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ALLGEMEINER TEIL

Student attrition in gender-atypical fields of study: a case of disapproval by parents and friends or lacking social integration?

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Abstract In most industrialized countries, the choice of college majors is segregated by gender. Few students enroll in gender-atypical majors. Previous studies suggested that some attrition risks are associated with the gender composition of majors. In this paper, I investigated whether students in gender-atypical majors are more likely to leave the major by dropping out or switching to a different major with more same-sex students than those majoring in gender-typical subjects. Furthermore, I hypothesized that the relation between gender composition and non-completion risks is partially mediated by two social processes, namely poor social integration and disapproval of the major from parents and friends. Using data from undergraduate students from the German National Educational Panel Study, I conducted discrete-time survival analyses and a KHB decomposition. I found that both men and women in gender-atypical majors have a higher risk of switching to a major with a higher percentage of same-sex students than students in gender-typical majors. Women in gender-atypical majors also have a higher dropout risk. Poor social integration and disapproval of the major by parents and friends increase the switching risk and, in the case of social integration, also the dropout risk for all students. However, these two aspects cannot explain the higher attrition risk for students in gender-atypical majors, with one exception. Only for women in gender-atypical majors, lower approval of the major by friends partly mediates the association between the gender composition of the major and the risk of switching to a more female-dominated major.

Keywords Gender inequality · University student attrition · Gender composition of the major · Social integration · Disapproval of the major by parents and friends

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Studien(-fach)abbruch in geschlechtsuntypischen Studienfächern: Missbilligung von Eltern und Freunden oder mangelnde soziale Integration als Ursache?

Zusammenfassung In den meisten Industrieländern ist die Studienfachwahl geschlechtsspezifsch. Wenige Studierende entscheiden sich für ein geschlechtsuntypisches Studienfach. Bisherige Studien verdeutlichten, dass es einen Zusammenhang zwischen der Geschlechterzusammensetzung eines Studienfaches und dem Studienabbruchrisiko gibt. In der vorliegenden Studie untersuchte ich, ob Studierende in geschlechtsuntypischen Studienfächern mit höherer Wahrscheinlichkeit das Studienfach verlassen als solche in geschlechtstypischen Fächern, in dem Sie das Studium abbrechen oder zu einem Fach mit einer höheren Zahl an gleichgeschlechtlichen Studierenden wechseln. Zudem nahm ich an, dass der Zusammenhang zwischen der Geschlechterzusammensetzung eines Studienfaches und dem Risiko, das Fach ohne Abschluss zu verlassen teilweise von zwei sozialen Prozessen mediiert wird, nämlich schlechter sozialer Integration und Missbilligung des Studienfaches durch Eltern und Freunde. Auf Basis von Daten des Nationalen Bildungspanels zu Bachelor-Studierenden schätzte ich diskrete Ereignisanalysemodelle und führte eine KHB Dekomposition durch. Die Ergebnisse zeigten, dass Männer und Frauen in geschlechtsuntypischen Studienfächern ein höheres Risiko aufweisen, zu einem Studienfach mit mehr gleichgeschlechtlichen Studierenden zu wechseln als Studierende in geschlechtstypischen Studienfächern. Frauen in geschlechtsuntypischen Fächern haben zudem ein erhöhtes Studienabbruchsrisiko. Eine ungenügende soziale Integration und die Missbilligung des Studienfaches durch Eltern und Freunde erhöht das Studienfachwechselrisiko und im Falle der sozialen Integration auch das Studienabbruchsrisiko. Diese beiden Aspekte tragen aber nicht zur Erklärung des erhöhten Risikos von Studierenden in geschlechtsuntypischen Studienfächern, das Fach ohne Abschluss zu verlassen, bei, mit einer Ausnahme. Nur für Frauen in geschlechtsuntypischen Studienfächern wird der Zusammenhang zwischen der Geschlechterzusammensetzung des Studienfaches und dem Risiko zu einem stärker frauendominierten Studienfach zu wechseln durch eine stärkere Missbilligung des Studienfaches durch Freunde mediiert.

Schlüsselwörter Geschlechterungleichheit · Studienabbruch · Geschlechterzusammensetzung des Studienfaches · Soziale Integration · Missbilligung des Studienfaches durch Eltern und Freunde

1 Introduction

In most European countries, there is a gender gap in favor of women regarding college completion below the doctoral level (OECD 2021). However, the choice of college majors is still highly segregated by gender. Women are more likely to enter health studies, humanities, education, and f ne arts programs, while men are more often attracted to STEM f elds (science, technology, engineering, and mathematics) (Bloom 2013). Students choosing a gender-atypical major are a highly selective

group that has already successfully acted against normative gender stereotypes. Nevertheless, they continue to face repercussions from their social environment due to the prevailing stereotypes regarding appropriate gender roles as long as they continue with a gender-atypical major (Ridgeway and Correll 2004). Evidence suggests that women in STEM leave this pathway during different stages of their careers. This fact is frequently described using the metaphor of a "leaky pipeline" (Blickenstaff 2005). However, whether male and female students in gender-atypical majors are, in general, more likely to leave their major than their counterparts taking gender-typical majors has not been fully determined. In this paper, I will explore whether the retention risks of male and female students in gender-atypical fields of study and the reasons for leaving are related to the gender composition of the major.

Previous empirical research on the non-completion risks of students majoring in gender-atypical subjects showed mixed results. Some studies found an association between the gender composition of a major and students' non-completion risk for both sexes (Johnes and McNabb 2004), some only for women (Mastekaasa and Smeby 2008), some only for men (Riegle-Crumb et al. 2016), and yet others find no association (Severiens and Dam 2012). Students can leave the gender-atypical field of study by dropping out of higher education or switching majors. Previous studies have the limitation that they either investigated only dropout risks from higher education (Johnes and McNabb 2004), only switching decisions (Riegle-Crumb et al. 2016) or did not distinguish between dropping out and switching decisions (Meyer and Mantinger 2021; Meyer and Strauß 2019). However, it is important to distinguish between these different risks because dropping out and switching major entail different costs. Furthermore, only a few studies (Meyer and Mantinger 2021; Riegle-Crumb et al. 2016) investigated whether students switching majors from gender-atypical fields actually leave for a more gender-typical field or whether they choose a new but still gender-atypical feld. In the latter case, the higher switching risks for students taking gender-atypical majors would not reinforce gender segregation.

I addressed these shortcomings and methodical limitations of previous studies by conducting within-gender comparisons and analyzing the association between the gender composition of the major and four educational decisions with event history analyses: completion of gender-atypical major, dropping out of higher education, switching the major for one with a higher proportion of same-sex students, and switching the major for one with an equal or even lower proportion of same-sex students. Additionally, I explored by conducting mediation analyses with a KHB decomposition whether social processes both at the outset and during study time—namely approval of the major by parents and friends and social integration with fellow students—might explain the higher non-completion risk for students in gender-atypical majors. For my analyses, I used a longitudinal sample of German undergraduate students who enrolled in a university in fall 2010.

2 Previous research on non-completion in gender-atypical majors

2.1 The association between gender composition and non-completion rates

Dropping out of higher education is a widespread phenomenon. In Germany, 27% of all undergraduate students leave university without a degree (Heublein et al. 2020). Many studies confrmed the "leaky pipeline" and showed that female STEM students have a higher dropout risk than their male counterparts (Astorne-Figari and Speer 2019; Griff th 2010). Meyer and Strauß (2019) demonstrated with German survey data that both male and female students taking gender-atypical majors face a higher non-completion risk than students with gender-typical majors.

Only a few studies investigated the link between the gender composition of a major and non-completion rates and conducted within-gender comparisons. Since the aim of my study is a within-gender comparison, I concentrate on studies using this method in the following literature review.

US Studies point to contradictory results: Griff th (2010) demonstrated that female students are more likely to persist in a STEM major at universities with a high percentage of female STEM graduate students; in contrast, other studies found a higher persistence rate for women in male-dominated majors (Rogers and Menaghan 1991), while others found no effect of the proportion of women in a major on female students' persistence rate (Sax 1996). Sax (1996) found that a higher proportion of women in the major promotes men's persistence.

European studies also show mixed results. Smith and Naylor (2001) examined British undergraduate university students and found no effect of the gender composition of the university department on men's or women's probability to drop out of higher education. However, a study by Johnes and McNabb (2004) with British university students suggested that female students in majors with a high proportion of male students are less likely to drop out of higher education than female students in female-dominated majors. In contrast, male students have a higher dropout risk from higher education in female-dominated majors than in male-dominated majors. Severiens and Dam (2012) found the same results for male students in a study with Dutch college leavers but found no effect of gender composition on women's risk to drop out of college. Analyzing Norwegian college students, Mastekaasa and Smeby (2008) illustrated that women in male-dominated majors have a higher non-completion probability than women in gender-balanced or female-dominated majors. The non-completion probability of male students is not infuenced by the gender composition of the major. For Germany, Meyer and Strauß (2019) illustrated that women in gender-atypical majors face a higher non-completion risk than women in gender-typical majors. However, this effect vanished when the average perceived diffculty of the study programs was controlled.

These previous studies have in common that they either only focused on students that drop out from higher education altogether or did not distinguish between dropping out and switching majors when looking at non-completion risks.

2.2 Switching decisions of students in gender-atypical majors

Research on switching decisions of students in gender-atypical majors is scarce. Four US studies (Astorne-Figari and Speer 2019; Denice 2021; Griff th 2010; Maltese and Cooper 2017) analyzed switching destinations of STEM students. All four studies illustrated that female STEM students are more likely to switch to a non-STEM f eld than male STEM students. Only one (Riegle-Crumb et al. 2016) looked at the switching decisions of students in gender-atypical majors and conducted within-gender comparisons. Riegle-Crumb et al. (2016) demonstrated that women in male-dominated majors do not have a higher risk of switching majors than women in gender-typical majors. However, men in female-dominated majors are more likely to switch majors than their male peers in male-dominated felds. Furthermore, male students in gender-atypical majors have a higher probability of switching to a gender-balanced major or male-dominated major than men in gender-typical majors. Based on German data, Meyer and Mantinger (2021) investigated the educational paths university students take when dropping out of university or switching majors. The study demonstrated that ca. 75% of students in gender-atypical majors who leave their major without a degree leave the gender-atypical educational pathway by either opting for vocational training or a new university major in a gender-balanced or gender-typical f eld. The limitation of this study is that it did not differentiate between choosing vocational training (and, hence, dropping out from higher education) and choosing a new major at university.

