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# The influence of gender composition in a field of study on students' drop-out of higher education

**Jasmin Meyer** | **Susanne Strauß**

Department of History and Sociology, University of Konstanz, PO Box 26, Konstanz, Germany

**Correspondence**
Jasmin Meyer, Department of History and Sociology, University of Konstanz, PO Box 26, 78457 Konstanz, Germany.
Email: jasmin.meyer@uni-konstanz.de

**Abstract**

Combining Tinto's classical model of student drop-out with Kanter's assessment of minorities, this article examines the influence of gender composition in a field of study on drop-out from higher education. Our empirical analysis is based on a sample of students who left German higher education in 2014. Our results confirm previous findings that women in gender-atypical subjects show a higher drop-out risk than their male fellow students. We assess several mechanisms which could contribute to explain this effect. Contrary to our expectations, social integration, in the sense of contact with lecturers, seems to be a protective factor for women and men in gender-atypical subjects. For women in gender-atypical fields of study, contact with peers is an additional protective factor against drop-out. The most important mechanism to explain higher education drop-out is women's more negative self-assessment of their suitability for male-dominated subjects.

## 1 | INTRODUCTION

As a result of educational expansion, women have overtaken men in participation in higher education. Whilst in some countries (France, Portugal, Sweden, the US) this happened as early as the 1980s, in Germany it took until 2005 to reach gender parity (Vincent-Lancrin, 2008). Today, women participate more often in higher education than men and obtain better grades in almost all levels of education (Buchmann, DiPrete, & McDaniel, 2008). At the same time, we observe persisting horizontal gender differences. Men and women still conform to gender

stereotypes when selecting their subject, with women studying subjects such as educational sciences or medicine, whilst men tend to opt for engineering or computer sciences (Charles & Bradley, 2002; OECD, 2016).

If students—male or female—decide to study a subject which is atypical for their gender, they could be socially less integrated or even discriminated against by their fellow students or faculty members. Moreover, students in atypical fields of study could have greater doubts about their abilities in the subject than their fellow students of the opposite gender (Murray, Meinholdt, & Bergmann, 1999). Ultimately, this could lead to early drop-out or a change of subject. Since women's competencies in the public sphere in general and in male-dominated fields in particular tend to be evaluated more critically (Ridgeway, 2011), it can be assumed that women in gender-atypical subjects are even more affected by these mechanisms than men. Hence, our research question: Are students studying in a gender-atypical field of study more likely to drop out than those in a gender-typical subject? And if so, is this the case for men and women in gender-atypical subjects alike?

We address the question in Germany which is a latecomer regarding gender parity in higher education participation. In terms of horizontal segregation, its performance is very similar to the OECD average (Vincent-Lancrin, 2008). Our study contributes to the existing literature on this topic in two ways. On the one hand, we were able to measure gender composition in specific fields of study for each higher education institution separately. Thus, although engineering is generally a highly male-dominated field of study, we do have female students of engineering in our sample who study in an exclusively female study environment. With our data, we were able to differentiate between these situations. For this purpose, we analyse data from a study conducted in 2015 by the German Centre for Higher Education Research and Science Studies (DZHW) which surveyed a representative sample of students who left a German higher education institution in 2014. This database is supplemented with data from the German Federal Statistical Office which provides information about gender composition in fields of study for each higher education institution. On the other hand, we combine Tinto's (1975) student drop-out model with Kanter's (1977) theoretical perspective on minorities by asking how Tinto's main driving forces of student drop-out, namely lack of academic and social integration, impact on students in gender-atypical subjects. More precisely, we assess the influence of two mechanisms on students' drop-out risk: social integration with fellow students and faculty members on the one hand and academic integration in the sense of self-assessment of academic performance on the other.

## 2 | LITERATURE REVIEW

Regarding the question as to whether men or women leave their field of study without obtaining a degree more often, we find contradictory results for the US. Whilst some studies in single colleges and specific subjects report higher attrition rates for women (Alarcon & Edwards, 2013; Ishitani, 2003), Buchmann and DiPrete (2006) find a higher college completion rate for female students than for their male counterparts in their study of younger cohorts. For Germany, Heublein (2014) also reports a higher drop-out rate for men (32%) than for women (24%).

