Applying Sequence Analysis in Higher Education Research: A Life Course Perspective on Study Trajectories

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Not only enrollment and retention: comparing the study trajectories at German universities and Universities of Applied Sciences

While there is an existing scholarly debate on whether less research-oriented universities disrupt or enable higher education success, we know less about students' actual study patterns beyond static indicators, such as completion or dropout. To address this gap, this article analyzes the study trajectories of bachelor's students at German universities and Universities of Applied Sciences (UASs). As a methodological contribution, study trajectories are reconstructed using sequence analysis, thereby providing a holistic perspective over a
period of more than five years using data from the National Educational Panel Study (NEPS) – a panel study that follows first-time higher education students throughout their higher education career. This study finds that UAS students are more likely than university students to experience linear study trajectories, whereas university students more often experience discontinuous trajectories. This finding remains robust against differences in individual student characteristics, including access pathways. Thus, this study concludes that studying at a UAS safeguards against engaging in detours or long and winding study trajectories.

Keywords: Universities of Applied Sciences; higher education pathways; study trajectories; enrollment patterns; sequence analysis; NEPS; university types

Introduction

In the course of educational expansion, the objectives of higher education (HE) have become more diverse, oscillating between open-access institutions and highly selective universities and between institutions with research and vocational orientations. This also applies to Germany, where the rising demand for HE has been partly absorbed by a long-since-established and less research-oriented HE sector – the Universities of Applied Sciences (UASs). In the realm of more recent developments and reforms, UASs have improved their position from being situated vertically below traditional universities toward being structurally different, yet horizontally equal (Witte, van der Wende, and Huisman 2008; de Weert 2015). However, while the implications of these policy changes have received much attention, their effects on students and their study patterns have not been similarly acknowledged. Previous descriptive studies indicate

lower dropout rates and shorter study durations at UASs (see Tables 1 and 2). Recent research has also investigated major switches and dropouts in German HE in more detail (Marczuk 2022; Meyer, Leuze, and Strauss 2022). However, the relevance of higher education institution (HEI) types remains an undermined theme. Thus, to address these gaps, this study analyzes study trajectories in German HE and assesses whether the study trajectories of university and UAS students differ despite the observed **t**endencies toward structural convergence. In the second step, the study analyzes **w**hether these differences are attributable to the HEI type, or rather to systematic differences in the student population. In the final step, the study tests whether the study trajectories systematically differ by social background and depending on the type of HEI in which they enroll.

The study trajectories of a 2010 cohort of students seeking bachelor's degrees were reconstructed using the National Educational Panel Study (NEPS), a high-quality large-scale panel data set. Identifying patterns in temporal data using sequence analysis offers a holistic perspective on study trajectories over a period of more than five years, as opposed to the more limited perspective obtained by investigating singular events such as dropouts, including study interruptions, switching majors, discontinuation, and (timely) degree completion (Haas 2022). Despite the few remaining formal differences in degree course organization, differences in study trajectories by HEI type were detected. Using multinomial logistic regression, these differences remain robust against differences in student characteristics. In fact, although UAS students originate less often from advantaged social backgrounds and often follow more nontraditional pathways into HE, their study trajectories are, on average, more linear, including fewer dropouts and fewer major switches. Thus, it is concluded that studying at a UAS appears to function as a safeguard against longer and more winding study trajectories.

Theoretical considerations

From functional differentiation to formal convergence

There are two main HEI types in the federally organized, almost fee-free and state-dependent German HE system: the universities and the UASs.[i] The universities are usually larger, possess a more international character, and offer a comprehensive range of subjects. In contrast, UASs often specialize in a limited range of subjects, such as social work or engineering (Kyvik and Lepori 2010).

This segmentation goes back to rising enrollments from the 1960s onwards. HE expansion gained momentum, and despite the founding of new universities, the traditional universities, established in the Humboldtian tradition of combining research and teaching, came under pressure. Thus, UASs were established to provide more applied HE degrees. The universities and UASs differed in three ways: by offering different degrees (UAS study programs were shorter and the returns were lower); by differing in their focus on imparted knowledge (universities were more theoretical, and UASs were more vocational); and by differing in their missions (universities stressed research and teaching, while the UASs prioritized teaching).

Although the share of UAS students has risen over time, UASs have absorbed significantly fewer students compared to similar institutions in other HE systems (see Figure 1; Kyvik and Lepori 2010). Furthermore, the former distinctive features of HEI types have slowly faded away—a process in which the relative positions of universities and UAS converged from vertical to horizontal. Whereas UASs developed more interest in research, universities shifted their focus from liberal education toward developing employable skills (de Weert 2015; Neave 1979; Witte, van der Wende, and Huisman 2008). Furthermore, the vertical differentiation (‘profile-building’) of the rather homogeneous university landscape began to be actively

promoted by political measures—for example, through the excellence initiative—although the differences in prestige remain low in comparison to other countries (Kehm 2012).

The development toward conversion culminated in major reforms during the first decade of the twenty-first century, first and foremost through the Bologna process, but also through the accreditation of study programs and New Public Management (Goglio and Regini 2017). Apart from fields such as law or medicine, a sequential degree structure consisting of the bachelor as the first-cycle degree and the master as the second-cycle degree was introduced in all subjects, thereby harmonizing degrees across universities and UASs.[ii] A standard study duration—a predefined 'ideal' study duration—has been defined. Six-semester (i.e., three-year) bachelor's programs were almost universal at the universities in the early phase of the Bologna process, whereas seven- or eight-semester programs were common in the UASs.