2.3 Limitations of previous studies

The overview of previous research shows that there are mixed results on the link between the gender composition of a major and dropout and switching risks. Results of studies based on non-German data, especially in the US context, cannot simply be transferred to the German context because non-completion is connected with higher costs in Germany. There are fn ancial returns to attending college in the US, even when not graduating with a degree (Reisel 2013). In contrast, German dropouts from higher education usually complete vocational training before entering the labor market because otherwise, their income prospects are low (Scholten and Tieben 2017). In Germany, switching majors is restricted institutionally and requires a new application.

The two aforementioned German studies that investigated the educational paths of students in gender-atypical majors (Meyer and Mantinger 2021; Meyer and Strauß 2019) have the limitation that they pooled different forms of non-completion and cannot differentiate between leaving university altogether and switching majors. However, such a differentiation is important because these two possible decisions have different consequences. Dropping out of higher education requires a new orientation outside academia and possibly lower income prospects.

Furthermore, it is possible that a major's gender composition is connected only with specif c non-completion risks. For example, suppose a low proportion of women in a major increases women's risk of switching to a more gender-typical major but decreases their risk of switching to a gender-atypical major or dropping out. In that

case, the true effect of the gender composition might become unclear when different forms of non-completion are not distinguished.

Overall, there is no previous study for the German context that analyzes the association between gender composition and the educational paths of students in gender-atypical majors, and that can compare the following four possible destinations: completion of the gender-atypical major, dropping out of higher education, switching to a major with a higher proportion of same-sex students, and switching to major with an equal or lower proportion of same-sex students. In my study, I aim to address the limitations of previous studies by drawing on longitudinal data and conducting event history analyses, which allow the differentiation of these four destinations. Furthermore, I am interested in the mechanisms that can explain the link between the gender composition of a major and students' non-completion risks. I investigate whether social processes at the outset and during study time—specifically approval of the major from parents and friends and social integration with fellow students—act as mediators between the association of the gender composition of a major and students' dropout and switching risks.

3 Theoretical framework

3.1 Gender status beliefs and tokenism

Women and men in gender-atypical majors are confronted with gender stereotypes. Gender stereotypes include cultural beliefs about gender and gender-specific competence expectations; men are viewed as more agentic, better at instrumental tasks and more competent than women in highly-valued fields such as technology and science, while women are seen overall as less competent but are more communal, more communicative and better at nurturing and other less valued tasks in society (Ridgeway and Correll 2004). Therefore, men and women in gender-atypical majors are often expected by their social environment to be less competent than students of the opposite sex in the same major, and their chosen major is judged as not sex-appropriate. As a consequence, students in gender-atypical majors face *stereotype threat*, the fear of confirming negative stereotypes of a lack of skills in gender-atypical felds (Steele 1997). Evidence suggested that gender beliefs and stereotype threat are connected to the gender composition of a student's major. Women in STEM majors with a very low proportion of female students are exposed to more stereotype threat than women in STEM fields with a comparatively higher proportion of women (Murphy et al. 2007).

Overall, it is evident that the social environment, with its gender beliefs, affects men and women in gender-atypical fields. Several theories suggest that social processes connected with gender beliefs can lead to the retention of both men and women in gender-atypical fields. Jacobs (1989) observed that women in male-dominated occupations often left the feld for a female-dominated feld. He called this process "revolving doors". According to Jacobs (1989), this phenomenon is caused by a system of social control in a society that aims to maintain the sexual division

of labor through institutional barriers and gender stereotypes. However, Jacobs did not specify the agents of social control in his theory.

Another widely applied theory that connects gender beliefs and social processes with attrition in gender-atypical fields is Kanter's (1977a) theory of tokenism. In contrast to Jacob's (1989) theory of social control, Kanter more directly referred to the numerical gender composition of a field and focused on social pressure exerted by actors within the field. Kanter (1977b) argued that men and women in the numerical minority in an occupational environment become "tokens", symbols or representatives of their category. There are three negative consequences of tokenism. First, tokens are highly visible because of their rarity, which creates performance pressure for the tokens. Second, the dominant group feels threatened by the token culture. The dominants thus exaggerate the differences between themselves and the tokens. As a consequence, tokens also face informal isolation and are excluded from informal socialization occasions and networks. Third, the tokens' characteristics are distorted to fit the pre-existing stereotypical attributes of their category. Consequently, they feel pressured to leave the occupational group (Kanter 1977b). Many empirical studies supported Kanter's theory (for an overview, see Watkins et al. 2019). Kanter (1977a) argued that tokenism applies not only to women but also to men in the numerical minority. Research showed that male tokens experience some negative effects of their minority status, but to a less exaggerated extent than women (Watkins et al. 2019).

Kanter's theory of tokenism has often been applied to undergraduate students. Some of the studies described in the literature review drew on Kanter's theory of tokenism when analyzing the effect of gender composition on students' non-completion behavior (Mastekaasa and Smeby 2008; Meyer and Strauß 2019; Rogers and Menaghan 1991; Sax 1996). Mastekaasa and Smeby (2008) found an effect of the major's gender composition on female tokens' decisions to leave the major and saw this as support for Kanter's theory, while other studies found no evidence in line with Kanter's arguments[1]. However, these previous studies did not differentiate different forms of non-completion and/or did not look at the paths token students took when switching to a new major. To really test Kanter's assumptions, it is necessary to observe whether students indeed leave the gender-atypical major for a major with a higher proportion of same-sex students where tokenism is less pronounced.

I follow previous studies and apply Kanter's theory to undergraduate students. I expect students in gender-atypical majors to experience tokenism and consequently to be pushed out of the major. These students can leave either by dropping out of higher education or by switching their major. According to Kanter, the negative effects of tokenism become less pronounced with an increasing proportion of tokens. When tokens become a larger minority, they can form alliances against the dominant group. The larger the proportion of tokens is, the larger the power of these alliances. Furthermore, a larger number of tokens showing different characteristics and behavior will make it harder for the dominant groups to reduce the tokens to stereotypical roles (Kanter 1977b). Consequently, I argue that majors with a higher proportion of same-sex students exert a pull factor on students in gender-atypical

[1] See literature review in chapter 2.

majors. When switching majors, tokens will be attracted to majors with a higher proportion of tokens than in their original major. These might be gender-typical majors, gender-balanced majors, or majors which are still gender-atypical but have a larger proportion of tokens. This leads to the following hypothesis:

H1 Students in gender-atypical majors have a higher risk of dropping out and of switching to a major with a higher proportion of same-sex students than students in gender-typical majors.

In the next step I examine in more detail the mechanisms that can explain how the gender composition of a major infuen ces students' dropout and switching risks.

3.2 Social integration as mediator

Meyer and Strauß (2019) argued that one mechanism that could mediate the negative effects of tokenism on students' non-completion is social integration within the major. I follow this assumption and connect Kanter's theory of tokenism with Tinto's model of student dropout.

Tinto (1975) argued that poor social integration is one of the signif cant determinants of student dropout from higher education. He argued that student dropout is the consequence of insuff cient social interaction with fellow students and faculty staff and insuff cient congruency with the values of the educational institution. Tinto called these two aspects social integration and academic integration. Successful social integration is characterized by positive communication and friendship with fellow students, support from faculty staff, and aff liation to the college collectivity. This paper only focuses on social integration with fellow students. Many empirical studies supported Tinto's arguments and showed that low levels of social integration not only increased students' risk to drop out but also to switch majors (Denice 2021; Hadjar et al. 2022; Klein 2019).

Kanter illustrated that tokens face various diff culties in their interaction with dominants: Tokens might be intentionally socially isolated by dominants; their high visibility, negative stereotyping, and the emphasis placed on their different and subordinate status make tokens outsiders in a group. These diffculties are also expected to affect the tokens' feeling of social integration with fellow students. As a consequence of their poor social integration, token students should be prone to dropping out of higher education or to switching to a major with a less-skewed gender composition, where there is a higher chance of experiencing good social integration.

However, I expect that due to their token status, only women—and not men—in gender-atypical majors are affected by poor social integration with fellow students. Kanter's theory has been criticized because empirical studies demonstrated that the attrition of women in male-dominated occupations is stronger than the attrition of men in female-dominated occupations (Busch-Heizmann 2015; Williams 1992). Furthermore, men are often ascribed a higher social status than women even when performing female-connoted tasks (Ridgeway and Correll 2004). Men in gender-atypical occupations also encounter discrimination and negative stereotypes, but more from outsiders and less from people within their f eld (Williams 1992). Con-

sequently, compared to that of women, male students' social integration with fellow students in gender-atypical majors should not be as negatively affected by their minority status.

Overall, this leads to the following hypothesis:

H2 The higher risk for women in gender-atypical majors of dropping out and of switching to a major with a higher proportion of same-sex students than women in gender-typical majors is partly mediated by low levels of social integration.

Previous studies on the social integration of students in gender-atypical majors are scarce and have shown mixed results. Empirical studies in the US context found no effect of the proportion of women in a major on male and female students' social integration (Rogers and Menaghan 1991; Sax 1996). In the German context, Meyer and Strauß (2019) tested the same hypotheses proposed in this study. Based on mean comparisons, they found that women in gender-atypical majors even experienced on average higher degrees of social integration with fellow students than women in gender-typical majors. Men in gender-atypical f elds of study reported, on average, lower levels of social integration with fellow students than male students in gender-typical majors. The authors illustrated with a mediation analysis that social integration could not explain the higher non-completion rate of students in gender-atypical majors. However, they measured social integration only retrospectively after students had either completed their studies or dropped out, and hence, the measurement may be biased. Furthermore, they observed only non-completion in contrast to persistence in the chosen major but did not distinguish between different switching decisions and dropout. In comparison to Meyer and Strauß (2019) I do not expect that the gender composition of a major and the level of social integration positively affect all switching decisions but rather that only the risk of switching to a major with a higher proportion of same-sex students is affected.

3.3 Parents and friends' approval of the major as mediators

A second social process, already prevalent from the beginning of academic studies, and which might mediate the impact of the gender composition on non-completion risks of students in gender-atypical majors is the judgement of students' major choice by social agents—such as parents and friends—outside the university context.

In line with Jacob's (1989) social control theory, I expect that parents and friends exert social pressure on students in gender-atypical majors to leave the major for a more gender-typical major. The support and opinion of parents and friends play an important role for students because they act as normative reference groups. Normative reference groups provide norms and values, including appropriate sex roles, with which an individual is expected to comply (Kemper 1968). Deviance from the group norms is sanctioned, for example, by social isolation or lack of support (Massad 1981). Since gender status beliefs are widespread within society, we can expect that many parents and friends of students endorse traditional gender norms about appropriate occupational f elds for men and women (Gabay-Egozi et al. 2015). Hence, choosing a gender-atypical major and, therefore, violating existing gender status beliefs is met with negative reinforcement and sanctioning.

