Short-Term Events, Long-Term Friends? Freshman Orientation Peers and Academic Performance

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Abstract: How does the formation of social connections at the beginning of college shape individuals' subsequent academic performance? Exploiting quasi-random assignment to groups of a two-day freshman orientation program, I find that such brief social activities can be sufficient to generate lasting performance spillovers: being assigned to a peer group with one SD higher ability improves the academic performance of business administration students by 0.05 to 0.08 SD up to three years later. I provide evidence that the effects result from the formation of lasting social ties, and that performance spillovers are moderated by the broader social environment.

Keywords: Peer Effects; Peer Ability; Academic Performance; Higher Education; Freshman Orientation; Quasi-Experiment

JEL Classification: I21, I23, J24

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1 Introduction

Few days are as formative for our social lives as the first days of college. We meet new people, some of whom become our study partners, friends, or even spouses (Back et al., 2008; Nielsen and Svarer, 2009; Thiemann, 2022). But how do these connections affect our academic progress and performance? The literature on peer effects provides only limited answers: while several studies find that being surrounded by higher ability peers in dorms, classes, or cohorts has a positive effect on students' achievement (Booij et al., 2017; Carrell et al., 2009; Corno et al., 2022; Feld and Zölitz, 2017), it is difficult to rule out that the effects in such long-lasting peer contexts arise because of other factors, such as the classroom environment and instructors' response to it (Coveney and Oosterveen, 2021).

Here, I provide more direct evidence on the role of social connections by investigating whether ability peer effects emerge in the context of a two-day freshman orientation program at the Department of Business Administration at a German university; a setting that minimizes the influence of other possible channels due to its short duration and non-instructional nature. To identify the causal effect of higher ability peers on students' academic achievement, I exploit the surname-based assignment of students to freshman orientation groups. Several tests provide strong evidence that the assignment mechanism generates peer group compositions that are as good as random.

I document that being assigned to a freshman orientation group with higher ability peers has significant and persistent positive effects on the academic achievement of students in Business Administration (BuA) – the largest program at the department. A one standard deviation (SD) increase in the average peer high school grade point average (GPA) increases an index of students' academic achievement by 0.08 SD at the end of the first year. Two years later, academic achievement is still 0.06 SD higher. Put differently, students assigned to a peer group at the 90^{th} percentile of the peer ability distribution, rather than the 10^{th} percentile, have 0.16 to 0.21 SD higher academic achievement. The effects are not driven by a single component of the achievement index: assignment to more able freshman orientation peers enhances study progress, as measured by accumulated course credits, leads to higher persistence, and improves students' GPA. Additional analyses provide no evidence for non-linear effects of peer ability and indicate that students of all ability levels benefit from being assigned to more able peers.

How can peer effects emerge from a setting as brief as a two-day freshman orientation event? In contrast to peer group contexts such as dormitories or tutorials, students do not observe or experience the behavior of their assigned peer group over an extended period of time. Persistent peer effects therefore require the formation of lasting social networks (Calvó-Armengol et al., 2009; Jackson et al., 2022). Using out-of-sample survey data, I show

that students meet at least one-third of their study partners – i.e., the individuals with whom they exchange or discuss course materials or plan to study for exams together – during freshman orientation, and that the relationships persist throughout their studies. To shed more light on whether social ties actually contribute to the effects I find, I use the survey sample to predict students' probability of having met no study partners during freshman orientation – i.e., their "isolation" probability – in the main estimation sample. Consistent with the proposed mechanism, the subsequent analysis shows that the main effects are almost entirely driven by students with a lower isolation probability. I complement this with an analysis showing that the specializations students choose from the fourth semester onward are positively correlated with the specialization choices of their peers. Together, the results show that orientation succeeds in creating lasting social connections that shape students' behavior and performance.

Are brief peer contexts for newcomers generally sufficient for positive effects of higher ability peers? Considering that peer effects are often highly context dependent (Sacerdote, 2014), the existence and nature of performance spillovers from freshman orientation peers might be related to the broader study environment. To examine this, I exploit that freshman orientation at the Department of Business Administration is organized in the same way for two other study programs: International Business (IB) and International Business & Technology (IBT). They have much smaller cohorts and therefore smaller classes (75 students per cohort instead of 350 to 400 in BuA), and are more selective about who they admit. A heterogeneity analysis shows that the estimated effects of more able peers in IB(&T) are significantly smaller and switch sign: a one SD increase in peers' high school GPA reduces academic achievement by an imprecisely estimated 0.01 to 0.05 SD.

I argue and provide evidence that this heterogeneity is related to the size of the programs, which may shape the overall social dynamics (Bernerth et al., 2023; Maurer et al., 2023), and thereby moderate the effects of freshman orientation peers. For instance, outside of the orientation program, it may be more costly to connect with others and seek information when the program is large and more anonymous (Chandrasekhar et al., 2018; Sandvik et al., 2020). Consistent with this idea, the out-of-sample surveys indicate differences in the social environment during the studies (i.e., after freshman orientation). Students in the smaller programs have more study partners and more learning-related social interactions (e.g., discussing course content and working together). This, in turn, may mitigate the influence of freshman orientation peers. Supporting this notion, and in contrast to the specialization choices in BuA, I find no evidence for a significant correlation between students' and their peers' choice of courses (IB) and minors (IBT). In addition, I do not find evidence that the heterogeneous effects are driven by the selectivity of the programs and the resulting differences in the student composition: the significant heterogeneity in the effects across pro-

grams is robust to controlling for the interaction of peer ability and students' background characteristics, and there is no significant difference in peer effects between BuA students who are more comparable to IB(&T) students and BuA students who are less comparable to them.

The first contribution of this paper is to investigate and show that even brief social activities can be sufficient for the emergence of substantial and persistent peer effects. Most previous studies investigate performance spillovers in longer-lasting peer contexts or when peers work alongside each other (see Sacerdote (2014) and Villeval (2020) for reviews). Consistent with my findings, studies in higher education mainly document positive effects when students are exposed to more able peers in their cohorts, tutorial groups, or dorms (Booij et al., 2017; Carrell et al., 2009; Feld and Zölitz, 2017; Frijters et al., 2019; Griffith and Main, 2019; Humlum and Thorsager, 2021; Ost, 2010; Sacerdote, 2001).[1] Research that provides evidence for the existence of performance spillovers in the workplace is also largely based on the contemporaneous effort or productivity of peers (Bandiera et al., 2010; Chan et al., 2014; Cohen-Zada et al., forthcoming; Cornelissen et al., 2017; Frakes and Wasserman, 2021; Guryan et al., 2009; Mas and Moretti, 2009; Tan and Netessine, 2019). Short-term peer groups, on the other hand, have received little attention to date. The two closest papers, Fischer and Rode (2020) and Thiemann (2022), study more extensive freshman orientation programs in more selective settings and find null or even negative effects of higher ability peers on later outcomes.[2]

Second, this study contributes to ongoing discussions about the mechanisms underlying ability peer effects in education (Conley et al., 2024; Coveney and Oosterveen, 2021; Guryan et al., 2008). One suggestion is direct social interaction between peers, such as discussions of course material in or out of class (Booij et al., 2017; Carrell et al., 2013; Feld and Zölitz, 2017; Garlick, 2018). Other proposed mechanisms are that the composition of the peer group influences the classroom environment and how well instructors are able to manage it (Duflo et al., 2011; Lavy and Schlosser, 2011; Lavy et al., 2012). In most contexts, it is difficult to isolate the individual contribution of each mechanism. The brief nature and non-instructional content of the freshman orientation program I study, however, virtually rules out any channels related to instructors and the classroom environment. Instead, my setting and the results I present on students' study partners and specialization choices underscore that persistent social networks can shape individuals' long-term performance and behavior (Calvó-Armengol

[1] There is also evidence of negative peer spillovers, at least for subgroups such as women and low ability students (Carrell et al., 2013; Feld and Zölitz, 2017; Fischer, 2017).

[2] My results suggest that the general level of social interaction, rather than the composition of the student body, is the main driver of the heterogeneous effects across programs. Because there are too many substantial differences between the setting of my study and the settings of Fischer and Rode (2020) and Thiemann (2022) (e.g., length and content of freshman orientation, selectivity of the programs, and composition of the student body), it would be too much of a stretch to conclude that the moderator I identify in my setting can also explain the heterogeneous effects across our studies.

et al., 2009; Field et al., 2016; Jackson et al., 2022).

Finally, the result that positive effects of higher ability freshman peers only emerge in a large and less interactive setting suggests that other social dynamics and knowledge flows may play an important moderating role for performance spillovers from brief social activities (Cai and Szeidl, 2018; Frakes and Wasserman, 2021; Sandvik et al., 2020). The paper therefore directly speaks to the external validity of its results and to the conditions under which they emerge (List, 2020). This is particularly relevant, because the direction and nature of peer effects is often highly context dependent (Sacerdote, 2014; Villeval, 2020).

2 Institutional background

Universities and colleges around the world offer freshman or new student orientation to help students with the transition to university. In the US, about 70% of colleges organize events that introduce students to the institution, familiarize them with resources and services, and allow them to form social connections and become part of the community (Feygin et al., 2022). In Germany, almost all students have access to events that provide opportunities to socialize with fellow students (92%), to events that introduce them to central facilities such as libraries, computer labs, and learning and communication platforms (90%), and to events about the organization of their studies (81%). 78, 66, and 65% of students attend these events, and of those, 90, 83, and 84% rate them as rather or very helpful (see Table A.2).[3]

2.1 Freshman orientation at the Department of Business Administration

The context of this study is the freshman orientation program of the Department of Business Administration at a large German university of applied sciences (UAS). It is organized for students of three bachelor programs: Business Administration (BuA), International Business (IB), and International Business and Technology (IBT).[4] The programs are structured according to the European Credit Transfer and Accumulation System (ECTS), have a scheduled study duration of seven semesters, and students must earn a total of 210 course credits to graduate.[5] Although there are no courses that students in the three programs take

[3]Data are from data from the representative National Educational Panel Study starting cohort five (`https://www.neps-data.de/Portals/0/NEPS/Datenzentrum/Forschungsdaten/SC5/17-0-0/SC5_17-0-0_Codebook_en.pdf`, retrieved on December, 12, 2022). Some universities also offer bridging courses (i.e., short remedial courses; 49%) and courses on academic and scientific skills (45%).

[4]Besides accounting for a substantial share of students at this UAS (about 20%), BuA was also the most popular study program in Germany in the winter semester 2020 among German freshman students (8.3%; Destatis 2021).

[5]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 also `https://ec.europ`

together, the intended study structure is generally the same. In the first and second year, students mostly take compulsory courses that provide them with the fundamentals. In the fourth or fifth semester, students must complete a mandatory internship, and in the final year, students mostly choose from elective courses and write their bachelor's thesis.[6]

There are, however, several important differences between the programs. First, they differ in terms of cohort size. While cohorts in BuA consist of about 350 to 400 students, there are only about 75 students per cohort in IB and IBT. Second, and relatedly, IB and IBT are more selective with respect to the high school GPA of the students that they admit to the program (cf. Section 3). Third, IB and IBT are aimed at a more international audience and the language of instruction is therefore English rather than German. In IB, students are expected to go abroad for one semester and for their mandatory internship. In addition, in the second and third semester, they are expected to take courses in one additional business language (French, Italian, Spanish, or German). In IBT, instead of going abroad, students choose one of three STEM minors to complement their business courses (Mechanical Engineering, Electrical Engineering, or Science and Technology). In BuA, starting in the fourth semester, students choose three out of sixteen specializations such as finance, controlling, human resource management, or business taxation.

To help students get started and to familiarize them with the university and their study program, the department organizes a two-day freshman orientation for each program during the first week of the semester. Orientation is organized in the same way for all three programs and includes the following activities, which students go through in groups of about 26 students: meet and greet with department staff, opportunities to socialize with fellow students such as team-building activities and going to lunch together, meetings with the student association, introduction to the services of the university's library, general information about studying at a university, information about the weekly study schedule during the semester, and a campus rally; i.e., the type of activities offered by most German universities (cf. Table A.2). The program is standardized so that all groups receive the same information and go through the same activities. The groups are supervised by tutors, i.e., students from a more advanced semester, who are randomly assigned to the groups. Although attendance is not mandatory, most students participate: according to the organizers and in line with survey evidence, the participation rates are typically between 80 to 90%.[7]

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a.eu/education/resources-and-tools/european-credit-transfer-and-accumulation-system-ects_en, retrieved on September 10, 2023.

[6] Students in the three programs attend lectures and tutorials on the same campus. Unlike in other countries, however, students at this and most other German universities do not live on campus. "College clubs", in which students might participate together, are also not widespread in Germany.

[7] The survey evidence stems from an online survey that was conducted in the summer semester of 2023 among all bachelor students at the university. The survey included the question *"Please think back to the be-*

The allocation of students to peer groups is organized in the following way: The department determines the number of groups based on the number of students who enroll. Students are then assigned to groups based on ranking them in the alphabetical order of their last names. One exception is that in BuA there is usually one group that is reserved for students who enroll in their program after the initial allocation; because of the different allocation mechanism, I exclude these groups from my analyses. Once students are assigned to their groups, they are not allowed to switch between them. In addition, after freshman orientation, these groupings are no longer used for any other study-related activities, such as lectures and tutorials. Similar surname-based assignments to peer groups have been used to analyze peer effects before (Goulas et al., 2022; Harmon et al., 2019; Mulhern, 2023), and in Section 4.2 I provide evidence that the allocation mechanism, which is the basis for my identification strategy, leads to peer group compositions that are as good as random.

2.2 Study partners and social environment

How can peer effects emerge in such a context? Given the short duration of the orientation program, and the absence of performance-oriented team activities like case study competitions (Thiemann, 2022), there is arguably little scope for direct peer effects to occur during the two days of orientation. Rather, it is more plausible that peer effects will emerge if the brief social interactions during orientation lead to longer-lasting, study-related relationships.[8] In addition, the influence that freshman orientation peers have on later outcomes may depend on how socially interactive the study programs are in general.

Study partners from freshman orientation. To provide direct evidence on the formation of lasting social ties, Figure 1 reports results from online surveys conducted in the summer semesters of 2022 and 2023.[9][10] The surveys asked students about the number of students from their study program with whom they are in contact so closely that they regularly exchange or discuss course materials or plan on studying for exams together (see notes of Figure 1 for the exact wording). Directly afterwards, students were asked how many of those

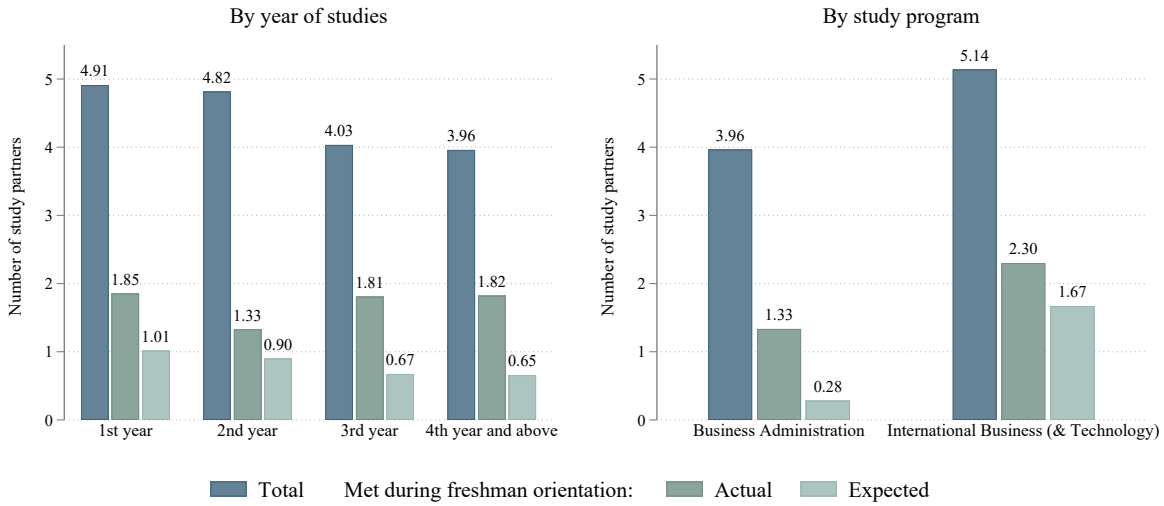
ginning of your studies. Which of the following services offered by the university did you make use of when you started your studies?" and the sub item *"Introductory/orientation days"*, to which 83.3% of the 215 participating students from the BuA department answered with "Yes" (10.7% answered with "No" and 6.0% answered that they were not aware of the orientation days).

[8] This idea is supported by Back et al. (2008), who show that randomly determined physical proximity in the classroom at the beginning of university leads to higher friendship intensity one year later, and by Thiemann (2022), who finds that students who are randomly assigned to the same freshman orientation group are more likely to choose the same tutorial groups later and to be among each other's five best friends.

[9] Summer and winter semesters in Germany are equivalent to spring and fall semesters in other countries.

[10] Table A.3 shows that the survey sample is very similar to the main estimation sample.

Figure 1: Average number of study partners from own study program



Notes: The figure plots students' number of study partners for the study programs at the Business Administration department based on data from online surveys that were conducted in the summer semesters of 2022 and 2023 among all bachelor students at the university. The numbers are linear predictions based on regressing the respective outcome on an IB(&T) dummy, year of study FE, survey wave FE, and a dummy indicating students whose orientation was conducted online because of the Covid-19 pandemic (results are qualitatively the same when excluding these students). The "total" number is based on the survey question *"With how many students from your current study program are you in contact so closely that you regularly exchange or discuss course materials or plan on studying for exams together?"*. The "actual" number of study partners met during freshman orientation is based on the survey question *"How many of these contacts have you met during an introductory week or during orientation days at the beginning of your studies?"*. For students who reported zero study partners and for students who reported that they did not attend freshman orientation, the number of study partners met during freshman orientation is set to zero. For the "expected" number of study partners met during freshman orientation, the total number of study partners is multiplied by the number of peers per freshman orientation group divided by the total number of peers per cohort. Based on the data presented in Section 3, on average, the peers in a student's own freshman orientation group make up 7.05 and 32.5% of all students in a Business Administration and International Business (& Technology) cohort, respectively. $N = 380$.

"study partners" they met during freshman orientation.[11] The left panel shows the number of study partners by respondents' year of study. Across all years, students report between 4 and 5 study partners from their own program. In all years except the second, they report meeting about 1.8 of their study partners during freshman orientation. To put this number in perspective, the figure also shows the expected number of study partners from the same orientation group if students were to select study partners from their cohort by chance alone. To do so, I multiply the total number of students' study partners by the ratio of orientation group peers to peers in the entire cohort. The results show that the actual number of study partners met during orientation is well above what would be expected by chance. Taken together, the main insight is that a substantial fraction of students' study partners can be traced back to the freshman orientation groups at the very beginning of their studies. It therefore seems reasonable to assume that the composition of the groups affects the type of study

[11] The survey question did not ask students about study partners from their own freshman orientation group, but from freshman orientation in general. I therefore have to assume that the number of students who met outside of their own freshman orientation group is negligible. The assumption is plausible, however, as students go through the entire freshman orientation program within the groups to which they were assigned.

partners students have later, which in turn is likely to affect their academic achievement and behavior.

Social environment during the studies. The size of the study programs – but potentially also the composition of the student body – may create different types of social environments. Larger cohorts and larger lectures arguably make BuA more anonymous. The right panel of Figure 1 provides the first piece of evidence for this. Compared to students in IB(&T), BuA students report having about 4 instead of 5 study partners, and they met 1.3 instead of 2.3 of their study partners during freshman orientation. The bigger cohort size in BuA, however, also makes it much less likely that a randomly selected study partner was in the same orientation group.

Table 1: Learning-related social interaction – by study program

Outcome	(1) Index	(2) Work together	(3) Discuss content	(4) Ask advice	(5) Joint goals	(6) Learning agreements	(7) Tell others about goals
IB(&T)	0.257**	0.220*	0.217*	0.095	0.141	0.335***	0.097
	(0.124)	(0.127)	(0.126)	(0.123)	(0.123)	(0.122)	(0.125)
Study year FE	yes	yes	yes	yes	yes	yes	yes
Covid cohort FE	yes	yes	yes	yes	yes	yes	yes
Survey FE	yes	yes	yes	yes	yes	yes	yes
R^2	0.03	0.03	0.03	0.01	0.02	0.06	0.02
N	321	319	319	320	316	315	316

Note: The table reports estimates from regressing different measures of social interaction on an IB(&T) dummy (reference group are BuA students). The underlying data is from online surveys that were conducted in the summer semesters of 2022 and 2023 among all bachelor students at the university. *Covid cohort FE* indicate students whose orientation was conducted online because of the Covid-19 pandemic (results are qualitatively the same when excluding these students). *Index* is the standardized inverse-covariance weighted average of the other outcomes. The outcomes in Columns (2) to (7) are standardized within survey waves and based on the following question and sub-items: "Now we would like to know more about learning with other students. For each activity, please indicate how often it is typically done by you."; *Work together:* "I work on texts or assignments together with my fellow students."; *Discuss content:* "I discuss the course content with fellow students."; *Ask advice:* "If something is not clear to me, I ask fellow students for advice"; *Joint goals:* "I set learning goals together with my fellow students."; *Learning agreements:* "I make learning agreements with my fellow students (e.g., distribution and preparation of learning content and group work)."; *Tell others about goals:* "I tell my fellow students, friends, or family about my learning goals."; Answer categories were 1 – Very rarely, 5 – Very often, and "no answer" in summer semester 2022, and 1 – Very rarely, 7 – Very often, and "no answer" in summer semester 2023. Robust standard errors clustered at the student level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Second, in the surveys, students were also asked how often they work together, discuss course content, ask each other for advice, set joint learning goals, make learning agreements, and tell others about their learning goals. Table 1 reports on the difference between BuA and IB(&T) students for each type of social activity. Considering an overall index (Column 1), the level of social interaction in IB and IBT is about 0.26 SD higher than in BuA ($p = 0.039$). Directionally, this difference is reflected in all six sub-items (Columns 2 to 7), but it is particularly pronounced for working on texts and assignments together, discussing course content, and making learning agreements. In sum, the evidence suggests that the study environment in IB(&T) is much more interactive than in BuA.