Female and male students in gender-atypical subjects drop out of their study programmes for different reasons. Women in male-dominated subjects are often faced with a difficult climate on campus. Murray et al. (1999) sum up research about US higher education that shows women being marginalised or harassed, for instance by sexualised jokes. Moreover, fellow students and teachers tend to have doubts about female students' talent for subjects such as engineering or the natural sciences (Murray et al., 1999). Derboven and Winker (2010) also document for Germany a lack of social integration of female students with their peers in engineering subjects. Analysing students in two engineering majors (computer sciences, mechatronics) at a Middle European university, Kronberger and Horwath (2013) find that the fact that women drop out from engineering subjects can be explained by self-doubt and poor social integration rather than insufficient grades, whilst the latter was a good predictor for their male fellow students' drop-out.

The situation of men in female-dominated subjects is largely under-researched. One article which addresses this issue, based on Dutch data, explains men's unease in female-dominated subjects by their fear of poor labour

market opportunities, feelings of not belonging and a lack of support from their parents and friends (Severiens & Dam, 2012).

Research analysing the effect of gender composition in subjects on student drop-out and on decisions to change their field of subject is very rare. Rogers and Menaghan (1991) show that female students change their field of study less often when they study a male-dominated subject. In gender-balanced fields, it is mostly women who change their field of study. Riegle-Crumb, King, and Moore (2016) examine US undergraduate students in gender-atypical fields of study: Whereas women in male-dominated fields are not more likely to change their subject than women in other fields, men in female-dominated majors are more likely to change their subject than their male peers specialising in other fields of study. Based on an analysis of British higher education students, Johnes and McNabb (2004) show that women are more likely to drop out if their proportion in a subject is high, whereas men have a lower risk of dropping out if they study in mainly female environments. Based on a survey of students at selected Norwegian colleges, Mastekaasa and Smeby (2008), on the contrary, cannot find any effect of gender composition on male drop-outs. At the same time, female students show lower drop-out rates in female-dominated subjects.

These contradictory findings are not surprising since the studies differ not only in terms of country context, but also in operationalisation and methodological design. Thus, studies differ in whether they focus exclusively on changes in the field of study (Riegle-Crumb et al., 2016) or on drop-out decisions (Johnes & McNabb, 2004) or both (Mastekaasa & Smeby, 2008). Moreover, the reference group varies between studies, i.e., sometimes women in gender-atypical subjects are compared with their male peers in the same subjects (Johnes & McNabb, 2004; Mastekaasa & Smeby, 2008) and sometimes with women in gender-typical subjects (Riegle-Crumb et al., 2016). Studies also differ in how they measure gender composition within a field of study: Whilst some include continuous measures (Johnes & McNabb, 2004), others work with different thresholds (Mastekaasa & Smeby, 2008; Riegle-Crumb et al., 2016). All studies which include representative national data collapse gender composition in a field of study across all higher education institutions and thus hide variance within subjects across institutions.

## 3 | THEORETICAL FRAMEWORK

When trying to explain the situation of minorities, one of the most prominent theoretical frameworks is Kanter's (1977) principle of tokenism. The author differentiates between groups whose members differ in outstanding characteristics such as gender or ethnicity. Those in the smaller and under-represented groups are defined as tokens, those in the larger group as dominants (p. 208). Tokens are not perceived as individuals but as representatives of their group. For example, a few women in predominantly male groups are merely viewed as stand-ins for all women (p. 207). Therefore, minorities are faced with the following three problems: First, they are more visible. Thus, a few female engineering students are more visible for their male fellow students, as well as for teachers. Second, the dominants become more aware not only of their similarities with other dominants, but also and especially of what sets the tokens apart. Thus, male engineering students could notice differences in leisure activities or learning styles between them and their (few) female fellow students. Finally, when dominants include the tokens in the group, they stereotype them so that they are not judged by their real behaviour but by their expected behaviour (p. 210f.). Since stereotypes expect women in male-dominated fields of study to be less competent than their male peers, this could lead to negative evaluations by their male fellow students, which could, in turn, increase women's doubts regarding their subject choice and consequently their drop-out risk. From these arguments, we deduce the following hypothesis:

> H1: *Students in gender-atypical fields of study have a higher risk of leaving their study programmes without obtaining a degree (drop-out or change of study programme) than students specialising in a gender-typical field of study.*