Although men are ascribed a higher social status in general, men in gender-atypical fields also face discrimination, especially from agents outside the field (Williams 1992). Since female-dominated majors have a lower income potential and are devalued in society, men seem to reject their higher social status when entering a female-dominated field (Riegle-Crumb et al. 2016). Furthermore, their masculinity is permanently questioned (Williams 1995). Men in female-dominated occupations are viewed as gay, wimpy, and feminine (Williams 1992). Consequently, I assume that not only women but also men in gender-atypical majors are more likely to meet the disapproval of parents and friends with regard to their choice of major than students in gender-typical majors. Additionally, evidence suggested that the perception of stereotypes is directly connected with the numerical proportion of same-sex students in a major (Murphy et al. 2007). The disapproval by parents and friends may lead students in gender-atypical majors to revoke their choice of major and to switch to a more gender-typical major or to drop out of higher education to comply with traditional gender norms or to arouse less disapproval. This leads to the following hypothesis:

H3 The higher risk for women and men in gender-atypical majors of dropping out and of switching to a major with a higher proportion of same-sex students than for students in gender-typical majors is partly mediated by approval of the major from parents and friends.

Research into the influence of parents' and friends' approval on non-completion by students in gender-atypical majors is scarce. More generally, some studies demonstrated that girls received less encouragement from parents and peers to choose a STEM major than boys (Gabay-Egozi et al. 2015; Maltese and Cooper 2017). However, Mastekaasa and Smeby (2008) found no relation between encouragement from parents and friends and the gender composition of a student's major. A Dutch study showed that men in female-dominated majors often cited a negative attitude from parents towards their study choice and a lack of support from parents and friends as reasons for dropping out of higher education (Severiens and Dam 2012). For Germany, Meyer et al. (2022) observed that disapproval of the major by parents and friends generally increased students' probability of switching majors and of switching to a major in a field which is academically far from their original major. However, Meyer et al. (2022) looked at students of all majors and did not analyze non-completion risks specifically for students in gender-atypical majors. Furthermore, they concentrated solely on switching decisions and did not investigate the impact of parents' and friends' approval on dropout decisions. I will attempt to close this research gap by investigating the association between the gender composition of a major, approval from parents and friends, and different non-completion risks.

4 Data and methods

I use data from the university student cohort of the German National Educational Panel Study (NEPS-SC5) to test my hypotheses. NEPS-SC5 is a representative

panel survey in Germany which follows 17,910 first-year undergraduate students who enrolled in either a full university or a university of applied science[2] in the winter term of 2010/11. Students are interviewed twice a year. The observation period consists of 6 years. Most students have either graduated with the first major they enrolled in 2020/11, dropped out, or switched to another major in this time span.

For my analysis, I exclude students who are enrolled in distance studies (2742) and students who do not report their major (856) or are enrolled in more than one major (5364)[3]. In the latter case, it is unclear which of the majors and its corresponding sex ratio causes the observed non-completion. Missing values are imputed for a subset of variables with multiple imputation by chained equations (m = 100). These restrictions and listwise deletion for non-imputed variables leave a sample size of 9792 students (54% female and 46% male). Further information on sample composition and imputation can be found in the appendix.

To test my hypotheses, I conduct a mediation analysis (VanderWeele 2015). In H1, I argue that tokenism, stereotype threat and social control lead students in gender-atypical majors to leave their major by dropping out or switching to a major with a higher proportion of same-sex students. In H2 and H3, I expect that this non-completion behavior is partly mediated by social integration and approval of the major by parents and friends. Figure 1 gives an overview of the relation of the exposure, the outcome and the proposed mediators of interest. The effect of the gender composition of the major (A) on students' non-completion behavior (Y) is the direct effect of the exposure on my outcome net of the mediators (M). Furthermore, the figure depicts the effect of the gender composition (A) on the three mediators (M) as well as the effect of the mediators (M) on students' non-completion behavior (Y).

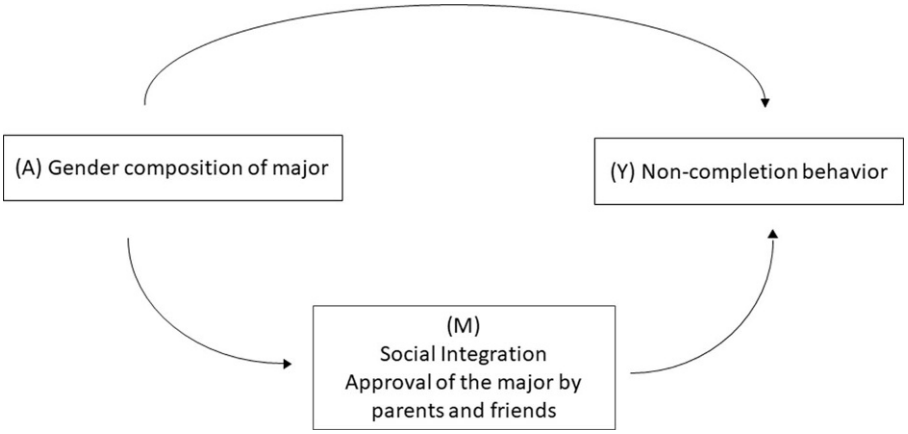

Fig. 1 The relation between exposure A, mediators M, and outcome Y

[2] Universities of applied science offer a limited number of programs, mainly engineering, management, and social work, and are more practically oriented.

[3] 96% of all students with more than one major are students aiming for a teaching degree.

In a preliminary step, I will analyze the effect of the major's gender composition (A) on every single mediator (M). In H2, I argue that women in gender-atypical majors experience lower social integration than women in gender-typical majors due to tokenism. Social integration is measured four times within my observation period. Hence, for the association between exposure and social integration, I conduct random effect models with time-varying covariates. Furthermore, in H3, I expect that men and women with gender-atypical majors are less likely to meet the approval of their major by parents and friends because these students violate gender norms. Approval of the major by parents and friends is measured once, in the first semester. Therefore, I estimate linear regression models to analyze the association between the exposure and approval of the major. These analyses allow me to assess whether the gender composition of the major affects the mediators as proposed in my hypotheses.

For my main analyses, I first estimate the total effect of the gender composition of the major on dropout and switching behavior. The total effect consists of the direct effect of the gender composition on students' non-completion behavior as well as of the indirect effect of the gender composition on my outcome, which is mediated by social integration and approval of the major by parents and friends. For this step, I conduct survival analyses with competing risks. Survival analysis analyzes the time to an event of interest; in my case, the time from students' enrollement in a major in the winter term of 2010/11 until graduation or non-completion behavior occurs. Students are only "at risk" of experiencing an event, i.e., non-completion, as long as they are still enrolled in the first major of the winter term of 2010/11. My observation period is restricted to 6 years. Students who do not experience an event within this observation period, i.e., after 6 years, they are still enrolled in the same major as in the winter term of 2010/11, but have not graduated yet, are right-censored observations. Students affected by panel dropout are also right-censored because it cannot be observed which events these students experience. The advantage of survival analysis is that these right-censored observations are still included in the estimation of the survival analysis of non-completion risks. Furthermore, time-varying covariates can be included in survival analysis.

Due to the large number of ties (events take place mostly at the end of a semester), I apply discrete-time survival analysis. I split my observation period of 6 years into 10 time intervals. Each time interval consists of 6 months, except the last one, which pools 18 months. Events rarely occur in the last year when students are already close to graduation.

I am interested in different types of student non-completion behavior, i.e., both dropping out and switching to another major. I previously argued that when switching, students in gender-atypical majors might be attracted to majors with a higher proportion of same-sex students. I use a 5% threshold to define whether, following a switch, the new major can be categorized as a major with a higher proportion of same-sex students. Following Kanter's (1977a) argument that an increase in the proportion of the minority group decreases the effects of tokenism and empirical evidence on stereotype threat (Murphy et al. 2007), I argue that even a relatively small increase in the proportion of same-sex students should decrease the negative impact of tokenism. Later, I conduct sensitivity analyses with a larger threshold to confirm the results.

Consequently, I differentiate three competing risks: 1. Switching to a major with an equal or lower proportion of same-sex students, 2. Switching to a major with at least a 5% higher proportion of same-sex students[4] and 3. Dropping out of higher education. If students drop out of higher education but enroll again within the observation period, the interruption is ignored and not counted as a dropout. I only investigate non-completion behavior regarding the first major students enrolled in 2010/11; (non-)completion decisions after non-completion of the first major are not analyzed. For women, I observe 741 events; for men, 801. Tables 1 and 2 provide an overview of the different events observed in the data.

For the discrete time analyses, I conduct multinomial logit models. The dependent variable is a categorical variable for the 3 competing risks and graduation/right-censoring. Graduation or right-censoring act as the reference group. The 10 time intervals are included as covariates in the models. The individual time interval variables reflect the students' risk of experiencing an event within this specific time interval. I present average marginal effects because AMEs offer an easier interpretation of the coefficients than for example, log odds. To consider the nesting of time intervals in persons, I estimate clustered standard errors. I also conducted models with person-specific random intercepts to see if unobserved heterogeneity between clusters and within-cluster dependence bias the results. There seems to be no substantial frailty, and the results do not differ from the analyses with clustered standard errors. Furthermore, the nesting of the individuals in universities only explains around 2% of the variance. Therefore, I do not include person- or university-specific random intercepts in the models. The aim of this first analysis is to provide an easy interpretation of the effects of the exposure and the mediators on the outcome and to test H1.

In the second step, I empirically test whether social integration and approval of the major from parents and friends mediate the relationship between the gender compo-

Table 1 Distribution of observed events for Women. Source: https://doi.org/10.5157/NEPS:SC5:11.0.0, own calculations

	Event type 1: Switching to a major with a lower or same prop. of same-sex students	Event type 2: Switching to a major with at least 5% higher prop. of same-sex students	Event type 3: Dropout	Total
Female-dom. majors	107	15	59	181
Gender-balanced	127	176	146	449
Male-dom. majors	13	58	40	111
Total	247 (33.3%)	249 (33.6%)	245 (33.1%)	741 (100%)

[4] Switching to a major with a higher proportion of same-sex students, which is still less than 5%, is included in Event 1. Switching university without switching the major is not counted as an event.

