

Gender disparities in career paths in math: findings from a mixed-method approach

Sophie Hofmeister (WZB), Anina Mischau (FU Berlin), Anna Ransiek (FU Berlin), Heike Solga (WZB)

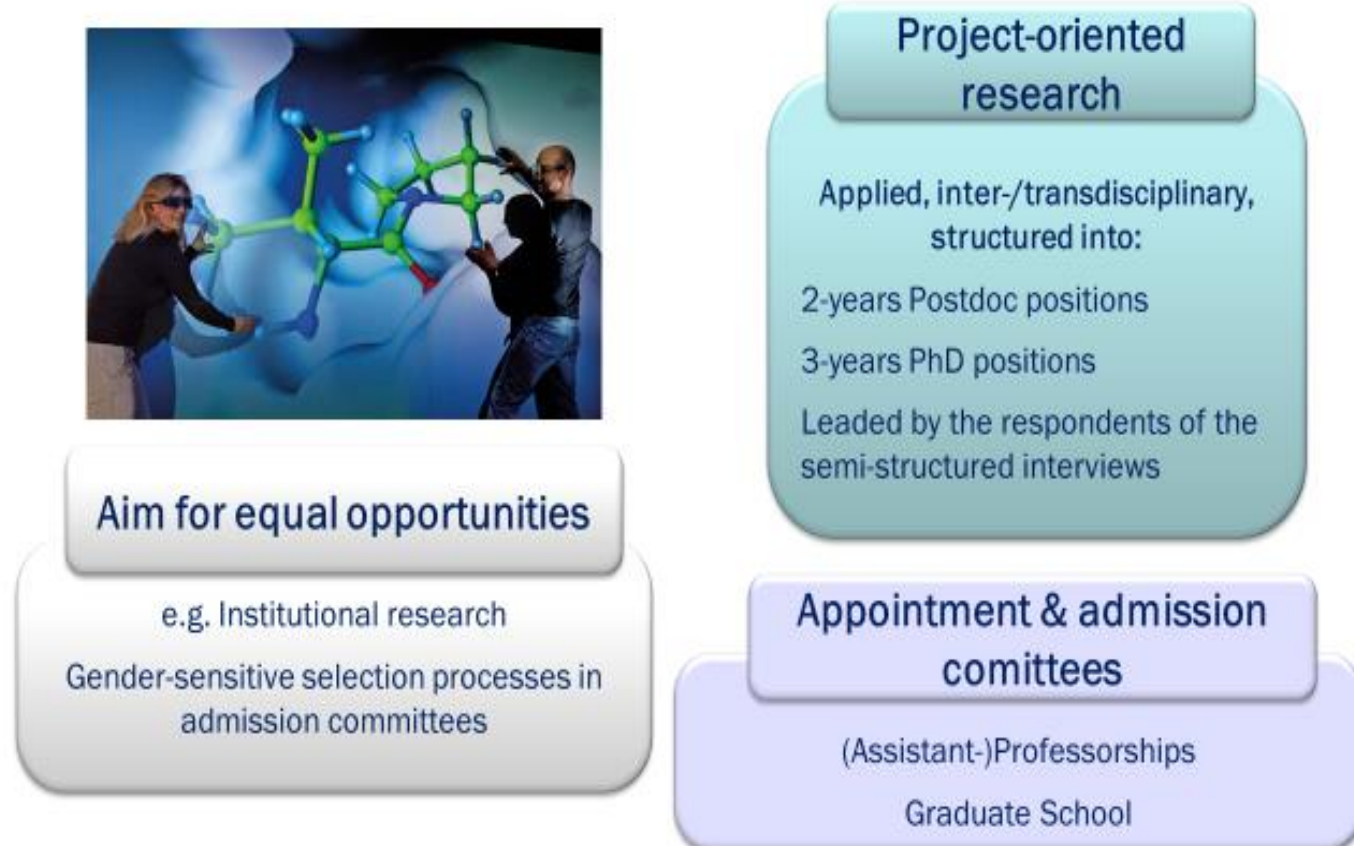
Introduction & Background

- Women still underrepresented among professorships in math (GWK 2021, Statistisches Bundesamt 2021)
- Two different explanations: *leaky pipeline* (Berryman 1983) and *glass ceiling* (Bryant 1984)
- Project goal: investigate possible causes and mechanisms that reproduce gender disparities in a mathematical cluster of excellence