Women in gender-atypical fields of study could be more affected by these unfavourable conditions than men in the same situation. The theory of gender status beliefs (Ridgeway, 2011) argues that men are considered to be more capable and powerful, especially in male-associated fields. The combination of women's greater difficulties in social integration and greater negative (self-) perceptions of their competencies in male-dominated fields should increase the drop-out risk for women in male-dominated subjects compared to men in female-dominated subjects. We therefore deduce the following:

> H1a: *Female students in gender-atypical subjects have a higher risk of leaving their study programme without obtaining a degree than male students in gender-atypical subjects*

In a second step, we aim to understand the mechanisms that could lead to unfavourable situations for men and women in atypical subjects. Tinto (1975) was one of the first to suggest a theoretical model explaining student drop-out. He developed his approach over the following two decades (1987, 1993) into a longitudinal interactionist model of student departure. The idea is that students must integrate the higher education institution academically and/or socially. Both the social and the academic system are seen as separate but connected. Whilst the first mainly refers to peer-group and faculty interactions, the latter refers to the student's grade performance and intellectual development (Tinto, 1975, p. 95).

Although Tinto's model has gained near paradigmatic status (Yorke & Longden, 2004), it has been criticised for a number of reasons: First, the broadness of the constructs of academic and social integration has led to problems with consistency in use (Kuh & Love, 2000, p. 197; Yorke & Longden, 2004, p. 79). Moreover, much of the understanding of student retention builds on research in the US, which makes it risky to extrapolate results to the situation of students in other countries (Yorke & Longden, 2004, p. 75). The most comprehensive empirical and conceptual assessment of Tinto's theory by Braxton, Sullivan, and Johnson (1997) concludes that only five of Tinto's original 13 primary propositions find support. Overall, however, we agree with Braxton (2000) that it makes more sense to continue working with Tinto's theoretical approach and develop it further than 'to start a new theoretical journey'. We therefore build on the assumption that social and academic integration influence students' risk of dropping out. As Tinto (1975) argues, drop-out is likely if students have no stable interaction with their fellow students and teaching staff but friendships with fellow students and faculty support can work as a social reward and thus become part of a person's generalised evaluation of the costs and benefits of continuing higher education. Well-integrated students experience better support and share the common values of the higher education institutions. Hence, with regard to the first factor in Tinto's model, social integration, our respective hypotheses read:

> H2a: *The higher risk of leaving tertiary education without a degree in gender-atypical subjects can to some extent be explained by poor social integration in terms of lacking contact with fellow students*.

> H2b: *The higher risk of leaving tertiary education without a degree in gender-atypical subjects can to some extent be explained by poor social integration in terms of lacking contact with faculty members*.

Following the theory of gender status beliefs (Ridgeway, 2011), we argue that the situation should be more difficult for female students in male-dominated subjects than for their male counterparts in female-dominated fields of study because of the more critical perception of women's competencies in male-dominated fields. This could also lead to less faculty interaction for women in male-dominated subjects, which leads us to the following hypothesis:

> H2c: *The negative effect of lacking social integration (in terms of contact with fellow students and faculty, H2a–b) is expected to be stronger for women in gender-atypical subjects than for men in gender-atypical subjects*.

With regard to the second factor that Tinto (1975) identifies as essential for student retention, namely academic integration, we measure it as perceived academic performance. Grades are the most visible form of extrinsic reward in the academic system. Low grades are thus a feedback which should be counted as cost in the students' internal evaluation and thus increase their risk of dropping out. Students' academic performance is, however, hardly ever assessed objectively in surveys; instead, we often have self-assessed academic performance measures which quantify both objective abilities and the student's subjective perception of this performance. Moreover, this is likely to be linked to a gender bias in the sense that women tend to assess their academic performance more critically than men, especially in male-dominated fields of study (Möller & Trautwein, 2015, p. 191). This could be caused by the 'stereotype threat' which causes women to underachieve because of negative stereotypes of their academic ability (Aronson, Quinn, & Spencer, 1998). Since women in gender-atypical subjects tend to be confronted with doubts regarding their competencies, they could be more affected by doubts about their personal suitability for the subject. On the contrary, men are expected to be more able to handle the demands which are necessary for successfully completing their studies, even in gender-atypical subjects. From these arguments we deduce the following:

H3: *The higher drop-out risk of students in gender-atypical subjects can to some extent be explained by a lower self-assessment of their own academic performance*

H3a: *This effect is stronger for women than for men in gender-atypical subjects*