Table 2 Distribution of observed events for Men. Source: https://doi.org/10.5157/NEPS:SC5:11.0.0, own calculations

	Event type 1: Switching to a major with a lower or same prop. of same-sex students	Event type 2: Switching to a major with at least 5% higher prop. of same-sex students	Event type 3: Dropout	Total
Female-dom. majors	6	18	11	35
Gender-bal-anced	121	85	112	318
Male-dom. majors	213	76	159	448
Total	340 (42.4%)	179 (22.3%)	282 (35.2%)	801 (100%)

sition of the major and the competing risks. I use the method proposed by Karlsen, Holm and Breen (KHB method, Kohler et al. 2011) to decompose the total effect into direct and indirect effects with the STATA ado *khb*. The KHB method is a state-of-the-art method for analyzing mediator effects in nested nonlinear probability models. Coeff cients of nonlinear models cannot be compared between models due to a rescaling bias that occurs whenever the mediator has an effect on the outcome, which is independent from the exposure. The KHB method deals with this problem and decomposes the total effect by comparing the coeff cient of a model without the mediators as covariate (the total effect) with a model including the mediators (direct effect). To make the two models comparable, the KHB method identifes the effect of rescaling. This is done by including the residuals of a regression of the mediators on the exposure in the model for the total effect. The residuals represent the part of the mediators not contained in the exposure. Subsequently, the difference between the total effect and the direct effect represents the indirect effect of the exposure on the outcome, which is running through the mediators, net of rescaling (Kohler et al. 2011). The KHB method provides statistical tests for the signifcan ce of the indirect effect. I apply the KHB decomposition to the same multinomial logistic regression model used for estimating my survival analyses with competing risks, as described above. However, the KHB method does not provide a signif cance test for the indirect effect when computing AMEs. Hence, I present logg ods for the decomposition results.

All analyses are conducted separately for men and women to allow for within-gender comparisons.

5 Variables

5.1 Gender composition of majors

I def ne majors with 30% or fewer women as *male-dominated*, majors with 70% or more women as *female-dominated,* and majors with more than 30%, but fewer than 70% women as *gender-balanced* (Riegle-Crumb et al. 2016)[5]. If a feld is dominated by one gender by 70% or more, then the general public strongly identif es the f eld with that gender and corresponding gender stereotypic images (Cejka and Eagly 1999). To capture the sex ratio in a major and, consequently, the conditions of students in a major as precisely as possible, I linked the NEPS-SC5 data with external data from the German Federal Statistics Off ce. The German Federal Statistics Off ce provides information on the exact sex ratio in 78 subject areas for each German university in 2010 (Statistisches Bundesamt 2011). For 17% of the cases, the specifc sex ratio in a major is not available[6]. For these cases, I used the average sex ratio in a major across all German universities. Following my defn ition, male-dominated majors include engineering programs, physics, informatics, and technology. Female-dominated majors include language programs, pedagogy, psychology, health studies, social sciences, and art. Table 3 displays the distribution of women and men over the different types of majors in the analysis sample. 520 women and 251 men are enrolled in a gender-atypical major.

5.2 Social integration and approval of the major from parents and friends

Social integration measurements follow Tinto's theoretical model and are adapted for the German context. Three items capture the quantity and quality of interactions with fellow students: "I have been successful in building contacts with other students", "I know a lot of classmates with whom I can exchange ideas about questions in my f eld of study", "I have many contacts with students in my cohort" (scales ranging from 1 does not apply at all, to 4 applies completely). I build an index of the mean over all items (Cronbach's alpha 0.84; further information in the appendix).

Table 3 Distribution of women and men over majors. Source: https://doi.org/10.5157/NEPS:SC5:11.0.0, own calculations

Sex ratio major	Women		Women in type of major experiencing events		Men		Men in type of major experiencing events	
	N	%	*N*	%	*N*	%	*N*	%
Female-dom	1769	33.2	181	10.2	251	5.6	35	14.0
Gender-balanced	3033	57.0	449	14.8	1926	43.1	318	16.5
Male-dom	520	9.8	111	21.4	2293	51.3	448	19.5
Total	5322	100	741	13.9	4470	100	801	17.9

[5] Although students in gender-balanced majors are not the focus of this study, I include those students in my analyses to provide a full picture.

[6] Universities are not obliged to provide these numbers to the German Federal Statistics Off ce.

Information on social integration is collected once per year in the first four years of students' studies.

Parents and friends' approval of the major is measured once in the first semester. Students report how much they agree with "my parents/my friends think that I chose a good major" (scales ranging from 1 does not apply at all, to 5 applies completely).

5.3 Control variables

I control for the background characteristics of students in all models: migration background (yes/no), parental education (1: both parents have no tertiary degree, 0: at least one parent has a tertiary degree), completed vocational educational training before enrollment (yes/no), age at enrollment, type of university (1: university of applied science, 0: full university), and whether students are aiming for a teaching degree (yes/no).

Tinto (1975) argued that not only social but also academic integration impacts non-completion. Therefore, I include measures of academic integration in the analyses. Academic integration is measured once per year and divided into three aspects, which are included as separate index variables: affective involvement, achievement orientation, and expectation fulfillment. Further information can be found in the appendix.

Additionally, I control whether students are working (yes/no; followed up continuously) and their self-rated health (scale ranging from 1 very bad, to 5 very good; measured every second wave) because both reflect how much time and energy they have to build social contacts.

Another important factor for self-selection and persistence in higher education is the level of preparation for higher education. Hence, I control for students' high-school leaving certificate GPA and whether they attended an advanced STEM course during high school finals (no advanced STEM course/no information[7] vs. advanced STEM course). I only consider hard science to be STEM i.e., mathematics, physics, informatics, technology, and general natural science.

6 Results

6.1 Preliminary analyses

Overall, the attrition rates for men and women in my sample are relatively low, at around 16%. Women in gender-atypical majors have a higher attrition rate (21%) than women in female-dominated majors (10%). The attrition rate for men in female-dominated majors is lower (14%) than for men in male-dominated majors (20%).

In H2 and H3, I hypothesize that social integration and approval of the major by parents and friends mediate the relationship between the gender composition of the major and students' non-completion behavior. In a preliminary step, I investigate the

[7] In some secondary educational institutions, students cannot choose advanced courses in specific subjects for their final exams. For these students, information on advanced STEM preparation is not available.

relationship between the exposure "gender composition of the major" and the three mediators (path between A and M in Fig. 1) before conducting a mediation analysis in the next chapter.

First, I assume that women in male-dominated majors experience lower social integration than women in female-dominated majors due to tokenism. In contrast, men's social integration should not be affected by the gender composition of their major. I conducted random effect models to investigate the effect of the sex ratio in the major on social integration (all results in Table 4). The results of Model 1 demonstrate that women in gender-atypical majors are slightly but signif cantly better integrated than women in gender-typical majors. Their minority status does not negatively affect social contacts. Instead, their token status seems to foster their social integration. This is in line with the results of Meyer and Strauß (2019), who found the same pattern with a German sample based on mean comparisons. As expected, men in female-dominated majors do not differ from men in male-dominated and gender-balanced majors regarding their social integration (Model 4). Meyer and Strauß (2019) found for Germany that men in gender-atypical majors report, on average, poorer social integration than men in gender-typical majors.

Secondly, I expect that women and men in gender-atypical majors are less likely to meet the approval from parents and friends than students in gender-typical majors because they violate gender norms. I analyzed the association between the gender

Table 4 Effects of gender composition of the major on mediators. Source: https://doi.org/10.5157/NEPS:SC5:11.0.0, own calculations

Women				Men			
	Social integration	Approval by parents	Approval by friends		Social integration	Approval by parents	Approval by friends
	M1	M2	M3		M4	M5	M6
Sex ratio in major (Ref: Female-dom.)				Sex ratio in major (Ref: Male-dom.)			
Gender-balanced	0.022 (0.016)	0.062* (0.031)	–0.111*** (0.031)	Gender-balanced	0.009 (0.018)	–0.133*** (0.033)	–0.134*** (0.037)
Male-dominated	0.095*** (0.026)	0.184*** (0.054)	–0.158** (0.054)	Female-dominated	0.030 (0.037)	–0.250*** (0.066)	–0.218** (0.076)
N	33,238	5322	5322	*N*	28,128	4470	4470
Adjusted R^2	–	0.049	0.023	Adjusted R^2	–	0.038	0.017
AIC	54,652	–	–	AIC	47,032	–	–
BIC	54,887	–	–	BIC	47,263	–	–

M1, M4: Random Effect Models. M2, M3, M5, M6: Linear Regression Models based on data of the frs t time interval

Coeffcients , standard errors in parentheses

Covariates in all models: migratory background, parental education, age at enrollment, university of applied science [a], aiming for teaching degree [a], working [a], health [a], advanced STEM course in high-school, high-school GPA, vocational training completed

Additional Covariates in M1 and M4: time intervals, academic integration [a]

Note: [a] time varying covariate in M1 and M4

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

composition of the major and approval of the major by parents and friends by estimating linear regression models based on data from the frst semester. The results show that women in male-dominated majors are even signifcan tly more likely to meet their parents' approval with their major choice than women in female-dominated majors (Model 2). However, approval from friends is signif cantly lower for women in male-dominated majors than for women in female-dominated majors (Model 3). Apparently, women in male-dominated majors are sanctioned for violating gender norms only by their friends but not by their parents. Results for male students are in line with my assumptions. Men in gender-atypical majors are significantly less likely to meet the approval of parents (Model 5) and friends (Model 6) with their choice of major than men in gender-typical majors. Apparently, men are more likely than women to be sanctioned for violating gender norms. This f nding corresponds with previous research that shows that when it comes to violating gender norms, men are evaluated more harshly than women by parents and peers (Blakemore 2003; Sandnabba and Ahlberg 1999).

Overall, these preliminary results show for men a pattern that I expected. However, for women, only the relationship between the gender composition of the major and approval of the major by friends point in the assumed direction. In the next chapter, I analyze the effect of the gender composition of the major on non-completion behavior and conduct mediation analyses to test the hypothesized mediation effects in depth.

6.2 Multivariate results for female students

Firstly, for my main analyses of female students, I conduct discrete-time survival analysis with competing risks, depicted in Table 5 (full models in the appendix). Results show average marginal effects. Model 1 shows the total effect of the sex ratio in a major on the different non-completion risks. Women in male-dominated majors have a small but signif cantly lower risk (0.7 percentage points) of switching to a major with the same or lower proportion of women than women in female-dominated majors. In line with Hypothesis 1, women in male-dominated majors have a signif cantly higher risk (2.1 percentage points) of switching to a major with at least a 5% higher proportion of female students than women in female-dominated majors, and a 0.5% higher dropout risk. Hence, the result supports the assumption that female tokens are prone to leave their major and that majors with a larger proportion of tokens exert a pull factor on them.