3 Data and descriptives

In addition to the out-of-sample surveys, the analyses in this paper are based on data from two sources. First, the organizers of the freshman orientation program provided information about the group assignments for the winter semesters of 2016 to 2019 (BuA) and 2017 to 2019 (IB and IBT).[12] Second, for 99% of the students, the assignment information could be matched with administrative data from the university (cf. Panel c) of Table 2), which contain information on students' background characteristics and their academic performance.[13]

Background characteristics. Panel a) in Table 2 reports descriptive statistics for students' background characteristics, separately for BuA and IB(&T). About 53% of the students are women[14], the mean age is 21.8 years, and students start their studies at this university on average about two years after obtaining their high school degree, i.e., their university entrance qualification. For 73% of the students in the sample, it is their first semester at any university, indicating that most students have little prior experience with the higher education system. And students enroll on average about 40 days before the start of the first semester.[15] Along these dimensions, students in the different degree programs are very similar.

In line with the more international target audience, IB(&T) has more students with a non-German citizenship (22 instead of 9% in BuA) and more students with a foreign high school degree (20 instead of 4%). Because the two smaller programs are more selective in who they admit, there are also differences in students' type of high school degree and their high school GPA. 70% of the students in IB(&T) obtained the "Abitur" as their entrance qualification, i.e., the high school degree from the German academic track schools (or a foreign equivalent). In BuA, this is the case for 44% of the students.[16] There is a similar difference in students' high

[12]Because of the Covid-19 pandemic, a large part of the classes from the summer semester of 2020 to the winter semester of 2021 were held online. In addition, during these semesters, some of the usual exam policies, such as the semester until which students must take certain exams for the first time, or how many times students can retake failed exams before failing their degree, were suspended and not reinstated until the summer semester of 2022.

[13]The main reason for unmatched cases are students who enroll but then withdraw in the first months of the semester. For these students, the administrative information is usually deleted, and a match is no longer possible. In my analyses, I exclude individuals who could not be matched, but I account for them by controlling for the share of students in each group who could not be matched, and the original group size.

[14]This is very similar to the proportion of women among all BuA freshman students in Germany (50% in the winter semester 2020; Destatis 2021).

[15]The enrollment date is usually available for all students, but for the winter semester of 2019 it was missing for some students (8% of the total sample) and, within study programs, I therefore imputed it linearly based on regressing the enrollment date on all other background characteristics.

[16]Compared to "regular", more research-intensive universities, students at UASs are more likely to arrive via alternative educational pathways, e.g., some of them have previously completed vocational training. This does not imply that UAS serve only a few students: in 2020, about 39.9% of German freshman students enrolled at a UAS (Destatis, 2021).

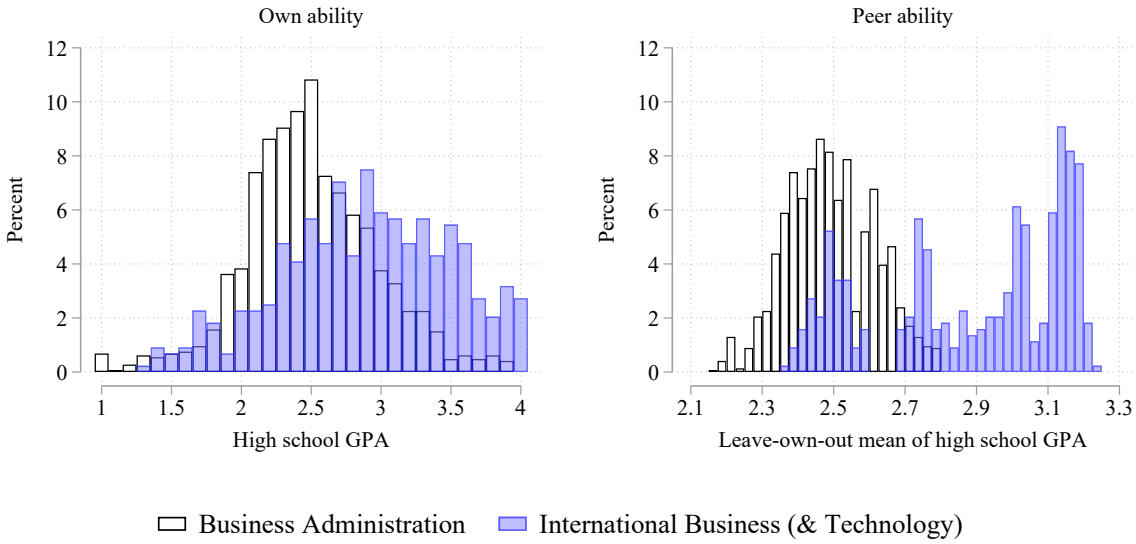
Table 2: Descriptive statistics

	Business Administration					*International Business (& Technology)*				
	(1) *N*	(2) Mean	(3) SD	(4) Min.	(5) Max.	(6) *N*	(7) Mean	(8) SD	(9) Min.	(10) Max.
a) *Students' background characteristics*										
Woman	1,459	0.54	0.50	0.00	1.00	440	0.50	0.50	0.00	1.00
Non-German citizen	1,459	0.09	0.28	0.00	1.00	440	0.22	0.41	0.00	1.00
Age	1,459	21.93	3.42	17.83	51.07	440	21.23	2.74	17.66	36.02
High school GPA	1,459	2.49	0.47	1.00	4.00	440	2.89	0.61	1.30	4.00
Time since HS degree	1,459	1.99	2.69	0.15	27.26	440	1.68	2.01	0.19	14.32
HS degree Abitur	1,459	0.44	0.50	0.00	1.00	440	0.70	0.46	0.00	1.00
HS degree local	1,459	0.31	0.46	0.00	1.00	440	0.24	0.43	0.00	1.00
HS degree other state	1,459	0.07	0.26	0.00	1.00	440	0.12	0.33	0.00	1.00
HS degree foreign	1,459	0.04	0.20	0.00	1.00	440	0.20	0.40	0.00	1.00
First university	1,459	0.72	0.45	0.00	1.00	440	0.77	0.42	0.00	1.00
Enrollment date	1,459	41.53	7.02	0.00	61.00	440	37.79	10.48	0.00	61.00
Enrollment date N/A	1,459	0.08	0.27	0.00	1.00	440	0.06	0.24	0.00	1.00
b) *Peer ability*										
Peer high school GPA	1,459	2.49	0.12	2.17	2.79	440	2.89	0.26	2.37	3.24
c) *Group characteristics*										
Original group size	55	26.85	2.14	17.00	32.00	18	25.22	2.34	22.00	28.00
Share not matched	55	0.01	0.02	0.00	0.07	18	0.03	0.06	0.00	0.21
Group size	55	26.53	2.19	17.00	32.00	18	24.44	2.25	22.00	28.00
d) *Students' academic achievement*										
First semester										
Accumulated credits	1,459	25.44	12.67	0.00	98.00	440	22.53	15.63	0.00	155.00
Persistence	1,459	0.95	0.22	0.00	1.00	440	0.95	0.23	0.00	1.00
GPA	1,377	2.52	0.53	1.15	4.00	393	2.53	0.69	1.00	4.00
Second semester										
Accumulated credits	1,459	46.78	21.24	0.00	149.00	440	47.12	24.23	0.00	186.00
Persistence	1,459	0.85	0.36	0.00	1.00	440	0.86	0.35	0.00	1.00
GPA	1,384	2.49	0.52	1.10	4.00	403	2.59	0.59	1.00	4.00
Third semester										
Accumulated credits	1,459	67.78	31.54	0.00	192.00	440	67.53	33.78	0.00	188.50
Persistence	1,459	0.82	0.38	0.00	1.00	440	0.84	0.37	0.00	1.00
GPA	1,386	2.48	0.50	1.15	4.00	404	2.57	0.56	1.00	4.00
Fourth semester										
Accumulated credits	1,459	88.29	42.82	0.00	210.00	440	87.72	44.09	0.00	210.00
Persistence	1,459	0.79	0.41	0.00	1.00	440	0.78	0.41	0.00	1.00
GPA	1,386	2.53	0.49	1.15	4.00	405	2.55	0.55	1.00	4.00
Fifth semester										
Accumulated credits	1,459	108.33	54.50	0.00	210.00	440	102.08	52.53	0.00	212.00
Persistence	1,459	0.78	0.41	0.00	1.00	440	0.77	0.42	0.00	1.00
GPA	1,386	2.55	0.49	1.15	4.00	405	2.55	0.54	1.00	4.00
Sixth semester										
Accumulated credits	1,459	127.81	65.82	0.00	221.00	440	120.73	63.16	0.00	212.00
Persistence	1,459	0.76	0.43	0.00	1.00	440	0.75	0.43	0.00	1.00
GPA	1,386	2.59	0.49	1.15	4.00	405	2.58	0.53	1.00	4.00

Note: See Table A.1 for a definition of all variables.

school GPA, i.e., the grade of the university entrance qualification (for ease of interpretation, the original German scale is reversed such that higher values indicate better grades; on the original scale, 1.0 is the best and 4.0 is the worst high school GPA).[17] Students in IB(&T) have a 0.4 grade points better mean high school GPA than students in BuA, which corresponds to a standardized difference of 0.727. As the left panel of Figure 2 shows, this difference is not only observed on average: for IB(&T) students, the entire high school GPA distribution is shifted to the right.

Figure 2: Distribution of ability – by study program



Notes: Students' high school GPA is reverse scaled such that higher values indicate better grades (on the original German scale 4.0 is the best and 1.0 the worst high school GPA). The histograms in the left panel start at 1 and use a binwidth of 0.1. The histograms in the right panel start at 2.1 and use a binwidth of 0.025. $N = 1,459$ for Business Administration and $N = 440$ for International Business (& Technology) in both panels.

Academic achievement. Panel d) reports on students' academic achievements until the end of the sixth semester. I consider three achievement dimensions: i) Accumulated course credits, which track students' progress and are thus directly related to the time it takes students to graduate. Faster graduation, in turn,implies that students have earlier access to the returns of their education. For students who drop out of their study program, the last observed accumulated course credits are carried forward. The outcome is therefore also observed for students who have already dropped out of their program. ii) Persistence, which indicates whether a student is still enrolled in their initial study program at the end of the respective

[17] On the original German scale, students in BuA have a mean high school GPA of 2.51, which is a bit worse than the the mean high school GPA among all German high school graduates (2.42). This number is based on the high school graduation cohorts of 2016 through 2019, i.e., the years in which the cohorts in my sample begin their first semester (see `https://www.kmk.org/dokumentation-statistik/statistik/schulstatistik/abiturnoten.html`, retrieved on October 04, 2022).

semester. The table shows that most of the dropout occurs in the first three to four semesters. At the end of my observation period, 76% of the students are still enrolled in their initial program. Since there is typically almost no additional dropout after that, it is very likely that all students who are still enrolled at that point will graduate.[18] iii) GPA, which is the cumulative grade point average at the end of each semester (the original German scale is reversed so that 4.0 is the best and 1.0 is the worst GPA).[19] It is only observed for students who pass at least one graded course, i.e., only passing grades enter a student's GPA (the values of dropouts are again carried forward). For the analyses, the GPA is standardized within cohorts and study programs.

I report results for all three outcomes, but I have no clear hypotheses which of them should be most affected by peer ability. Therefore, as well as to increase the statistical power and to reduce concerns related to multiple hypothesis testing, I use an index of overall academic achievement as my main outcome variable. Following Anderson (2008) and Schwab et al. (2020), the index is computed as the standardized inverse-covariance weighted average of the other three outcomes; before computing the index, the accumulated credits are also standardized within cohorts and study programs. In essence, the effects on this academic achievement index can be interpreted as a summary effect size that indicates whether there is any effect on students' academic achievements. Similar to the accumulated course credits and persistence, the index is observed for all students in the sample, and in the estimations, I therefore do not have to worry about selective attrition.

(Peer) Ability. I use students' high school GPA and the leave-own-out mean of students' high school GPA as proxies for their own and their peers' ability (Panel b) in Table 2 and the right panel of Figure 2 report on peer ability). To facilitate the interpretation of the estimated effects in this paper, and to make them more comparable to other estimates in the literature, I standardize both the individual and the peer high school GPAs within cohorts and study programs for my analyses.

The German high school GPA is not a standardized test, and instead consists of two (high school degree Abitur) or one (other high school degrees) year of written and oral school exams, plus state-specific exit exams (Germany has no central exit exams). Nevertheless, I am confident in its suitability as a proxy for students' ability. First, I can control for a number of institutional determinants such as students' place, type, and timing of high school degree. Second, I can also control for several other important individual characteristics such

[18]The rate of persistence is consistent with national and international dropout rates. In Germany, 25% of bachelor's students at UAS drop out of their studies (Heublein et al., 2022), and in OECD countries, three years after the scheduled duration of studies, 23% have left tertiary education without a degree (OECD, 2022).

[19]Achieving a good GPA itself is important, as it has been shown to affect the employability of graduates in Germany (Piopiunik et al., 2020).

as gender, migration background, age, first university status, and enrollment date. Third, in a robustness check, I show that my results do not change when controlling for the leave-own-out mean of all those characteristics. Last, even when controlling for all other individual characteristics, the high school GPA is highly predictive of all the academic achievement dimensions that I consider, and there are hardly any significant differences in the slope for students with or without high school degree Abitur (see Table A.4).[20] In essence, I assume that (conditional on observable characteristics) individuals with a high innate ability are more likely to achieve a good high school GPA than individuals with a low innate ability. Even if one is not willing to make the assumption, the high school GPA is still highly predictive for students' academic achievements and would therefore be an obvious candidate dimension for tracking students into groups.

4 Empirical strategy

4.1 Linear-in-means model of peer effects

The goal of this study is to identify the effect of being assigned to higher ability freshman orientation peers on academic achievement.[21] Going back to the seminal work of Manski (1993), I follow large parts of the literature and use a linear-in-means peer effects model as my main specification. I estimate it via OLS separately for each of the sixth semesters of my observation period:

$$Y_{igc}^{k} = \alpha_0 + \alpha_1 x_i + \alpha_2 \overline{x}_{-ig} + \mathbf{z_i}\boldsymbol{\alpha_3} + \mathbf{s_g}\boldsymbol{\alpha_4} + \mathbf{w_c}\boldsymbol{\alpha_5} + \varepsilon_{igc}, \tag{1}$$

where Y_{igc}^{k} is the outcome measure k for student i in freshman orientation group g of cohort c. x_i is the standardized high school GPA of student i, and $\overline{x}_{-ig}$ denotes the standardized average high school GPA of all students in group g excluding student i, i.e., the "leave-own-out mean". Accordingly, the main parameter of interest is α_2, which captures the effect of being assigned to a peer group with a one SD higher peer high school GPA. I also include the vector $\mathbf{z_i}$ with individual background characteristics (see Panel a) of Table 2), group-level characteristics $\mathbf{s_g}$ (share of students who could not be matched and the original group size;

[20] Similar to results from another university in Germany (Brade, 2024), the high school GPA is most strongly correlated with students' GPA, and less so with their accumulated credits and their persistence.

[21] Note that I am estimating the effect of being assigned to a peer group with higher ability peers and not the effect of attending a peer group with higher ability peers, because attendance is not mandatory and because I do not have information on students' attendance. But given that attendance in many freshman orientation programs is not mandatory, the estimated effect of assignment is arguably the more relevant parameter from a pure policy perspective. In addition, as noted in Section 2.1, attendance rates in my context are typically well above 80%.

cf. Section 3), and selection pool (i.e., cohort) fixed effects (FE; $\mathbf{w_c}$).[22] Unless noted otherwise, I report standard errors clustered at the freshman orientation group level throughout the paper.

Three well-known identification problems can prevent a causal interpretation of α_2. First, the reflection problem, which arises because individuals in a group simultaneously influence each other's behavior. I address this by using the high school GPA, which is determined before students enter university and attend freshman orientation, as my (peer) ability measure. Second, there could be unobserved common shocks. If they occur at the selection pool level, they are captured by the corresponding FE in my specification. The remaining concern are common shocks at the freshman orientation group level. Arguably, they are unlikely to be a major problem in my context. As described in Section 2.1, all freshman orientation groups are provided with a standardized set of information and go through the same activities. The tutors who supervise the groups are randomly assigned and interact with students only for the brief period of freshman orientation, minimizing the potential impact of tutors on student behavior. In addition, orientation group assignments are not used for any other study-related events afterwards.

Third, endogenous selection of students into peer groups, which could lead to correlations between (unobserved) student and peer characteristics and biased estimates of the parameter of interest α_2. This could happen if students were allowed to self-select into peer groups. In my context, self-selection is not an issue, because students are grouped based on the first letter of their last name. A major concern, however, is that the assignment mechanism itself introduces an association between students' characteristics and the characteristics of their peers. Below, I therefore report evidence from several tests for random assignment, and show that the freshman orientation groups resulting from the surname-based assignment mechanism are plausibly as good as random. In addition, I show in the analysis that the results are robust to including first letter of last name FE.

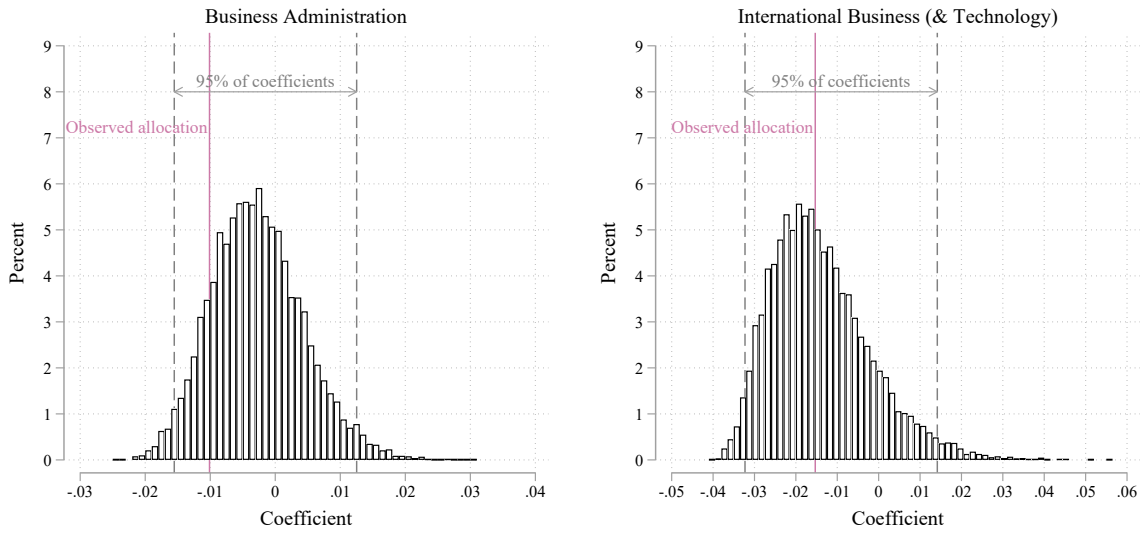
4.2 Tests for random assignment

Regressing peer ability on students' own characteristics. The standard test for random assignment used in the peer effects literature is to regress peer background characteristics on students' own characteristics, or vice versa. As noted by Guryan et al. (2009) and formalized by Caeyers and Fafchamps (2020), this test can suffer from "exclusion bias", i.e., small negative correlations, that arise because a student cannot be their own peer.

I address this in two ways: First, I adopt a permutation-based approach similar to the

[22] As I explain in Section 5, I focus on the sample of BuA students in my main analysis. Therefore, Equation 1 does not include study program by cohort FE.

Figure 3: Regression of peer ability on students' own ability – permutation based test



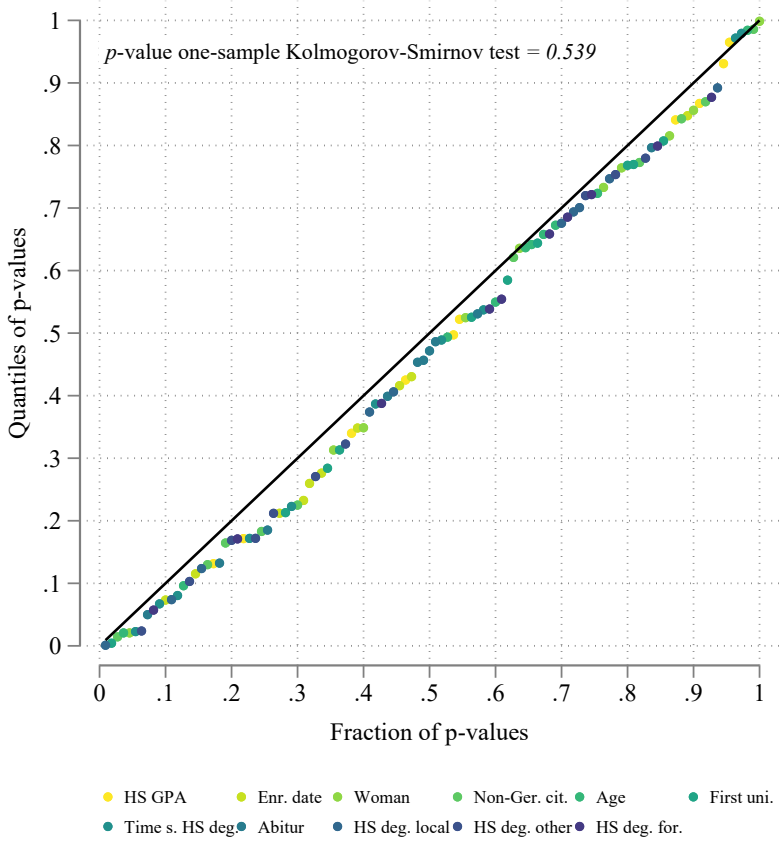
Notes: In both panels, the solid line depicts the estimated coefficient from regressing peer high school GPA on own high school GPA controlling for selection pool FE based on the observed group allocation. In addition, in both panels, the distribution of the estimated coefficient under the null of random assignment within selection pools is plotted based on 10,000 re-randomizations that keep the selection pools as well as group sizes fixed.

one proposed in Caeyers and Fafchamps (2020). Namely, I regress the peer high school GPA on students' own high school GPA, controlling for selection pool FE. To account for the exclusion bias, I re-randomize the group assignments 10,000 times, holding the selection pool and the group sizes fixed, to simulate the distribution of the estimated coefficient under the null of random assignment within selection pools. The distributions of the coefficients, as well as the coefficients from the observed allocations, are plotted in Figure 3, separately for BuA and IB(&T). They show that the observed allocations are well within the range of the estimated coefficients that would be observed under pure random assignment. Figures A.1 and A.2 show that the same is true for the correlation between all other observed student characteristics and their respective peer characteristics.

Second, following the suggestions of Guryan et al. (2009), in Table A.5, I regress peer high school GPA on student background characteristics and the selection pool leave-own-out mean, while also controlling for selection pool FE. The results confirm that there is little to no correlation between peer ability and students' own characteristics.