Research Questions

Gendered patterns of gatekeeping & recruitment in different career stages

(RECRUITMENT) STRUCTURE OF THE CLUSTER



Two different approaches:

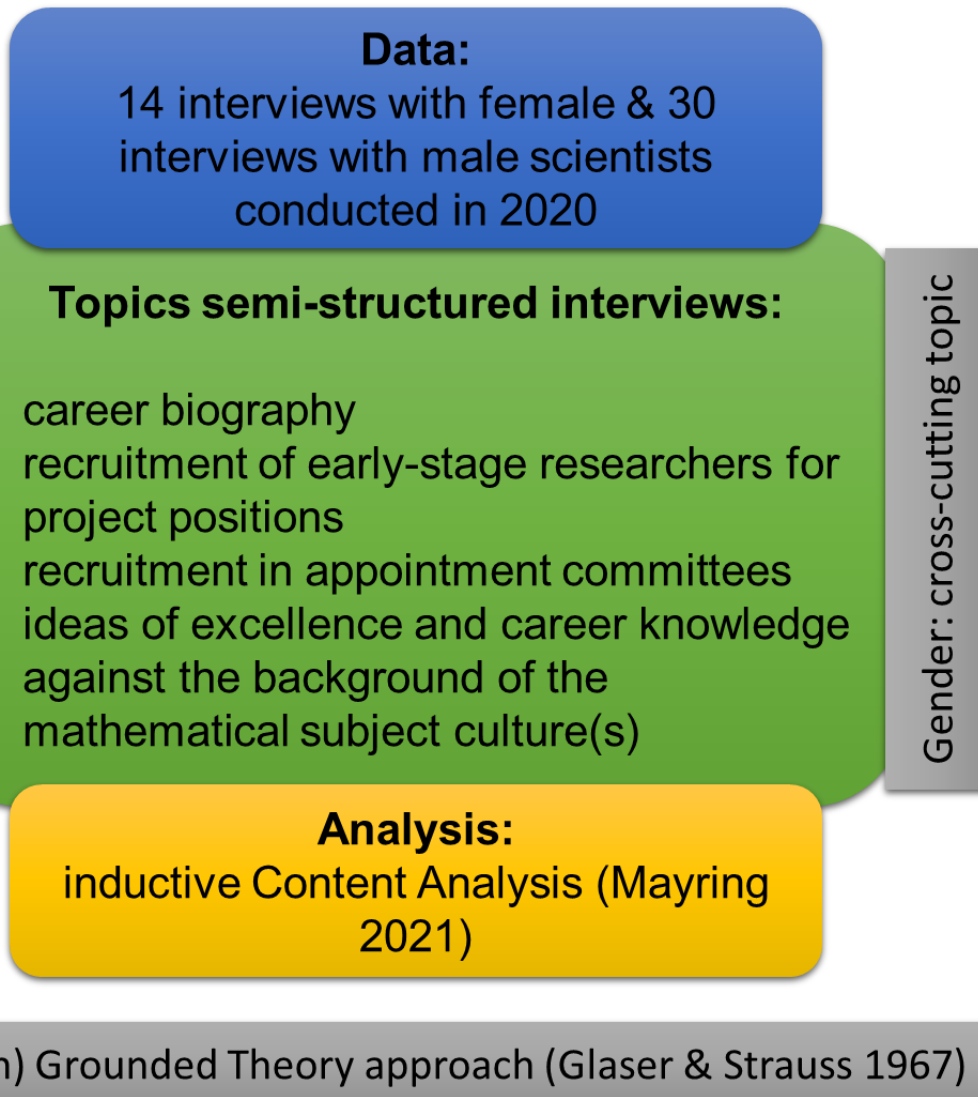
	Qualitative approach	Quantitative approach
Research questions	(1) What patterns of gendered gatekeeping in the recruitment of (early-stage) researchers for project positions can be found? (2) Are there variations for early- and later-stage researchers?	(1) Are there antifemale gender biases in the recruitment of (W1-) assistant professors? (2) Do we see preferential selection of equally qualified women?
State of research	<ul style="list-style-type: none"> Gendered gatekeeping as a reason for women's underrepresentation in academia (also in excellent research environments) (e.g. Husu 2004; Wolfram 2018) Gender stereotypes contribute to women being ignored in recruitment processes (Kahlert 2013) Affirmative action policies and excellence are perceived as mutually exclusive by German professors (Klammer et al. 2020) 	<ul style="list-style-type: none"> Hardly any studies on gender disparities in hiring for assistant professorships & mixed findings: gender biases against women (Gérhahni, Kulic, Liecht 2021) vs. no gender biases against women (e.g. Williams, Ceci 2015; Carlsson, Finseraas, Midtbeem, Guobjörg, Rafnsdóttir 2021, Henningsen, Horvath, Jonas 2021)
Research desiderata	No studies focusing on math and comparison between different job positions and career stages	Further validation needed