Model 2 illustrates that good social integration with fellow students signifcantly decreases the risk of experiencing any of the three events, supporting Tinto's theoretical assumption that social integration affects student retention. However, the effect of social integration on women's risk of switching to a major with an equal or lower proportion of women loses signif cance once approval of the major by parents and friends is controlled in Model 3. Model 3 demonstrates that an increasing approval of the major by parents and friends decreases the risk of both switching events. The approval of the major does not predict dropout. Consequently, some evidence supports the assumption that parents and friends act as normative reference groups exerting inf uence on students' non-completion decisions. However, disapproval of

Table 5 Women: discrete-time survival analysis with competing risks. Source: https://doi.org/10.5157/NEPS:SC5:11.0.0, own calculations

	Event 1: Switching to major with lower or same prop. of same-sex students			Event 2: Switching to major with at least 5% higher prop. of same-sex students			Event 3: Drop out		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
Sex ratio in major (Ref: Female-dom.)									
Gender-balanced	–0.005***	–0.005***	–0.005***	0.008***	0.008***	0.008***	0.002	0.002	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Male-dominated	–0.007***	–0.007***	–0.007***	0.021***	0.022***	0.022***	0.005*	0.005**	0.005**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Social Integration[a]	–	–0.002*	–0.002	–	–0.003**	–0.003*	–	–0.005***	–0.005***
	–	(0.001)	(0.001)	–	(0.001)	(0.001)	–	(0.001)	(0.001)
Approval of the major									
By parents	–	–	–0.002***	–	–	–0.002***	–	–	0.000
	–	–	(0.001)	–	–	(0.001)	–	–	(0.001)
By friends	–	–	–0.002**	–	–	–0.002**	–	–	0.000
	–	–	(0.001)	–	–	(0.001)	–	–	(0.000)
McFadden R^2 adj	0.106	0.114	0.123	0.106	0.114	0.123	0.106	0.114	0.123
N events	247				249			245	
N person-intervals	33,238								
N persons	5322								

Multinomial logistic regression, average marginal effects, clustered standard errors in parentheses

Covariates in all 3 models: time intervals, migratory background, parental education, age at enrollment, academic integration[a], aiming for teaching degree[a], university of applied science[a], working[a], health[a], advanced STEM course in high-school, high-school GPA, vocational training completed

Note: [a] time varying covariate

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

the major by parents and friends seems not to push students only towards a more gender-normative major but affects students' general decision to switch the major.

In the next step, I conduct a mediation analysis for Model 3. I apply the KHB method to decompose the total effect of the gender composition of the major on the different non-completion behavior in the direct effect and indirect effect mediated through social integration and approval of the major. The results are depicted in Table 6 and show logg odds. The decomposition analysis with social integration as a mediator reveals a signif cant indirect effect for dropping out but not for any of the switching decisions. However, the results show that social integration acts as a suppressor. When including social integration as a covariate in the model, the effect of gender composition on dropping out does not decrease but increases (the direct effect is larger than the total effect). This means that social integration does not reinforce the higher dropout risk of women in male-dominated majors. The preliminary analysis of the effect of the gender composition of the major on social integration revealed that women in male-dominated majors experience even signif cantly higher social integration than women in female-dominated majors. The decomposition analysis shows that the better social integration of women in gender-atypical majors protects them from experiencing an even higher risk of dropping out. Consequently, the hypothesis (H2) that the higher non-completion risk of female token students is partly mediated by low levels of social integration cannot be supported.

The decomposition analysis for approval of the major by parents illustrates significant indirect effects for both switching risks but not for dropping out. The mediation analysis shows that the lower risk of women in male-dominated majors of switching to a major with a lower or same proportion of women than women in female-dominated majors (total effect) is signif cantly reduced when approval of the major by parents is included in the model (direct effect). Hence, parental approval contributes to the lower risk of women in male-dominated majors to switch to a major with the same amount or even fewer women. Furthermore, there is a signif cant suppressor effect of parents' approval of the major for Event 2. The higher risk of women in male-dominated majors of switching to a major with a 5% higher proportion of women (total effect) signifcantly increases when approval by parents is controlled (direct effect). This can be explained by the fact that women in male-dominated majors are even signifcan tly more likely to meet their parents' approval with their major choice than women in female-dominated majors, as my preliminary analyses demonstrated. Furthermore, the discrete-time survival analysis in Table 5 illustrated that approval of the major by parents decreases women's risk for both switching decisions. Consequently, parental approval protects women in gender-atypical majors from switching their major in general. Hence, parents' disapproval of the major does not contribute to the higher attrition risk of women in male-dominated majors as proposed in H2.

Mediation analysis results for approval of the major by friends are partly in line with my assumptions. There are signif cant indirect effects for both risks to switch the major but not for dropping out. The lower risk of women in male-dominated majors of switching to a major with a lower or same proportion of women (total effect) decreases signif cantly further when approval of the major by friends is controlled

Table 6 Women: Mediation analyses. Source: https://doi.org/10.5157/NEPS:SC5:11.0.0, own calculations

Sex ratio in major (Ref: Female-dom., gender-balanced not displayed)	Social integration			Approval of the major by parents			Approval of the major by friends		
	Event 1	Event 2	Event 3	Event 1	Event 2	Event 3	Event 1	Event 2	Event 3
Male-dominated									
Total effect	–0.941**	2.883***	0.635**	–0.978**	2.843***	0.708**	–0.864**	2.967***	0.700**
	(0.294)	(0.310)	(0.235)	(0.295)	(0.310)	(0.236)	(0.294)	(0.311)	(0.236)
Direct effect	–0.911**	2.920***	0.707**	–0.911**	2.920***	0.707**	–0.911**	2.920***	0.707**
	(0.295)	(0.311)	(0.236)	(0.295)	(0.311)	(0.236)	(0.295)	(0.311)	(0.236)
Indirect effect	–0.030	–0.037	–0.072*	–0.067**	–0.077**	0.001	0.047*	0.047*	–0.007
	(0.018)	(0.019)	(0.030)	(0.022)	(0.025)	(0.021)	(0.020)	(0.020)	(0.016)
N persons	5322								

Decomposition of total effects into direct and indirect effects for model 3, multinomial logistic regression, logg ods, clustered standard errors in parentheses
Event 1: Switching to major with lower or same prop. of same-sex students; Event 2: Switching to major with at least 5% higher prop. of same-sex students; Event 3: Drop out
Covariates: time intervals, migratory background, parental education, age at enrollment, academic integration, aiming for teaching degree, university of applied science, working, health, advanced STEM course in high-school, high-school GPA, vocational training completed, social integration, approval of the major by parents, approval of the major by friends
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

(direct effect). Consequently, approval of the major by friends impedes women from experiencing an even lower risk of switching to a major with a lower or same-sex proportion. Additionally, the higher risk for women in male-dominated majors of switching to a more female-dominated major (total effect) decreases signifcantly when approval by friends is controlled (direct effect). According to my preliminary analyses, women in male-dominated majors indeed more often meet disapproval from friends with their major choice. This lower approval partly mediates the association between the gender composition of the major and the risk of switching to a more female-dominated major. Hence, the results partly support H3.

To sum up, the results support H1. Women in gender-atypical majors have a signif cantly higher risk of switching to a major with at least a 5% higher proportion of women and a higher dropout risk than women in gender-typical majors. H2 and partly H3 must be rejected for women. Lower levels of social integration or parental disapproval of the major do not mediate the link between gender-composition of the major and non-completion risks of women in gender-atypical majors. However, disapproval of the major by friends partly mediates the higher risk of switching to a more female-dominated major for women in male-dominated majors.

6.3 Multivariate results for male students

For male students, in a f rst step, I also conduct discrete-time survival analysis with competing risks. Table 7 depicts the results (full models in the appendix). The results show a similar picture to the analysis for women. Model 1 depicts the total effect and illustrates that men in female-dominated majors have a signifcan tly lower risk (1.4 percentage points) of switching to a major with the same or lower proportion of men than men in gender-typical majors. In contrast, they have a very small and signif cantly higher risk (0.7 percentage points) of switching to a major with at least a 5% higher proportion of men than men in male-dominated majors. This result is in line with H1 and supports the assumption that not only female but also male token students are likely to leave their major and that majors with a larger proportion of tokens exert a pull factor on them. However, male students in female-dominated majors do not have a higher dropout risk than men in gender-typical majors.

Model 2 demonstrates, in accordance with Tinto's theory of student retention, that good social integration with other students decreases the risk of experiencing any of the three non-completion events.

Model 3 illustrates that increasing parental approval of the major reduces the risk of switching to a more female-dominated major but does not affect the risk of switching to a more male-dominated major and dropping out. Approval of the major by friends decreases both switching risks but does not impact dropout decisions. Overall, some evidence supports the assumption that parents and friends affect students' switching decisions. Similar to the results for women, it seems that disapproval of the major by parents and friends does not nudge students only towards a more gender-typical major but impacts students' general decision to switch the major.

In the second step, I conduct a mediation analysis for Model 3. Table 8 shows the results of the KHB decomposition of the total effect of the gender composition of

Table 7 Men: discrete-time survival analysis with competing risks. Source: https://doi.org/10.5157/NEPS:SC5:11.0.0, own calculations

	Event 1: Switching to major with lower or same prop. of same-sex students			Event 2: Switching to major with at least 5% higher prop. of same-sex students			Event 3: Drop out		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
Sex ratio in major (Ref: Male-dom.)									
Gender-balanced	–0.009***	–0.009***	–0.010***	0.001	0.001	0.001	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Female-dominated	–0.014***	–0.014***	–0.015***	0.007*	0.007*	0.005	–0.002	–0.002	–0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Social Integration[a]	–	–0.005*	–0.004*	–	–0.003*	–0.003*	–	–0.004*	–0.004*
	–	(0.002)	(0.002)	–	(0.001)	(0.001)	–	(0.002)	(0.002)
Approval of the major									
By parents	–	–	–0.002*	–	–	–0.001	–	–	–0.000
	–	–	(0.001)	–	–	(0.001)	–	–	(0.001)
By friends	–	–	–0.003*	–	–	–0.002***	–	–	0.000
	–	–	(0.001)	–	–	(0.001)	–	–	(0.001)
McFadden R^2 adj	0.096	0.103	0.110	0.096	0.103	0.110	0.096	0.103	0.110
N events	340			179			282		
N person-intervals	28,128								
N persons	4470								

Multinomial logistic regression, average marginal effects, clustered standard errors in parentheses

Covariates in all 3 models: time intervals, migratory background, parental education, age at enrollment, academic integration[a], aiming for teaching degree[a], university of applied science[a], working[a], health[a], advanced STEM course in high-school, high-school GPA, vocational training completed

Note: [a] time varying covariate

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

the major on the different non-completion behavior in the direct effect and indirect effect mediated through social integration and approval of the major by parents and friends. The mediation analysis reveals no signifcant indirect effect for social integration. Hence, the higher risk of men in female-dominated majors of switching to a less female-dominated major is not mediated by lower social integration. This is in line with my assumption that male tokens (and their non-completion behavior) are not affected by low levels of social integration within their f eld. The preliminary analyses already showed that men in female-dominated majors do not differ from men in male-dominated majors regarding their social integration.