Regressing student background characteristics on peer group dummies. The third test for random assignment is adopted from similar approaches in Goulas et al. (2022) and Isphording and Zölitz (2022), and is related to the usual balance checks for randomized experiments. Within each selection pool, I regress students' background characteristics on freshman orientation group dummies. Under random assignment, the group dummies should not be

Figure 4: Quantile plot of p-values from regressing student characteristics on freshman orientation group dummies



Notes: This figure plots 110 ordered p-values of the following randomization check against the quantiles of the uniform distribution. Within each cohort by study program combination, students' background characteristics are regressed on freshman orientation group dummies. The p-values are from F-tests for joint significance of all included freshman orientation group dummies. See Table A.6 for the exact p-values for each background characteristic and cohort study program combination. The Kolmogorov-Smirnov test tests whether the observed distribution of p-values is equal to a uniform distribution.

predictive of student characteristics, and the p-values of the corresponding F-tests for joint significance of the orientation group dummies should follow a uniform distribution. Given the ten peer group assignments (two study programs with three years of data and one with four years) and eleven background variables, Figure 4 shows a quantile plot of the 110 p-values and the p-value of a Kolmogorov-Smirnov test whether the observed distribution of p-values is equal to a uniform distribution (see Table A.6 for the exact p-values for each background characteristic and cohort by study program combination). The observed distribution, which closely follows the theoretical uniform distribution, and the test, which fails to reject the null hypothesis, provide evidence that the p-values are uniformly distributed and that the peer group compositions are as good as random.

5 Effects of peer ability on academic achievements in Business Administration

Having established that the peer group assignments underlying my estimation strategy are plausibly random, I now turn to presenting the results for the effects of peer ability on academic achievements. Because the study programs in my context differ substantially in terms of their size and social environment (cf. Section 2) as well as their student composition (cf. Section 3), I restrict the main analyses presented in this section to the larger sample of BuA students. In Section 6, I then leverage the fact that freshman orientation is organized in the same way for all study programs and examine whether the effects that I find in BuA extrapolate to smaller, more interactive, and more selective study programs.

5.1 Main effects

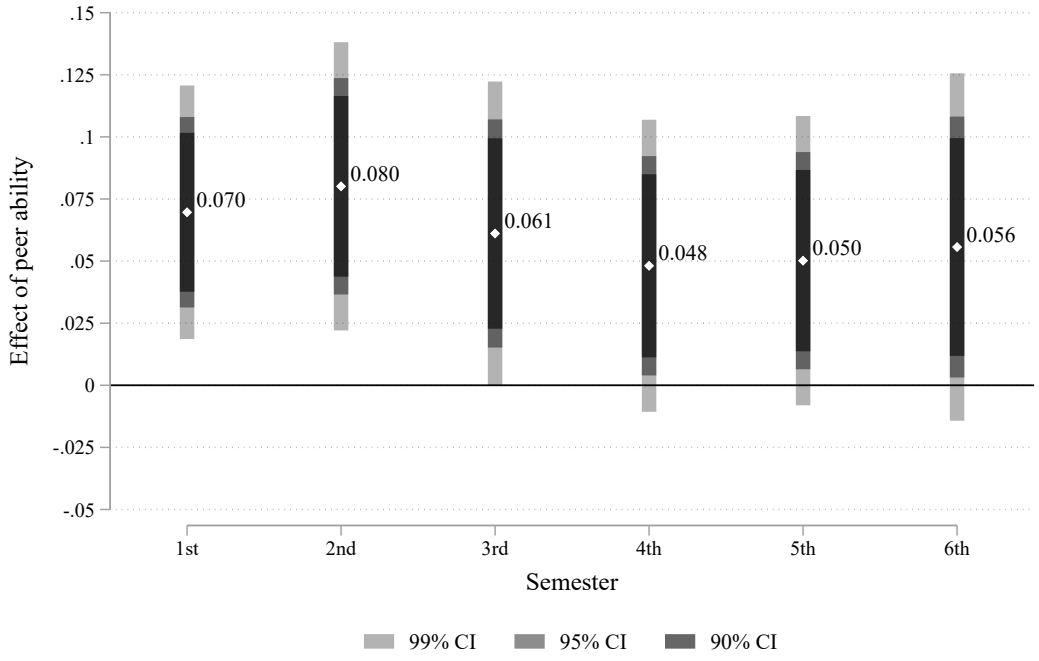
Academic achievement index. The estimated effects reported in Figure 5 and Panel a) of Table A.7 provide evidence that being assigned to higher ability peers has a long-lasting positive effect on the academic achievement of BuA students. A one SD increase in peer ability increases the index of academic achievement by 0.070 and 0.080 SD ($p = 0.001$ and $p = 0.001$) in the first and second semester of studies. In the following two years, peer ability has a positive effect of 0.048 to 0.061 SD ($p = 0.033$ to $p = 0.010$). One way to interpret these estimates is that students who have been assigned to a group at the 90^{th} rather than the 10^{th} percentile of the peer ability distribution have approximately 0.19 to 0.21 SD and 0.13 to 0.16 SD higher academic achievement.[23]

Accumulated course credits. Turning to the three underlying measures of academic achievement, Panel a) of Figure 6 and Panel b) in Table A.7 report estimated effects on students' accumulated course credits. By the end of the fourth semester, being assigned to a group with a one SD higher peer ability increases the accumulated course credits by 2.620 credits ($p = 0.003$). On average, higher ability peers thus increase the course credits earned in each of the first four semesters by 0.655 credits. The estimates suggest little additional effects in the fifth and sixth semester, and the effect on the accumulated courses therefore levels off at 2.986 credits ($p = 0.026$).[24] In sum, these estimates show that exposure to more able freshman orientation peers has a significant positive effect on BuA students' study progress. The effect accumulates mainly in the first two years, when students are tasked with taking

[23] In the non-standardized peer ability distribution, one SD corresponds to 0.12 grade points (cf. Table 2) and there is a difference of about 2.67 SD between the 10^{th} (2.34) and the 90^{th} (2.66) percentile of peer ability.

[24] Effects are estimated less precisely in later semesters, because of the increasing variance in the accumulated course credits (cf. Table 2).

Figure 5: Effect of peer ability on academic achievement index – Business Administration



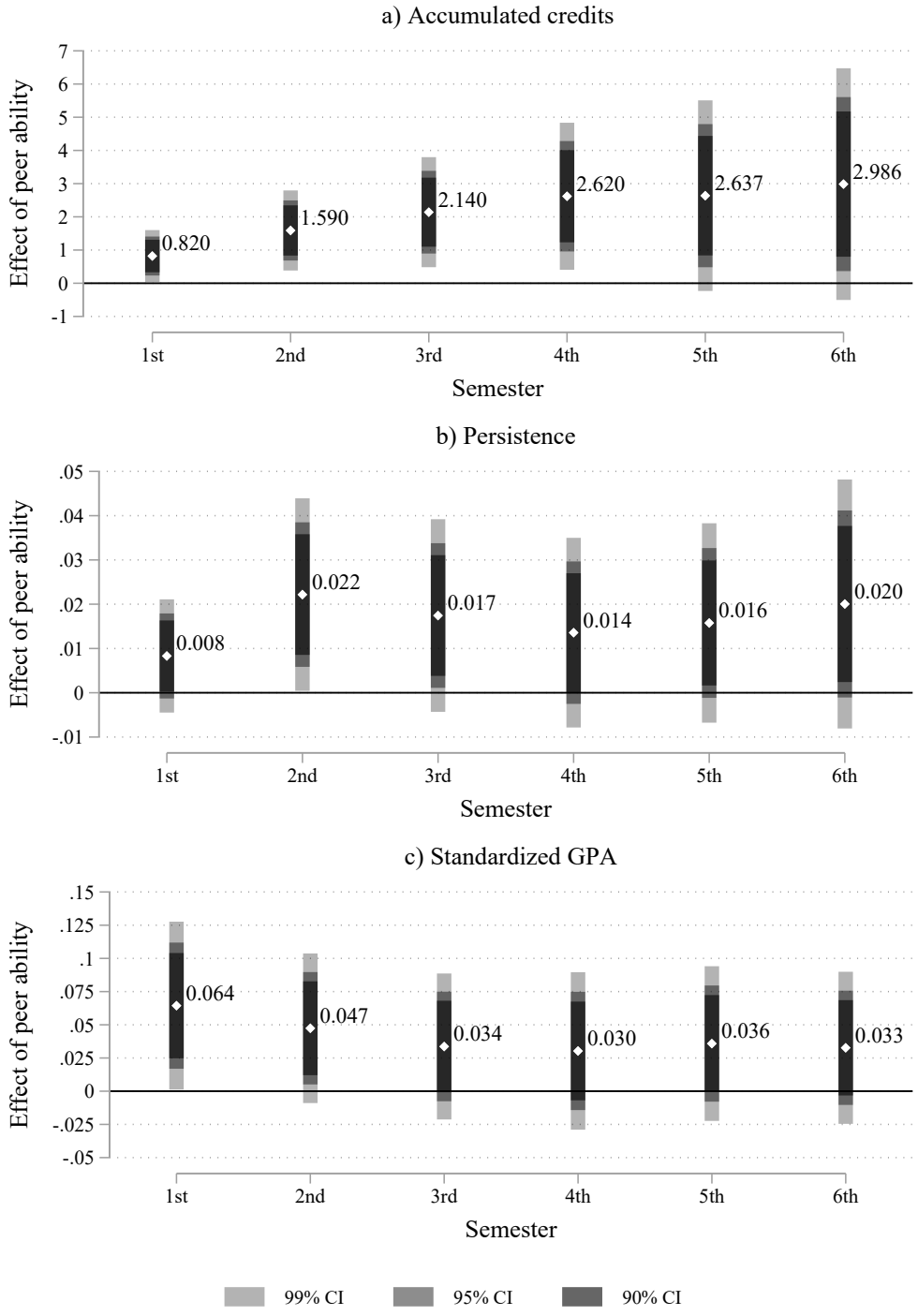
Notes: All coefficients and the corresponding confidence intervals are from separate regressions based on Equation 1. Estimates are also reported in Table A.7. *Peer ability* is the leave-own-out mean of the high school GPA, standardized within cohorts. *Academic achievement index* is the standardized inverse-covariance weighted average of the standardized accumulated credits, persistence, and the standardized GPA. Regressions include the following *controls:* standardized high school GPA, cohort FE, enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. The confidence intervals are based on robust standard errors clustered at the freshman orientation group level.

and passing the required core courses. In the third year, when students begin to take electives and are expected to complete their internships, there is little additional effect on credit accumulation.

Persistence. Panel b) in Figure 6 and Panel c) in Table A.7 show the estimated effects on BuA students' persistence. In line with the effects on study progress, higher ability peers increase the likelihood that students remain enrolled in BuA. By the end of the first year, a one SD increase in peer ability increases persistence by 2.2 percentage points (pp; $p = 0.009$). The effect remains roughly the same thereafter, amounting to 2 pp by the end of the sixth semester ($p = 0.062$). Put differently, assignment to a peer group at the 90^{th} instead of the 10^{th} percentile of the peer ability distribution improves persistence by 5.3 pp; a substantial effect, given that 24% of students drop out during my observation period (cf. Table 2). Considering that there is little additional dropout after the fourth semester tentatively suggests that the effect on persistence might also translate into positive effects on degree attainment.[25]

[25]The mean time to graduation in previous BuA cohorts is 8.5 semesters, but it can take over 12 semesters for all students to either graduate or drop out of the program. This implies that it would take up to six additional

Figure 6: Effect of peer ability on academic achievements – Business Administration



Notes: All coefficients and the corresponding confidence intervals are from separate regressions based on Equation 1. Estimates are also reported in Table A.7. *Peer ability* is the leave-own-out mean of the high school GPA, standardized within cohorts. *Accumulated credits* are the accumulated course credits at the end of the respective semester. *Persistence* indicates if a student is still enrolled in their initial study program at the end of the respective semester. *Standardized GPA* is the GPA at the end of the respective semester, standardized within cohorts. The GPA is based on passing grades only, i.e., it is unobserved for students who have not passed any courses. Regressions include the following *controls:* standardized high school GPA, cohort FE, enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. The confidence intervals are based on robust standard errors clustered at the freshman orientation group level.

Standardized grade point average. Panel c) of Figure 6 and Panel d) of Table A.7 report estimated effects on students' standardized GPA. They provide evidence that higher peer ability is beneficial not only for students' progress in university, but also for the quality of that progress. Here, the positive effects of peer ability are strongest in the first (0.064 SD; $p = 0.009$) and second semester (0.047 SD; $p = 0.029$). Afterwards, it levels off at about 0.030 to 0.036 SD ($p = 0.178$ to 0.106), and is not estimated precisely enough to be significant at any conventional level. Consistent with the observed effects on accumulated course credits, this pattern tentatively suggests that the grades that students earn in later semesters are no longer positively affected by higher ability freshman orientation peers.

5.2 Robustness of main effects

In Figure A.3 and Tables A.8 to A.10, I provide evidence that the main results presented above are robust to different ways of conducting inference and to the exact choice of specification.

Multiple hypothesis correction for index components. Using the index as my main outcome reduces concerns regarding multiple hypothesis testing with respect to effects on students' overall academic achievement. But it is still a concern for the effects on the three components of the index. Table A.8 therefore reports model p-values, as well as Sidak-Holm and false-discovery-rate adjusted p-values following Anderson (2008). Adjusting for multiple comparisons, the effects on accumulated course credits are still significant at the 5 or 10% level in each semester. For the other two outcomes this is true in the first year. Afterwards most p-values are either slightly below, or slightly above 10%.

Wild cluster bootstrap. In my main specification, I cluster standard errors at the freshman orientation group level. The 55 orientation groups I observe for BuA are just above the number that is often considered as sufficient for using conventional cluster-robust variance estimators (Angrist and Pischke, 2009). In Panel b) of Table A.9, I thus report p-values obtained from using the wild cluster bootstrap (Cameron et al., 2008). Except for the fourth ($p = 0.061$) and the sixth semester ($p = 0.060$), all my effects remain significant at the 5% level.

Non-clustered standard errors. Regarding inference, from a design-based perspective one might argue that the standard errors should reflect the level of the quasi-random assignment to peer groups, which takes place at the student level (Abadie et al., 2022). Panel b) of Table A.9 therefore also reports estimates with non-clustered, heteroskedasticity-robust standard errors. Compared to the main estimates, the standard errors are somewhat larger in most semesters, but the effects are still significant at or below the 5% level in all but one of the semesters.

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semesters to observe with certainty whether the graduation rate is positively affected by higher ability peers.

Permutation based inference. Given the quasi-random assignment of students to freshman orientation groups, another way to conduct inference is to use a permutation-based approach. I do this using an approach similar to the respective tests for random assignment in Section 4.2. Namely, I re-randomize group assignments 10,000 times, keeping the selection pools and group sizes fixed. For each draw, I then re-run the analyses presented in Figure 5 and Panel c) of Table A.7. Figure A.3 plots the distribution of the peer effect coefficients from the 10,000 re-randomizations, the peer effect estimate from the observed allocation, and p-values that denote the proportion of coefficients from the re-randomization that are larger than the observed effect of peer ability. In all semesters this proportion is at or below 0.027, thus confirming the conclusions from Figure 5 and Panel a) of Table A.7.

Exclusion of control variables. In my main specification, I include a large set of controls covering individual background characteristics and variables accounting for group size and the share of unmatched observations; mainly to potentially increase the precision of my estimates. Importantly, given the quasi-random assignment to groups, these controls should have little effect on the estimated peer effect coefficients. In Panel c) of Table A.9, I therefore exclude all of these controls. As expected, the standard errors are slightly larger without the controls. The peer effect estimates show almost no change, leaving the conclusions from my main specification intact.

First letter of last name fixed effects. The assumption of as good as random assignment to freshman orientation groups underlying my estimation strategy could be violated, and my estimated effects biased, if the first letters of the last names that determine grouping are systematically related to unobservables that affect student performance. In Panel d) of Table A.9, I therefore follow Mulhern (2023) and present results including first letter of last name FE. Reassuringly, this leads only to a small decrease in the estimated effects, and – as indicated by the R^2 – the inclusion of the FE also adds little explanatory power to my main specification. Moreover, the coefficient on students' own standardized high school GPA is also barely affected, further suggesting that students' surnames are not related to important unobservables.

Other peer characteristics. Another concern is that my measure of peer ability, i.e., students' high school GPA, is correlated with other peer characteristics that actually drive the results. For instance, studies on peer effects in college have found effects of ethno-linguistic diversity (Chevalier et al., 2020), the gender composition (Oosterbeek and Van Ewijk, 2014), and peers' personality (Golsteyn et al., 2021). In Panel a) of Table A.10, I therefore report estimates controlling for other peer characteristics, i.e., the leave-own-out mean of the other student background characteristics. Importantly, this includes peers' citizenship and whether they obtained their high school GPA abroad, peers' gender, and peers' enrollment date, which

other studies have used as a proxy for students' procrastination tendencies.[26] Again, there is only little change in the estimated coefficients. This is particularly reassuring, because the specification also includes peer level controls for several high school degree characteristics such as the place, type, and timing, which could have effects on students' achievement and are potentially correlated with students' high school GPA.

Allowing for heterogeneous peer effects. Recent studies have shown that OLS with FE is not necessarily a consistent estimator of average treatment effects in the presence of heterogeneous treatment effects, proposing, for instance, interaction-weighted estimators (Gibbons et al., 2018). Given the presence of cohort FE, my main specification can be thought of as a one-way FE model, and my average effects could thus also be affected by the presence of heterogeneous treatment effects. In Table A.10, I therefore report the marginal effects of peer ability from specifications that allow for heterogeneous effects of peer ability by selection pool FE (Panel b) and by all other controls (Panel c). Compared to my main specification, the estimated effects are virtually the same in the first case and somewhat larger in the second.

5.3 Nonlinear peer effects and heterogeneity by own ability

Nonlinear effects of peer ability. Several studies on peer effects find evidence for models more complex than the linear-in-means approach that I adopt here (Sacerdote, 2014). To assess this, in Figure A.4, I first follow the approach of Cattaneo et al. (2023, forthcoming) and use binned scatterplots to visualize the effects of peer ability on the academic achievement index. They suggest that the linear-in-means model that I use as my main specification provides a good approximation of the underlying relationship between peer ability and student achievement.

Second, in Table A.11, I present results from a specification that replaces average peer ability with the fractions of high and low ability peers. Providing no evidence for a nonlinear pattern, the estimates indicate that replacing middle ability with high (low) ability peers generally increases (decreases) students' academic achievements. The effects are, however, often estimated rather imprecisely.

Heterogeneity by students' own ability. A common finding in the peer effects literature is that the effects of peer ability depend on students' own ability levels (Carrell et al., 2013; Feld and Zölitz, 2017; Thiemann, 2022). To assess whether this is also the case in my context, in Table A.12, I start by simply interacting peer ability with students' own ability, finding no

[26] In Brade (2024), I document that students who enroll in the last month before the beginning of the first semester have significantly lower academic achievement. Similarly, Himmler et al. (2019) use the application date as a proxy for procrastination and show that it is highly correlated with performance.

evidence for a significant interaction of the two.

Dropping the assumption of a linear interaction, Table A.13 reports results from a specification that interacts peer ability with dummies that indicate terciles of the standardized high school GPA. As shown in Panels a) to c), I find no evidence of heterogeneous peer effects with respect to students' own ability for the academic achievement index, accumulated course credits, and students' persistence. For the standardized GPA (Panel b) I find some tentative evidence that the effects of peer ability are strongest for students in the lowest ability tercile. But the F-tests for joint significance of the interaction terms are never statistically significant at any conventional level ($p = 0.173$ to 0.362).

5.4 Mechanisms

5.4.1 Heterogeneity by students' social isolation probability

What mechanism is driving the robust and persistent performance spillovers that I find? In Section 2.2, I proposed that peer effects in this context arise, because freshman orientation facilitates the formation of lasting social ties. In support, I provided evidence from out-of-sample surveys showing that at least one-third of students' study partners are from freshman orientation. But are the positive peer effects really driven by this? To shed light on this, I leverage the out-of-sample survey to examine heterogeneity along students' probability of having no study partners from freshman orientation.

Table 3: Student background characteristics by isolation status – Business Administration

	Survey sample			*Main sample*			p-value
	All	Not isolated	Isolated	All	Low Pr(isol.)	High Pr(isol.)	(1) vs (4)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Pr(isolated)	-	-	-	-	0.411	0.651	-
Woman	0.634	0.686	0.583	0.541	0.693	0.388	0.007
Non-German citizen	0.080	0.076	0.083	0.089	0.064	0.114	0.639
Age	22.086	22.005	22.165	21.934	21.255	22.614	0.531
High school GPA	2.437	2.447	2.426	2.492	2.512	2.472	0.103
Time since HS degree	2.010	1.990	2.030	1.990	1.726	2.254	0.915
HS degree Abitur	0.466	0.551	0.383	0.435	0.714	0.156	0.369
HS degree local	0.181	0.178	0.183	0.308	0.248	0.369	0.000
HS degree other state	0.080	0.068	0.092	0.074	0.070	0.078	0.752
HS degree foreign	0.034	0.034	0.033	0.042	0.025	0.059	0.553
First university	0.681	0.729	0.633	0.721	0.810	0.632	0.201
N	238	118	120	1,459	730	729	

Note: Isolation status is equal to one for students who reported in the surveys used for Figure 1 that they met zero of their study partners during freshman orientation. Students in the main sample are grouped into low and high isolation probability based on a median split of the predicted probabilities that are derived from a survey-sample logistic regression of isolation status on all background characteristics (cubic terms for the continuous variables are used; cf. Table A.14). See Table A.1 for definitions of all other variables. The p-values reported in Column (7) are from two-sample tests on the equality of proportions and means.

The left panel of Table 3 reports descriptive statistics for Business Administration students in the out-of-sample survey. Reassuringly, the composition of the survey sample (Column 1) is very similar to that of my main sample (Column 4). I observe significant differences only with respect to the share of women and the share of students who obtained their high school degree in the county in which the university is located (Column 7). Within the survey sample, the main differences between students who are "isolated" – i.e., students who did not meet any of their study partners in freshman orientation – and non-isolated students are the share of women, the share with the Abitur as their high school degree, and the share for whom this is the first semester at any university.

To derive predictions for the isolation probability in my main sample, I run logistic regressions in the survey sample in which I regress the isolation status dummy on all background characteristics (see Table A.14). Because it provides the best fit, I use the model with cubic terms for the continuous variables. Students are then grouped into low and high isolation probability, by splitting the main sample at the median of the predicted probabilities; descriptive statistics for students in the two groups are reported in the right panel of Table 3.