What are the implications of these developments for students at universities and UASs? In general, the HEI type and the respective study program strongly affect how students proceed through HE, for example by defining ideal study pathways or sequential course orders. Due to the modularization of study programs, they have become more structured. This shift constituted a major change for universities compared to UASs. Before the reforms, universities granted a high degree of autonomy to their students, whereas the learning progress is now continuously evaluated. On the one hand, these changes have been criticized because they discourage students from becoming independent learners. On the other hand, these changes have been linked with high hopes of solving long-recognized problems, including decreasing late dropouts and delaying degree completion (Brändle 2016; Mause 2013). In fact, the dropout rates across HEI types have approximated to each other, although the factors to which this development can be attributed remain unclear (see Table 1).

To sum up, the relationship between UASs and universities and the relative position of UASs in the German HE system has changed over time from once being considered inferior to now occupying a horizontal and, in some respects, equal position with universities while still

differing in their orientation (applied compared to research oriented). Given the few remaining differences in formal study regulations between universities and UASs, it is hypothesized that the study trajectories of a post-Bologna student cohort at universities and UASs *do not differ* (*Hypothesis 1*).

Persistent differences in institutional self-understanding

Having said that, the implementation of the reforms was not without its problems, particularly at universities (Brändle 2016; Mause 2013). At the core of criticisms of the reforms was that the standardization and accreditation of study programs ran counter to the universities' self-conception and Humboldtian ideals. The universities perceived themselves as institutions that fostered free autonomous thinking and the exploration of personal interests; thus, the modularization of curricula, temporal compression, sequential course orders, and a shift toward skills-based instruction clashed with the holistic understanding of *Bildung* (Serrano-Velarde and Stensaker 2010). In contrast, this was not so much an issue at the UASs, which had fewer normative self-conceptions. UAS degree courses have always been more structured, allowing fewer individual choices and requiring less independent learning (Vogel 2009). Furthermore, learning takes often place in smaller and permanent groups.

Therefore, it can be assumed that the normative and cultural-cognitive pillars of the university lagged behind its regulative pillar, given that levels of acceptance by the professors and academic staff (and from the students) did not run parallel to the formal changes in how courses of study became organized (Scott 2005). In practice, the academic staff at the universities might have been reluctant to demand that their students stick to a predefined course structure. Consequently, despite the convergence of the formal study context, it is expected that this did not immediately translate into the aligning study trajectories at UASs and universities. In fact, the median study duration at UASs and universities approximated during the early years of reform but drifted apart again, with university students needing taking longer to graduate in

the long run (see Table 2). Thus, in contrast to the abovementioned hypothesis, it could also be hypothesized that the study trajectories of university and UAS students in post-Bologna student cohort *differ* in that the study trajectories of university students are less linear than the trajectories of UAS students; that is, they tend to experience more interruptions, major switches, delayed degree completion, and dropouts, whereas UAS students more frequently stick to the predefined course structure (*Hypothesis 2*).

The student perspective: differences in student populations and students' preferences

The previous section argues that differences between HEI types persist despite formal conversion. Another explanation is the systematic differences in student populations entering specific HEI types, for example, in regard to their socio-demographic background characteristics and differences in their expectations and aspirations. According to the *attraction-selection-attrition* theory, students aim to maximize the congruency between their preferences and the organization's characteristics (Schneider, Goldstein, and Smith 1995). Such perceptions may be based on generalized beliefs that do not reflect the altered study structures that were implemented during the Bologna process. Thus, prospective students may still perceive the university as providing a more holistic, less structured education, and the UAS as having a more skill-oriented, structured approach.

Such differences also result from the strong path dependencies of the German education system, in which pupils are separated into different ability tracks at an early age (usually at age 10). Thus, academic preparation and learning environments in secondary education also differ; consequently, so do pupils' vocational interests and aspirations (Kramer et al. 2011). Only completion of the upper secondary track via the *Gymnasium* enables full access to the university, whereas alternative pathways into HE confer subject-specific or UAS access. However, pathways to HE are known to be socially stratified (Becker and Hecken 2008; Mayer, Müller, and Pollak 2007). Students who enroll in UASs via alternative pathways and who have

completed vocational education and training (VET) might have a clear goal orientation and a well-defined interest in a specific subject. By contrast, students who follow the academic track into HE might be academically well prepared but have a less defined orientation regarding their interest in a specific field of study. Furthermore, less risk-averse students prefer study contexts that allow them to fully develop their interests, irrespective of the timing or sighted study duration. In contrast, more security-oriented students favor applied, structured, and predictable study programs. Thus, especially students from low socioeconomic backgrounds are more likely to approach UASs (Kramer et al. 2011; Schindler and Reimer 2011). Hence, it is hypothesized that systematic differences in study trajectories between UAS and university students (if detected) are to some extent *mediated by students' background characteristics*, given that UAS students may prefer more predictable and linear study pathways, whereas this might apply to a lesser extent to university students, and thus self-select into the respective HE environments (*Hypothesis 3*).

However, this may not apply to all students in a similar way. Given their lack of relevant networks, resources, and information about HE, first-generation students and students from lower socioeconomic backgrounds might face particular obstacles in navigating HE (O'Shea 2016; Yee 2016). Lacking this knowledge may matter more in the HE context, which requires its students to be autonomous in constructing their study trajectories. Given that universities have always expected more individual responsibility, it follows that a student's knowledge of HE would be more relevant at the universities and would result in larger differences in study trajectories according to social background at universities compared to UASs. By contrast, studying at a UAS could be advantageous for students who are less familiar with HE, given the smaller learning groups, less anonymous environment, and more structured learning approach. Furthermore, the cultural barriers for students from lower social background could be greater at universities. Students from lower social backgrounds may feel less comfortable with the degree to which universities embody a long-established research tradition, perhaps as a result

of an unfamiliarity with certain cultural codes. Taken together, students from lower social backgrounds might be more at ease in and adapt better to the UAS environment than the university environment. Thus, it is hypothesized that *students from low social backgrounds are less likely to follow a linear study trajectory at universities than they are at UAS* (*Hypothesis 4*).

