Do women outperform men? Gender differences in participation and performance in STEM and non-STEM university subjects of gender dominance



Motivation

- Women are less likely than men to choose STEM subjects (science, technology, engineering and mathematics), obtain fewer STEM university degrees and are underrepresented in the STEM workforce (Barone & Assirelli 2020; Statistisches Bundesamt 2023)
- The examination of performance is

Research Interest

- Examination of gender-specific differences in performance and success of students at module level from two perspectives is necessary:
- 1. between STEM and non-STEM study programmes
- 2. between female- and male-

Previous Research of Study Performance

- Previous studies of gender differences in STEM higher education have produced inconsistent results
- Some studies suggest an advantage for men and others for women in terms of overall academic performance, while others find no significant differences in performance between the genders (Matz

mainly limited to general academic performance at an aggregated level

dominated study programmes

Research Question: How do gender differences in student behaviour vary across STEM and gender-dominated programmes?

et al., 2017; Vooren et al.,2022)

 Only a few studies examine performance at module level; again, depending on the module content and course format, sometimes women and sometimes men perform better (Salehi et al., 2019; Whitcomb et al., 2020)

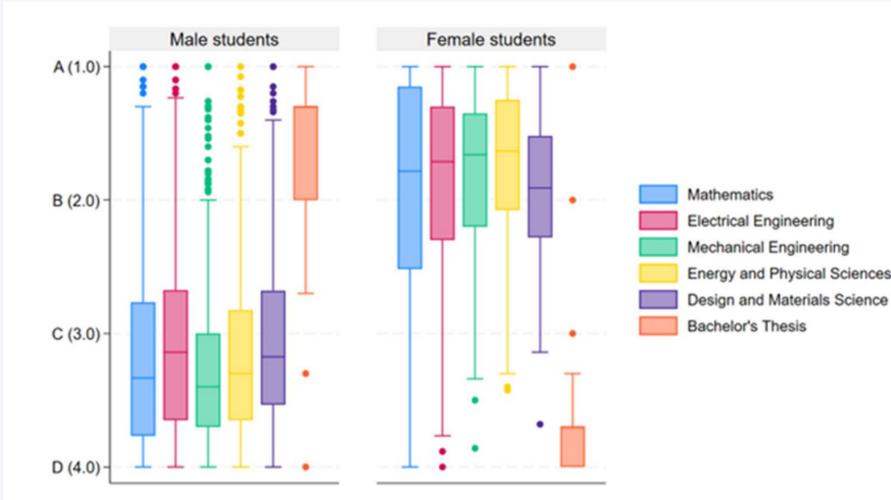
Data and Methods

Administrative data from a large German research university

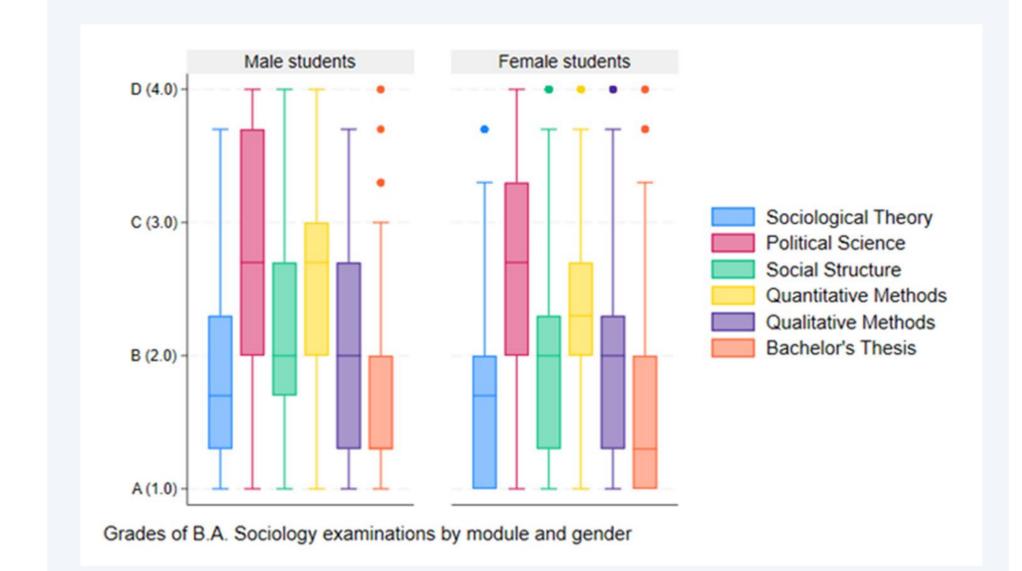
- Students in three study programmes
 - nine cohorts of B.S. Mechanical
 Engineering (N=3,290, 2017-2021)
 - **STEM, male-dominated**
 - five cohorts of B.A. Political

Differences in Grades

Male-dominated STEM



Female-dominated Non-STEM



Science (N=1,186, 2016-2021)
Non-STEM, male-dominated

- five cohorts of B.A. Sociology
 (N=1,377, 2016-2021)
 Non-STEM, female-dominated
- N = 5,853
- Gender differences in study behaviour: **t-tests and box plots**