Assuming that my prediction model provides a reasonable proxy for students' actual probability of meeting zero study partners in freshman orientation, and that the effects of freshman orientation peers do indeed operate through lasting social ties, I should find stronger peer effects for students with low isolation probabilities. To investigate whether this is the case, I estimate the following equation:

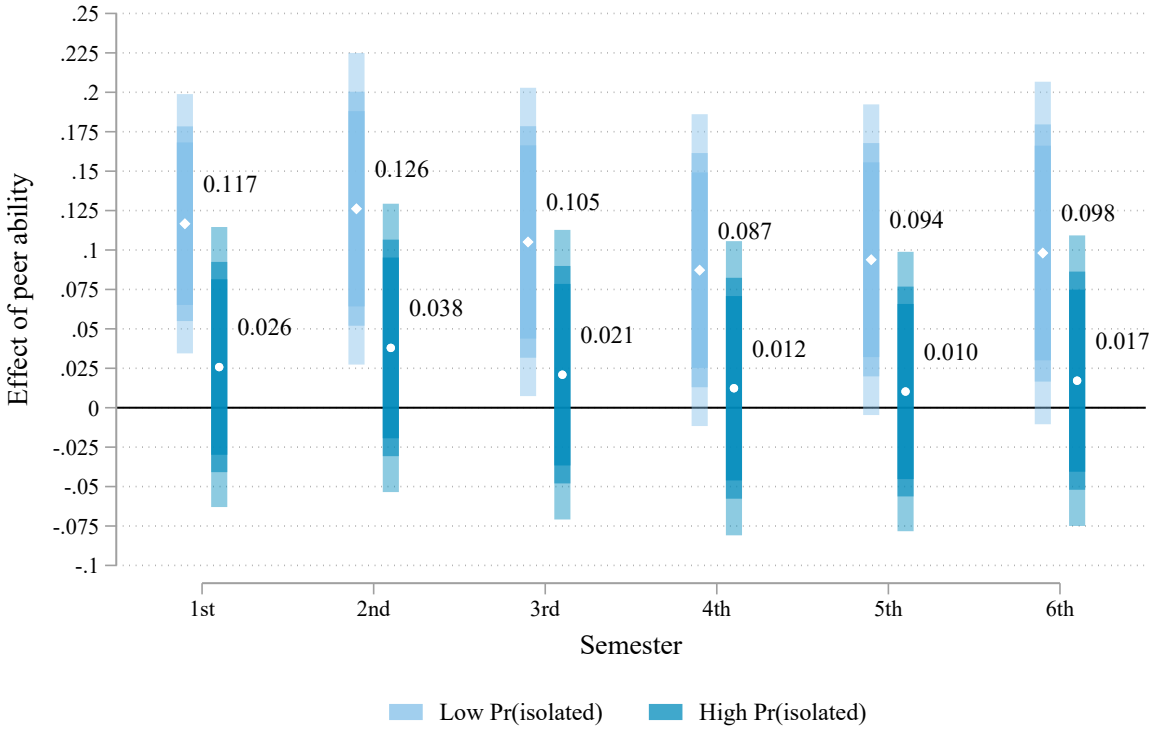
$$\begin{aligned} Y_{igc}^{k} = \alpha_0 + \alpha_1 x_i + \alpha_2 \overline{x}_{-ig} + \alpha_3 \text{High Pr(isolated)}_i \\ + \alpha_{23} \overline{x}_{-ig} \text{High Pr(isolated)}_i + \mathbf{z_i}\boldsymbol{\alpha_4} + \mathbf{s_g}\boldsymbol{\alpha_5} + \mathbf{w_c}\boldsymbol{\alpha_6} + \varepsilon_{igc}, \end{aligned} \tag{2}$$

where High Pr(isolated)$_i$ is a dummy indicating students with a high predicted probability of having met zero study partners in freshman orientation; all other parameters are defined as in Equation 1.

The estimated effects on the academic achievement index are reported in Figure 7 and Panel a) of Table A.15. In line with the reasoning above, I find that the effects of higher ability peers are almost entirely driven by students with a low isolation probability. For them, I find effects between 0.087 and 0.126 SD ($p = 0.022$ and 0.001), while the effects for the students with a high isolation probability are between 0.010 and 0.038 SD and never close to being statistically significant at any conventional level ($p = 0.273$ and 0.758). This evidence should be interpreted with some caution, as the effects for the two groups are marginally significantly different from each other only in the first semester ($p = 0.085$).

Reassuringly, Panels b) to d) of Table A.15 show that the reported pattern holds for all of the individual performance dimensions that I consider. In addition, the results are not

Figure 7: Effect of peer ability on academic achievement index by isolation probability – Business Administration



Notes: Coefficients for each semester and the corresponding confidence intervals are from separate regressions based on Equation 2. The coefficients of the interaction term α_{23} are reported in Table A.15. *High Pr(isolated)* indicates students that have a high predicted probability of having met zero of their study partners during freshman orientation (cf. Table 3). *Peer ability* is the leave-own-out mean of the high school GPA, standardized within cohorts. *Academic achievement index* is the standardized inverse-covariance weighted average of the standardized accumulated credits, persistence, and the standardized GPA. Regressions include the following *controls:* standardized high school GPA, cohort FE, enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. The 99, 95, and 90% confidence intervals are based on robust standard errors clustered at the freshman orientation group level.

very sensitive to the exact specification used to predict the isolation probabilities: Table A.16 shows that the differences between the two groups are slightly less pronounced when using linear terms for the continuous background characteristics, and slightly stronger when using quadratic terms. In Table A.17, students whose orientation was conducted online because of the Covid-19 pandemic are dropped from the survey sample that I use for predicting the isolation probabilities. This leaves the estimated effects virtually unchanged.

5.4.2 Association between students' specialization choices

To provide more evidence that the study behavior of students who have been assigned to the same freshman orientation group is actually correlated, I adopt a second approach. From the fourth semester onward, students in BuA have to choose three out of sixteen possible specializations such as finance, controlling, human resource management, or business taxation.

I estimate the following pooled OLS specification to assess whether students' specialization choice is correlated with the choice of their peers:

$$Specialization_{igcs} = \alpha_0 + \alpha_1 \overline{Specialization}_{-igs} + \mathbf{v_s}\boldsymbol{\alpha_2} + \mathbf{w_c}\boldsymbol{\alpha_3} + \varepsilon_{igc}, \tag{3}$$

where $Specialization_{igcs}$ indicates whether student i in the orientation group g of cohort c chooses specialization s. $\overline{Specialization}_{-igs}$ is the fraction of other students in the same orientation group who choose the same specialization. Following Jones and Kofoed (2020), I include specialization FE ($\mathbf{v_s}$) to account for the overall popularity of specializations. $\mathbf{w_c}$ indicates cohort FE, and standard errors are clustered at the freshman orientation group level. In an additional specification, I replace the cohort FE with student FE. In both cases, α_1 should still be interpreted as a simple association between specialization choices and not as the causal effect of peers' specialization choice on own specialization choice, as the reflection problem cannot be avoided here.

Table 4: Association between students' specialization choices – Business Administration

	(1)	(2)
Fraction of peers	0.167***	0.188***
	(0.047)	(0.048)
Cohort FE	yes	no
Specialization FE	yes	yes
Student FE	no	yes
N	23,344	23,344
N_s	1,459	1,459

Note: Pooled OLS regression of students' specialization choice on the fraction of peers choosing the same specialization based on Equation 3. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 4 indicates that students' specialization choices are in fact correlated. Increasing the fraction of freshman orientation peers who choose a specialization by 10 pp increases a students' own probability to choose this specialization by 1.67 pp ($p = 0.001$; Column 1). With the inclusion of student FE, the coefficient is 1.88 pp ($p = 0.000$; Column 2). Figure A.5 presents results from a permutation based approach, and provides evidence that the observed association in students' specialization choices is extremely unlikely to be produced by chance alone. These results complement the heterogeneous effects by students' isolation probability and provide further evidence that freshman orientation creates social ties that influence students' behavior throughout their studies.

6 Are the positive effects of higher ability freshman peers context dependent?

The results presented so far provide evidence that short-term peer groups can be sufficient for the emergence of substantial and persistent ability peer effects. Considering that peer effects are often highly context dependent (Sacerdote, 2014), an important question is whether the introduction of a similarly brief freshman orientation program can create the same peer dynamics elsewhere. The fact that Thiemann (2022) and Fischer and Rode (2020), who also study peer effects in freshman orientation programs, report no significant or even significantly negative effects of higher ability freshman peers on students' academic performance may suggest that this is not the case. However, in their studies, the freshman orientation programs last a full week and – in the setting of Thiemann (2022) – the program also includes intensive group work and a case study competition. In addition, both mention that the study programs in their studies are rather selective, which is not the case for the BuA program in my context. It is therefore not possible to pin down whether the different results arise from the different organization of freshman orientation, from differences in the composition of the student body, or from differences in the broader setting of the studies.

6.1 Heterogeneous effects of peer ability across study programs

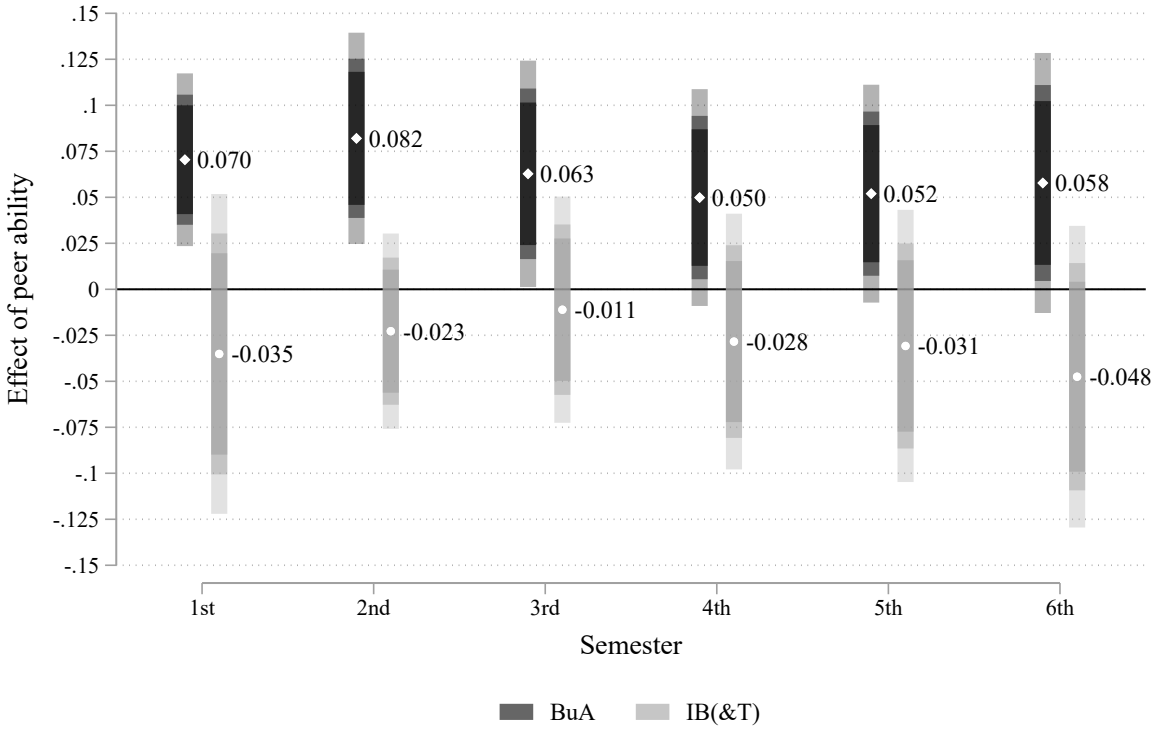
To provide more rigorous evidence on the context dependence of my findings, I leverage that the orientation program in my setting is organized in exactly the same way for very different programs: BuA and IB(&T). I use the following estimation equation to examine whether peer effects are heterogeneous across study programs:

$$Y_{igc}^{k} = \alpha_0 + \alpha_1 x_i + \alpha_2 \overline{x}_{-ig} + \alpha_3 \text{IB(\&T)}_i + \alpha_{23} \overline{x}_{-ig} \text{IB(\&T)}_i + \mathbf{z_i}\boldsymbol{\alpha_4} + \mathbf{s_g}\boldsymbol{\alpha_5} + \mathbf{w_c}\boldsymbol{\alpha_6} + \varepsilon_{igc}, \quad (4)$$

where $\text{IB(\&T)}_i$ is a dummy indicating students who are studying IB or IBT.

Based on this estimation equation, Figure 8 and Panel (a) of Table A.18 report effects of peer ability on the academic achievement index in BuA and IB(&T); the table also reports the p-value of the interaction term α_{23}. In contrast to BuA, IB(&T) students do not benefit from higher ability peers: Being assigned to a peer group with a one SD higher ability has no statistically significant effect on their academic achievement index; if anything, the coefficients are even negative (-0.011 to -0.048 SD; $p = 0.634$ to 0.129). Importantly, the effects in BuA and IB(&T) are statistically significantly different from each other at or below the 5% level in all semesters. In addition, as reported in Panels b) and c) of Table A.18, these results are observed for the effects on accumulated course credits and persistence. For the standard-

Figure 8: Effect of peer ability on academic achievement index by study programs



Notes: Coefficients for each semester and the corresponding confidence intervals are from separate regressions based on Equation 4. The coefficients of the interaction term α_{23} are reported in Table A.18. *Peer ability* is the leave-own-out mean of the high school GPA, standardized within cohorts and study programs. *Academic achievement index* is the standardized inverse-covariance weighted average of the standardized accumulated credits, persistence, and the standardized GPA. Regressions include the following *controls:* standardized high school GPA, cohort FE, enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. The 99, 95, and 90% confidence intervals are based on robust standard errors clustered at the freshman orientation group level.

ized GPA (Panel d), the pattern is the same in the first year, but becomes less pronounced over time. The strong heterogeneity across study programs suggests that – depending on the context – the same freshman orientation program can generate very different peer dynamics.

6.2 Potential mechanisms behind the differential effects of peer ability across study program

Students' ability and background characteristics. One of the main differences between the study programs is that students in IB(&T) are more positively selected in terms of their ability. The idea that the ability level may matter for peer effects has been expressed, for instance, by (Stinebrickner and Stinebrickner, 2006), who argue that "strong academic ability, good study habits, and strong beliefs about the importance of college may substantially mitigate the potential influence of peer effects". Consistent with this idea, Humlum and Thorsager

(2021) provide suggestive evidence from Danish universities that peer effects are consistently smaller in selective programs. This gives rise to the hypothesis that peer effects in IB(&T) are negated by the higher ability level of the students that are enrolled in these programs.

The finding that peer effects in BuA are not heterogeneous with respect to students' own ability already provides some evidence to the contrary, but I now provide additional evidence that differences in students' background characteristics across programs are unlikely to be the main driver of the heterogeneous effects. In Table A.19, I report estimates based on Equation 4, but additionally control for interactions of peer ability with student background characteristics. If differences in student characteristics were driving the heterogeneity across study programs, one would expect the differences in peer effects to become smaller. But as the results in the table show, the heterogeneity is, if anything, even more pronounced.

In a second approach, I examine the heterogeneity in the effects of peer ability by BuA students' likelihood of being enrolled in IB(&T). I first estimate a logistic regression model that regresses a dummy for enrollment in IB(&T) on the background characteristics reported in Table A.20 (cubic terms are used for the continuous variables). I then use the estimates to predict students' propensity to be enrolled in IB(&T). Within cohorts, I then split the sample of BuA students at the median of the predicted probability to create two groups: BuA students with a low probability of being enrolled in IB(&T), and BuA students with a high probability. In essence, this approach allows me to identify a group of students within BuA who are similar to the IB(&T) students in terms of their observable characteristics (Table A.20 reports descriptive statistics). In Table A.21, I then present estimates based on interacting peer ability with a high probability of enrolling in IB(&T) dummy for the sample of BuA students. The results are consistent with the notion that students' background characteristics do not explain the heterogeneity across study programs: there is no significant difference in the effects of peer ability between the two subgroups of BuA students. Taken together, the two analyses provide evidence that differences in student characteristics are unlikely to be the main reason for the heterogeneous effects across study programs.

Social environment. An alternative explanation is that differences in the broader social environment are moderating the effects of peer ability. As described in Section 2, BuA and IB(&T) differ substantially in terms of the cohort size and the social environment. In particular, IB(&T) students have more study partners and there seems to be more social interaction among students during the course of the study programs. What does this imply for the potential effects of freshman orientation peers? On the one hand, more social interaction could indicate that students also interact more with their freshman peers, which should have led to more pronounced effects in IB(&T). On the other hand, if the general level of social interaction in a study program is higher and the whole environment is less anonymous due to smaller classes, this could also reduce the impact of social connections formed during fresh-

man orientation, since students are much more likely to interact with other students or the instructors. Evidence that class size may be important for the effects of social interactions is provided by Maurer et al. (2023). They study student-instructor gender matches at a German university and find that positive gender match effects for women are entirely driven by classes with 73 or fewer students.

Table 5: Association between students' language/minor choices – IB(&T)

	Int. Bus.		*Int. Bus. & Tech*	
	(1)	(2)	(3)	(4)
Fraction of peers	0.057	0.092	-0.234	-0.164
	(0.190)	(0.195)	(0.281)	(0.272)
Cohort FE	yes	no	yes	no
Language/minor FE	yes	yes	yes	yes
Student FE	no	yes	no	yes
N	900	900	645	645
N_s	225	225	215	215

Note: Using the same approach as in Table 4, this table reports results from pooled OLS regression of students' language (IB) or minor (IBT) choice on the fraction of peers choosing the same language or minor. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

To provide additional evidence on how the broader social environment shapes students' social interactions, I follow my analysis of correlations in specialization choices among BuA students, and assess whether freshman orientation peers also affect students' study choices in IB and IBT. In IB, the study plan requires students to take courses in an additional business language in the second and third semester (French, Italian, Spanish, or German). In IBT, students choose one of the three STEM minors (Mechanical Engineering, Electrical Engineering, or Science and Technology), which changes the subjects they are supposed to take from the third semester onward.

Contrary to the finding for BuA, the results reported in Table 5 show no significant positive association between students' and their peers' choice of language or minor in IB and IBT; results of the permutation based approach depicted in Figure A.6 confirm this. While tentative, the evidence is consistent with the idea that the higher overall level of social interaction in the smaller study programs mitigates the influence of freshman orientation peers on students' later study choices.

7 Conclusions

Exploiting the quasi-random assignment of incoming university students to groups of a two-day freshman orientation program, this paper documents that such brief social interactions

can be sufficient for the emergence of persistent performance spillovers. Assignment to a group with a one SD higher peer ability increases the academic achievement of business administration students by 0.05 to 0.08 SD, even three years later. My results further indicate that the underlying mechanism for the effects is the formation of lasting, study-related social ties. In examining whether the results transfer to other settings, I find that the presence and nature of performance spillovers depend on the broader setting, and that they occur only in a large and less interactive study environment.

The insight that brief social interactions in orientation programs can shape the subsequent success of incoming students is important for policy makers and administrators in settings where it is infeasible or too costly to create the longer-term peer contexts in which such spillovers have typically been found. My findings also suggest that designers of such programs need to consider the social dynamics of the broader study environment: settings that are already highly interactive may mitigate performance spillovers from orientation programs.

As for the optimal composition of freshman orientation groups, my findings provide only limited guidance. They suggest that the presence of high ability individuals in groups is desirable, but this can usually only be achieved by exchanging them with a lower ability individual. Given the linearity of the peer effects I find, this reallocation will reduce the performance of the group that the lower ability individual joins. Policy makers and administrators therefore face a trade-off between promoting high achievers through ability tracking and reducing inequality in academic achievement through ability mixing.

References

Abadie, Alberto, Susan Athey, Guido W. Imbens, and Jeffrey M. Wooldridge. 2022. "When Should You Adjust Standard Errors for Clustering?" *Quarterly Journal of Economics*, 138(1): 1–35.

Anderson, Michael L. 2008. "Multiple Inference and Gender Differences in the Effects of Early Intervention: A Reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects." *Journal of the American Statistical Association*, 103(484): 1481–1495.

Angrist, Joshua D., and Jörn-Steffen Pischke. 2009. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton, NJ:Princeton University Press.

Back, Mitja D., Stefan C. Schmukle, and Boris Egloff. 2008. "Becoming Friends by Chance." *Psychological Science*, 19(5): 439.

Bandiera, Oriana, Iwan Barankay, and Imran Rasul. 2010. "Social Incentives in the Workplace." *Review of Economic Studies*, 77(2): 417–458.

Bernerth, Jeremy B., Jeremy M. Beus, Catherine A. Helmuth, and Terrance L. Boyd. 2023. "The More the Merrier or Too Many Cooks Spoil the Pot? A Meta-Analytic Examination of Team Size and Team Effectiveness." *Journal of Organizational Behavior*, 44(8): 1230–1262.

Booij, Adam S., Edwin Leuven, and Hessel Oosterbeek. 2017. "Ability Peer Effects in University: Evidence from a Randomized Experiment." *Review of Economic Studies*, 84(2): 547–578.

Brade, Raphael. 2024. "Social Information and Educational Investment – Nudging Remedial Math Course Participation." *Education Finance and Policy*, 19(1): 106–142.

Caeyers, Bet, and Marcel Fafchamps. 2020. "Exclusion Bias in the Estimation of Peer Effects." *mimeo*.

Cai, Jing, and Adam Szeidl. 2018. "Interfirm Relationships and Business Performance." *Quarterly Journal of Economics*, 133(3): 1229–1282.

Calvó-Armengol, Antoni, Eleonora Patacchini, and Yves Zenou. 2009. "Peer Effects and Social Networks in Education." *Review of Economic Studies*, 76(4): 1239–1267.

Cameron, A. Colin, Jonah B. Gelbach, and Douglas L. Miller. 2008. "Bootstrap-Based Improvements for Inference with Clustered Errors." *Review of Economics and Statistics*, 90(3): 414–427.

Carrell, Scott E., Bruce I. Sacerdote, and James E. West. 2013. "From Natural Variation to Optimal Policy? The Importance of Endogenous Peer Group Formation." *Econometrica*, 81(3): 855–882.

Carrell, Scott E., Richard L. Fullerton, and James E. West. 2009. "Does Your Cohort Matter? Measuring Peer Effects in College Achievement." *Journal of Labor Economics*, 27(3): 439–464.

Cattaneo, Matias D., Richard K. Crump, Max H. Farrell, and Yingjie Feng. 2023. "Binscatter Regressions." *mimeo*.

Cattaneo, Matias D., Richard K. Crump, Max H. Farrell, and Yingjie Feng. forthcoming. "On Binscatter." *American Economic Review*.

Chandrasekhar, Arun G., Benjamin Golub, and He Yang. 2018. "Signaling, Shame, and Silence in Social Learning." *NBER Working Paper No. 25169*.