Data & Method

Qualitative approach

Semi-structured interviews

- Respondents: Scientists in leadership positions in research projects in the cluster (n=44)



Quantitative approach

Experimental data from factorial survey (vignette study)

- Respondents: German professors in Math/Physics (n=700), Social Sciences (n=908), German Studies (n=249)
- Rating of short fictitious profiles ("vignettes") of applicants for assistant (W1-) position in terms of (a) perceived competence and (b) likelihood of inviting the applicant to a job interview
- Between-subject design for applicant's gender

Dependent Variables	Scale
- Qualified - Invite	1-7
Vignette Dimensions	Levels
- Gender applicant	Female Male
- Type of position	Tenure-track Non-tenure track
- Publication type	Majority solo-authored (peer-reviewed) Majority co-authored (peer-reviewed) All co-authored (peer-reviewed)
- Research collaborations	With renowned scholars With scholars of same level
- Third-party funding	No (note does not appear) Successful acquisition
- Parental leave	No (note does not appear) 6 months parental leave
Fixed Characteristics & Control Variables	
Fixed characteristics: completed German PhD with <i>magna cum laude</i> (very good), 4 years work experience as Postdoc, Teaching experience	
Control variables: gender respondent, academic age respondent, other controls necessary for vignette analyses (e.g. position vignette within deck)	

Method: Multi-level linear models with random intercepts and Average marginal Effects (AME)

Results

Qualitative study

(1) Tendencies for reinforcement of gender disparities in recruitment of early-stage researchers for project positions due to:

Internal recruitment as a common practice

- Problematic when the proportion of women is low → proportion remains low
- Possible reinforcement of this cycle: female early-stage researchers perceived as unwilling to pursue academic career