In sum, the gap between universities and UASs has narrowed in regard to their formal study regulations in recent decades. Following this line of argument, study trajectories may not differ greatly by HEI type. On the other hand, path dependencies within the education system and enduring differences in the perceptions of universities and UASs might lead to persistent differences in study trajectories, despite the described tendencies of formal conversion. Furthermore, given that UASs might still provide a more structured study context than universities, it is hypothesized that this enables more linear study trajectories for all students, but particularly for students of low social background.

Data, methods, and research strategy

Data

The analysis uses the student cohort from the NEPS, specifically a cohort of students enrolling in German HE for the first time in 2010 (Blossfeld, von Maurice, and Schneider 2011). The survey was based on a stratified, clustered sampling design. As in other panel surveys, attrition was high (see Table 3).[iii]

Reconstruction of trajectories and sequence analysis

Sequence analysis identifies patterns in time-ordered data. The survey respondents were regularly asked about their educational pathways and current and completed education. This information was prepared (excluding non-HE activities and double enrollments) and transformed into monthly enrollment patterns; that is, for each student, a study trajectory was

reconstructed up to the month of graduation or, alternatively, for the period of September/October 2010 to February 2016.

Each month was assigned one of the following enrollment states:

(1) BA Studies—Enrolled in a bachelor's degree program and *graduating* from it (default state)

(2) BA Studies, Not Completed—Enrolled in the bachelor's degree program course for which they *initially enrolled* and having *not* (*yet*) *completed* it (either due to dropping out or remaining enrolled as of February 2016)

(3) Second BA Studies, Not Completed—Enrolled in a *different degree program* than the one in which they initially enrolled and having *not* (*yet*) *completed* it

(4) >Second BA Studies, Not Completed—Enrolled in a *different degree program* than the one in which they initially enrolled and having *not* (*yet*) *completed* it[iv]

(5) Study Interruptions

Enrollment states 2 to 4 are consecutive; that is, state 4 can only be experienced if states 2 and 3 have been experienced prior to that. The trajectories were compared using optimal matching (Cornwell 2015). Next, a cluster analysis using Ward's linkage method was conducted, yielding an optimal solution of five trajectory clusters.

Operationalization of independent variables

Social background is operationalized as the parents' highest level of education (based on the Comparative Analysis of Social Mobility in Industrial Nations (CASMIN) scheme) collapsed into three categories, keeping the highest level of education. A low level of education means not higher than a middle secondary schooling degree, with no VET. A middle level of education

includes all qualifications above the lower category, apart from HE. A high level includes all HE degrees. Academic achievement is based on the final secondary school examination grade point average (GPA). A pre-HE pathways variable combines whether a student has completed VET prior to enrolling in HE—a pathway quite common in the German case—and the type of HE entrance qualification obtained, which distinguishes traditional pathways via upper secondary schooling (*Allgemeine Hochschulreife*) from alternative access qualifications (*Fachhochschulreife* or *fachgebundene Hochschulreife*).

Table 4 provides an overview of the covariates and illustrates the differences in student characteristics at UASs compared to universities.[v] Observations were excluded listwise if they concerned less than 10 cases per covariate. For categorical variables with higher incidences of unit nonresponse (e.g., GPA, pre-HE pathway, parents' education), missing information was recoded into a distinct missing value category to keep these cases in the sample.

Analytic strategy

Since the dependent variable (study trajectories) is a multicategorical variable, multinomial logistic regressions were used. The analytic strategy was as follows: first, differences in study trajectories between UASs and universities were assessed according to a baseline model (M1); subsequently, more covariates were added to the model (M2); finally, the last model (M3) included the same predictors as the second model, but the coefficients were based on the inverse probability of treatment weighting (IPTW) for studying at UASs. The rationale behind this approach was to rule out systematic differences in student populations as the result of selection effects. This was achieved by weighting the university student population to render it similar to the UAS students in terms of social background, gender, migration background, interests, major, age, achievement, and prior educational pathway. In addition, two items from the Interest Inventory Life-Span Scale based on Holland's (1997) model of vocational choices were used.

Thus, M3 enables a more accurate assessment of the 'pure' institution effect net of differences in student populations.

All models controlled for the oversampling of students in teaching degrees. As logit coefficients are difficult to interpret beyond effect direction, average marginal effects—marginal changes in the outcome given a discrete change of the dependent variable—were displayed.[vi] Finally, the actual predefined standard study duration was unknown. This complicated the interpretation of differences in study duration beyond the general notion that university bachelor's programs usually take three years to complete, while the outlined program duration at the UASs is often longer and varies (Wissenschaftsrat 2010). Hence, the two linear trajectory clusters (Clusters 1 and 2) were combined for the purpose of multinomial logistic regression models.

Results

Descriptive results of the sequence analysis: five trajectory clusters

The cluster analysis revealed five clusters as the optimal cluster solution.[vii] Of the students sampled, 78.9% obtained a bachelor's degree distributed over three trajectory clusters (see Figure 2 and Table 5). The first two clusters comprised students who followed linear trajectories: they remained in the bachelor's program in which they initially enrolled and successfully completed their studies. Of these students, about a quarter (27.2%) completed their program within three years (Cluster 1), while 40.8% finished the bachelor's degree after 3.5 years or more (Cluster 2). Almost 11% of the sample followed the switch trajectory: students switched their major, most after their first year in HE, and completed their degree course.

Approximately one-fifth (21.1%) of all students had not (yet) obtained a bachelor's degree after more than five years (Clusters 4 and 5). Cluster 4 (10.2%) comprised students who remained enrolled in their initial degree course for the entire observation period or dropped out at a very late stage. Cluster 5 (10.9%) comprises early dropout trajectories and more complex

trajectories—those who switched their major several times or failed to complete their degree and reenrolled for a different major after an interruption.