Chan, Tat Y., Jia Li, and Lamar Pierce. 2014. "Compensation and Peer Effects in Competing Sales Teams." *Management Science*, 60(8): 1965–1984.

Chevalier, Arnaud, Ingo E. Isphording, and Elena Lisauskaite. 2020. "Peer Diversity, College Performance and Educational Choices." *Labour Economics*, 64: 101833.

Cohen-Zada, Danny, Itay Dayag, and Naomi Gershoni. forthcoming. "Effort Peer Effects in Team Production: Evidence from Professional Football." *Management Science*.

Conley, Timothy G., Nirav Mehta, Ralph Stinebrickner, and Todd Stinebrickner. 2024. "Social Interactions, Mechanisms, and Equilibrium: Evidence from a Model of Study Time and Academic Achievement." *Journal of Political Economy*, 132(3): 723–1063.

Cornelissen, Thomas, Christian Dustmann, and Uta Schönberg. 2017. "Peer Effects in the Workplace." *American Economic Review*, 107(2): 425–456.

Corno, Lucia, Eliana La Ferrara, and Justine Burns. 2022. "Interaction, Stereotypes, and Performance: Evidence from South Africa." *American Economic Review*, 112(12): 3848–3875.

Coveney, Max, and Matthijs Oosterveen. 2021. "What Drives Ability Peer Effects?" *European Economic Review*, 136: 103763.

Destatis. 2021. *Bildung und Kultur: Studierende an Hochschulen Wintersemester 2020/2021*. Statistisches Bundesamt.

Duflo, Esther, Pascaline Dupas, and Michael Kremer. 2011. "Peer Effects, Teacher Incentives, and the Impact of Tracking: Evidence from a Randomized Evaluation in Kenya." *American Economic Review*, 101(5): 1739–74.

Feld, Jan, and Ulf Zölitz. 2017. "Understanding Peer Effects: On the Nature, Estimation, and Channels of Peer Effects." *Journal of Labor Economics*, 35(2): 387–428.

Feygin, Amy, Trey Miller, Jenny Poole, Mark Hatcher, and Linda Choi. 2022. "Advising for College Success: Policies, Practices, and Programs That Support Students on the Path to College Completion." *College Completion Network*.

Field, Erica, Seema Jayachandran, Rohini Pande, and Natalia Rigol. 2016. "Friendship at Work: Can Peer Effects Catalyze Female Entrepreneurship?" *American Economic Journal: Economic Policy*, 8(2): 125–153.

Fischer, Stefanie. 2017. "The Downside of Good Peers: How Classroom Composition Differentially Affects Men's and Women's STEM Persistence." *Labour Economics*, 46: 211–226.

Fischer, Thomas, and Johannes Rode. 2020. "Classroom or Pub – Where are Persistent Peer Relationships Between University Students Formed?" *Journal of Economic Behavior & Organization*, 178: 474–493.

Frakes, Michael D., and Melissa F. Wasserman. 2021. "Knowledge Spillovers, Peer Effects, and Telecommuting: Evidence from the US Patent Office." *Journal of Public Economics*, 198: 104425.

Frijters, Paul, Asad Islam, and Debayan Pakrashi. 2019. "Heterogeneity in Peer Effects in Random Dormitory Assignment in a Developing Country." *Journal of Economic Behavior & Organization*, 163: 117–134.

Garlick, Robert. 2018. "Academic Peer Effects with Different Group Assignment Policies: Residential Tracking versus Random Assignment." *American Economic Journal: Applied Economics*, 10(3): 345–369.

Gibbons, Charles E., Juan Carlos Suárez Serrato, and Michael B. Urbancic. 2018. "Broken or Fixed Effects?" *Journal of Econometric Methods*, 8(1): 20170002.

Golsteyn, Bart H. H., Arjan Non, and Ulf Zölitz. 2021. "The Impact of Peer Personality on Academic Achievement." *Journal of Political Economy*, 129(4): 1052–1099.

Goulas, Sofoklis, Silvia Griselda, and Rigissa Megalokonomou. 2022. "Comparative Advantage and Gender Gap in STEM." *Journal of Human Resources*, 0320–10781R2.

Griffith, Amanda L., and Joyce B. Main. 2019. "First Impressions in the Classroom: How do Class Characteristics Affect Student Grades and Majors?" *Economics of Education Review*, 69: 125–137.

Guryan, Jonathan, Brian Jacob, Eric Klopfer, and Jennifer Groff. 2008. "Using Technology to Explore Social Networks and Mechanisms Underlying Peer Effects in Classrooms." *Developmental Psychology*, 44(2): 355.

Guryan, Jonathan, Kory Kroft, and Matthew J. Notowidigdo. 2009. "Peer Effects in the Workplace: Evidence from Random Groupings in Professional Golf Tournaments." *American Economic Journal: Applied Economics*, 1(4): 34–68.

Harmon, Nikolaj, Raymond Fisman, and Emir Kamenica. 2019. "Peer Effects in Legislative Voting." *American Economic Journal: Applied Economics*, 11(4): 156–80.

Heublein, Ulrich, Christopher Hutzsch, and Robert Schmelzer. 2022. *Die Entwicklung der Studienabbruchquoten in Deutschland.* DZHW Brief 05|2022.

Himmler, Oliver, Robert Jäckle, and Philipp Weinschenk. 2019. "Soft Commitments, Reminders and Academic Performance." *American Economic Journal: Applied Economics*, 11(2): 114–142.

Humlum, Maria Knoth, and Mette Thorsager. 2021. "The Importance of Peer Quality for Completion of Higher Education." *Economics of Education Review*, 83: 102120.

Isphording, Ingo E., and Ulf Zölitz. 2022. "The Value of a Peer." *mimeo*.

Jackson, Matthew O., Stephen M. Nei, Erik Snowberg, and Leeat Yariv. 2022. "The Dynamics of Networks and Homophily." *NBER Working Paper No. 30815*.

Jones, Todd R., and Michael S. Kofoed. 2020. "Do Peers Influence Occupational Preferences? Evidence from Randomly-Assigned Peer Groups at West Point." *Journal of Public Economics*, 184: 104154.

Lavy, Victor, and Analia Schlosser. 2011. "Mechanisms and Impacts of Gender Peer Effects at School." *American Economic Journal: Applied Economics*, 3(2): 1–33.

Lavy, Victor, M. Daniele Paserman, and Analia Schlosser. 2012. "Inside the Black Box of Ability Peer Effects: Evidence from Variation in the Proportion of Low Achievers In the Classroom." *Economic Journal*, 122(559): 208–237.

List, John A. 2020. "Non est Disputandum de Generalizability? A Glimpse into The External Validity Trial." *NBER Working Paper No. 27535*.

Manski, Charles F. 1993. "Identification of Endogenous Social Effects: The Reflection Problem." *Review of Economic Studies*, 60(3): 531–542.

Mas, Alexandre, and Enrico Moretti. 2009. "Peers at Work." *American Economic Review*, 99(1): 112–145.

Maurer, Stephan, Guido Schwerdt, and Simon Wiederhold. 2023. "Do Role Models Matter in Large Classes? New Evidence on Gender Match Effects in Higher Education." *CESifo Working Paper No. 10208*.

Mulhern, Christine. 2023. "Beyond Teachers: Estimating Individual School Counselors Effects on Educational Attainment." *American Economic Review*, 113(11): 2846–2893.

Nielsen, Helena Skyt, and Michael Svarer. 2009. "Educational Homogamy: How Much is Opportunities?" *Journal of Human Resources*, 44(4): 1066–1086.

OECD. 2022. *Education at a Glance 2022: OECD Indicators*. OECD Publishing.

Oosterbeek, Hessel, and Reyn Van Ewijk. 2014. "Gender Peer Effects in University: Evidence from a Randomized Experiment." *Economics of Education Review*, 38: 51–63.

Ost, Ben. 2010. "The Role of Peers and Grades in Determining Major Persistence in the Sciences." *Economics of Education Review*, 29(6): 923–934.

Piopiunik, Marc, Guido Schwerdt, Lisa Simon, and Ludger Woessmann. 2020. "Skills, Signals, and Employability: An Experimental Investigation." *European Economic Review*, 123: 103374.

Sacerdote, Bruce. 2001. "Peer Effects with Random Assignment: Results for Dartmouth Roommates." *Quarterly Journal of Economics*, 116(2): 681–704.

Sacerdote, Bruce. 2014. "Experimental and Quasi-Experimental Analysis of Peer Effects: Two Steps Forward?" *Annual Review of Economics*, 6(1): 253–272.

Sandvik, Jason J., Richard E. Saouma, Nathan T. Seegert, and Christopher T. Stanton. 2020. "Workplace Knowledge Flows." *Quarterly Journal of Economics*, 135(3): 1635–1680.

Schwab, Benjamin, Sarah Janzen, Nicholas P. Magnan, and William M. Thompson. 2020. "Constructing a Summary Index Using the Standardized Inverse-Covariance Weighted Average of Indicators." *Stata Journal*, 20(4): 952–964.

Stinebrickner, Ralph, and Todd R. Stinebrickner. 2006. "What Can Be Learned about Peer Effects Using College Roommates? Evidence from New Survey Data and Students from Disadvantaged Backgrounds." *Journal of Public Economics*, 90(8-9): 1435–1454.

Tan, Tom Fangyun, and Serguei Netessine. 2019. "When You Work with a Superman, Will You Also Fly? An Empirical Study of the Impact of Coworkers on Performance." *Management Science*, 65(8): 3495–3517.

Thiemann, Petra. 2022. "The Persistent Effects of Short-Term Peer Groups on Performance: Evidence from a Natural Experiment in Higher Education." *Management Science*, 68(2): 1131–1148.

Villeval, Marie Claire. 2020. "Performance Feedback and Peer Effects." In *Handbook of Labor, Human Resources and Population Economics.* , ed. Klaus F. Zimmermann, 1–38. Cham:Springer.

Online Appendix

A Additional tables and figures

Table A.1: Description of variables

Variable	Description
a) *Student background*	
Woman	Indicator for being a woman.
Non-German citizen	Indicator for non-German citizenship.
Age	Age in years at the beginning of the first semester.
High school GPA	Reverse scaled grade of the high school degree (=university entrance qualification; 1.0=best, 4.0=worst on original German scale). Standardized within cohorts and study programs for the analyses.
Time since HS degree	Time in years since obtaining the high school degree at the beginning of the first semester.
HS degree Abitur	Indicator for a general track high school degree ("Abitur"; 0=vocational track degree ("Fachhochschulreife") or other degrees.)
HS degree local	Indicator for high school degree obtained in the county in which the university is located (0=rest of Bavaria, other federal state, or abroad).
HS degree other state	Indicator for high school degree obtained in another federal state (0=Bavaria or abroad).
HS degree foreign	Indicator for high school degree obtained abroad (0=Bavaria or other federal state).
First university	Indicates if the first semester was the first semester at any university.
Enrollment date	Number of days between the start of the first semester and the date of enrollment at university.
Enrollment date N/A	Indicates if the enrollment date was missing.
b) *Peer ability*	
Peer high school GPA	Leave-own-out mean of the high school GPA. Standardized within cohorts and study programs for the analyses.
c) *Group characteristics*	
Original group size	Size of the freshman orientation groups according to the data received by the organizers.
Share not matched	Share of students in each freshman orientation group that could not be matched to the administrative data.
Group size	Size of the freshman orientation groups in the estimation data, i.e., after matching with the administrative data.
d) *Student outcomes*	
Accumulated credits	Total number of course credits accumuluated until the end of the respective semester. Standardized within cohorts and study programs for the construction of the achievement index.
Persistence	Indicator for still being enrolled in the initital study program.
GPA	Reverse scaled grade point average at the end of the respective semester based on passing grades only (1.0=best, 4.0=worst on original German scale). Missing for students who have not passed any graded course. Standardized within cohorts and study programs for the analyses.
Achievement index	Standardized inverse-covariance weighted average of the standardized accumulated credits, persistence, and the standardized GPA.

Table A.2: Freshman orientation events at German higher education institutions

Type of event	(1) Offer	(2) Participation	(3) Rather/very helpful
Getting to know fellow students	92.48%	77.64%	90.18%
Central facilities	90.26%	65.51%	82.67%
Study organization	80.83%	65.45%	84.09%
Bridging courses	49.17%	24.41%	78.16%
Academic skills	44.74%	27.07%	79.14%
No event offered	0.33%		

Note: Own depiction based on data from the representative National Educational Panel Study starting cohort five (`https://www.neps-data.de/Portals/0/NEPS/Datenzentrum/Forschungsdaten/SC5/17-0-0/SC5_17-0-0_Codebook_en.pdf`, retrieved on December, 12, 2022). Participation is the share of all respondents, who participated in the respective type of event. Only students who indicated that they made use of the offer were asked how helpful they rated the participation in the respective type of event.

Table A.3: Comparison between main estimation and survey sample by study programs

	Business Administration			*International Business (& Technology)*		
	Main sample (1)	Svy. sample (2)	p-value (3)	Main sample (4)	Svy. sample (5)	p-value (6)
Woman	0.541	0.618	0.024	0.500	0.646	0.002
Non-German citizen	0.089	0.081	0.689	0.218	0.306	0.033
Age	21.934	22.040	0.658	21.230	21.162	0.800
High school GPA	2.492	2.433	0.078	2.891	2.994	0.081
Time since HS degree	1.990	1.964	0.891	1.676	1.716	0.847
HS degree Abitur	0.435	0.463	0.410	0.698	0.743	0.299
HS degree local	0.308	0.187	0.000	0.241	0.132	0.006
HS degree other state	0.074	0.085	0.534	0.123	0.090	0.289
HS degree foreign	0.042	0.033	0.494	0.200	0.271	0.074
First university	0.721	0.687	0.273	0.770	0.743	0.502
N	1,459	246		440	144	

Note: See Table A.1 for definitions of all variables. The p-values reported in Columns (3) and (6) are from two-sample tests on the equality of proportions and means.

Table A.4: Regression of academic achievements on students' high school GPA and type of high school degree

	Ach. ind.		*Acc. credits*		*Persistence*		*Std. GPA*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Semester	Second	Sixth	Second	Sixth	Second	Sixth	Second	Sixth
a) *Full sample*								
High School GPA	0.401***	0.533***	6.902***	17.801***	-0.011	0.072**	0.960***	0.944***
	(0.076)	(0.072)	(1.543)	(4.522)	(0.027)	(0.032)	(0.070)	(0.069)
HS degree Abitur	0.387	0.516**	15.262***	32.711**	0.002	0.169	0.566***	0.589***
	(0.243)	(0.233)	(5.471)	(15.317)	(0.087)	(0.105)	(0.216)	(0.219)
Abitur*HS GPA	-0.097	-0.129	-4.564**	-9.041	0.000	-0.054	-0.107	-0.112
	(0.097)	(0.092)	(2.054)	(5.883)	(0.034)	(0.040)	(0.084)	(0.084)
Cohort FE	yes	yes	yes	yes	yes	yes	yes	yes
Study program FE	yes	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.09	0.14	0.11	0.12	0.02	0.05	0.25	0.27
N	1,899	1,899	1,899	1,899	1,899	1,899	1,787	1,791
b) *Business Administration*								
High School GPA	0.419***	0.538***	6.221***	15.889***	-0.011	0.070*	0.941***	0.949***
	(0.085)	(0.083)	(1.742)	(5.186)	(0.029)	(0.036)	(0.081)	(0.080)
HS degree Abitur	0.429	0.543*	15.732**	33.184*	0.031	0.176	0.439*	0.554**
	(0.294)	(0.281)	(6.655)	(18.691)	(0.104)	(0.124)	(0.258)	(0.259)
Abitur*HS GPA	-0.120	-0.149	-4.954*	-9.712	-0.016	-0.062	-0.060	-0.099
	(0.119)	(0.112)	(2.542)	(7.315)	(0.041)	(0.048)	(0.102)	(0.101)
Cohort FE	yes	yes	yes	yes	yes	yes	yes	yes
Study program FE	no	no	no	no	no	no	no	no
Controls	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.09	0.14	0.09	0.10	0.02	0.04	0.23	0.26
N	1,459	1,459	1,459	1,459	1,459	1,459	1,384	1,386
c) *International Business (& Technology)*								
High School GPA	0.403**	0.549***	16.135***	38.999***	0.039	0.141*	1.026***	0.919***
	(0.175)	(0.151)	(3.861)	(9.688)	(0.068)	(0.077)	(0.132)	(0.133)
HS degree Abitur	0.348	0.582	30.737**	66.256**	0.029	0.299	0.918**	0.699
	(0.538)	(0.482)	(12.023)	(31.231)	(0.197)	(0.241)	(0.460)	(0.444)
Abitur*HS GPA	-0.036	-0.106	-7.956*	-15.698	0.023	-0.058	-0.244	-0.158
	(0.199)	(0.177)	(4.226)	(11.259)	(0.072)	(0.088)	(0.167)	(0.163)
Cohort FE	yes	yes	yes	yes	yes	yes	yes	yes
Study program FE	no	no	no	no	no	no	no	no
Controls	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.11	0.17	0.15	0.18	0.05	0.09	0.32	0.31
N	440	440	440	440	440	440	403	405

Notes: Academic achievement index is the standardized inverse-covariance weighted average of the other three outcomes. *Accumulated credits* are the accumulated course credits at the end of the respective semester. *Persistence* indicates if a student is still enrolled in their initial study program at the end of the respective semester. *Standardized GPA* is the GPA at the end of the respective semester, standardized within cohorts and study programs. The GPA is based on passing grades only, i.e., it is unobserved for students who have not passed any courses. *Controls:* enrollment date imputed, first university, woman, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the enrollment date, the age at the beginning of the first semester, and the time between the HS degree and the beginning of the first semester. Robust standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.5: Regression of peer ability on students' own characteristics

	(1) Bus. Adm.	(2) Int. Bus. (& Tech)	(3) Full Sample
High school GPA	-0.026	0.075	-0.009
	(0.081)	(0.111)	(0.008)
Enrollment date	0.000	0.001	0.000
	(0.000)	(0.000)	(0.000)
Woman	0.002	-0.000	0.001
	(0.004)	(0.006)	(0.003)
Non-German citizen	0.012*	0.010	0.011**
	(0.007)	(0.007)	(0.005)
Age	0.000	-0.000	0.000
	(0.001)	(0.001)	(0.001)
First uni. sem.	-0.000	0.012	0.002
	(0.006)	(0.009)	(0.005)
Time since HS degree	-0.000	-0.001	-0.000
	(0.001)	(0.002)	(0.001)
HS degree Abitur	-0.004	0.006	-0.002
	(0.004)	(0.010)	(0.004)
HS degree local	0.002	0.016	0.005
	(0.004)	(0.010)	(0.004)
HS degree other state	-0.014*	0.014	-0.005
	(0.007)	(0.013)	(0.006)
HS degree foreign	0.003	0.005	0.004
	(0.009)	(0.010)	(0.007)
Cohort FE	yes	no	no
Cohort LOO mean	yes	no	no
Cohort*study program FE	no	yes	yes
Cohort*study program LOO mean	no	yes	yes
N	1,459	440	1,899

Notes: The table depicts coefficients of regressing the peer high school GPA on student background characteristics, controlling for cohort (by study program) FE, and, following Guryan et al. (2009), the cohort (by study program) level leave-own-out (LOO) mean of the high school GPA. Each row depicts the coefficient from a separate regression. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.6: P-values from regressing student characteristics on freshman orientation group dummies

Dependent variable	HS GPA	Enr. date	Woman	Non-Ger. cit.	Age	First uni.	Time s. HS	Abitur	HS deg. local	HS deg. oth.	HS deg. for.	*N*
Business Administration												
2016	[0.841]	[0.276]	[0.183]	[0.637]	[0.004]	[0.979]	[0.132]	[0.701]	[0.169]	[0.388]	[0.815]	341
2017	[0.497]	[0.073]	[0.843]	[0.724]	[0.585]	[0.172]	[0.453]	[0.406]	[0.720]	[0.659]	[0.525]	349
2018	[0.425]	[0.430]	[0.225]	[0.096]	[0.525]	[0.067]	[0.399]	[0.074]	[0.172]	[0.554]	[0.856]	370
2019	[0.867]	[0.848]	[0.014]	[0.494]	[0.313]	[0.489]	[0.050]	[0.374]	[0.780]	[0.721]	[0.349]	399
International Business												
2017	[0.522]	[0.115]	[0.986]	[0.984]	[0.770]	[0.080]	[0.472]	[0.676]	[0.323]	[0.057]	[0.764]	73
2018	[0.965]	[0.416]	[0.130]	[0.642]	[0.644]	[0.537]	[0.457]	[0.124]	[0.754]	[0.877]	[0.733]	68
2019	[0.340]	[0.348]	[0.621]	[0.021]	[0.213]	[0.387]	[0.486]	[0.001]	[0.271]	[0.538]	[0.021]	84
International Business and Technology												
2017	[0.931]	[0.233]	[0.870]	[0.550]	[0.807]	[0.023]	[0.797]	[0.747]	[0.024]	[0.799]	[0.636]	73
2018	[0.172]	[0.212]	[0.773]	[0.658]	[0.284]	[0.972]	[0.185]	[0.892]	[0.103]	[0.685]	[0.999]	67
2019	[0.131]	[0.260]	[0.165]	[0.673]	[0.768]	[0.223]	[0.531]	[0.694]	[0.212]	[0.171]	[0.313]	75

Notes: The table depicts the individual p-values from the following randomization check. Within each cohort by study program combination, students' background characteristics are regressed on freshman orientation group dummies. The p-values are from F-tests for joint significance of all included freshman orientation group dummies.

