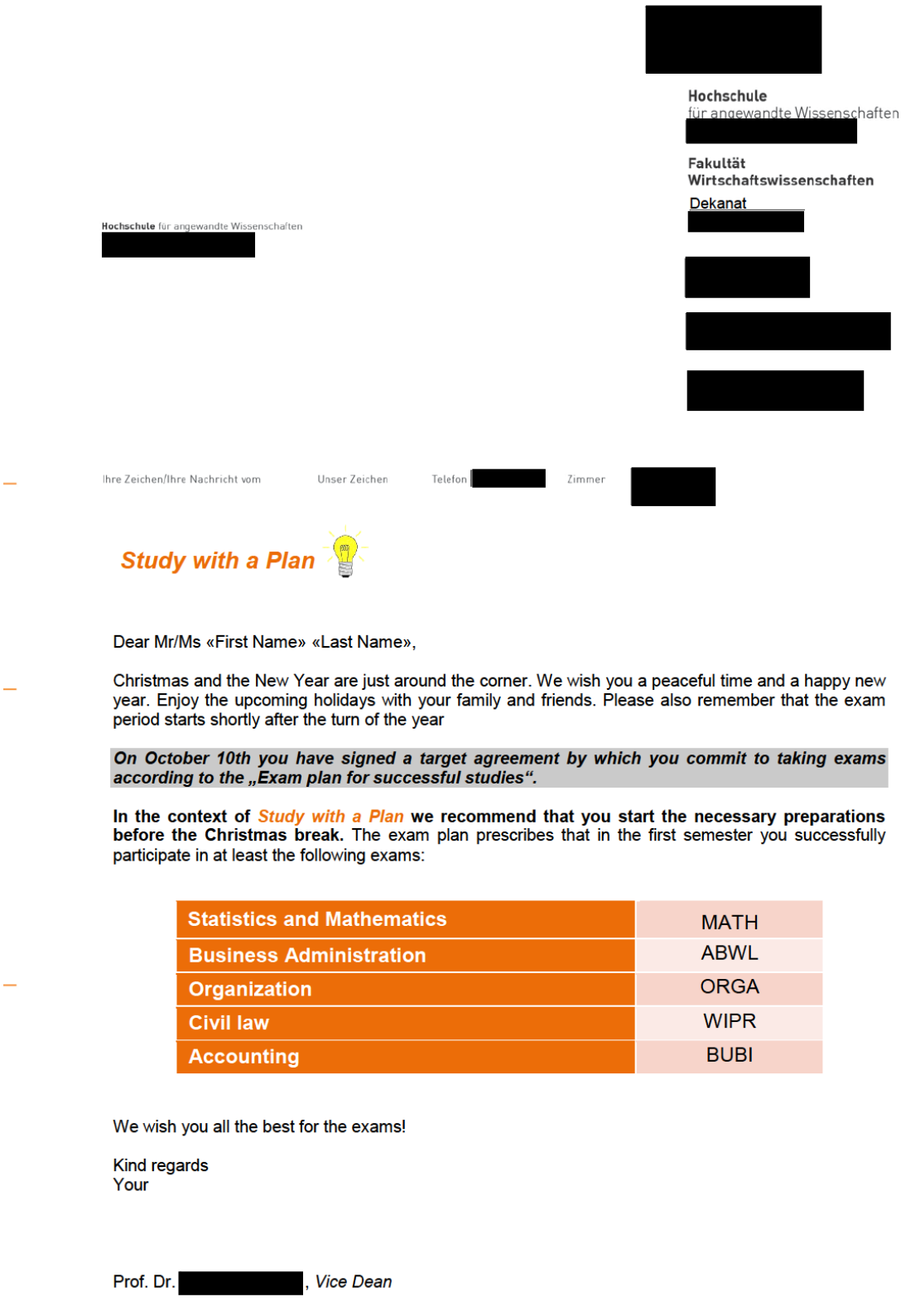
Statistics and Mathematics	MATH
Business Administration	ABWL
Organization	ORGA
Civil law	WIPR
Accounting	BUBI

We wish you all the best for the exams!

Kind regards
Your

Prof. Dr. [redacted], *Vice Dean*

Figure B.10: STUDY LETTER 1ST SEMESTER – COMMITMENT, TEXT ADDED TO REMINDER LETTER IN GREY (ENGLISH)



[redacted]

Hochschule
für angewandte Wissenschaften
[redacted]

Fakultät
Wirtschaftswissenschaften
Dekanat
[redacted]

Hochschule für angewandte Wissenschaften
[redacted]

[redacted]

[redacted]

[redacted]

Ihre Zeichen/Ihre Nachricht vom | Unser Zeichen | Telefon [redacted] | Zimmer [redacted]

Study with a Plan

Dear Mr/Ms «First Name» «Last Name»,

Christmas and the New Year are just around the corner. We wish you a peaceful time and a happy new year. Enjoy the upcoming holidays with your family and friends. Please also remember that the exam period starts shortly after the turn of the year

On October 10th you have signed a target agreement by which you commit to taking exams according to the „Exam plan for successful studies".

In the context of *Study with a Plan* we recommend that you start the necessary preparations before the Christmas break. The exam plan prescribes that in the first semester you successfully participate in at least the following exams:

Statistics and Mathematics	MATH
Business Administration	ABWL
Organization	ORGA
Civil law	WIPR
Accounting	BUBI

We wish you all the best for the exams!

Kind regards
Your

Prof. Dr. [redacted], *Vice Dean*