By far, a long linear trajectory was the most common UAS trajectory, followed by short linear trajectories. Together, these accounted for up to 75.7% of the linear trajectories for UASs (see Table 5). In contrast, the share of linear trajectories was much lower for universities (65.2%). Even when adding switch trajectories, the share of degree-completed trajectories was higher for UASs compared to universities (81.6% compared to 77.8%, respectively). Regarding the not (yet) completed trajectories, the share of complex/early dropout trajectories (Cluster 5) did not differ greatly between UASs and universities (10.4% and 11.2%, respectively), whereas the share of students in Cluster 4 (having not yet completed or having dropped out late) was lower at UASs than at universities (8.1% and 11.0%, respectively).

Figure 3 demonstrates how these trajectories were distributed across HEI types and fields of study and shows that there were differences by discipline, that these differences were in line with the overall differences between UASs and universities, and that these differences were larger in the social sciences and the humanities compared to the sciences fields.

Multivariate analysis predicting trajectory types

Table 6 displays the results of the multinomial logistic regression analysis. Three models are displayed. The first is a baseline model (M1), which includes the HEI types and control variables. The second model includes individual-level predictors. The last model included identical predictors using the reweighted sample.

Model 1 mirrors the descriptive findings of Table 5: UAS students have a 10 percentage point higher chance of following a linear trajectory (Clusters 1 and 2), a 6 percentage point lower chance of following a switch trajectory (Cluster 3), and a 3 percentage point lower chance of following a not completed/late dropout trajectory (Cluster 4). The difference between UAS and university students regarding the complex cluster (Cluster 5) was negligible and insignificant.

Regarding the two opposing hypotheses on study trajectory differences by HEI type (*Hypotheses 1* and *2*), it is concluded that the study trajectories of a post-Bologna student cohort exhibit differences beyond those related to study duration because the study trajectories of UAS students are more frequently linear compared to those of university students.

Models 2 and 3 added individual-level covariates. Interestingly, the positive UAS effect of Cluster 1 and the negative effects of Clusters 4 and 5 became larger (while remaining almost unchanged for Cluster 3), which indicates that studying at a UAS seems to mitigate some of the (unfavorable) effects of student characteristics on study trajectories. Thus, contrary to the theoretical expectations (*Hypothesis 3*), it is not that student (self-)selection explains the differences in study trajectories by HEI type but the opposite. Among the student attributes, academic achievement is in particular a strong predictor in that students with a secondary school GPA equal to 'satisfactory' or 'sufficient' have a 28 percentage point lower chance of following a linear trajectory compared to students with GPAs equal to 'very good' or 'excellent'. Furthermore, students' pre-HE pathways strongly impact their study trajectories.

The negligible difference in coefficients between Models 2 and 3 provides further evidence that student (self-)selection into specific HEI types and related differences in student bodies can be ruled out as a major explanation for the differences in study trajectories. Consequently, the robustness of the HEI effect suggests that the study trajectories of UAS and university students differ not due to student populations but rather due to factors related to the HE context.

Based on the argument that UASs provide a more structured, less anonymized study context, *Hypothesis 4* suggested that low social background students at UASs might be more likely to follow linear trajectories compared to low social background students at universities. Figure 4 depicts the average predicted margins according to the students' social backgrounds and HEI type. The HEI difference was significant across all cluster and social background groups. Furthermore, Figure 4 reveals higher predicted margins of low social background university students for Cluster 4 and Cluster 5 compared to high social background university students,

while such a difference by social background group did not exist among UAS students. However, the confidence intervals are rather large and these differences are not statistically significant. Thus, tentatively, the HEI type seems to make a difference for students of different social backgrounds, although this study cannot confirm that this effect is systematic.

Conclusion and implications

This article emerged from two notions. First, the observed tendencies toward convergence between German universities and UASs raised the question of how far these processes affected students and their study trajectories. Second, compared to other countries, we know little about how students progress through HE in Germany beyond dropout (Haas and Hadjar 2020; Meggiolaro, Giraldo, and Clerici 2017; Tumen, Shulruf, and Hattie 2008). Thus, this study aimed to address this gap by reconstructing the study trajectories of university and UAS students to assess the general differences and differences between different groups of students. It has also been demonstrated that sequence analysis enables the reconstruction of study trajectories as a holistic attainment process (Boylan 2020; Haas 2022; Monaghan 2020).

Five distinct study trajectory types were established. Most notably, this study detected that the study trajectories of UAS and university students differ in that UAS students follow fewer complex trajectories compared to university students. To be more specific, UAS students are less likely to switch their degree course, drop out, or follow more complex trajectories that do not lead to completion after five years or more. One possible explanation for these differences—(self-)selection into HEI types—was ruled out. In fact, the students' background characteristics enhanced this effect. In terms of pre-HE pathways and social backgrounds, nontraditional students are more prone to following complex or discontinuous study trajectories overall, which agrees with findings from Germany and other countries (Childs, Finnie, and Ross 2017; Müller and Schneider 2013; Goldrick-Rab 2006). However, in the specific context of German HE, the UASs seem to function as safeguards against long and winding study trajectories.

Regarding the limitations of this study, it must be stressed that the analysis is based on first-year students who enrolled in 2010—a time when the reforms were almost complete but had perhaps not yet reached a stage of smooth implementation. Thus, this cohort's trajectories might have been affected and complicated by these changes. Another caveat refers to the potential bias that resulted from high participation attrition, a common problem with panel surveys that might have led to the underestimation of discontinuous study trajectories in this study.

Given that sequence analysis works best if the number of states is kept to a minimum, not all enrollment states and degree types can be considered. In particular, students who switch HEIs should be included in future research. Furthermore, students enrolled in long degree programs (e.g., state examination degrees) should be considered, especially given that students from advantageous socioeconomic backgrounds are more likely than others to choose fields such as law or medicine (Schneider et al. 2017).