## 4 | DATA AND METHODS

Our empirical analyses are based on a survey conducted by the German Centre for Higher Education Research and Science Studies (DZHW). From January to May 2015, a standardised survey was undertaken with a representative selection of students who had left a German higher education institution in the 2014 summer semester. First, a clustered sample of 60 higher education institutions was drawn and a random selection of students was contacted. Special institutions such as colleges of administration, art academies or private universities were not included. The reasons for leaving higher education were manifold: some dropped out of their study programme, others changed their subject of study and some graduated. Overall, 6,029 students took part in the survey. An additional larger sample was drawn in the Federal State of Baden-Württemberg so that the overall number of cases reached 8,773. The students were primarily asked about their reasons for dropping out (Heublein, Hutzsch, & König, 2015).

For the analysis below, we reduced the sample to 6,093 cases. First, we did not include the small group of students who were over 40 (about 1% of our sample). Furthermore, we only analysed students who aspired to a bachelor's degree or a state examination,[1] excluding older forms of degree programmes which involved substantially different study conditions and students who aspired to a second degree who had already decided to change their subject once before. Since students from the Federal State of Baden-Württemberg are over-represented in the sample, we weighted the Federal States for our calculations by adapting the distribution in the sample to the real distribution (derived from the German Federal Statistical Office).

The *drop-out* variable combines student drop-outs and subject changes in one dummy variable.[2] Graduates are used as the comparative group. Since our focus is on measuring potential difficulties for students in gender-atypical fields of study, we consider students to be in a *gender-atypical field of study* if their gender makes up less than 35% of students in their subject at their local higher education institution. Our classification of fields of study is based on that of the German Statistical Office which differentiates between 78 subjects. Our dataset includes 58 of these 78 subjects. Fields of study with more than 35% of men or women are the comparison group.[3] Additional important variables include both the students' *gender* and an interaction between gender and belonging to a

gender-atypical field of study. Furthermore, we control for the *difficulty of the programme* by calculating mean values of students' (subjective) assessment within each field of study, measured on a 5-point Likert scale whereby higher values stand for greater difficulty.[4]

The students' *social integration* is measured by two variables. The first measures students' contact with fellow students. It is operationalised by a factor variable which we built on the basis of a set of six items, such as contact intensity with fellow students or participation in learning groups, ranging from −2.4 to 1.7 (factor loadings all above 0.6, see Appendix Table A1). The higher the value of the factor variable, the better the students' social integration through contact with their fellow students. The second variable measures whether students report having contact with faculty members outside class. This aspect is measured using a 5-point scale, with higher values indicating better contact.

Academic integration is measured by the students' assessment of their *academic performance* in comparison with their fellow students' using a 5-point scale whereby low values indicate those who assess their performance as lower than that of their fellow students. Because a student's academic self-assessment can mostly be seen as a subjective evaluation, we add not only the already mentioned difficulty of the subject level, but also students' final school grade (Abitur) (which ranges in Germany on a scale from 1 to 6, with higher values indicating lower performance) as a control.

Building on previous research which identified a number of additional factors influencing social and/or academic integration and higher education drop-out and could thus potentially confound our main effects, we added the following control variables: The first is whether students reported having a job that was related to their field of study. Those who responded as not employed were allocated to the lowest category. As previous research has shown, although work off campus is an adverse factor, especially when it involves high weekly working hours, work on campus, e.g., jobs in direct contact with faculty members, actually reduces drop-out risk (Pascarella & Terenzini, 2005, pp. 414–415). In Germany, student assistant jobs are available in all subject areas (Statistisches Bundesamt, 2017, p. 35).