Furthermore, there are no signif cant mediation effects for approval of the major by parents and friends. Although the preliminary analyses revealed that men in female-dominated majors are less likely to meet the approval of parents and friends with their choice of major, this disapproval does not contribute to the higher risk of male token students to switch to a major with at least a 5% higher proportion of men. Hence, the results do not support H3 for men.

In summary, the empirical evidence for male students partially supports H1. Men in gender-atypical majors have a signif cantly higher risk of switching to a major with at least a 5% higher proportion of men but not a signif cantly higher dropout risk. As expected, social integration does not explain the non-completion risk of male students. However, H3 also has to be rejected for men. Disapproval of the major by parents and friends also does not seem to be the cause of the higher risk for men in female-dominated majors of switching to a major with a higher proportion of men.

6.4 Robustness checks

The results are robust when I increase the threshold for switching to a major with a higher proportion of same-sex students to 10% instead of 5% as dependent variables (see appendix).

NEPS-SC5 is affected by panel attrition. 33% of the students leave the panel before the end of my observation period without having experienced any events. Most panel dropouts (30%) occur after the f rst survey wave. If students who drop out of higher education have a higher risk of leaving the panel because they lose interest in participating in a panel aimed at university students, my results might be biased by selectivity.

I conducted regression analysis to investigate whether there are signif cant differences between panel dropouts and students who continue to participate in the panel (results in the appendix). The results illustrate that students with a migratory background, older students, and students who report a high approval of their major by friends have a signifcantly higher probability of panel dropout. Students in male-dominated or female-dominated majors have a signif cantly lower panel dropout likelihood than students in gender-balanced majors. Furthermore, a very good or very bad high-school leaving certif cate GPA decreases the panel dropout probability compared to students with a good high-school GPA. Hence, I f nd evidence for selective panel attrition. I tried to address this by including control variables in my models which account for the differences between students that drop out of the panel

Table 8 Men: Mediation analyses. Source: https://doi.org/10.5157/NEPS:SC5:11.0.0, own calculations

Sex ratio in major (Ref: Male-dom., Gender-balanced not displayed)	Social integration			Approval of the major by parents			Approval of the major by friends		
	Event 1	Event 2	Event 3	Event 1	Event 2	Event 3	Event 1	Event 2	Event 3
Female-dominated									
Total effect	–1.800***	0.581*	–0.262	–1.750***	0.626*	–0.231	–1.745***	0.651*	–0.242
	(0.425)	(0.280)	(0.370)	(0.425)	(0.278)	(0.370)	(0.425)	(0.280)	(0.368)
Direct effect	–1.781***	0.602*	–0.240	–1.781***	0.602*	–0.240	–1.781***	0.602*	–0.240
	(0.425)	(0.280)	(0.370)	(0.425)	(0.280)	(0.369)	(0.425)	(0.280)	(0.369)
Indirect effect	–0.018	–0.021	–0.022	0.031	0.024	0.001	0.034	0.049	–0.001
	(0.070)	(0.020)	(0.022)	(0.018)	(0.020)	(0.016)	(0.019)	(0.027)	(0.011)
N persons	4470								

Decomposition of total effects into direct and indirect effects for model 3, multinomial logistic regression, logg ods, clustered standard errors in parentheses
Event 1: Switching to major with lower or same prop. of same-sex students; Event 2: Switching to major with at least 5% higher prop. of same-sex students; Event 3: Drop out
Covariates: time intervals, migratory background, parental education, age at enrollment, academic integration, aiming for teaching degree, university of applied science, working, health, advanced STEM course in high-school, high-school GPA, vocational training completed, social integration, approval of the major by parents, approval of the major by friends
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

and students who continue to participate in the survey. Nevertheless, panel attrition cannot be completely abolished by this method.

7 Summary and discussion

This paper focused on students that act against traditional gender norms and enter gender-atypical majors. I estimated discrete-time survival analyses with competing risks to investigate whether students in gender-atypical majors have a higher risk of dropping out or leaving for a more gender-typical major than students in gender-typical majors. Furthermore, I conducted a KHB decomposition to test whether social integration (only for women) and approval of the major by parents and friends (for both sexes) mediate the relationship between gender composition of the major and non-completion behavior.

The discrete-time survival analyses revealed that men and women in gender-atypical majors indeed have a signif cantly higher risk of switching to a major with at least a 5% higher proportion of same-sex students than students of the same gender in gender-typical majors. At the same time, they have a signif cantly lower risk of switching to a major with an equal or even lower proportion of same-sex students than do students in gender-typical majors. Additionally, women but not men in gender-atypical majors have a signif cantly higher dropout risk than their counterparts in gender-typical majors.

Regarding switching decisions, my results are partially in line with Riegle-Crumb et al. (2016). In a US study, these authors focused only on switching decisions and also found that men in gender-atypical majors have a higher probability of switching to a gender-balanced or male-dominated major than men in gender-typical majors. However, they did not f nd this effect for female token students. In contrast to Severiens and Dam (2012) and Smith and Naylor (2001), who analyze only university dropout of students in gender-atypical majors, I did f nd a positive association between the gender composition of the major and the dropout risk of women in male-dominated majors. However, I found no signif cant higher dropout risk for male token students, as in previous studies (Johnes and McNabb 2004; Severiens and Dam 2012).

Previous studies pooled all non-completion risks, only observed dropout decisions, only switching decisions, and/or did not look at the destinations of switching decisions. My results demonstrate how important it is to distinguish between different forms of non-completion risks and to consider the type of new major students choose when switching. My evidence suggests that students in gender-atypical majors do not have a generally higher non-completion risk or a higher risk of switching majors but have a higher risk of leaving the gender-atypical environment by switching to more gender-typical majors or, in the case of women, dropping out altogether. One can see that majors with a higher proportion of same-sex students exert a pull factor on students in gender-atypical majors. Therefore, my results seem to align with the assumptions of social control theory (Jacobs 1989) and tokenism (Kanter 1977a) which propose that men and women in the numerical minority are pushed to leave the gender-atypical f eld for a more gender-typical environment.

Additionally, I conducted a KHB decomposition to test whether the higher risk for women in gender-atypical majors of dropping out and switching to a major with a higher proportion of same-sex students than women in gender-typical majors is partly mediated by low levels of social integration. Based on Kanter (1977a) I assumed that dominants socially isolate female tokens. The results demonstrated that social integration cannot explain the female tokens' higher risk of dropping out and switching to a major with a higher proportion of same-sex students. Preliminary analyses showed that women in male-dominated majors are even better socially integrated than women in other majors. The decomposition analysis revealed a suppressor effect for women's dropout risk: the better social integration of female token students even reduces their dropout risk. In line with my assumptions, men in gender-atypical majors are unaffected by poorer social integration and their higher non-completion risk is not mediated by social integration.

The results are partly in line with previous fn dings with German data by Meyer and Strauß (2019). Meyer and Strauß also found that female token students report higher levels of social integration, and social integration does not mediate the association between the gender composition of a major and the higher non-completion risks of both men and women in gender-atypical f elds. However, in contrast to my f ndings, their descriptive results showed that men in female-dominated majors are integrated worse than men in male-dominated majors.

Overall, my evidence does not support Kanter's (1977a) assumption that female tokens are socially isolated and discriminated against by the dominants and that this is one of the causes that push women out of male-dominated f elds. Therefore, I cannot conclude that tokenism is one of the causes of the higher attrition risk of women in gender-atypical majors.

Furthermore, I conducted a KHB decomposition to test the mediation effect of parents and friends' approval of the major. I assumed that parents and friends might act as social agents and inf uence students of both sexes in gender-atypical majors to comply with gender status beliefs and gender norms. However, the decomposition results demonstrated that the link between the gender composition of a major and non-completion risks is not mediated by approval of the major by parents and friends for men and women, with two exceptions:

In contrast to my expectation, the preliminary results showed that women in male-dominated majors are even more likely to receive parental approval than women in female-dominated majors. This parental approval protects female token students from experiencing an even higher risk of switching to a more female-dominated major. Nevertheless, results also demonstrated that women in gender-atypical majors more often meet disapproval from friends regarding their major choice, as preliminary results showed. The lower approval by friends partly mediates the association between the gender composition of the major and the risk of switching to a more female-dominated major. Consequently, the results only support that the gender status beliefs of friends drive women in gender-atypical majors to comply with gender norms and to opt for a more gender-typical environment. A selection effect might explain this. Students experiencing very strong pressure from important actors in their social environment to comply with traditional gender norms probably will not choose a gender-atypical major in the f rst place.

My analyses have some limitations. First, with my data and method, I could not identify causal effects. Therefore, the results only show associations. Second, I only observed a small number of events and few students in a gender-atypical major. Third, my measurement of the gender composition in the majors does not account for the different attrition rates of men and women in a major. When more and more tokens leave gender-atypical majors over time, the sex ratio in these majors becomes increasingly skewed. Tokens that persist longer in the major might experience greater pressure to leave. However, these tokens might have developed a coping strategy to remain (Kanter 1977a). Hence, I assume that a continuously measured sex ratio might not overly affect the results. Fourth, the NEPS-SC5 is affected by panel attrition. Students who drop out of higher education might also have a higher probability of panel dropout. I tried to address this issue by controlling for factors that increase the panel dropout probability. Nevertheless, the results for dropout of higher education might be biased.

Nevertheless, the overall results conf rm the picture of a "leaky pipeline" for both women and men. The few students who choose a pathway contradicting gender norms and enroll in gender-atypical studies are more likely to leave this path, opting for a more gender-typical f eld or, in the case of women, dropping out of higher education altogether. These switching decisions subsequently lead to a further reinforcement of occupational gender segregation. The explanation for this robust effect should be addressed in further studies with a larger sample of students in gender-atypical majors. Future research might explore other explanations for the higher attrition risk of women and men in gender-atypical majors.