In addition, this study concentrated on differences at the level of HEIs rather than disciplines and fields of study. However, German HE is stratified across academic disciplines, an aspect of German HE that has not yet been sufficiently addressed, given the broad disciplinary differentiation in this approach. Furthermore, the binary account might underestimate the current tendencies of diversification between universities (Hüther and Krücken 2018). At the same time, the role played by private UASs is becoming vital—a development that seems to agree with students' desires for predictable study trajectories. Many of these private UASs offer flexible and remote study opportunities that are particularly attractive to working students (Autorengruppe Bildungsberichterstattung 2020). Thus, future research might consider a finer-grained categorization of HEI types, for example, by differentiating between public and private universities and considering universities that benefit from the excellence initiative.

The implications of this study raise two notable points. First, the differences in study trajectories can be interpreted as institutional path dependencies remaining despite isomorphic pressure (Meyer et al. 2007). Likely influenced by their ties to VET-offering industries and economic

sectors, UASs have always provided more structured study programs. By contrast, implementing the Bologna reforms was more difficult for the universities. Second, this study has demonstrated that UASs are more effective than universities at retaining and successfully graduating students. In fact, previous research has found that UAS students are more satisfied with the teaching received, they indicate a higher contact rate with their professors, perceive HE as a space that is not too overcrowded, and complain less about issues related to anonymity. No differences in terms of guidance or counseling were detected (Multrus et al. 2017).

As HE attainment is closely linked to equal opportunity and social mobility, these findings are not promising. On average, UAS graduates achieve higher earnings at the beginning of their careers, more often have permanent working contracts, and experience lower unemployment risks (Neugebauer and Weiss 2018). However, in the long term, their labor market prospects are less advantageous than those of university graduates (Fichtl and Piopiunik 2017). Furthermore, a university degree remains a key requirement for accessing executive positions in many sectors. Consequently, ambitious and upwardly mobile students are still diverted from university education due not only to formal barriers and prior path dependencies but also, perhaps, to biased incentive structures. Thus, although the convergence between UASs and universities may signal equal opportunities, this perspective disguises social closure in the long term through students' choices of HEI type.

Table 1. Dropout rates at UAS and universities.

First-year cohort	UAS	University
2006	19%	35%
2010	27%	32%
2014	23%	32%

Source: Heublein, Richter, and Schmelzer (2020). DZHW Dropout study. Note: German students only.

Table 2. Median study duration at UAS and universities.

		UAS	University
2000	Non-consecutive degrees	8.9	12.7
2010	Bachelor	6.6	6.4
2018	Bachelor	7.4	7.8

Source: Autorengruppe Bildungsberichterstattung 2020. Table F4-3web. Note: international students not included.

Table 3. Data preparation steps.

Data preparation steps	**Case loss**	**Remaining observations**
Original sample		**17,909**
Panel attrition		
Participation in wave 10, 12, 13 and/or 15	7,574	10,335
Sample definition (exclusion criteria)		
1) Not bachelor studies; dual studies	3,330	
2) Implausible cases (very short trajectories; first enrolment > 12/2010)	96	
3) Private HE	184	
4) Students that switched into state examinations degrees	188	6,537
Missing values on covariates	156	6,381
Analytic sample		**6,381**

Source: NEPS SC5 15.0.0.

Table 4. Variable description by HEI type.

Variable	Categories	UAS	University	Total
HE sector		0.26	0.74	1.00
Major	Humanities (incl. languages, cultural studies, arts)	0.09	0.32	0.26
	Social sciences (incl. economics and)	0.39	0.23	0.27
	Sciences (incl. technology, engineering, health-related majors)	0.52	0.45	0.47
Gender	Male	0.52	0.43	0.46
	Female	0.48	0.57	0.54
Migration background	None	0.86	0.85	0.85
	1st generation	0.04	0.02	0.03
	2nd generation	0.10	0.12	0.12
Age		22.71 (0.11)	21.46 (0.06)	21.79 (0.05)
Parents' level of education	Low	0.17	0.10	0.12
	Middle	0.48	0.40	0.42
	High	0.35	0.49	0.46
Final sec. school GPA	Excellent/very good	0.08	0.17	0.15
	Good	0.51	0.55	0.54
	Satisfactory/sufficient	0.41	0.28	0.31
Pre-HE pathway	Traditional access / no VET	0.45	0.85	0.75
	Traditional access / VET	0.12	0.10	0.06
	Alternative access / no VET	0.18	0.02	0.10
	Alternative access / VET	0.25	0.03	0.09
Interests	Practical-technical (range: 1-5)	3.11 (0.03)	2.78 (0.01)	2.86 (0.01)
	Intellectual-investigative (range: 1-5)	3.11 (0.02)	3.12 (0.01)	3.12 (0.01)

Source: NEPS SC5 15.0.0. N = 6,381. Note: Mean (std. err.) for continuous variables; proportion for categorical variables. Missing value category not shown.

Table 5. Distribution of trajectory cluster types at UAS and universities.

	Trajectory type	All students	UAS	University
Bachelor degree obtained (78.9%)	Linear short	27.2%	17.1%	30.9%
	Linear long	40.8%	58.6%	34.3%
	Switch	10.8%	5.9%	12.6%
Bachelor degree not (yet) obtained (21.1%)	Not completed/ late dropout	10.2%	8.1%	11.0%
	Complex/early dropout	10.9%	10.4%	11.2%
Total		100.0%	100.0%	100.0%

Source: NEPS SC5 15.0.0. N=6,381.