Whether students obtained a *general higher education entrance qualification* (Abitur) or another kind of higher education entrance qualification such as a field-specific entrance qualification (Fachabitur) can be an indicator of whether they are well enough prepared for the demands of their study programme. Moreover, their educational background contains a dummy variable that measures whether they completed *vocational training* before. According to Heublein (2014), a student's decision to drop out of higher education can be influenced by available alternatives such as working in a vocational occupation. The characteristics of the higher education institution and the study programme consist of the following variables: Students attending a *university* show higher drop-out rates than students at universities of applied sciences and students attending *teacher training* have lower drop-out rates (Heublein et al., 2017). *Restricted admission* and studying the *preferred subject* can also lead to greater motivation to complete the study programme. Apart from the students' educational history, we also took their parents' educational background into account, using a dummy variable which provides information on whether at least one of the parents holds an academic degree. Research shows that 'first generation students' in particular, i.e., students whose parents did not attend tertiary education, experience difficulties in higher education (Ishitani, 2003). We checked on a 5-point scale whether students had access to sufficient financial means, whereby higher values stand for better *ensured financing*. Moreover, having *children* of one's own can be a factor which leads to student drop-out because of additional time restrictions. Finally, a number of personality traits were included in the models: *Students' self-efficacy* as a factor variable (based on three items, factor loadings all above 0.8, see Appendix Table A1) and *conscientiousness*, one of the Big Five personality traits which was identified in previous research as being of special relevance for success in higher education (Van Bragt, Bakx, Bergen, & Croon, 2011). Moreover, we controlled for *students' attitudes towards learning*, i.e., whether they were self-organised and well prepared for exams, including a factor variable (based on five items, factor loadings all above 0.5, see Appendix Table A1). In a final step, we controlled with factor variables for the students' *study choice motives*, which can be

extrinsic, intrinsic, motivated by the council of others or social motives.[5] As other studies show, both extrinsic (Blüthmann, Lepa, & Thiel, 2008) and intrinsic motives (Heublein et al., 2017) have an impact on drop-out.

In the multivariate analysis, we calculated logistic regression models whereby students' drop-out or subject change were the dependent variables and students' gender, affiliation with a gender-atypical field of study and the interaction effect of the two variables were the independent variables. This explanatory variable is considered as the direct effect. Moreover, we included three variables in our models which we expected to work as mechanisms, i.e., they should indirectly increase students' drop-out risks. These include contact with fellow students and faculty and self-assessment of academic performance compared with fellow students. All other variables described above represent control variables in this study.

To check whether higher drop-out risks of students in gender-atypical fields of study could, to some extent, be explained by differences in social and academic integration, we calculated models which assessed the importance of the mentioned indirect effects on drop-out risks in gender-atypical subjects (Kohler, Karlson, & Holm, 2011). The method compared the estimated coefficients of two nested non-linear probability models in order to analyse how far social integration and the self-assessment of academic performance mediated the relationship between a gender-atypical subject and student drop-out.

## 5 | RESULTS

In a first step, we present descriptive results showing the distributions of relevant variables for women and men in gender-atypical and gender-typical fields of study (see Table 1).

Concerning social integration, the data partly show different results from those expected. Women in general are socially better integrated by their fellow students, whether they study in a gender-typical (0.04) or a gender-atypical field of study (0.18), than men in gender-atypical (−0.16) or gender-typical (−0.09) subjects. Similarly, women in gender-atypical subjects are better integrated in terms of faculty contact (2.32) than women in

**TABLE 1** Social integration and academic performance by gender and gender composition

| | Women in gender-atypical subjects | Men in gender-atypical subjects | Women in gender-typical subjects | Men in gender-typical subjects |
|---|---|---|---|---|
| Contact with fellow students | | | | |
| Mean | 0.18*** | −0.16*** | 0.04*** | −0.09*** |
| Standard deviation | 1.01 | 1.02 | 1.00 | 0.98 |
| *N* | 415 | 302 | 3,005 | 2,363 |
| Contact with lecturers | | | | |
| Mean | 2.32*** | 2.66*** | 2.21*** | 2.09*** |
| Standard deviation | 1.29 | 1.36 | 1.25 | 1.21 |
| *N* | 415 | 302 | 3,005 | 2,363 |
| Self-assessment of the academic performance | | | | |
| Mean | 1.74*** | 2.25*** | 2.23*** | 1.82*** |
| Standard deviation | 1.12 | 1.10 | 1.04 | 1.11 |
| *N* | 415 | 302 | 3,005 | 2,363 |

*Note:* The first variable (fellow students) is a factor variable, ranging from −2.4 to 1.7, where 0 stands for average social integration, negative values for below average and positive values for above average contact with fellow students. Contact with lecturers is measured on a 5-point Likert scale, where higher values stand for more contact and a higher relation respectively. The last variable is measured on a scale from 0 to 4, where 0 indicates that the students classify themselves in the lowest category and 4 stands for the highest category.
Significance of T-Tests: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