8 Appendix

8.1 Samples and imputation

The following variables are imputed in both samples: age at enrollment, social integration, academic integration (i.e., affective involvement, achievement orientation, expectation fulf llment), health, high-school GPA, disapproval of major by parents, disapproval of major by friends.

Social and academic integration are measured once per year. The frst measurement occurs in students' second semester, which corresponds to the second time interval in my discrete-time survival analyses. Missing values on social and academic integration for students who drop out or switch the major before measuring these variables (i.e., in the f rst time interval) are imputed.

8.2 Detailed description of the operationalization of social and academic integration

8.2.1 Social integration

In the NEPS, social integration is measured by three items of the Social Integration Scale (Schiefele et al. 2002). Students rate how much the following statements apply to them:

Table 9 Sample women (5% threshold) before imputation

	Count	Mean	Standard deviation	Min	Max	Percent missing
Time intervals	33,238	4.161	2.420	1	10	0
Migratory background	33,238	–	0.420	0	1	0
At least one parent with higher education	33,238	–	0.500	0	1	0
Age at enrollment in century months	33,238	352.056	43.661	–78	409	0
Affective involvement	21,289	3.725	0.864	1	5	35.95
Achievement orientation	21,289	3.628	0.816	1	5	35.95
Expectation fulfllm ent	22,015	2.654	0.659	1	4	33.77
Aiming for a teaching degree	33,238	–	0.228	0	1	0
University of applied science	33,238	–	0.456	0	1	0
Working	33,238	–	0.500	0	1	0
Health	30,096	4.296	0.705	1	5	9.45
Precollege STEM Education	33,238	–	0.589	0	2	0
High-school GPA	32,444	2.104	0.624	1	4.2	2.39
Vocational Training completed	33,238	–	0.410	0	1	0
Gender composition of major	33,238	–	0.319	0	3	0
Social Integration	22,092	3.095	0.658	1	4	33.53
Approval of the major by parents	28,653	4.217	0.890	1	5	13.79
Approval of the major by friends	28,637	3.907	0.932	1	5	13.84

Table 10 Sample Men (5% threshold) before imputation

	Count	Mean	Standard deviation	Min	Max	Percent missing
Time intervals	28,128	4.187	2.431	1	10	0
Migratory background	28,128	–	0.421	0	1	0
At least one parent with higher education	28,128	–	0.500	0	1	0
Age at enrollment in century months	28,128	350.965	33.451	–159	402	0
Affective involvement	16,917	3.742	0.839	1	5	39.86
Achievement orientation	16,917	3.416	0.856	1	5	39.86
Expectation fulfllm ent	17,393	2.615	0.662	1	4	38.16
Aiming for a teaching degree	28,128	–	0.151	0	1	0
University of applied science	28,128	–	0.484	0	1	0
Working	28,128	4.409	0.672	0	5	0
Health	25,857	–	0.646	1	3	8.07
Precollege STEM Education	28,128	–	0.554	0	2	0
High-school GPA	27,511	2.277	0.646	1	5	2.19
Vocational Training completed	28,128	–	0.427	0	1	0
Gender composition of major	28,128	–	0.353	0	3	0
Social Integration	17,804	3.043	0.655	1	4	36.70
Approval of the major by parents	23,501	4.315	0.831	1	5	16.45
Approval of the major by friends	23,475	3.907	0.954	1	5	16.54

- I have been successful in building contacts with other students during my studies to date.
- I know a lot of classmates with whom I can exchange ideas about questions in my f eld of study.
- I have many contacts with students in my cohort.

Response options for all items range from 1—does not apply at all, to 4—applies completely. The scale shows a good internal consistency (cronbach's alpha 0.84). I built an index with the mean over all three items of the construct.

8.2.2 Academic integration

The NEPS captures academic integration by measuring three different aspects: achievement orientation, affective involvement, and fulf lment of expectation. The frst two aspects are measured by six items of the Academic Commitment Scale (Grässmann et al. 1998). The NEPS developmental study showed that these six items represent two discriminable factors: affective involvement and achievement orientation (Dahm and Lauterbach 2016). Each subdimension consists of three items.

Achievement orientation Students rate how much the following statements apply to them:

- I no longer do anything more for my studies than that which is absolutely necessary.
- When it comes to performing in this degree program, I always set myself the highest standards.
- I invest a lot of energy in being successful in my degree program.

Response options for all three items range from 1—does not apply at all, to 5—applies completely. The scale shows a sufficient internal consistency (cronbach's alpha 0.74). I built an index with the mean over all three items of the construct.

Affective involvement Students rate how much the following statements apply to them:

- I really enjoy my degree program.
- Frankly, my degree program is not really all that fun.
- I can fully identify with my degree program.

Response options for all the items range from 1—does not apply at all, to 4—applies completely. The scale shows a good internal consistency (cronbach's alpha 0.85). I built an index with the mean over all three items of the construct.

Fulfillment of expectation Another aspect of academic integration according to Tinto, is performance. Since it is hard for students to evaluate their performance compared to other students in the first year of their studies, the NEPS measures the perceived academic performance by three items of the Fulfllment of Achievement Expectation Scale (Trautwein et al. 2007). The items capture whether the students' achievement expectation has been realized. Students rate how much the following statements apply to them:

- I have fully met my own expectations for my performance and grades in this degree program.
- My academic achievements (grades) are better than I had originally expected.
- I am satisfed with my performance in the degree program.

Response options for all three items range from 1—does not apply at all, to 4—applies completely. The scale shows a sufficient internal consistency (cronbach's alpha 0.78). For the analysis, I built an index with the mean over all three items of the construct.

All social and academic integration measurement scales show sufficient internal consistency and factorial validity (Dahm and Lauterbach 2016). Further information on the measurement of social integration and academic integration in the NEPS starting cohort 5 can be found at Dahm and Lauterbach 2016.

Table 11 Women: discrete-time survival analysis with competing risks (5% threshold). Source: https://doi.org/10.5157/NEPS:SC5:11.0.0, own calculations

	Event 1: Switching to major with lower or same prop. of same-sex students			Event 2: Switching to major with at least 5% higher prop. of same-sex students			Event 3: Drop out		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
Time interval (Ref: Interval 1)									
Interval 2	0.010***	0.010***	0.010***	0.008***	0.008***	0.008***	0.003	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interval 3	0.001	0.001	0.001	0.002	0.002	0.002	–0.003	–0.003	–0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interval 4	0.002	0.002	0.002	–0.002	–0.002	–0.002	0.005*	0.004*	0.004*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interval 5	–0.005**	–0.005**	–0.004**	–0.007***	–0.007***	–0.007***	–0.002	–0.003	–0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interval 6	–0.006***	–0.006***	–0.006***	–0.007***	–0.007***	–0.007***	–0.002	–0.002	–0.002
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interval 7	–0.006***	–0.006***	–0.006***	–0.009***	–0.009***	–0.008***	–0.006***	–0.007***	–0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Interval 8	–0.007***	–0.007***	–0.007***	–0.007***	–0.007***	–0.007***	–0.004	–0.004*	–0.004*
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interval 9	–0.005*	–0.005**	–0.005*	–0.008***	–0.009***	–0.008***	–0.005*	–0.005*	–0.005*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interval 10	–0.005	–0.005	–0.004	–0.008***	–0.008***	–0.008***	0.006	0.005	0.005
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.005)	(0.004)	(0.004)
Migratory background	0.000	0.000	0.000	–0.002	–0.002	–0.002	–0.001	–0.001	–0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
At least one parent with higher education	–0.001	–0.001	–0.002	–0.001	–0.001	–0.001	–0.000	–0.001	–0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

Table 11 (Continued)

	Event 1: Switching to major with lower or same prop. of same-sex students			Event 2: Switching to major with at least 5% higher prop. of same-sex students			Event 3: Drop out		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
Age at enrollment	0.000*	0.000*	0.000*	0.000	0.000	0.000	–0.000**	–0.000*	–0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Affective involvement[a]	0.001	0.001	0.002	0.003*	0.003**	0.003**	–0.004***	–0.003*	–0.003*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Achievement orientation[a]	0.001	0.001	0.001	0.000	0.000	0.000	–0.002	–0.001	–0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Expectation fulfllment[a]	–0.001	–0.001	–0.001	–0.000	–0.000	–0.000	–0.004**	–0.004*	–0.004*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Teaching degree[a]	–0.003	–0.003	–0.002	–0.003	–0.003	–0.002	–0.006*	–0.006	–0.006
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
University of applied science[a]	–0.005***	–0.005***	–0.005***	–0.007***	–0.006***	–0.006***	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Working[a]	–0.000	–0.000	–0.001	0.002	0.001	0.001	–0.000	–0.000	–0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Health[a]	–0.000	–0.000	0.000	–0.001	–0.001	–0.001	–0.001	–0.001	–0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Precollege Education (Ref: no advanced STEM course)									
Advanced STEM course	–0.002	–0.002	–0.002	0.002	0.002	0.001	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
No course choice	–0.001	–0.002	–0.002	0.006	0.006	0.005	0.006	0.005	0.005
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
High-school GPA	0.003***	0.003***	0.003**	0.005***	0.005***	0.004***	0.007***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

Table 11 (Continued)

	Event 1: Switching to major with lower or same prop. of same-sex students			Event 2: Switching to major with at least 5% higher prop. of same-sex students			Event 3: Drop out		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
Vocational Training completed	–0.006**	–0.006**	–0.006**	–0.005*	–0.005**	–0.004*	–0.001	–0.001	–0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Sex ratio in major (Ref: Female-dom.)									
Gender-balanced	–0.005***	–0.005***	–0.005***	0.008***	0.008***	0.008***	0.002	0.002	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Male-dominated	–0.007***	–0.007***	–0.007***	0.021***	0.022***	0.022***	0.005*	0.005**	0.005**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Social Integration[a]	–	–0.002*	–0.002	–	–0.003**	–0.003*	–	–0.005***	–0.005***
	–	(0.001)	(0.001)	–	(0.001)	(0.001)	–	(0.001)	(0.001)
Approval of the major									
By parents	–	–	–0.002***	–	–	–0.002***	–	–	0.000
	–	–	(0.001)	–	–	(0.001)	–	–	(0.001)
By friends	–	–	–0.002**	–	–	–0.002**	–	–	0.000
	–	–	(0.001)	–	–	(0.001)	–	–	(0.001)
McFadden R^2 adj	0.106	0.114	0.123	0.106	0.114	0.123	0.106	0.114	0.123
N events	247			249			245		
N person-intervals	33,238								
N persons	5322								