Table A.7: Effect of peer ability on academic achievements – Business Administration

Semester	(1) First	(2) Second	(3) Third	(4) Fourth	(5) Fifth	(6) Sixth
a) *Academic achievement index*						
Std(Peer HS GPA)	0.070***	0.080***	0.061**	0.048**	0.050**	0.056**
	(0.019)	(0.022)	(0.023)	(0.022)	(0.022)	(0.026)
Std(HS GPA)	0.070**	0.172***	0.195***	0.203***	0.213***	0.219***
	(0.029)	(0.024)	(0.027)	(0.028)	(0.029)	(0.028)
R^2	0.05	0.10	0.11	0.12	0.13	0.14
N	1,459	1,459	1,459	1,459	1,459	1,459
b) *Accumulated credits*						
Std(Peer HS GPA)	0.820***	1.590***	2.140***	2.620***	2.637**	2.986**
	(0.293)	(0.452)	(0.621)	(0.829)	(1.075)	(1.307)
Std(HS GPA)	0.620*	1.835***	2.691***	3.689***	4.478***	5.307***
	(0.360)	(0.558)	(0.859)	(1.139)	(1.427)	(1.693)
R^2	0.07	0.09	0.09	0.10	0.10	0.10
N	1,459	1,459	1,459	1,459	1,459	1,459
c) *Persistence*						
Std(Peer HS GPA)	0.008*	0.022***	0.017**	0.014*	0.016*	0.020*
	(0.005)	(0.008)	(0.008)	(0.008)	(0.008)	(0.011)
Std(HS GPA)	-0.013*	-0.008	-0.001	0.005	0.013	0.019
	(0.007)	(0.009)	(0.011)	(0.012)	(0.012)	(0.012)
R^2	0.02	0.03	0.02	0.03	0.04	0.05
N	1,459	1,459	1,459	1,459	1,459	1,459
d) *Standardized GPA*						
Std(Peer HS GPA)	0.064***	0.047**	0.034	0.030	0.036	0.033
	(0.024)	(0.021)	(0.021)	(0.022)	(0.022)	(0.021)
Std(HS GPA)	0.414***	0.427***	0.436***	0.430***	0.424***	0.421***
	(0.027)	(0.028)	(0.028)	(0.028)	(0.029)	(0.028)
R^2	0.22	0.23	0.25	0.25	0.25	0.26
N	1,377	1,384	1,386	1,386	1,386	1,386
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes

Notes: Std(high school GPA) is the high school GPA, standardized within cohorts. *Std(Peer high school GPA)* is the leave-own-out mean of the high school GPA, standardized within cohorts. *Academic achievement index* is the standardized inverse-covariance weighted average of the other three outcomes. *Accumulated credits* are the accumulated course credits at the end of the respective semester. *Persistence* indicates if a student is still enrolled in their initial study program at the end of the respective semester. *Standardized GPA* is the GPA at the end of the respective semester, standardized within cohorts. The GPA is based on passing grades only, i.e., it is unobserved for students who have not passed any courses. *Controls:* enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.8: Effect of peer ability on academic achievements – MHT correction for index components

Semester	(1) First	(2) Second	(3) Third	(4) Fourth	(5) Fifth	(6) Sixth
a) *Accumulated credits*						
Std(Peer HS GPA)	0.820	1.590	2.140	2.620	2.637	2.986
Model p-value	[0.007]	[0.001]	[0.001]	[0.003]	[0.017]	[0.026]
Sidak-Holm p-value	[0.021]	[0.003]	[0.003]	[0.008]	[0.051]	[0.077]
FDR q-value	[0.014]	[0.003]	[0.004]	[0.008]	[0.056]	[0.086]
N	1,459	1,459	1,459	1,459	1,459	1,459
b) *Persistence*						
Std(Peer HS GPA)	0.008	0.022	0.017	0.014	0.016	0.020
Model p-value	[0.088]	[0.009]	[0.037]	[0.096]	[0.067]	[0.062]
Sidak-Holm p-value	[0.088]	[0.017]	[0.072]	[0.184]	[0.130]	[0.121]
FDR q-value	[0.031]	[0.009]	[0.039]	[0.107]	[0.072]	[0.086]
N	1,459	1,459	1,459	1,459	1,459	1,459
c) *Standardized GPA*						
Std(Peer HS GPA)	0.064	0.047	0.034	0.030	0.036	0.033
Model p-value	[0.009]	[0.029]	[0.108]	[0.178]	[0.106]	[0.133]
Sidak-Holm p-value	[0.021]	[0.029]	[0.108]	[0.184]	[0.130]	[0.133]
FDR q-value	[0.014]	[0.014]	[0.059]	[0.135]	[0.077]	[0.098]
N	1,377	1,384	1,386	1,386	1,386	1,386
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes

Notes: Based on the results reported in Table A.7, this table reports the model p-values, as well as Sidak-Holm p-values and FDR q-values (i.e., false-discovery-rate adjusted p-values Anderson (2008)) to adjust for multiple hypothesis testing separately for each semester. *Std(Peer high school GPA)* is the leave-own-out mean of the high school GPA, standardized within cohorts. *Accumulated credits* are the accumulated course credits at the end of the respective semester. *Persistence* indicates if a student is still enrolled in their initial study program at the end of the respective semester. *Standardized GPA* is the GPA at the end of the respective semester, standardized within cohorts. The GPA is based on passing grades only, i.e., it is unobserved for students who have not passed any courses. *Controls:* enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the standardized high school GPA, the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size.

Table A.9: Effect of peer ability on academic achievement index – robustness checks I

Semester	(1) First	(2) Second	(3) Third	(4) Fourth	(5) Fifth	(6) Sixth
a) *Wild cluster bootstrap (WCB; 10,000 replications)*						
Std(Peer HS GPA)	0.070	0.080	0.061	0.048	0.050	0.056
Model p-value	[0.001]***	[0.001]***	[0.010]**	[0.033]**	[0.025]**	[0.038]**
WCB p-value	[0.004]***	[0.003]***	[0.028]**	[0.061]*	[0.048] **	[0.060]*
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes
R^2	0.05	0.10	0.11	0.12	0.13	0.14
N	1,459	1,459	1,459	1,459	1,459	1,459
b) *Non-clusted standard errors*						
Std(Peer HS GPA)	0.070***	0.080***	0.061**	0.048*	0.050**	0.056**
	(0.027)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Std(HS GPA)	0.070**	0.172***	0.195***	0.203***	0.213***	0.219***
	(0.030)	(0.030)	(0.030)	(0.029)	(0.029)	(0.028)
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes
R^2	0.05	0.10	0.11	0.12	0.13	0.14
N	1,459	1,459	1,459	1,459	1,459	1,459
c) *Without controls*						
Std(Peer HS GPA)	0.068***	0.079***	0.059**	0.045*	0.046*	0.052*
	(0.019)	(0.024)	(0.026)	(0.025)	(0.025)	(0.029)
Std(HS GPA)	0.094***	0.201***	0.226***	0.236***	0.244***	0.254***
	(0.027)	(0.023)	(0.024)	(0.025)	(0.025)	(0.024)
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	no	no	no	no	no	no
R^2	0.01	0.05	0.05	0.06	0.06	0.07
N	1,459	1,459	1,459	1,459	1,459	1,459
d) *Controling for first letter of last name FE*						
Std(Peer HS GPA)	0.074***	0.072***	0.052**	0.038*	0.039*	0.046*
	(0.019)	(0.020)	(0.021)	(0.022)	(0.021)	(0.025)
Std(HS GPA)	0.074**	0.172***	0.195***	0.202***	0.211***	0.216***
	(0.029)	(0.024)	(0.027)	(0.028)	(0.028)	(0.027)
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes
First letter of last name FE	yes	yes	yes	yes	yes	yes
R^2	0.06	0.11	0.13	0.14	0.14	0.15
N	1,459	1,459	1,459	1,459	1,459	1,459

Notes: Std(high school GPA) is the high school GPA, standardized within cohorts. *Std(Peer high school GPA)* is the leave-own-out mean of the high school GPA, standardized within cohorts. *Academic achievement index* is the standardized inverse-covariance weighted average of the standardized accumulated credits, persistence, and the standardized GPA. *Controls:* enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as (the standardized high school GPA; Panel a), the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. Robust standard errors (clustered at the freshman orientation group level) in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.10: Effect of peer ability on academic achievement index – robustness checks II

Semester	(1) First	(2) Second	(3) Third	(4) Fourth	(5) Fifth	(6) Sixth
a) *Controling for other peer characteristics*						
Std(Peer HS GPA)	0.091***	0.075***	0.056***	0.045**	0.043**	0.047**
	(0.017)	(0.019)	(0.019)	(0.018)	(0.018)	(0.021)
Std(HS GPA)	0.078**	0.174***	0.198***	0.205***	0.213***	0.219***
	(0.030)	(0.024)	(0.027)	(0.027)	(0.028)	(0.027)
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes
Peer controls	yes	yes	yes	yes	yes	yes
R^2	0.06	0.12	0.13	0.14	0.15	0.16
N	1,459	1,459	1,459	1,459	1,459	1,459
b) *Allowing for heterogeneous peer effects by Cohort FE*						
Std(Peer HS GPA)	0.070***	0.080***	0.061***	0.048**	0.050***	0.055***
	(0.018)	(0.021)	(0.021)	(0.020)	(0.019)	(0.019)
Cohort FE	yes	yes	yes	yes	yes	yes
Std(Peer HS GPA)*(Cohort FE)	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes
Std(Peer HS GPA)*controls	no	no	no	no	no	no
R^2	0.05	0.10	0.11	0.13	0.14	0.15
N	1,459	1,459	1,459	1,459	1,459	1,459
c) *Allowing for heterogeneous peer effects by all covariates*						
Std(Peer HS GPA)	0.079***	0.094***	0.076***	0.061***	0.062***	0.068***
	(0.020)	(0.022)	(0.022)	(0.021)	(0.019)	(0.020)
Cohort FE	yes	yes	yes	yes	yes	yes
Std(Peer HS GPA)*(Cohort FE)	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes
Std(Peer HS GPA)*controls	yes	yes	yes	yes	yes	yes
R^2	0.05	0.11	0.12	0.13	0.14	0.15
N	1,459	1,459	1,459	1,459	1,459	1,459

Notes: Estimates reported in Panels b) and c) are marginal effects at the average of the covariates. *Std(high school GPA)* is the high school GPA, standardized within cohorts. *Std(Peer high school GPA)* is the leave-own-out mean of the high school GPA, standardized within cohorts. *Academic achievement index* is the standardized inverse-covariance weighted average of the standardized accumulated credits, persistence, and the standardized GPA. *Controls:* enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as (the standardized high school GPA; Panels b and c), the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. *Peer controls:* leave-own-out means of all variables shown in Panel a) of Table 2, except the enrollment date imputed dummy. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.11: Nonlinear effects of peer ability on academic achievements – Business Administration

Semester	(1) First	(2) Second	(3) Third	(4) Fourth	(5) Fifth	(6) Sixth
a) *Academic achievement index*						
Frac. high ability peers	0.338	0.439	0.195	0.238	0.156	0.199
	(0.264)	(0.268)	(0.249)	(0.240)	(0.241)	(0.273)
Frac. low ability peers	-0.535**	-0.382	-0.420	-0.239	-0.328	-0.437
	(0.264)	(0.316)	(0.322)	(0.305)	(0.300)	(0.348)
Frac. high - frac. low	0.873**	0.821**	0.616	0.478	0.484	0.636
	(0.330)	(0.358)	(0.370)	(0.353)	(0.348)	(0.417)
N	1,459	1,459	1,459	1,459	1,459	1,459
b) *Accumulated credits*						
Frac. high ability peers	6.387*	13.864**	18.173**	21.873**	22.928*	21.186
	(3.644)	(5.986)	(7.989)	(9.923)	(12.634)	(15.039)
Frac. low ability peers	-2.370	-2.055	-4.829	-7.906	-2.884	-8.767
	(3.255)	(5.316)	(8.843)	(11.578)	(14.826)	(17.751)
Frac. high - frac. low	8.757*	15.919**	23.002**	29.779**	25.813	29.953
	(4.868)	(6.584)	(9.510)	(12.127)	(16.151)	(20.798)
N	1,459	1,459	1,459	1,459	1,459	1,459
c) *Persistence*						
Frac. high ability peers	0.046	0.171	0.101	0.144	0.105	0.153
	(0.069)	(0.112)	(0.103)	(0.106)	(0.111)	(0.126)
Frac. low ability peers	-0.071	-0.055	-0.061	0.013	-0.044	-0.100
	(0.069)	(0.107)	(0.111)	(0.110)	(0.111)	(0.138)
Frac. high - frac. low	0.117	0.226	0.162	0.131	0.149	0.253
	(0.095)	(0.144)	(0.140)	(0.136)	(0.143)	(0.178)
N	1,459	1,459	1,459	1,459	1,459	1,459
d) *Standardized GPA*						
Frac. high ability peers	0.115	0.044	-0.084	-0.005	-0.001	-0.036
	(0.288)	(0.286)	(0.270)	(0.271)	(0.287)	(0.274)
Frac. low ability peers	-0.639**	-0.439	-0.440	-0.308	-0.374	-0.368
	(0.266)	(0.298)	(0.278)	(0.285)	(0.289)	(0.281)
Frac. high - frac. low	0.754**	0.483	0.356	0.302	0.373	0.332
	(0.329)	(0.313)	(0.307)	(0.347)	(0.342)	(0.337)
N	1,377	1,384	1,386	1,386	1,386	1,386
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes

Notes: Based on grouping students into terciles of the standardized high school GPA (*Lowest* ($N = 499$), *Middle* ($N = 478$), and *Highest* ($N = 482$)), this table presents effects of regressing academic achievements on the fractions of high and low ability peers (middle-ability peers are the reference group). *Academic achievement index* is the standardized inverse-covariance weighted average of the other three outcomes. *Accumulated credits* are the accumulated course credits at the end of the respective semester. *Persistence* indicates if a student is still enrolled in their initial study program at the end of the respective semester. *Standardized GPA* is the GPA at the end of the respective semester, standardized within cohorts. The GPA is based on passing grades only, i.e., it is unobserved for students who have not passed any courses. *Controls:* enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the standardized high school GPA, the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.12: Effect of peer ability on academic achievements by own ability – Business Administration

	(1)	(2)	(3)	(4)	(5)	(6)
Semester	First	Second	Third	Fourth	Fifth	Sixth
a) *Academic achievement index*						
Std(Peer HS GPA)	0.070***	0.080***	0.061**	0.048**	0.050**	0.056**
	(0.019)	(0.022)	(0.023)	(0.022)	(0.022)	(0.026)
Std(HS GPA)	0.070**	0.172***	0.195***	0.203***	0.213***	0.219***
	(0.029)	(0.024)	(0.027)	(0.028)	(0.029)	(0.027)
Std(Peer HS GPA)*Std(HS GPA)	-0.005	0.010	0.007	-0.002	-0.000	-0.008
	(0.029)	(0.023)	(0.022)	(0.023)	(0.021)	(0.021)
N	1,459	1,459	1,459	1,459	1,459	1,459
b) *Accumulated credits*						
Std(Peer HS GPA)	0.828***	1.590***	2.134***	2.622***	2.634**	2.980**
	(0.304)	(0.453)	(0.621)	(0.826)	(1.070)	(1.299)
Std(HS GPA)	0.621*	1.835***	2.690***	3.689***	4.477***	5.305***
	(0.361)	(0.558)	(0.859)	(1.140)	(1.430)	(1.697)
Std(Peer HS GPA)*Std(HS GPA)	-0.139	0.002	0.127	-0.044	0.059	0.126
	(0.420)	(0.573)	(0.840)	(0.980)	(1.151)	(1.397)
N	1,459	1,459	1,459	1,459	1,459	1,459
c) *Persistence*						
Std(Peer HS GPA)	0.008*	0.022**	0.017**	0.013	0.015*	0.020*
	(0.005)	(0.008)	(0.008)	(0.008)	(0.008)	(0.011)
Std(HS GPA)	-0.013*	-0.008	-0.001	0.005	0.013	0.019
	(0.007)	(0.009)	(0.011)	(0.012)	(0.012)	(0.012)
Std(Peer HS GPA)*Std(HS GPA)	0.001	0.011	0.009	0.006	0.007	0.003
	(0.006)	(0.008)	(0.009)	(0.011)	(0.009)	(0.009)
N	1,459	1,459	1,459	1,459	1,459	1,459
d) *Standardized GPA*						
Std(Peer HS GPA)	0.066***	0.049**	0.035*	0.032	0.038*	0.034
	(0.024)	(0.021)	(0.021)	(0.023)	(0.022)	(0.022)
Std(HS GPA)	0.414***	0.427***	0.437***	0.431***	0.425***	0.421***
	(0.026)	(0.028)	(0.028)	(0.028)	(0.029)	(0.028)
Std(Peer HS GPA)*Std(HS GPA)	-0.041	-0.037	-0.034	-0.039	-0.038	-0.038
	(0.027)	(0.028)	(0.027)	(0.026)	(0.025)	(0.024)
N	1,377	1,384	1,386	1,386	1,386	1,386
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes

Notes: Std(high school GPA) is the high school GPA, standardized within cohorts. *Std(Peer HS GPA)* is the leave-own-out mean of the high school GPA, standardized within cohorts. *Academic achievement index* is the standardized inverse-covariance weighted average of the other three outcomes. *Accumulated credits* are the accumulated course credits at the end of the respective semester. *Persistence* indicates if a student is still enrolled in their initial study program at the end of the respective semester. *Standardized GPA* is the GPA at the end of the respective semester, standardized within cohorts. The GPA is based on passing grades only, i.e., it is unobserved for students who have not passed any courses. *Controls:* enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.13: Effect of peer ability on academic achievements by terciles of own ability – Business Administration

Semester	(1) First	(2) Second	(3) Third	(4) Fourth	(5) Fifth	(6) Sixth
a) *Academic achievement index*						
Effect of Std(Peer HS GPA) in lowest tercile	0.080***	0.087***	0.079**	0.058	0.058	0.066
	(0.030)	(0.031)	(0.033)	(0.038)	(0.036)	(0.041)
Effect of Std(Peer HS GPA) in middle tercile	0.074	0.065	0.031	0.033	0.038	0.054
	(0.056)	(0.048)	(0.050)	(0.050)	(0.049)	(0.055)
Effect of Std(Peer HS GPA) in highest tercile	0.063	0.095**	0.079*	0.061	0.062	0.054
	(0.042)	(0.038)	(0.040)	(0.040)	(0.041)	(0.040)
P-value int. term	0.946	0.887	0.689	0.909	0.931	0.972
N	1,459	1,459	1,459	1,459	1,459	1,459
b) *Accumulated credits*						
Effect of Std(Peer HS GPA) in lowest tercile	0.883	1.468**	1.920*	2.185*	1.623	1.895
	(0.661)	(0.732)	(0.989)	(1.259)	(1.557)	(2.024)
Effect of Std(Peer HS GPA) in middle tercile	1.195***	1.758**	2.396*	3.308*	3.826	4.306
	(0.423)	(0.847)	(1.320)	(1.893)	(2.450)	(3.172)
Effect of Std(Peer HS GPA) in highest tercile	0.496	1.720**	2.368*	2.796*	2.961	3.331
	(0.467)	(0.821)	(1.207)	(1.598)	(2.053)	(2.471)
P-value int. term	0.620	0.948	0.939	0.894	0.745	0.815
N	1,459	1,459	1,459	1,459	1,459	1,459
c) *Persistence*						
Effect of Std(Peer HS GPA) in lowest tercile	0.007	0.015	0.015	0.004	0.005	0.012
	(0.007)	(0.013)	(0.016)	(0.019)	(0.018)	(0.021)
Effect of Std(Peer HS GPA) in middle tercile	0.011	0.024	0.013	0.020	0.026	0.033
	(0.013)	(0.016)	(0.018)	(0.018)	(0.018)	(0.022)
Effect of Std(Peer HS GPA) in highest tercile	0.009	0.029**	0.025*	0.019	0.019	0.018
	(0.009)	(0.013)	(0.013)	(0.015)	(0.015)	(0.016)
P-value int. term	0.953	0.740	0.803	0.836	0.766	0.813
N	1,459	1,459	1,459	1,459	1,459	1,459
d) *Standardized GPA*						
Effect of Std(Peer HS GPA) in lowest tercile	0.129***	0.097**	0.088**	0.083**	0.089**	0.078**
	(0.047)	(0.040)	(0.036)	(0.035)	(0.034)	(0.034)
Effect of Std(Peer HS GPA) in middle tercile	0.034	0.016	-0.005	-0.009	-0.007	0.001
	(0.051)	(0.051)	(0.048)	(0.049)	(0.047)	(0.047)
Effect of Std(Peer HS GPA) in highest tercile	0.041	0.041	0.030	0.028	0.037	0.032
	(0.035)	(0.039)	(0.039)	(0.040)	(0.040)	(0.037)
P-value int. term	0.173	0.362	0.224	0.230	0.218	0.355
N	1,377	1,384	1,386	1,386	1,386	1,386
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes

Notes: Based on grouping students into terciles of the standardized high school GPA (*Lowest* (N = 499), *Middle* (N = 478), and *Highest* (N = 482)), this table presents effects of peer ability by Business Administration students' own ability. The p-values are from F-tests on the joint significance of all interaction terms between the standardized high school GPA terciles and the peer high school GPA. *Std(Peer HS GPA)* is the leave-own-out mean of the high school GPA, standardized within cohorts. *Academic achievement index* is the standardized inverse-covariance weighted average of the other three outcomes. *Accumulated credits* are the accumulated course credits at the end of the respective semester. *Persistence* indicates if a student is still enrolled in their initial study program at the end of the respective semester. *Standardized GPA* is the GPA at the end of the respective semester, standardized within cohorts. The GPA is based on passing grades only, i.e., it is unobserved for students who have not passed any courses. *Controls:* enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.14: Logistic regression of isolation status on background characteristics – Business Administration, survey sample

	(1) Linear	(2) Quadratic	(3) Cubic
Woman	-0.342	-0.308	-0.340
	(0.288)	(0.294)	(0.300)
Non-German citizen	0.000	-0.061	0.074
	(0.570)	(0.578)	(0.590)
Age	-0.022	0.259	-6.460*
	(0.064)	(0.493)	(3.880)
High school GPA	0.151	1.033	-8.021
	(0.271)	(1.759)	(7.702)
Time since HS degree	0.011	0.120	0.032
	(0.083)	(0.149)	(0.303)
HS degree Abitur	-0.894***	-0.909***	-0.966***
	(0.306)	(0.308)	(0.316)
HS degree local	0.024	0.064	0.069
	(0.356)	(0.360)	(0.368)
HS degree other state	0.576	0.496	0.556
	(0.524)	(0.528)	(0.534)
HS degree foreign	0.726	0.678	0.797
	(0.906)	(0.924)	(0.958)
First university	-0.631*	-0.508	-0.562
	(0.325)	(0.341)	(0.356)
Age^2		-0.006	0.267*
		(0.010)	(0.156)
(High school GPA)^2		-0.167	3.874
		(0.351)	(3.325)
(Time since HS degree)^2		-0.006	0.000
		(0.013)	(0.063)
Age^3			-0.004*
			(0.002)
(High school GPA)^3			-0.573
			(0.463)
(Time since HS degree)^3			0.001
			(0.003)
Age p-value	[0.732]	[0.864]	[0.345]
High school GPA p-value	[0.578]	[0.675]	[0.532]
Time since HS degree p-value	[0.896]	[0.697]	[0.645]
Pseudo R^2	0.04	0.05	0.07
χ^2 p-value	[0.147]	[0.193]	[0.084]
N	238	238	238