**TABLE 2** Logistic regression of student dropout, odds ratios and standard deviations

| Dropout | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Woman | 0.534*** (0.045) | 0.716*** (0.065) | 0.753** (0.074) |
| Gender-atypical subject | 0.667* (0.117) | 0.940 (0.168) | 1.102 (0.211) |
| Gender-atypical subject * woman | 2.825*** (0.666) | 1.538 (0.379) | 0.898 (0.236) |
| Fellow students | 0.772*** (0.032) | 0.761*** (0.031) | 0.789*** (0.035) |
| Contact with lecturers | 0.859*** (0.025) | 0.862*** (0.026) | 0.805*** (0.026) |
| Academic performance | 0.411*** (0.018) | 0.463*** (0.021) | 0.459*** (0.024) |
| Difficulty of programme | | 2.559*** (0.305) | 1.959*** (0.264) |
| Abitur grade | | 1.387*** (0.091) | 1.258** (0.092) |
| Related employment | | 0.696*** (0.018) | 0.695*** (0.019) |
| University (ref.: Univ. of applied sciences) | | | 0.234*** (0.034) |
| Teacher training | | | 1.188 (0.133) |
| Restricted admission | | | 1.255* (0.119) |
| Preferred subject | | | 0.464*** (0.044) |
| General higher education entrance qualification (ref.: field-specific) | | | 0.931 (0.169) |
| Previous vocational training completed | | | 0.952 (0.129) |
| Parent with academic degree | | | 0.897 (0.075) |
| Financing ensured | | | 0.877*** (0.034) |
| Own children | | | 0.546** (0.115) |
| Self-efficacy | | | 0.928 (0.042) |
| Conscientiousness | | | 1.109*** (0.031) |
| Attitudes towards learning | | | 0.908 (0.049) |
| Choice motive: extrinsic | | | 1.024 (0.048) |
| Choice motive: intrinsic | | | 1.241*** (0.051) |
| Choice motive: council of others | | | 0.948 (0.043) |
| Choice motive: social motives | | | 1.275*** (0.055) |
| Constant | 84.085 (12.431) | 0.997 (0.509) | 17.409 (11.402) |
| Pseudo $R^2$ | 0.224 | 0.237 | 0.298 |
| *N* | 6,085 | 6,085 | 6,085 |

*Source*: Survey of German university leavers 2014, DZHW, own calculations, weighted by Federal States; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

gender-typical subjects (2.21). They are also better integrated in this respect than men in gender-typical subjects (2.09). Only men in gender-atypical subjects report even better faculty contact (2.66) (see Table 1). Table 1 also shows that women studying gender-atypical subjects judge their academic performance as lower than that of men (lower values stand for lower categories). This seems to reflect gender stereotypes regarding competencies which attribute higher STEM competencies to men and a greater aptitude for humanities subjects to women (Möller & Trautwein, 2015, p. 191).

Finally, we present the results of the multivariate analysis to see whether the group differences hold true if we control for other variables that could influence student drop-out (see Table 2). The coefficients are presented as odds ratios.[6]

Model 1 indicates that men in general have a higher drop-out risk than women (see Table 2). Furthermore, students in gender-atypical subjects are more likely to leave higher education without a degree than those who study gender-typical subjects. But the latter effect can be explained by the control variables that are added in models 2 and 3. Therefore we cannot confirm the hypothesis that students in gender-atypical subjects generally have a higher drop-out risk (H1). Rather, the experiences leading to drop-out seem to be mediated through gender, social integration and subject-specific characteristics, as well as their interactions. Looking at the interaction between students' gender and their enrolment in a gender-typical or gender-atypical subject, we see a significant positive effect. This implies that women studying a gender-atypical subject face a drop-out risk which is 1.5 times higher than men's (model 1) and almost twice the women's in a gender-typical field of study.[7] In model 2, we added average difficulty of the field of study (mean value within study programme) (see Table 2). These results show that the more difficult a study programme is evaluated, the higher the risk of students dropping out. This variable can also explain differences between male and female students in gender-atypical subjects. As we add the variable, interaction between gender and gender-atypical subject loses its significance. Therefore, we can only partially confirm the hypothesis that female students in gender-atypical subjects generally have a higher drop-out risk than male students (H1a). Instead, the direct effect of gender composition on drop-out risk seems to be explained by the mean (perceived) difficulty of the subject field.