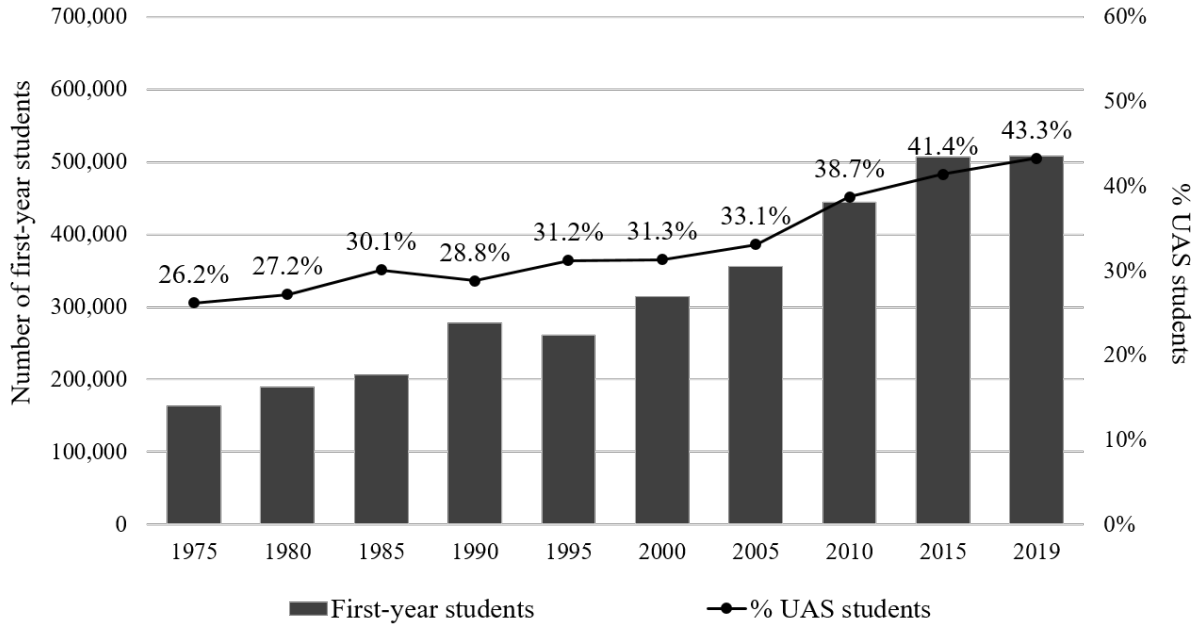
Table 6. Multinomial logistic regression: Average marginal effects.

	Cluster 1/2: Linear trajectory			Cluster 3: Switch trajectory		
	M1	M2	M3	M1	M2	M3
HE type (ref: university)						
UAS	0.10***	0.15***	0.17***	-0.06***	-0.06***	-0.06***
Parents' education (ref: high)						
Low		-0.03	0.01		-0.00	-0.00
Middle		0.01	-0.01		-0.01	0.02
GPA (ref: excellent/very good)						
Good		-0.09***	-0.07**		0.02*	0.01
Satisfactory/sufficient		-0.28***	-0.24***		0.03**	0.02
Pre-HE pathway (ref: trad. access/no VET)						
Traditional access/VET		0.09***	0.07***		-0.03	-0.02
Alternative access/no VET		-0.07*	-0.08***		-0.02	-0.03***
Alternative access/VET		-0.03	-0.03*		0.02	0.04**
Interests						
Practical-technical		-0.01*	-0.04***		-0.00	0.01
Intellectual-investigative		0.00	-0.00		-0.01	-0.01
Major (ref: humanities)						
Social sciences		0.03*	0.02		-0.01	-0.01
Sciences		-0.01	-0.03		-0.00	-0.04*
Age		-0.01***	-0.01***		-0.00*	-0.01***
Gender (ref: male)						
Female	0.05***	0.03*	-0.01	0.02**	0.02*	-0.00
Migration background (ref: none)						
1st gen. migrant	-0.11**	-0.04	-0.06	-0.01	-0.00	-0.00
2nd gen. migrant	-0.07***	-0.05**	-0.08***	0.02	0.02	0.02

	Cluster 4: Not completed/late dropout			Cluster 5: Complex/early dropout		
	M1	M2	M3	M1	M2	M3
HE type (ref: university)						
UAS	-0.03***	-0.05***	-0.06***	-0.01	-0.04***	-0.05***
Parents' education (ref: high)						
Low		0.02	-0.00		0.01	-0.00
Middle		-0.01	-0.01		0.01	0.00
GPA (ref: excellent/very good)						
Good		0.02**	0.05***		0.04***	0.01
Satisfactory/sufficient		0.08***	0.07***		0.18***	0.15***
Pre-HE pathway (ref: trad. access/no VET)						
Traditional access/VET		-0.02	-0.02		-0.04***	-0.03*
Alternative access/no VET		0.04	0.02		0.05**	0.09***
Alternative access/VET		-0.00	-0.01		0.01	0.01
Interests						
Practical-technical		0.01**	0.01***		0.01	0.01***
Intellectual-investigative		0.01	0.01		0.00	0.00
Major (ref: humanities)						
Social sciences		0.00	-0.01		-0.02	0.00
Sciences		-0.01	-0.00		0.03*	0.08***
Age		0.01***	0.01***		0.00***	0.00**
Gender (ref: male)						
Female	-0.04***	-0.03***	0.00	-0.04***	-0.01	0.01
Migration background (ref: none)						
1st gen. migrant	0.10***	0.06*	0.11***	0.01	-0.02	-0.04**
2nd gen. migrant	0.03*	0.02	0.04**	0.02	0.01	0.01