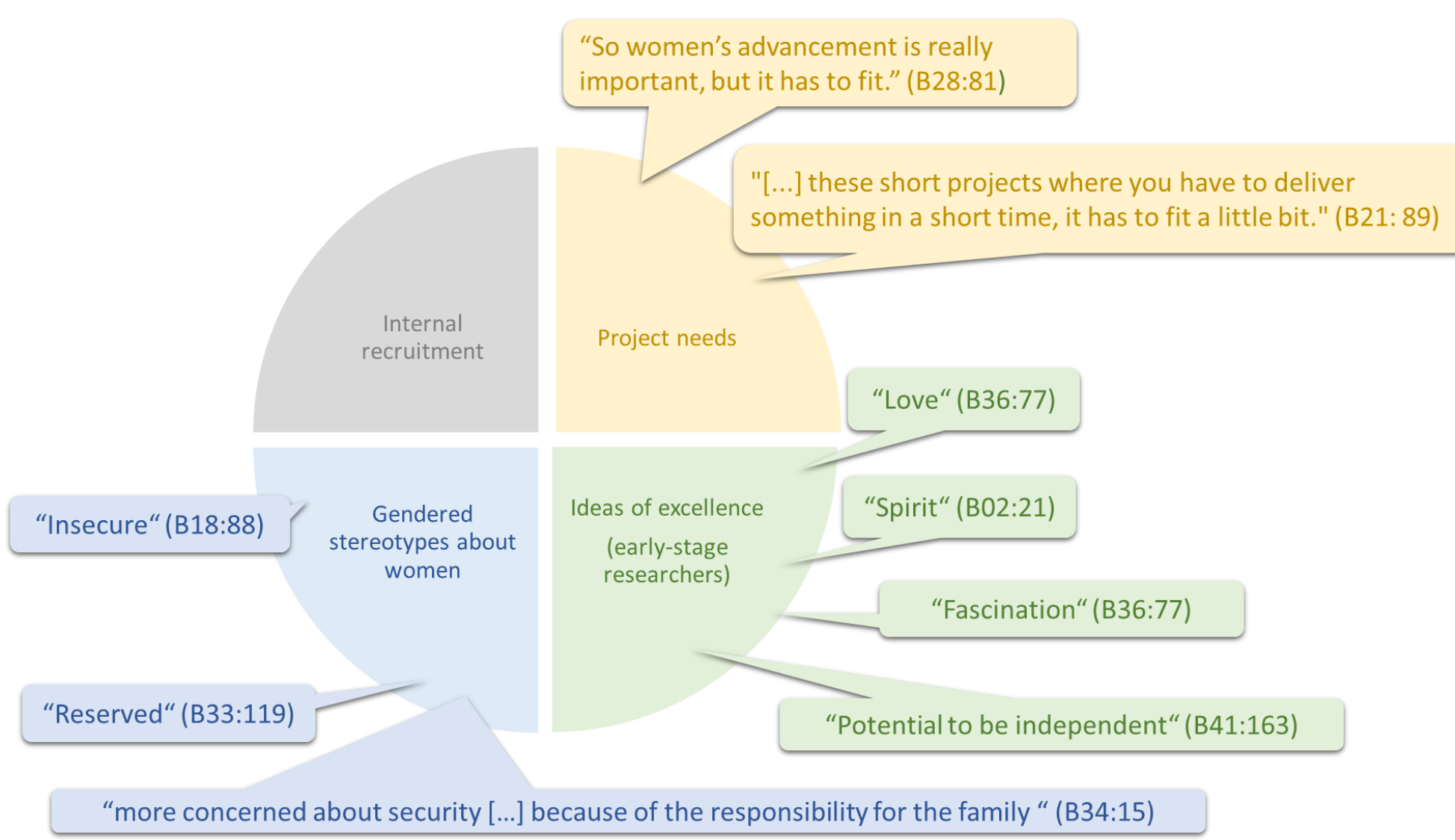
(Subjective) ideas of excellence and project needs

- Excellence, the specifics of project work, and the support of women are perceived as mutually exclusive by some respondents
- No consistent and objective definition of excellence in recruitment of early-stage researchers

Gendered stereotypes

- Gendered stereotypes still powerful also in excellent research environments

(A) Factors reinforcing gender disparities in recruitment of early-stage researchers for project positions



(2) Attribution of good chances for female later-stage researchers in appointment procedures