As for the mediating variables, model 1 shows, on the contrary, that both explanatory factors show the expected effects, as suggested in H2a–H2c: Students who report having less social contact with their fellow students are more likely to drop out. Students who report less faculty contact are more likely to leave without obtaining a degree. Finally, the worse the students rate their academic performance in comparison with their fellow students, the more likely they are to drop out. Effects of all three variables are similar for men and women; interaction effects are thus not significant (additional calculations, not shown here). In model 3, which includes all control variables, gender still plays a significant role, whereby women generally show a lower drop-out risk than men (see Table 2).

To check whether students' higher drop-out risk in gender-atypical subjects can to some extent be explained by poor social integration, measured by contact with fellow students and faculty or low academic self-assessment, we used the Kohler-Karlson-Holm method to identify direct and indirect effects (Kohler et al., 2011). Table 3

**TABLE 3** Logistic regressions of student drop-out, direct and indirect effects of social integration and academic performance with control variables, log odds and standard deviations

| | Social integration (Fellow students) | | Social integration (Contact with lecturers) | |
|---|---|---|---|---|
| | Men | Women | Men | Women |
| Reduced | 0.188 (0.185) | −0.114 (0.171) | 0.089 (0.185) | −0.137 (0.171) |
| Full | 0.153 (0.185) | −0.062 (0.171) | 0.153 (0.185) | −0.062 (0.171) |
| Difference | 0.035 (0.018) | −0.052** (0.019) | −0.063** (0.023) | −0.074*** (0.019) |
| *N* | 2,665 | 3,420 | 2,665 | 3,423 |
| | Self-assessment of academic performance | | | |
| | Men | Women | | |
| Reduced | 0.199 (0.182) | 0.006 (0.168) | | |
| Full | 0.164 (0.182) | −0.096 (0.168) | | |
| Difference | 0.035 (0.052) | 0.102** (0.038) | | |
| *N* | 2,665 | 3,420 | | |

*Source*: Survey of German university leavers 2014, DZHW, own calculations, weighted by Federal States; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

shows the results for men and women whereby the estimated effect of the reduced model shows the total effect, for instance that of studying a gender-atypical subject on student drop-out. The coefficient of the full model lists the direct effect of studying a gender-atypical field of study, controlling for social integration and academic performance. The estimated difference stands for the indirect effect. We see that for women in gender-atypical fields of study, contact with fellow students reduces their drop-out risk, as the difference effect is statistically significant. For both genders, contact with faculty protects against drop-out. Finally, negative self-assessment in gender-atypical subjects contributes to the higher drop-out risk of women (H3 only confirmed for women, H3a confirmed). For self-assessment of academic performance and social integration in the sense of contact with fellow students, we can confirm that it plays a stronger role for women than for men (H2c, H3a). We can thus conclude that the higher drop-out risk of women in gender-atypical subjects is mainly mediated by their negative self-assessment. Women's good social integration with fellow students and faculty serves as a protective factor which prevents even higher drop-out rates.

## 6 | CONCLUSION

In this article we sought to explain student drop-outs and programme changes by the gender composition in different fields of study. Based on Tinto's (1975) classical model, we assessed the influence of academic integration in the sense of self-assessed academic performance and social integration with fellow students and teaching staff on drop-out risk. Along with Kanter's (1977) analysis of minorities, we argued that students in gender-atypical subjects, especially women in male-dominated subjects, had a higher risk of low academic and social integration and thus faced a higher drop-out risk. In comparison with other studies explaining student drop-outs in gender-atypical subjects, we calculated gender composition in a field of study locally for each higher education institution, thus being able to rely on more precise information and more variance.

Our analysis confirms earlier German findings that female students have a generally lower drop-out risk than men (Heublein & Wolter, 2011). Students in gender-atypical fields of study show a higher risk of dropping out. This effect is even stronger for women than for men. However, when controlling for the average perceived difficulty of a study programme, the effect vanishes. This is in line with previous research in the US which showed that the gap in grades partly explained why students in business, education and humanities had higher persistence rates than those in physical sciences and engineering (King, 2015). Also, previous studies pointed to the fact that female students (studying physical sciences at a large US élite research university) seemed to be more responsive to grades than male students (Ost, 2010).