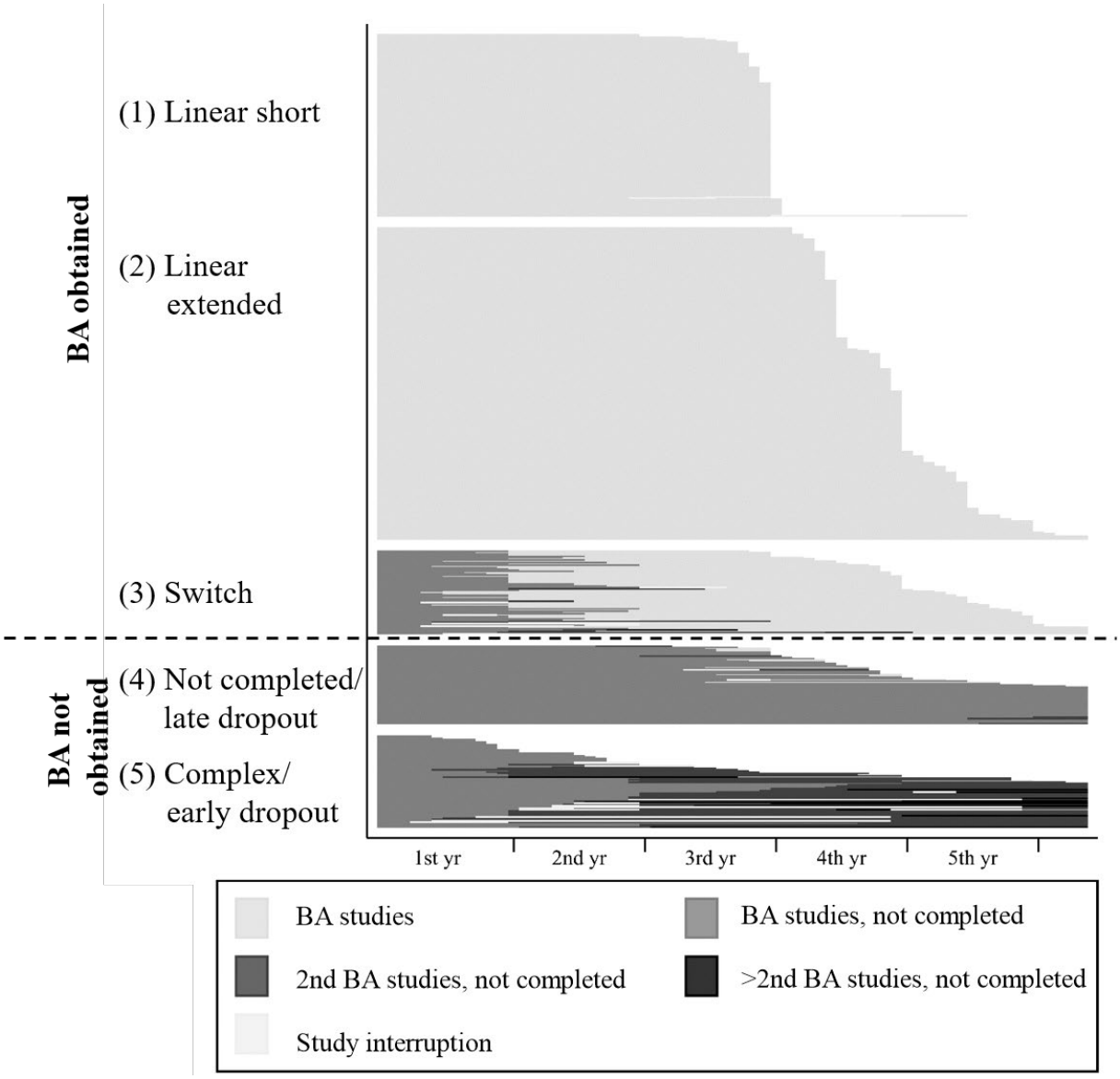
Source: NEPS SC15.0.0. N=6,381. Note: * p<.05 ** p<.01 *** p<.001.

Figure 1. Number of first-year students and percentage of first-year UAS students, 1975–2019.



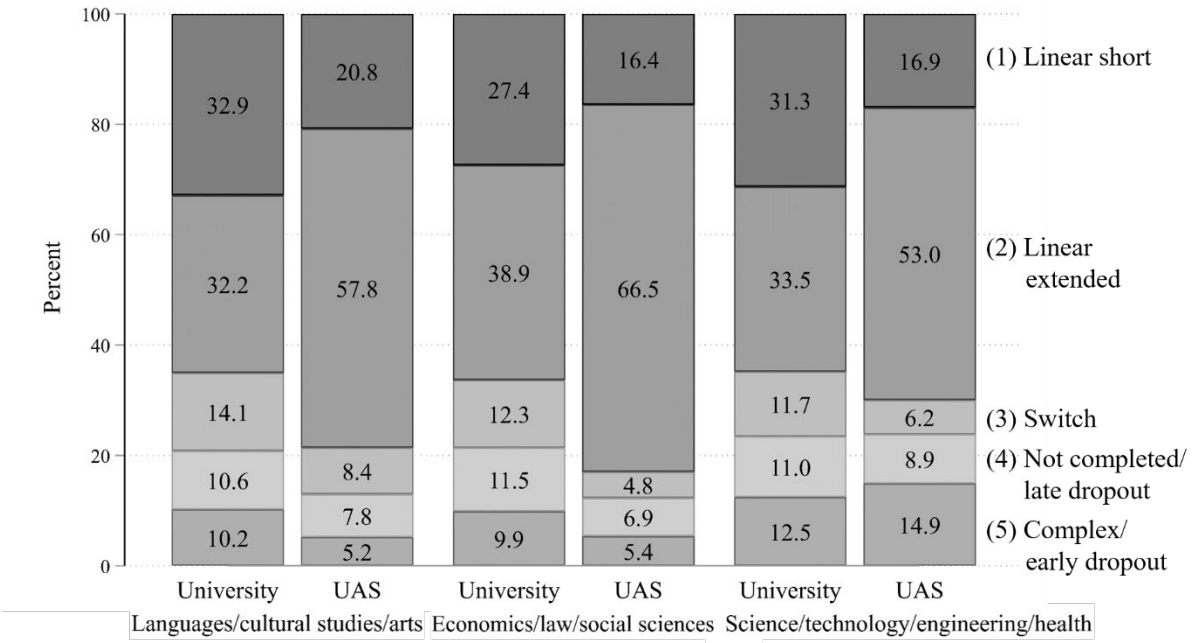
Source: Autorengruppe Bildungsberichterstattung 2020. Table F3-1web. Note: 1975 – 1989: West Germany only.