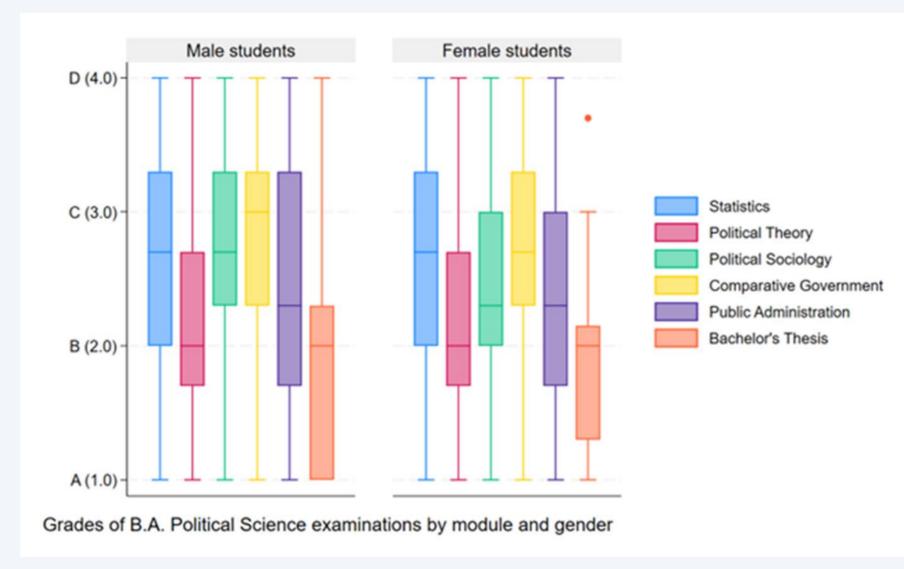
Differences in Participation Rates

	Women	Men	Difference (pp)
B.Sc. Mechanical Engineering			
Mathematics	0.38	0.40	1.9 (ns)
Electrical Engineering	0.43	0,47	4.1 (ns)
Mechanical Engineering	0.31	0.35	4.3 (+)
Energy and Physical Sciences	0.22	0.24	2.4 (ns)
Design and Materials Science	0.31	0.35	4.8 (*)
Bachelor's Thesis	0.04	0.05	1.2 (ns)
Energy and Physical Sciences Design and Materials Science	0.22 0.31	0.24 0.35	2.4 (ns) 4.8 (*)

B.A. Political Science

Grades of B.Sc. Mechanical Engineering examinations by module and gender

Male-dominated Non-STEM



Summary and Outlook

• Women tend to outperform men, regardless of whether they are studying a STEM degree programme or a gender-specific subject area

Differences in Exam Taking

	Women	Ν	/len	
B.Sc. Mechanical Engineering				
Mathematics				Positive significant
Electrical Engineering				Positive significant
Mechanical Engineering		Not sign	ificant	
Energy and Physical Sciences		Not sign	ificant	
Design and Materials Science		Not sign	ificant	
Bachelor's Thesis		Not significant		
B.A. Political Science				
Statistics		Not sign	ificant	
Political Theory				Positive significant
Political Sociology		Not sign	ificant	
Comparative Government	Positive significant			
Public Administration		Not sign	ificant	
Bachelor's Thesis		Not sign	ificant	
B.A. Sociology				
All Modules		Not sign	ificant	

Statistics	0.45	0.38	6.6 (*)
Political Theory	0.43	0.36	6.8 (*)
Political Sociology	0.41	0.38	2.8 (ns)
Comparative Government	0.52	0.45	6.5 (*)
Public Administration	0.43	0.39	3.7 (ns)
Bachelor's Thesis	0.40	0.33	7.0 (*)
B.A. Sociology			
Sociological Theory	0.53	0.47	6.4 (*)
Political Science	0.57	0.48	9.7 (***)
Social Structure	0.59	0.47	11.6 (***
Quantitative Methods	0.43	0.36	6.7 (*)
Qualitative Methods	0.43	0.38	5.2 (+)
Bachelor's Thesis	0.40	0.31	9.2 (***)

- Women achieve higher grades than men in some modules, regardless of programme
- In the subjects of the male-dominated STEM degree programme, men resit more often than women. In the male-dominated non-STEM degree programme, there are models in which women resit more often than men, and modules in which men resit more often
- Men have higher participation rates in STEM, while women have higher participation rates in non-STEM programmes
- Results cannot fully disentangle male-dominance and STEM effects; further studies are needed to fully investigate gendered student behaviour and its causes

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References:
Barone, C. & Assirelli, G. (2020). Gender segregation in higher education: an empirical test of seven explanations. Higher Education, 79, 55–78. https://doi.org/10.1007/s10734-019-00396-2
Federal Statistical Office (2023). Studierende in Mathematik, Informatik, Naturwissenschaft (MINT) und Technik-Fächern. URL: https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bildung-Forschung-Kultur/Hochschulen/Tabellen/studierende-mint-faechern.html
Matz, R. L., Koester, B. P., Fiorini, S., Grom, G., Shepard, L., Stangor, C. G., Weiner, B., & McKay, T. A. (2017). Patterns of Gendered Performance Differences at Five Research Universities. AERA Open, 3(4). https://doi.org/10.1177/2332858417743754
Salehi, S., Cotner, S., Azarin, S. M., Carlson, E. E., Driessen, M., Ferry, V. E., Harcombe, W., McGaugh, S., Wassenberg, D., Yonas, A., & Ballen, C. J. (2019). Gender performance gaps across different assessment methods and the underlying mechanisms: The case of incoming preparation and test anxiety. Frontiers in Education,
4. <u>https://doi.org/10.3389/feduc.2019.00107</u>
Vooren, M., Haelermans, C., Groot, W., & van den Brink, H. M. (2022). Comparing success of female students to their male counterparts in the STEM fields: an empirical analysis from enrollment until graduation using longitudinal register data. International Journal of STEM Education, 9(1). https://doi.org/10.1186/s40594-
<u>021-00318-8</u>
Whitcomb, K. M., Kalender, Z. Y., Nokes-Malach, T. J., Schunn, C. D., & Singh, C. (2020). Comparison of self-efficacy and performance of engineering undergraduate women and men. International Journal of Engineering Education, 36(6), 1996–2014.