Multinomial logistic regression, average marginal effects, clustered standard errors in parentheses
Note: [a] time varying covariate
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Table 12 Men: discrete-time survival analysis with competing risks (5% threshold). Source: https://doi.org/10.5157/NEPS:SC5:11.0.0, own calculations

	Event 1: Switching to major with lower or same prop. of same-sex students			Event 2: Switching to major with at least 5% higher prop. of same-sex students			Event 3: Drop out		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
Time interval (Ref: Interval 1)									
Interval 2	0.013***	0.013***	0.013***	0.005*	0.005*	0.005*	0.008***	0.008***	0.008***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interval 3	0.011***	0.011***	0.011***	0.004*	0.004*	0.004*	0.003	0.003	0.003
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interval 4	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.004	0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interval 5	–0.002	–0.002	–0.002	0.002	0.001	0.002	0.001	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interval 6	–0.005*	–0.005*	–0.005*	–0.003*	–0.003*	–0.003*	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Interval 7	–0.008***	–0.008***	–0.008***	–0.003*	–0.004*	–0.003*	–0.003	–0.003	–0.003
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Interval 8	–0.006*	–0.006*	–0.006*	–0.003*	–0.003*	–0.003*	–0.003	–0.003	–0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interval 9	–0.007*	–0.007*	–0.007*	–0.000	–0.000	–0.000	–0.005*	–0.005*	–0.005*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
Interval 10	0.001	0.001	0.002	–0.002	–0.002	–0.001	0.009	0.008	0.008
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)
Migratory background	0.002	0.002	0.002	–0.002	–0.002	–0.002	–0.003	–0.003*	–0.003*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
At least one parent with higher education	0.000	–0.000	–0.001	0.000	–0.000	–0.000	0.003*	0.003*	0.003*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

Table 12 (Continued)

	Event 1: Switching to major with lower or same prop. of same-sex students			Event 2: Switching to major with at least 5% higher prop. of same-sex students			Event 3: Drop out		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
Age at enrollment	0.000	0.000	0.000	–0.000	–0.000	–0.000	–0.000*	–0.000*	–0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Affective involvement[a]	0.001	0.002	0.003	0.002*	0.002*	0.003*	–0.005***	–0.004*	–0.004*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Achievement orientation[a]	–0.002	–0.002	–0.002	–0.001	–0.000	–0.001	–0.001	–0.001	–0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Expectation fulfllment[a]	–0.004*	–0.004*	–0.004*	–0.004***	–0.004*	–0.004*	–0.010***	–0.010***	–0.010***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Teaching degree[a]	0.002	0.002	0.003	–0.003	–0.003	–0.002	0.002	0.002	0.002
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
University of applied science[a]	–0.009***	–0.008***	–0.009***	–0.004***	–0.004*	–0.004*	0.004*	0.004*	0.004*
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Working[a]	0.001	0.001	0.001	–0.002*	–0.002	–0.002	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Health[a]	–0.002	–0.001	–0.001	–0.001	–0.000	–0.000	–0.001	–0.001	–0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Precollege Education (Ref: no advanced STEM course)									
Advanced STEM course	0.007***	0.007***	0.007***	–0.000	–0.000	–0.000	–0.001	–0.001	–0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
No course choice	0.000	0.000	0.001	–0.002	–0.002	–0.002	0.006	0.006	0.006
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)	(0.004)
High-school GPA	0.007***	0.006***	0.006***	0.003*	0.002*	0.002*	0.009***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

Table 12 (Continued)

	Event 1: Switching to major with lower or same prop. of same-sex students			Event 2: Switching to major with at least 5% higher prop. of same-sex students			Event 3: Drop out		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
Vocational Training completed	–0.006*	–0.006*	–0.006*	–0.002	–0.002	–0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Sex ratio in major (Ref: Male-dom.)									
Gender-balanced	–0.009***	–0.009***	–0.010***	0.001	0.001	0.001	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Female-dominated	–0.014***	–0.014***	–0.015***	0.007*	0.007*	0.005+	–0.002	–0.002	–0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Social Integration[a]	–	–0.005*	–0.004*	–	–0.003*	–0.003*	–	–0.004*	–0.004*
	–	(0.002)	(0.002)	–	(0.001)	(0.001)	–	(0.002)	(0.002)
Approval of the major									
By parents	–	–	–0.002*	–	–	–0.001	–	–	–0.000
	–	–	(0.001)	–	–	(0.001)	–	–	(0.001)
By friends	–	–	–0.003*	–	–	–0.002***	–	–	0.000
	–	–	(0.001)	–	–	(0.001)	–	–	(0.001)
McFadden R^2 adj	0.096	0.103	0.110	0.096	0.103	0.110	0.096	0.103	0.110
N events	340			179			282		
N person-intervals	28,128								
N persons	4470								

Multinomial logistic regression, average marginal effects, clustered standard errors in parentheses
Note: [a] time varying covariate
+ <0.07, *p<0.05, **p<0.01, ***p<0.001

8.4 Robustness checks: results with a 10% threshold

Table 13 Women: discrete-time survival analysis with competing risks (10% threshold). Source: https://doi.org/10.5157/NEPS:SC5:11.0.0, own calculations

	Event 1: Switching to major with lower or same prop. of same-sex students	Event 2: Switching to major with at least 5% higher prop. of same-sex students	Event 3: Drop out
	M3	M3	M3
Sex ratio in major (Ref: Female-dom.)			
Gender-balanced	–0.004***	0.007***	0.002
	(0.001)	(0.001)	(0.001)
Male-dominated	–0.007***	0.022***	0.005**
	(0.002)	(0.003)	(0.002)
Social Integration[a]	–0.002*	–0.002*	–0.005***
	(0.001)	(0.001)	(0.001)
Approval of the major			
By parents	–0.002***	–0.002***	0.000
	(0.001)	(0.001)	(0.001)
By friends	–0.002***	–0.002***	0.000
	(0.001)	(0.001)	(0.001)
McFadden R^2 adj	0.125	0.125	0.125
N events	265	231	245
N person-intervals	33,238		
N persons	5322		

Multinomial logistic regression, average marginal effects, clustered standard errors in parentheses
Covariates in all 3 models: time intervals, migratory background, parental education, age at enrollment, academic integration[a], aiming for teaching degree[a], university of applied science[a], working[a], health[a], advanced STEM course in high-school, high-school GPA, vocational training completed
Note: [a] time varying covariate
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Table 14 Men: discrete-time survival analysis with competing risks (10% threshold). Source: https://doi.org/10.5157/NEPS:SC5:11.0.0, own calculations

	Event 1: Switching to major with lower or same prop. of same-sex students	Event 2: Switching to major with at least 5% higher prop. of same-sex students	Event 3: Drop out
	M3	M3	M3
Sex ratio in major (Ref: Female-dom.)			
Gender-balanced	–0.010***	0.000	0.002
	(0.002)	(0.001)	(0.001)
Male-dominated	–0.015***	0.005+	–0.002
	(0.002)	(0.003)	(0.003)
Social Integration[a]	–0.004*	–0.003*	–0.004*
	(0.002)	(0.001)	(0.002)
Approval of the major			
By parents	–0.002*	–0.001	–0.001
	(0.001)	(0.001)	(0.001)
By friends	–0.003***	–0.002*	0.000
	(0.001)	(0.001)	(0.001)
McFadden R^2 adj	0.110	0.110	0.110
N events	355	164	282
N person-intervals	28,128		
N persons	4470		

Multinomial logistic regression, average marginal effects, clustered standard errors in parentheses
Covariates in all 3 models: time intervals, migratory background, parental education, age at enrollment, academic integration[a], aiming for teaching degree[a], university of applied science[a,] working[a], health[a], advanced STEM course in high-school, high-school GPA, vocational training completed
Note: [a] time varying covariate
$+p < 0.07$, $*p < 0.05$, $**p < 0.01$, $***p < 0.001$

8.5 Robustness checks: panel attrition

Table 15 Logistic regression with panel dropout as dependent variable. Source: https://doi.org/10.5157/NEPS:SC5:11.0.0, own calculations

	Panel dropout
Gender composition of the major (Ref: gender-balanced)	
Male-dominated	–0.235***
	(0.062)
Female-dominated	–0.121*
	(0.051)
Missing	–1.074*
	(0.491)
Woman	–0.045
	(0.050)
Migratory background	0.157**
	(0.050)
At least one parent with higher education	0.026
	(0.043)
Age at enrollment (Ref: 1. Quantile)	
2. Quantile	0.321***
	(0.082)
3. Quantile	0.394***
	(0.089)
4. Quantile	0.341***
	(0.092)
5. Quantile	0.406***
	(0.092)
Teaching degree	0.053
	(0.051)
University of applied science	0.007
	(0.061)
High-school GPA (Ref: 2.0–2.9)	
1.0–1.9	–0.176***
	(0.050)
3.0–3.9	0.106
	(0.063)
4.0–5.0	–2.438*
	(1.114)
Missing	0.115
	(0.146)
Vocational training completed	–0.017
	(0.082)

Table 15 (Continued)

	Panel dropout
Children in the household (Ref: no)	
Yes	0.115
	(1.103)
Missing	2.816***
	(0.053)
High-school certificate (Ref: Abitur)	
No Abitur	–0.012
	(0.073)
Missing	1.939***
	(0.171)
Social integration (Ref: 1. Quantile)	
2. Quantile	–0.109
	(0.081)
3. Quantile	–0.058
	(0.060)
Missing	0.393***
	(0.049)
Approval of the major by parents (Ref: 1. Quantile)	
2. Quantile	–0.028
	(0.132)
3. Quantile	0.172
	(0.121)
Missing	–0.121
	(0.300)
Approval of the major by parents (Ref: 1. Quantile)	
2. Quantile	0.208*
	(0.103)
3. Quantile	0.358***
	(0.099)
Missing	0.672*
	(0.290)
Constant	–2.405***
	(0.158)
Pseudo R^2	0.332
N	17,249

Logistic regression, log odds, standard errors in parentheses
Dependent variable: panel dropout before the end of the observation period of 6 years and without experiencing an event.
Based on the initial sample of the NEPS-SC5 with 17,910 students. 661 observations are omitted due to collinearity of missing values on sex, migratory background, parental education, age, vocational training completed, teaching degree, university of applied science.
The signif cant positive correlation between missings on social integration and panel attrition might be caused by the fact that 30% of panel dropouts occur after wave 1 and social integration is measured in wave 2
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

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Conflict of interest R. Jusri declares that he/she has no competing interests.

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