Figure 2. Sequence index plot of five trajectory cluster.



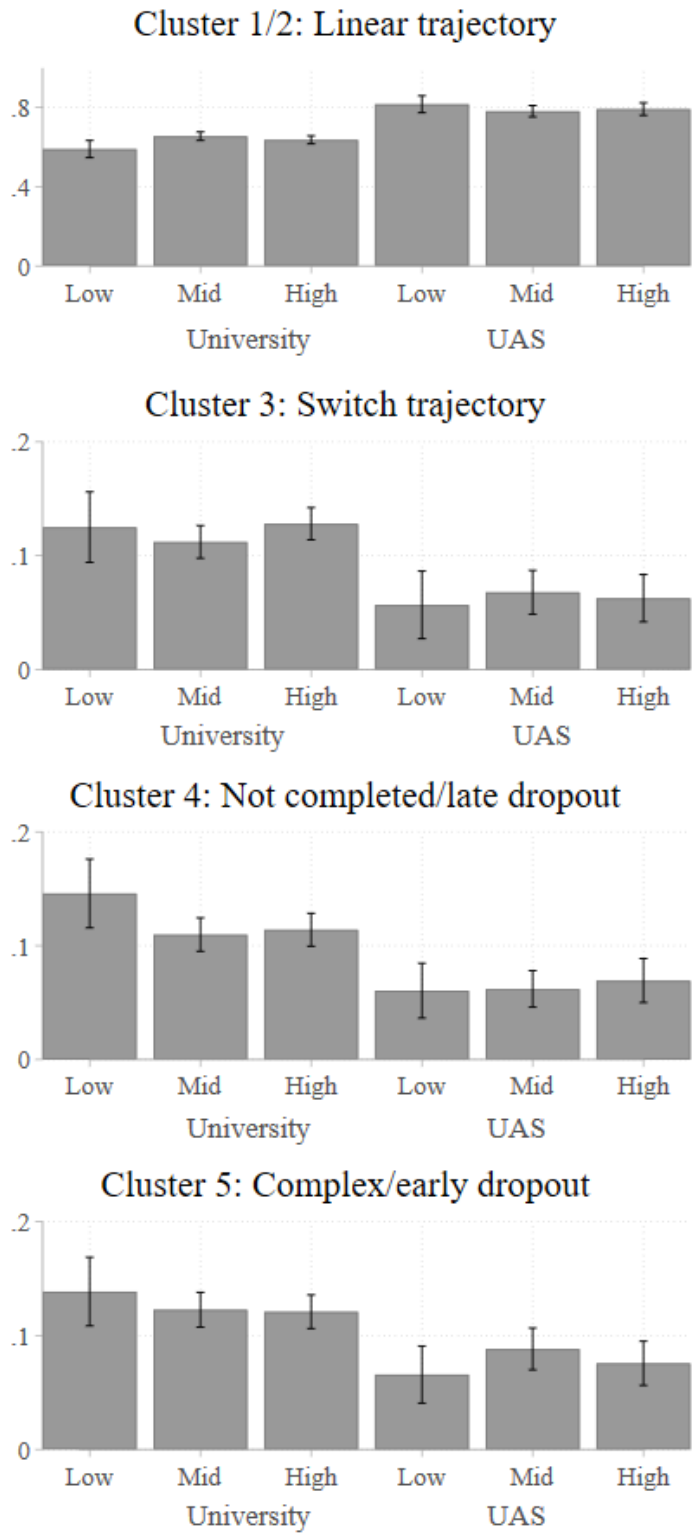
Source: NEPS SC5 15.0.0. Note: Based on a random selection of 600 trajectories.

Figure 3. Bar chart: Trajectory cluster by HEI type and field of study.



Source: NEPS SC5 15.0.0. N = 6,381.

Figure 4. Average predicted margins (95% confidence intervals) of trajectory types by HEI type and social origin.



Source: NEPS SC5 15.0.0. N=6,381. Note: Based on the full model (model 2).

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[i] Universities with a specific focus, such as pedagogical and technical universities, art or theological colleges, and universities of public administration, are subsumed here under universities. Universities and UASs are not the only HEI types, but with 96% of all students attending them they are the most relevant.

[ii] With the exception of some fields, universities almost completely replaced the long, single-cycle *Magister* and *Diplom* degrees. The state examinations degree (*Staatsexamen*) is only offered at universities in fields such as medicine, pharmacy, law, and to some extent, in teaching studies.

[iii] Comprehensive checks of trajectory indicators (e.g., study completion, major switch, study duration) against alternative data sources (e.g., the DZHW Panel Study of School Leavers and administrative data) yielded fairly similar results. This data is available upon request.

[iv] A running count of all the bachelor's degree programs in which students enrolled was created. These were merged into one category, '>Second BA Studies, Not Completed'. Since long degree programmes (*Staatsexamen*) are not offered at UASs, trajectories in which students had switched from a bachelor's degree to a long degree type were excluded.

[v] In this sample, 26% of the students were enrolled at a UAS and 74% at a university. This deviates somewhat from official data which suggests that 60% of students were at universities compared to 40% at UASs (cf. https://www.datenportal.bmbf.de/portal/de/Tabelle-2.5.20.html, last accessed on 23/09/2020).

[vi] Relative risk ratios of the respective models are included in the appendix.

[vii] Based on a visual inspection of the dendrogram, the Calinski-Harabasz, and the Duda-Hart cluster stopping indices (Cornwell 2015).