Notes: Isolation status is equal to one for students who reported in the surveys used for Figure 1 that they met zero of their study partners during freshman orientation. See Table A.1 for definitions of all other variables. The p-values for age, high school GPA, time since high school graduation are from F-tests on the joint significance of all terms of the respective variable. Standard errors in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.15: Effect of peer ability on academic achievements by isolation probability – Business Administration

Semester	(1) First	(2) Second	(3) Third	(4) Fourth	(5) Fifth	(6) Sixth
a) *Academic achievement index*						
Effect of Std(Peer HS GPA) for low Pr(isolated)	0.117***	0.126***	0.105***	0.087**	0.094**	0.098**
	(0.031)	(0.037)	(0.037)	(0.037)	(0.037)	(0.041)
Effect of Std(Peer HS GPA) for high Pr(isolated)	0.026	0.038	0.021	0.012	0.010	0.017
	(0.033)	(0.034)	(0.034)	(0.035)	(0.033)	(0.035)
Low Pr(isolated) - high Pr(isolated)	0.091*	0.088	0.084	0.075	0.084	0.081
	(0.052)	(0.057)	(0.055)	(0.058)	(0.056)	(0.055)
N	1,459	1,459	1,459	1,459	1,459	1,459
b) *Accumulated credits*						
Effect of Std(Peer HS GPA) for low Pr(isolated)	1.409***	2.365***	3.507***	4.575***	4.801**	5.351**
	(0.378)	(0.651)	(1.014)	(1.419)	(1.847)	(2.257)
Effect of Std(Peer HS GPA) for high Pr(isolated)	0.282	0.883	0.893	0.830	0.654	0.824
	(0.418)	(0.731)	(1.055)	(1.481)	(1.842)	(2.224)
Low Pr(isolated) - high Pr(isolated)	1.126**	1.481	2.615	3.745	4.147	4.527
	(0.539)	(1.050)	(1.669)	(2.410)	(3.038)	(3.684)
N	1,459	1,459	1,459	1,459	1,459	1,459
c) *Persistence*						
Effect of Std(Peer HS GPA) for low Pr(isolated)	0.015**	0.034**	0.028**	0.022	0.028*	0.032*
	(0.007)	(0.014)	(0.013)	(0.014)	(0.015)	(0.018)
Effect of Std(Peer HS GPA) for high Pr(isolated)	0.002	0.011	0.008	0.006	0.004	0.009
	(0.009)	(0.013)	(0.013)	(0.014)	(0.014)	(0.015)
Low Pr(isolated) - high Pr(isolated)	0.013	0.024	0.021	0.017	0.024	0.022
	(0.012)	(0.021)	(0.021)	(0.023)	(0.024)	(0.026)
N	1,459	1,459	1,459	1,459	1,459	1,459
d) *Standardized GPA*						
Effect of Std(Peer HS GPA) for low Pr(isolated)	0.096**	0.071*	0.059*	0.055	0.063*	0.062*
	(0.040)	(0.035)	(0.033)	(0.033)	(0.033)	(0.031)
Effect of Std(Peer HS GPA) for high Pr(isolated)	0.035	0.026	0.011	0.009	0.011	0.006
	(0.036)	(0.032)	(0.033)	(0.034)	(0.035)	(0.033)
Low Pr(isolated) - high Pr(isolated)	0.062	0.044	0.048	0.046	0.052	0.056
	(0.060)	(0.052)	(0.052)	(0.051)	(0.052)	(0.048)
N	1,377	1,384	1,386	1,386	1,386	1,386
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes

Notes: This table presents effects of peer ability by students' probability of having met zero of their study partners during freshman orientation (cf. Table 3). *Std(Peer HS GPA)* is the leave-own-out mean of the high school GPA, standardized within cohorts. *Academic achievement index* is the standardized inverse-covariance weighted average of the other three outcomes. *Accumulated credits* are the accumulated course credits at the end of the respective semester. *Persistence* indicates if a student is still enrolled in their initial study program at the end of the respective semester. *Standardized GPA* is the GPA at the end of the respective semester, standardized within cohorts. The GPA is based on passing grades only, i.e., it is unobserved for students who have not passed any courses. *Controls:* enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the standardized high school GPA, the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.16: Effect of peer ability on academic achievements by isolation probability – Business Administration, robustness to different prediction model specifications

Semester	(1) First	(2) Second	(3) Third	(4) Fourth	(5) Fifth	(6) Sixth
a) *Prediction with linear terms for continuous variables*						
Effect of Std(Peer HS GPA) for low Pr(isolated)	0.112***	0.108***	0.090**	0.072*	0.077**	0.080**
	(0.031)	(0.035)	(0.036)	(0.037)	(0.036)	(0.036)
Effect of Std(Peer HS GPA) for high Pr(isolated)	0.029	0.054	0.035	0.026	0.027	0.034
	(0.037)	(0.037)	(0.039)	(0.037)	(0.038)	(0.043)
Low Pr(isolated) - high Pr(isolated)	0.083	0.054	0.055	0.046	0.049	0.046
	(0.055)	(0.057)	(0.058)	(0.058)	(0.060)	(0.060)
b) *Prediction with quadratic terms for continuous variables*						
Effect of Std(Peer HS GPA) for low Pr(isolated)	0.118***	0.116***	0.105***	0.094***	0.097***	0.102***
	(0.028)	(0.031)	(0.033)	(0.032)	(0.030)	(0.035)
Effect of Std(Peer HS GPA) for high Pr(isolated)	0.026	0.049	0.022	0.007	0.008	0.014
	(0.032)	(0.032)	(0.032)	(0.030)	(0.030)	(0.032)
Low Pr(isolated) - high Pr(isolated)	0.092*	0.067	0.084*	0.087*	0.090**	0.089**
	(0.047)	(0.047)	(0.047)	(0.045)	(0.043)	(0.042)
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes
N	1,459	1,459	1,459	1,459	1,459	1,459

Notes: This table presents effects of peer ability by students' probability of having met zero of their study partners during freshman orientation (cf. Table 3). See Table A.14 for the estimated coefficients of the different prediction models. *Std(Peer HS GPA)* is the leave-own-out mean of the high school GPA, standardized within cohorts. *Academic achievement index* is the standardized inverse-covariance weighted average of the standardized accumulated credits, persistence, and the standardized GPA. *Controls:* enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the standardized high school GPA, the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.17: Effect of peer ability on academic achievements by isolation probability – Business Administration, robustness to excluding covid cohort from prediction

Semester	(1) First	(2) Second	(3) Third	(4) Fourth	(5) Fifth	(6) Sixth
a) *Academic achievement index*						
Effect of Std(Peer HS GPA) for low Pr(isolated)	0.119***	0.123***	0.114***	0.096**	0.100***	0.104**
	(0.033)	(0.038)	(0.040)	(0.038)	(0.037)	(0.040)
Effect of Std(Peer HS GPA) for high Pr(isolated)	0.022	0.038	0.010	0.001	0.001	0.008
	(0.032)	(0.031)	(0.031)	(0.031)	(0.030)	(0.031)
Low Pr(isolated) - high Pr(isolated)	0.097*	0.085	0.104*	0.095*	0.099*	0.096*
	(0.052)	(0.054)	(0.055)	(0.054)	(0.052)	(0.051)
N	1,459	1,459	1,459	1,459	1,459	1,459
b) *Accumulated credits*						
Effect of Std(Peer HS GPA) for low Pr(isolated)	1.120***	1.994***	3.148***	4.188***	4.469***	5.106***
	(0.329)	(0.547)	(0.867)	(1.152)	(1.547)	(1.872)
Effect of Std(Peer HS GPA) for high Pr(isolated)	0.520	1.183	1.145	1.089	0.845	0.877
	(0.484)	(0.745)	(1.086)	(1.501)	(1.872)	(2.285)
Low Pr(isolated) - high Pr(isolated)	0.600	0.811	2.003	3.099	3.624	4.229
	(0.591)	(0.945)	(1.530)	(2.119)	(2.711)	(3.312)
N	1,459	1,459	1,459	1,459	1,459	1,459
c) *Persistence*						
Effect of Std(Peer HS GPA) for low Pr(isolated)	0.015*	0.030**	0.031**	0.024	0.026*	0.030*
	(0.008)	(0.014)	(0.015)	(0.014)	(0.015)	(0.017)
Effect of Std(Peer HS GPA) for high Pr(isolated)	0.002	0.014	0.005	0.003	0.005	0.010
	(0.007)	(0.012)	(0.012)	(0.013)	(0.013)	(0.014)
Low Pr(isolated) - high Pr(isolated)	0.012	0.016	0.026	0.020	0.021	0.019
	(0.012)	(0.020)	(0.021)	(0.022)	(0.022)	(0.023)
N	1,459	1,459	1,459	1,459	1,459	1,459
d) *Standardized GPA*						
Effect of Std(Peer HS GPA) for low Pr(isolated)	0.119***	0.081**	0.069*	0.065	0.077**	0.075**
	(0.041)	(0.039)	(0.039)	(0.039)	(0.037)	(0.036)
Effect of Std(Peer HS GPA) for high Pr(isolated)	0.010	0.013	-0.002	-0.004	-0.005	-0.010
	(0.031)	(0.029)	(0.029)	(0.031)	(0.032)	(0.030)
Low Pr(isolated) - high Pr(isolated)	0.108*	0.068	0.071	0.069	0.082	0.085
	(0.058)	(0.055)	(0.056)	(0.056)	(0.054)	(0.051)
N	1,377	1,384	1,386	1,386	1,386	1,386
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes

Notes: This table repeats the approach from Table A.15, but excludes students whose orientation was conducted online because of the Covid-19 pandemic from the survey sample that is used for predicting the isolation probabilities. *Std(Peer HS GPA)* is the leave-own-out mean of the high school GPA, standardized within cohorts. *Academic achievement index* is the standardized inverse-covariance weighted average of the other three outcomes. *Accumulated credits* are the accumulated course credits at the end of the respective semester. *Persistence* indicates if a student is still enrolled in their initial study program at the end of the respective semester. *Standardized GPA* is the GPA at the end of the respective semester, standardized within cohorts. The GPA is based on passing grades only, i.e., it is unobserved for students who have not passed any courses. *Controls:* enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the standardized high school GPA, the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.18: Effect of peer ability on academic achievements by study programs

Semester	(1) First	(2) Second	(3) Third	(4) Fourth	(5) Fifth	(6) Sixth
a) *Academic achievement index*						
Effect of Std(Peer HS GPA) in BuA	0.070***	0.082***	0.063***	0.050**	0.052**	0.058**
	(0.018)	(0.022)	(0.023)	(0.022)	(0.022)	(0.027)
Effect of Std(Peer HS GPA) in IB(&T)	-0.035	-0.023	-0.011	-0.028	-0.031	-0.048
	(0.033)	(0.020)	(0.023)	(0.026)	(0.028)	(0.031)
BuA - IB(&T)	0.106***	0.105***	0.074**	0.078**	0.083**	0.105**
	(0.038)	(0.029)	(0.033)	(0.034)	(0.036)	(0.040)
N	1,899	1,899	1,899	1,899	1,899	1,899
b) *Accumulated credits*						
Effect of Std(Peer HS GPA) in BuA	0.773**	1.594***	2.144***	2.639***	2.673**	2.981**
	(0.357)	(0.518)	(0.692)	(0.912)	(1.133)	(1.394)
Effect of Std(Peer HS GPA) in IB(&T)	0.290	-0.227	-0.268	-1.103	-1.063	-3.358
	(1.373)	(1.713)	(2.240)	(2.890)	(2.987)	(4.355)
BuA - IB(&T)	0.483	1.822	2.412	3.741	3.736	6.339
	(1.408)	(1.768)	(2.311)	(2.993)	(3.165)	(4.520)
N	1,899	1,899	1,899	1,899	1,899	1,899
c) *Persistence*						
Effect of Std(Peer HS GPA) in BuA	0.008*	0.023***	0.018**	0.014*	0.016*	0.021*
	(0.004)	(0.008)	(0.008)	(0.008)	(0.009)	(0.011)
Effect of Std(Peer HS GPA) in IB(&T)	-0.018	-0.020	-0.012	-0.024	-0.030	-0.036
	(0.011)	(0.014)	(0.016)	(0.020)	(0.020)	(0.023)
BuA - IB(&T)	0.026**	0.043***	0.030	0.038*	0.046**	0.057**
	(0.012)	(0.016)	(0.018)	(0.021)	(0.021)	(0.025)
N	1,899	1,899	1,899	1,899	1,899	1,899
d) *Standardized GPA*						
Effect of Std(Peer HS GPA) in BuA	0.067***	0.049**	0.035*	0.031	0.036	0.032
	(0.025)	(0.021)	(0.020)	(0.022)	(0.022)	(0.021)
Effect of Std(Peer HS GPA) in IB(&T)	-0.002	0.012	0.013	0.024	0.029	0.022
	(0.046)	(0.040)	(0.042)	(0.041)	(0.041)	(0.044)
BuA - IB(&T)	0.069	0.037	0.022	0.007	0.006	0.011
	(0.052)	(0.045)	(0.046)	(0.046)	(0.046)	(0.048)
N	1,770	1,787	1,790	1,791	1,791	1,791
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes

Notes: Std(Peer HS GPA) is the leave-own-out mean of the high school GPA, standardized within cohorts and study programs. *Academic achievement index* is the standardized inverse-covariance weighted average of the other three outcomes. *Accumulated credits* are the accumulated course credits at the end of the respective semester. *Persistence* indicates if a student is still enrolled in their initial study program at the end of the respective semester. *Standardized GPA* is the GPA at the end of the respective semester, standardized within cohorts and study programs. The GPA is based on passing grades only, i.e., it is unobserved for students who have not passed any courses. *Controls:* enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the standardized high school GPA, the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.19: Effect of peer ability on academic achievements by study programs – robustness to interacting peer ability with other controls

Semester	(1) First	(2) Second	(3) Third	(4) Fourth	(5) Fifth	(6) Sixth
a) *Academic achievement index*						
Effect of Std(Peer HS GPA) in BuA	0.074***	0.089***	0.071***	0.059***	0.061***	0.069**
	(0.020)	(0.022)	(0.024)	(0.022)	(0.022)	(0.027)
Effect of Std(Peer HS GPA) in IB(&T)	-0.044	-0.034	-0.024	-0.044	-0.047	-0.072**
	(0.038)	(0.028)	(0.028)	(0.030)	(0.032)	(0.033)
BuA - IB(&T)	0.118**	0.123***	0.094**	0.103**	0.108***	0.141***
	(0.047)	(0.039)	(0.040)	(0.039)	(0.040)	(0.046)
N	1,899	1,899	1,899	1,899	1,899	1,899
b) *Accumulated credits*						
Effect of Std(Peer HS GPA) in BuA	0.957***	1.862***	2.605***	3.286***	3.464***	3.970***
	(0.321)	(0.494)	(0.691)	(0.945)	(1.191)	(1.467)
Effect of Std(Peer HS GPA) in IB(&T)	-0.119	-0.792	-1.284	-2.527	-2.834	-5.823
	(1.328)	(1.678)	(2.175)	(2.835)	(2.937)	(4.246)
BuA - IB(&T)	1.076	2.655	3.889*	5.813*	6.299*	9.793**
	(1.367)	(1.756)	(2.290)	(3.009)	(3.240)	(4.505)
N	1,899	1,899	1,899	1,899	1,899	1,899
c) *Persistence*						
Effect of Std(Peer HS GPA) in BuA	0.008*	0.023***	0.020**	0.016**	0.019**	0.024**
	(0.005)	(0.008)	(0.008)	(0.008)	(0.009)	(0.011)
Effect of Std(Peer HS GPA) in IB(&T)	-0.018	-0.022	-0.015	-0.030	-0.036*	-0.045**
	(0.011)	(0.015)	(0.017)	(0.021)	(0.020)	(0.022)
BuA - IB(&T)	0.026**	0.046**	0.034*	0.046**	0.055**	0.069***
	(0.013)	(0.018)	(0.019)	(0.022)	(0.021)	(0.024)
N	1,899	1,899	1,899	1,899	1,899	1,899
d) *Standardized GPA*						
Effect of Std(Peer HS GPA) in BuA	0.072***	0.056**	0.041*	0.039	0.045*	0.043*
	(0.026)	(0.023)	(0.022)	(0.024)	(0.023)	(0.023)
Effect of Std(Peer HS GPA) in IB(&T)	-0.001	0.003	0.007	0.013	0.015	0.003
	(0.049)	(0.044)	(0.043)	(0.044)	(0.044)	(0.046)
BuA - IB(&T)	0.073	0.053	0.034	0.026	0.029	0.040
	(0.061)	(0.052)	(0.051)	(0.051)	(0.051)	(0.053)
N	1,770	1,787	1,790	1,791	1,791	1,791
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes
Std(Peer HS GPA)*controls	yes	yes	yes	yes	yes	yes

Notes: Std(Peer HS GPA) is the leave-own-out mean of the high school GPA, standardized within cohorts and study programs. *Academic achievement index* is the standardized inverse-covariance weighted average of the other three outcomes. *Accumulated credits* are the accumulated course credits at the end of the respective semester. *Persistence* indicates if a student is still enrolled in their initial study program at the end of the respective semester. *Standardized GPA* is the GPA at the end of the respective semester, standardized within cohorts and study programs. The GPA is based on passing grades only, i.e., it is unobserved for students who have not passed any courses. *Controls:* enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the standardized high school GPA, the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A.20: Student background characteristics by study program and Int. Bus. (& Tech.) probability

	Business Administration		*Int. Bus. (& Tech.)*	p-value	p-value
	Low Pr(IB(&T))	High Pr(IB(&T))		(1) vs (3)	(2) vs (3)
	(1)	(2)	(3)	(4)	(5)
IB(&T) probability	0.100	0.277	0.375	0.000	0.000
Woman	0.637	0.444	0.500	0.000	0.061
Non-German citizen	0.052	0.126	0.218	0.000	0.000
Age	22.492	21.374	21.230	0.000	0.388
High school GPA	2.272	2.713	2.891	0.000	0.000
Time since HS degree	2.229	1.750	1.676	0.001	0.542
HS degree Abitur	0.175	0.696	0.698	0.000	0.963
HS degree local	0.345	0.272	0.241	0.000	0.241
HS degree other state	0.027	0.121	0.123	0.000	0.925
HS degree foreign	0.001	0.082	0.200	0.000	0.000
First university	0.705	0.738	0.770	0.014	0.209
N	731	728	440		

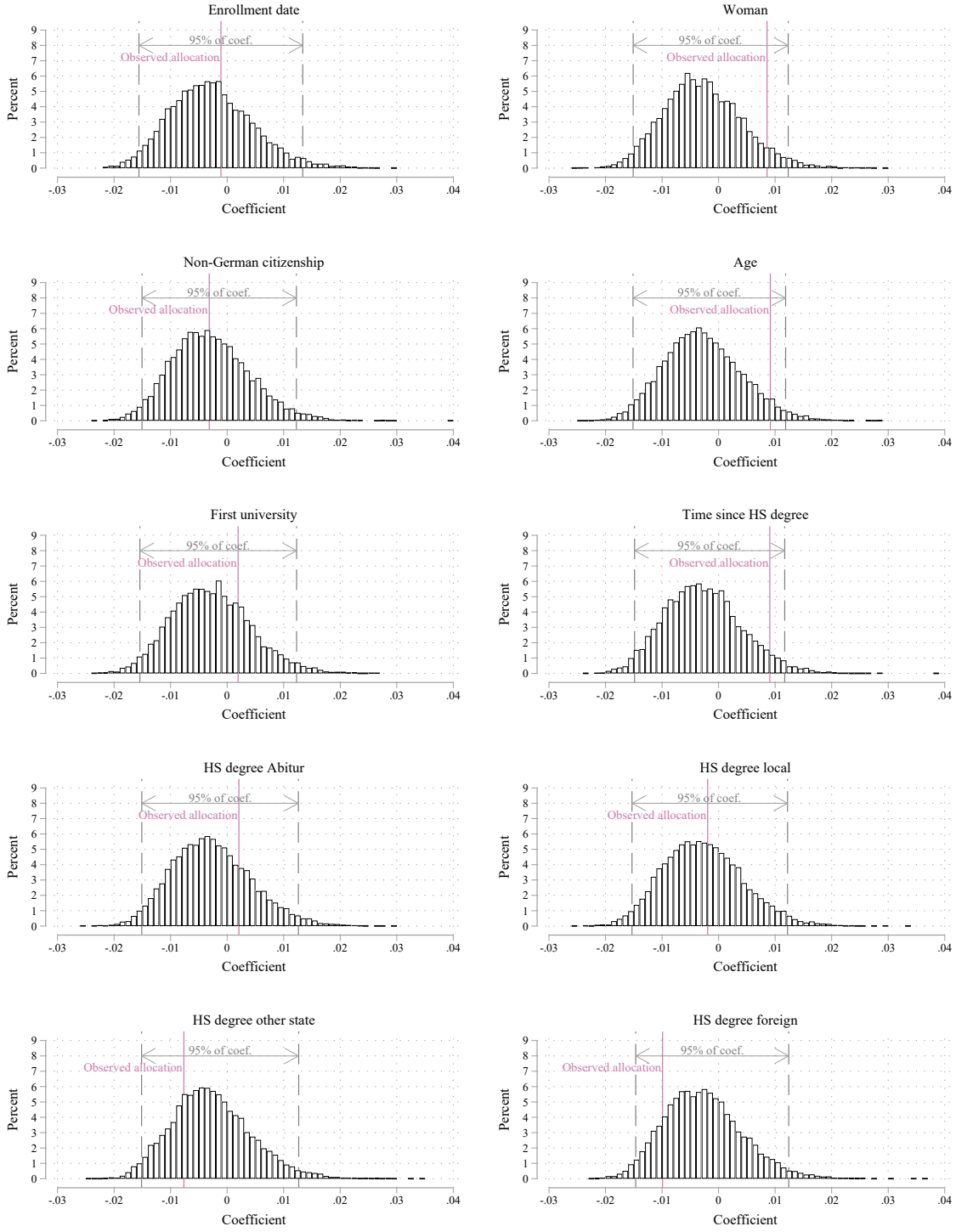
Note: Students in BuA are grouped into low and high IB(&T) probability based on a median split of the predicted probabilities that are derived from a logistic regression of being enrolled in IB(&T) on all background characteristics (cubic terms for the continuous variables are used). See Table A.1 for definitions of all other variables. The p-values reported in Columns (4) and (5) are from two-sample tests on the equality of proportions and means.