Contrary to expectations based on theories on minorities (Kanter, 1977), students in atypical fields of study seemed to be socially well integrated with their fellow students. Moreover, we see that contact with faculty members serves as a protective factor for both men and women in gender-atypical subjects. Academic integration in the sense of self-assessment of one's academic performance seems, however, to play a role: As predicted by Tinto's (1975) model, academic integration in the sense of negative self-assessment increases students' costs when evaluating the personal benefits of the study programme and consequently increases their drop-out risk. In particular, women in gender-atypical subjects tend to assess their academic performance more negatively than their male counterparts. In view of previous findings that women's grades in higher education are on average higher than men's (Buchmann et al., 2008), this suggests that women assess their academic performance more negatively than their male fellow students. We therefore conclude that women in gender-atypical subjects are at particular risk of drop-out because of an overly critical self-assessment which could be related to gender stereotypes about female competencies in male-dominated subjects.

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## ENDNOTES

[1] In Germany, subjects such as medicine, law and teacher training end with a state examination.

[2] One should note, however, that students in our sample who indicated that they had changed their field of study had also changed their higher education institution. They thus constitute a specific sub-group, which could resemble students who drop out rather than the average student who changes the field of subject at the same institution. This could explain why—in previous versions of this article where we estimated multinomial logistic regressions—we did not find different effects for both. We therefore decided to collapse both to one binary dependent variable.

[3] We did some robustness checks empirically with other threshold values, since minorities are defined differently in theory. Since we could not find any differences between the models, we opted for the 35% threshold which reflects Kanter's (1977) suggestion.

[4] To create meaningful values, we only calculated mean values for fields of study which included more than 10 respondents.

[5] These factor variables are built on a set of 13 items measuring the four different study choice motives (factor loadings are all above 0.5 with the exception of "scientific interest", which has a factor loading of 0.4 on intrinsic motivation, see Appendix Table A1).

[6] Odds ratios indicate the change in the odds for a unit change in the explanatory variable, holding all other variables constant. Values greater than 1 indicate positive effects; negative effects show values between 0 and 1. Odds ratios cannot be interpreted as probabilities (Scott Long, 1997, p. 82).

[7] This interpretation is based on the multiplication of odds ratios in model 1:2.825*0.667 = 1.9 for a woman in a gender-atypical versus a gender-typical field of study; 2.825*0.534 = 1.5 for a woman versus a man in an atypical field of study.

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## APPENDIX

**TABLE A1.** Factors, item wording and factor loadings

| Factors | Item wording | Factor loadings |
|---|---|---|
| Self-efficacy | In difficult situations I can rely on own my skills | 0.824 |
| *(Agreement: 1 = do not agree at all to 5 = perfectly agree)* | Most problems I can master well on my own | 0.860 |
| | I can normally also solve arduous and complicated tasks | 0.851 |
| Big Five: Conscientiousness | I am laid-back, tend to be lazy | index (1 to 9, sum of two items with 5-point scale) |
| | I complete tasks thoroughly | |
| Social integration: fellow students | It was easy for me to maintain contact to fellow students | 0.80 |
| *(Agreement: 1 = do not agree at all to 5 = perfectly agree)* | I had close contact with fellow students in my department | 0.87 |
| | I frequently worked together with other students in a study group | 0.75 |
| | I had more contact with friends outside university than with fellow students | 0.60 |
| | Having contact and communication with fellow students had a decisively positive impact on my studies | 0.75 |
| | During my studies, I felt I was on my own | 0.68 |
| Students' attitudes towards learning | I had the resources to organize my studies very well | 0.68 |
| *(Agreement: 1 = do not agree at all to 5 = perfectly agree)* | Normally, I prepared for and finished homework for my courses on my own | 0.75 |
| | I actively participated in class | 0.51 |
| | I usually put off the preparation of exams until the last minute | 0.71 |
| | During my studies I was able to draw on my potential and expand my capabilities to the full | 0.64 |

(Continues)

**TABLE A1** (Continued)

| Factors | Item wording | Factor loadings |
|---|---|---|
| Reason for subject choice | | |
| *(Agreement: 1 = do not agree at all to 5 = perfectly agree)* | | |
| extrinsic | good labour market opportunities | 0.88 |
| | possibility of high income | 0.91 |
| | aspiration for prestigious occupation | 0.77 |
| intrinsic | personal talent | 0.70 |
| | wish for personal development | 0.67 |
| | scholarly interest | 0.40 |
| | professional interest | 0.74 |
| | fixed career aspiration | 0.54 |
| advice of others | advice from parents/relatives | 0.87 |
| | advice from friends/acquaintances | 0.88 |
| | advice from study or occupational counselor | 0.65 |
| social motives | to help other people | 0.88 |
| | to have a lot of contact with people at my work | 0.88 |