Table A.21: Effect of peer ability on academic achievements by probability to be enrolled in International Business (& Technology) – Business Administration

Semester	(1) First	(2) Second	(3) Third	(4) Fourth	(5) Fifth	(6) Sixth
a) *Academic achievement index*						
Effect of Std(Peer HS GPA) for low Pr(IB(&T))	0.034	0.053	0.034	0.020	0.023	0.033
	(0.032)	(0.033)	(0.033)	(0.034)	(0.032)	(0.033)
Effect of Std(Peer HS GPA) for high Pr(IB(&T))	0.104**	0.105**	0.087**	0.074*	0.076*	0.076*
	(0.043)	(0.042)	(0.043)	(0.041)	(0.040)	(0.044)
Low Pr(IB(&T)) - high Pr(IB(&T))	-0.069	-0.052	-0.053	-0.054	-0.053	-0.043
	(0.065)	(0.062)	(0.062)	(0.061)	(0.057)	(0.058)
N	1,459	1,459	1,459	1,459	1,459	1,459
b) *Accumulated credits*						
Effect of Std(Peer HS GPA) for low Pr(IB(&T))	0.556	1.291*	1.669*	2.159*	1.859	2.088
	(0.461)	(0.747)	(0.922)	(1.226)	(1.578)	(1.955)
Effect of Std(Peer HS GPA) for high Pr(IB(&T))	1.065***	1.859***	2.578**	3.037**	3.377*	3.843
	(0.358)	(0.643)	(1.061)	(1.513)	(1.976)	(2.423)
Low Pr(IB(&T)) - high Pr(IB(&T))	-0.509	-0.569	-0.909	-0.878	-1.519	-1.755
	(0.580)	(1.059)	(1.556)	(2.204)	(2.869)	(3.557)
N	1,459	1,459	1,459	1,459	1,459	1,459
c) *Persistence*						
Effect of Std(Peer HS GPA) for low Pr(IB(&T))	0.002	0.016	0.012	0.006	0.010	0.019
	(0.008)	(0.012)	(0.013)	(0.014)	(0.014)	(0.015)
Effect of Std(Peer HS GPA) for high Pr(IB(&T))	0.014	0.028*	0.023	0.021	0.021	0.021
	(0.009)	(0.015)	(0.015)	(0.014)	(0.015)	(0.017)
Low Pr(IB(&T)) - high Pr(IB(&T))	-0.012	-0.012	-0.010	-0.014	-0.011	-0.002
	(0.014)	(0.022)	(0.023)	(0.023)	(0.023)	(0.024)
N	1,459	1,459	1,459	1,459	1,459	1,459
d) *Standardized GPA*						
Effect of Std(Peer HS GPA) for low Pr(IB(&T))	0.063*	0.038	0.022	0.020	0.021	0.014
	(0.036)	(0.033)	(0.029)	(0.031)	(0.030)	(0.029)
Effect of Std(Peer HS GPA) for high Pr(IB(&T))	0.062**	0.054*	0.042	0.038	0.048	0.048
	(0.026)	(0.030)	(0.033)	(0.035)	(0.033)	(0.034)
Low Pr(IB(&T)) - high Pr(IB(&T))	0.001	-0.016	-0.019	-0.018	-0.027	-0.034
	(0.042)	(0.047)	(0.046)	(0.049)	(0.046)	(0.047)
N	1,377	1,384	1,386	1,386	1,386	1,386
Cohort FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes

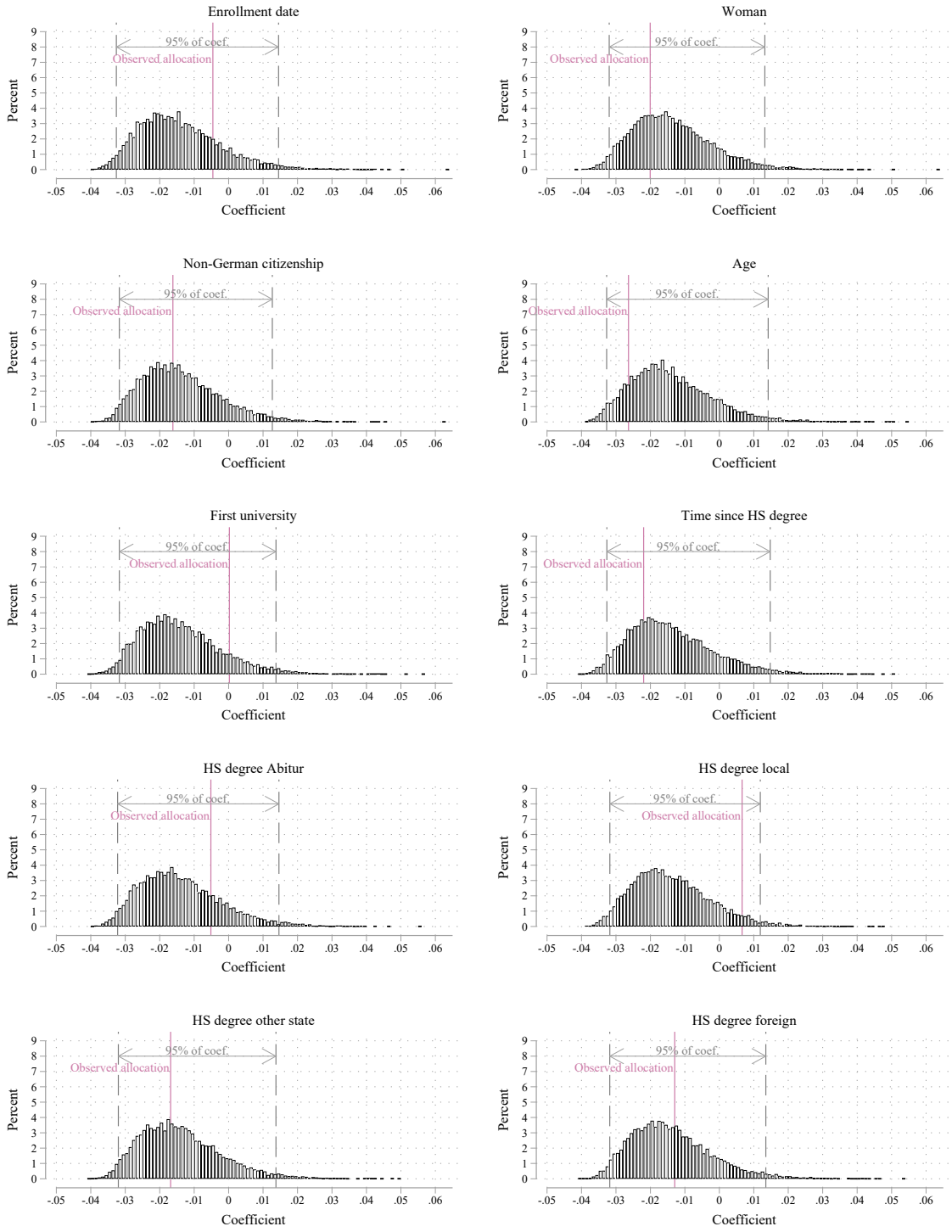
Notes: This table presents effects of peer ability by Business Administration students' probability to be enrolled in International Business (& Technology). *Std(Peer HS GPA)* is the leave-own-out mean of the high school GPA, standardized within cohorts. *Academic achievement index* is the standardized inverse-covariance weighted average of the other three outcomes. *Accumulated credits* are the accumulated course credits at the end of the respective semester. *Persistence* indicates if a student is still enrolled in their initial study program at the end of the respective semester. *Standardized GPA* is the GPA at the end of the respective semester, inverse scaled and standardized within study programs. The GPA is based on passing grades only and, on the original scale, the best passing grade is 1.0 and the worst passing grade is 4.0. *Controls:* enrollment date imputed, first university, woman, HS degree Abitur, HS degree local, HS degree other state, HS degree foreign, and non-German citizen dummies as well as the standardized high school GPA, the enrollment date, the age at the beginning of the first semester, the time between the HS degree and the beginning of the first semester, the share in each group that could not be matched, and the original group size. Robust standard errors clustered at the freshman orientation group level in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Figure A.1: Regression of peer characteristics on students' own characteristics – permutation based test, Business Administration



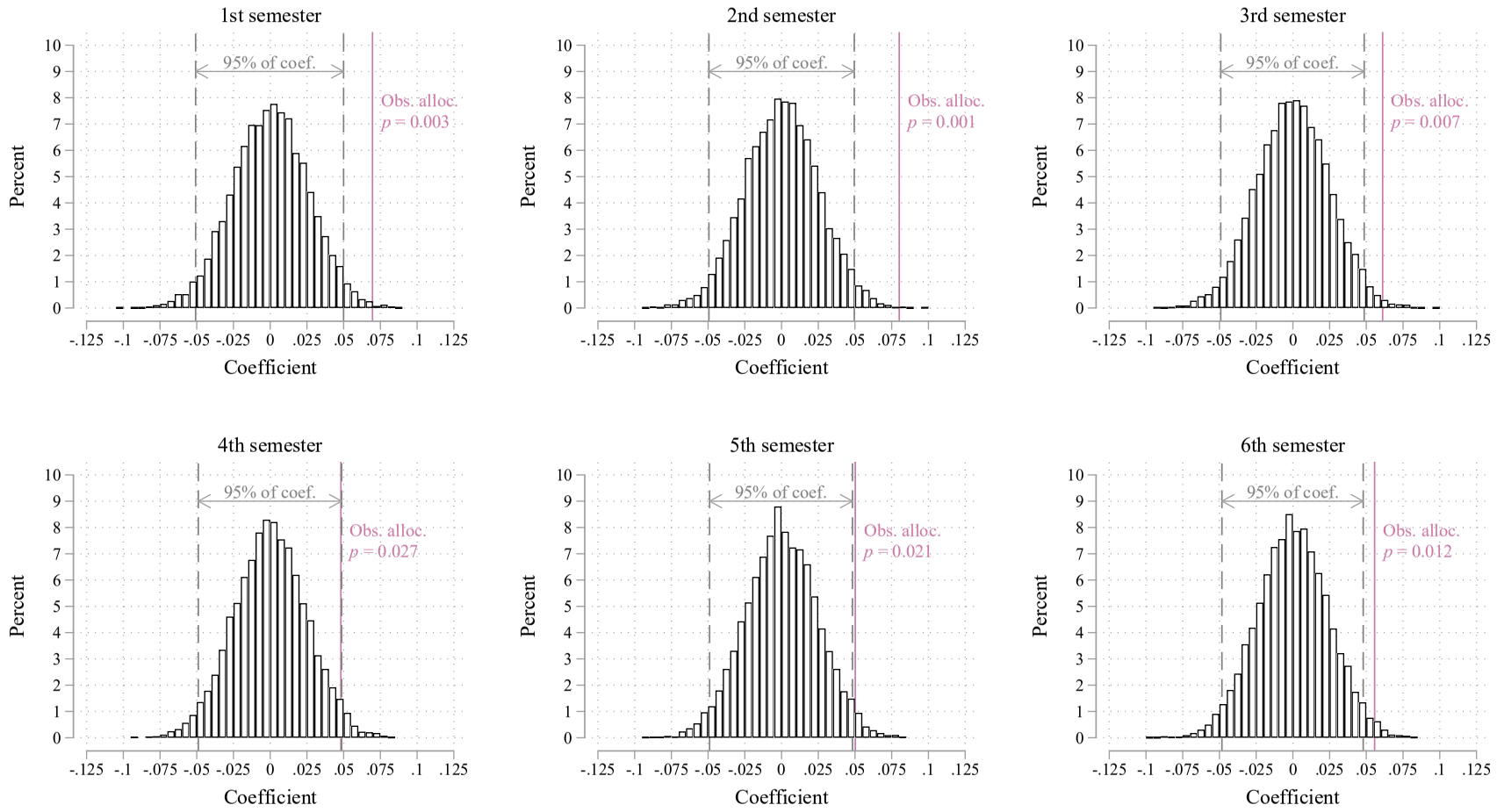
Notes: The solid line in all panels in this figure shows the estimated coefficient from regressing the respective peer characteristic on students' own characteristic controlling for cohort FE based on the observed group allocation. In addition, each panel plots the distribution of the estimated coefficients under the null of random assignment within selection pools based on 10,000 re-randomizations that keep the selection pools as well as group sizes fixed.

Figure A.2: Regression of peer characteristics on students' own characteristics – permutation based test, International Business (& Technology)



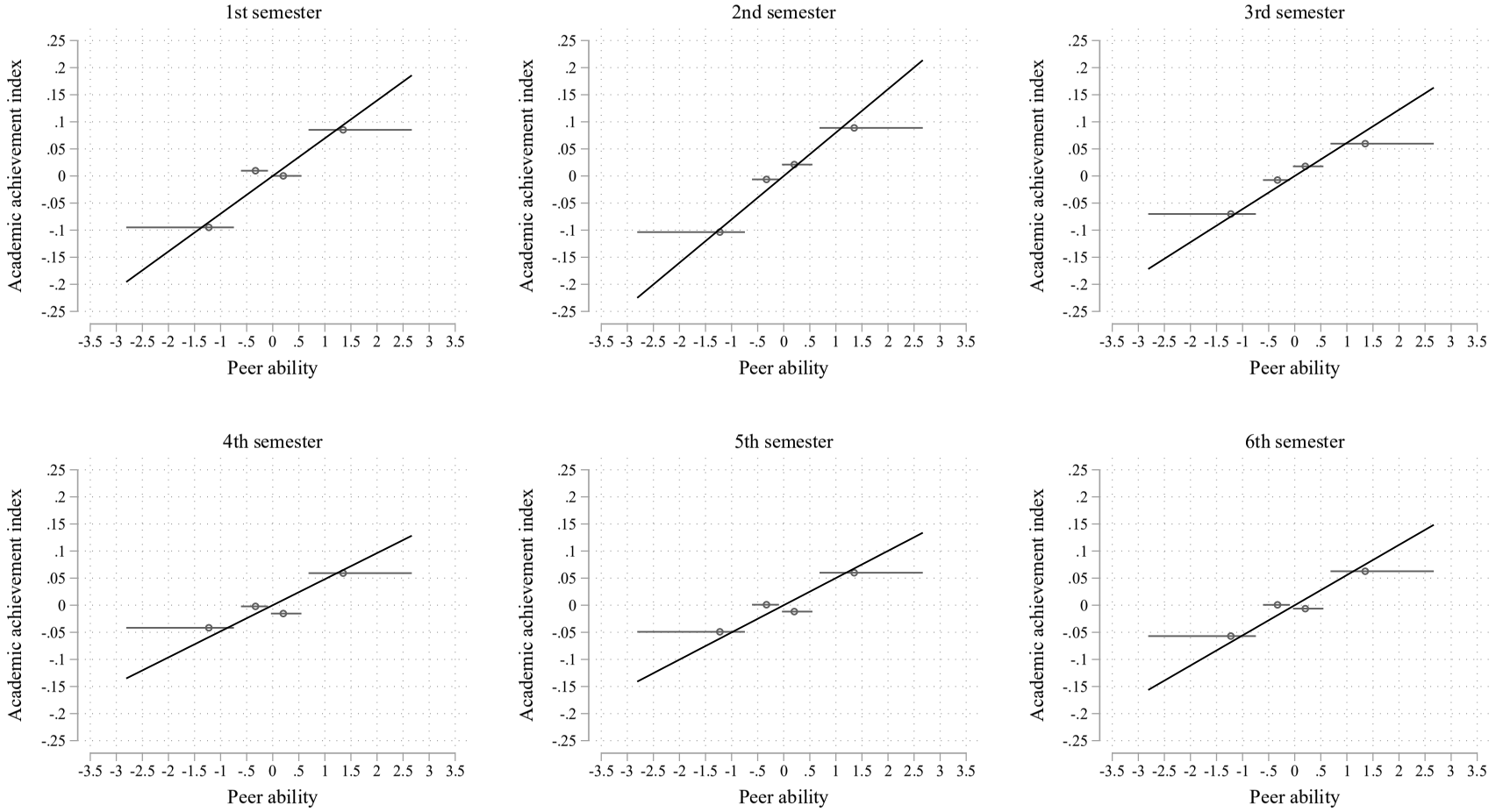
Notes: The solid line in all panels in this figure shows the estimated coefficient from regressing the respective peer characteristic on students' own characteristic controlling for cohort by study program FE based on the observed group allocation. In addition, each panel plots the distribution of the estimated coefficients under the null of random assignment within selection pools based on 10,000 re-randomizations that keep the selection pools as well as group sizes fixed.

Figure A.3: Effect of peer ability on academic achievement index – permutation based inference



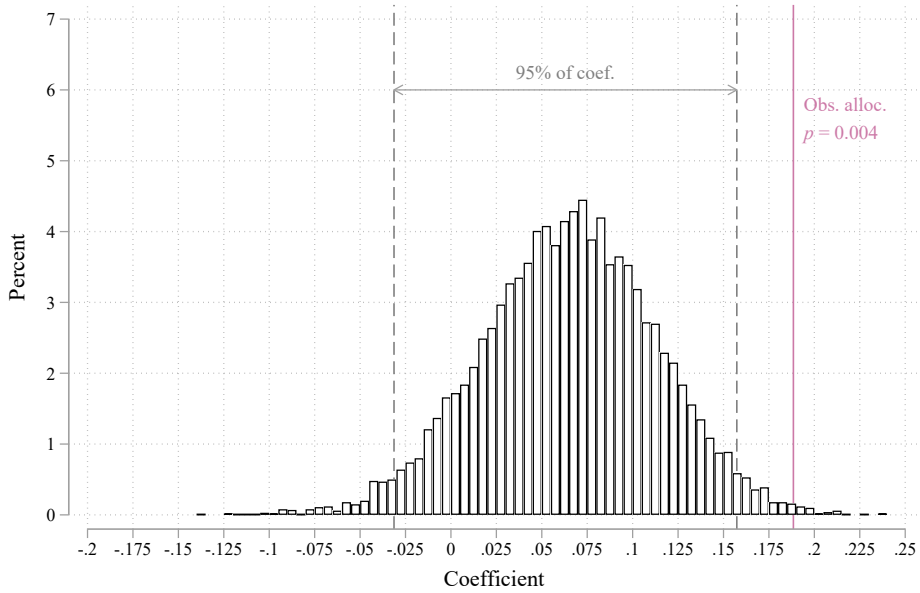
Notes: The solid line in all panels in this figure shows the estimated effect of peer ability as reported in Figure 5 and Panel a) of Table A.7, i.e., for the observed group allocation. In addition, each panel plots the distribution of the estimated coefficients of peer ability under the null of random assignment within selection pools based on 10,000 re-randomizations that keep the selection pools as well as group sizes fixed. The reported p-values denote the respective proportion of coefficients from the re-randomizations that are larger than the observed effect of peer ability.

Figure A.4: Binned scatterplots of the effect of peer ability on academic achievement index – Business Administration



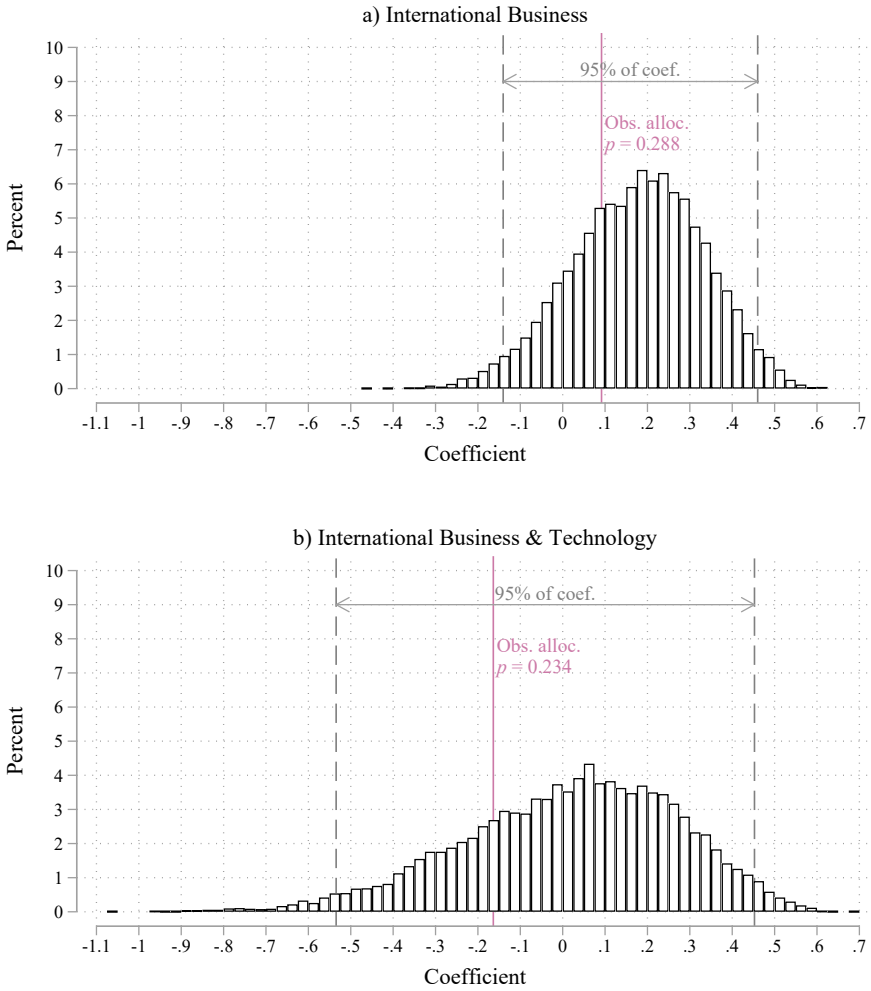
Notes: These plots visualize the regression results reported in Figure 5 and Panel a) of Table A.7 using the Stata *binsreg* command (Cattaneo et al., 2023, forthcoming) and four quantile-spaced bins.

Figure A.5: Association between students' specialization choices – Business Administration



Notes: The solid line in this figure shows the estimated association between students' and their peers' specialization choice as reported in Column (2) of Table 4, i.e. for the observed group allocation. In addition, the figure plots the distribution of the estimated coefficients of peer specialization choice under the null of random assignment within selection pools based on 10,000 re-randomizations that keep the selection pools as well as group sizes fixed. The reported p-values denote the respective proportion of coefficients from the re-randomizations that are larger than the observed association between students' and their peers' specialization choice.

Figure A.6: Association between students' language/minor choices – IB(&T)



Notes: The solid line in both panels in this figure shows the estimated association between students' and their peers' language (IB) and minor (IBT) choice as reported in Columns (2) and (4) of Table 5, i.e. for the observed group allocations. In addition, both panels plot the distribution of the estimated coefficients of peer language/minor choice under the null of random assignment within selection pools based on 10,000 re-randomizations that keep the selection pools as well as group sizes fixed. The reported p-values denote the respective proportion of coefficients from the re-randomizations that are smaller than the observed association between students' and their peers' language/minor choice.