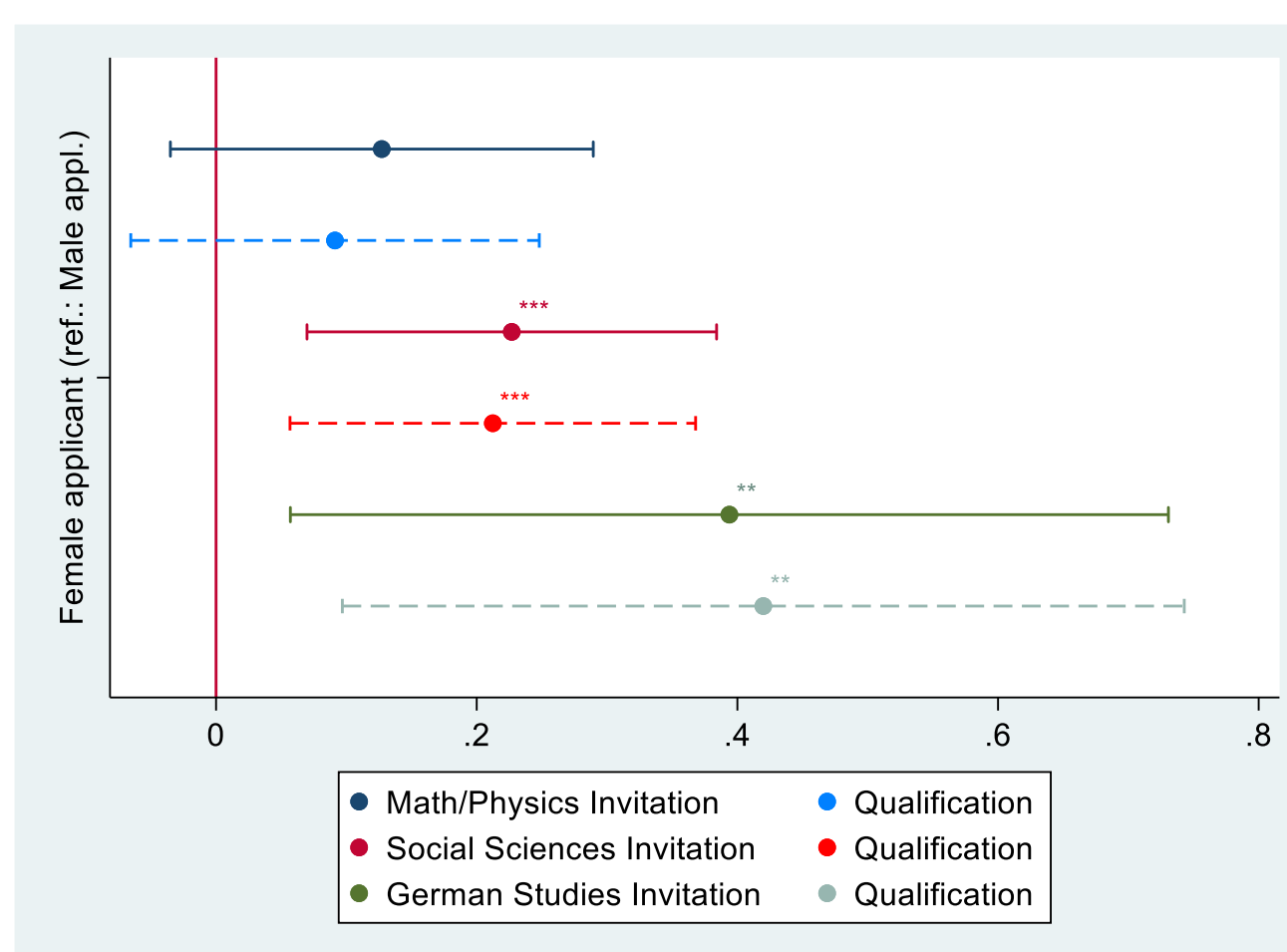
"But what I also observe is that the women who, for whatever reason, have fought their way through [...] who then get to the point so to speak, that they are traded for professorships suddenly the market for these women is very very good." (B04:77)

- Female scientists perceived to have good, or even better, chances than men to be "traded for professorships"
- However, this is mainly justified on the grounds of affirmative action and not on performance

"[...] that I was invited so often, of course had to do with the fact that women should also be invited more often [...] but I also knew that in advance." (B41:55)

Quantitative study

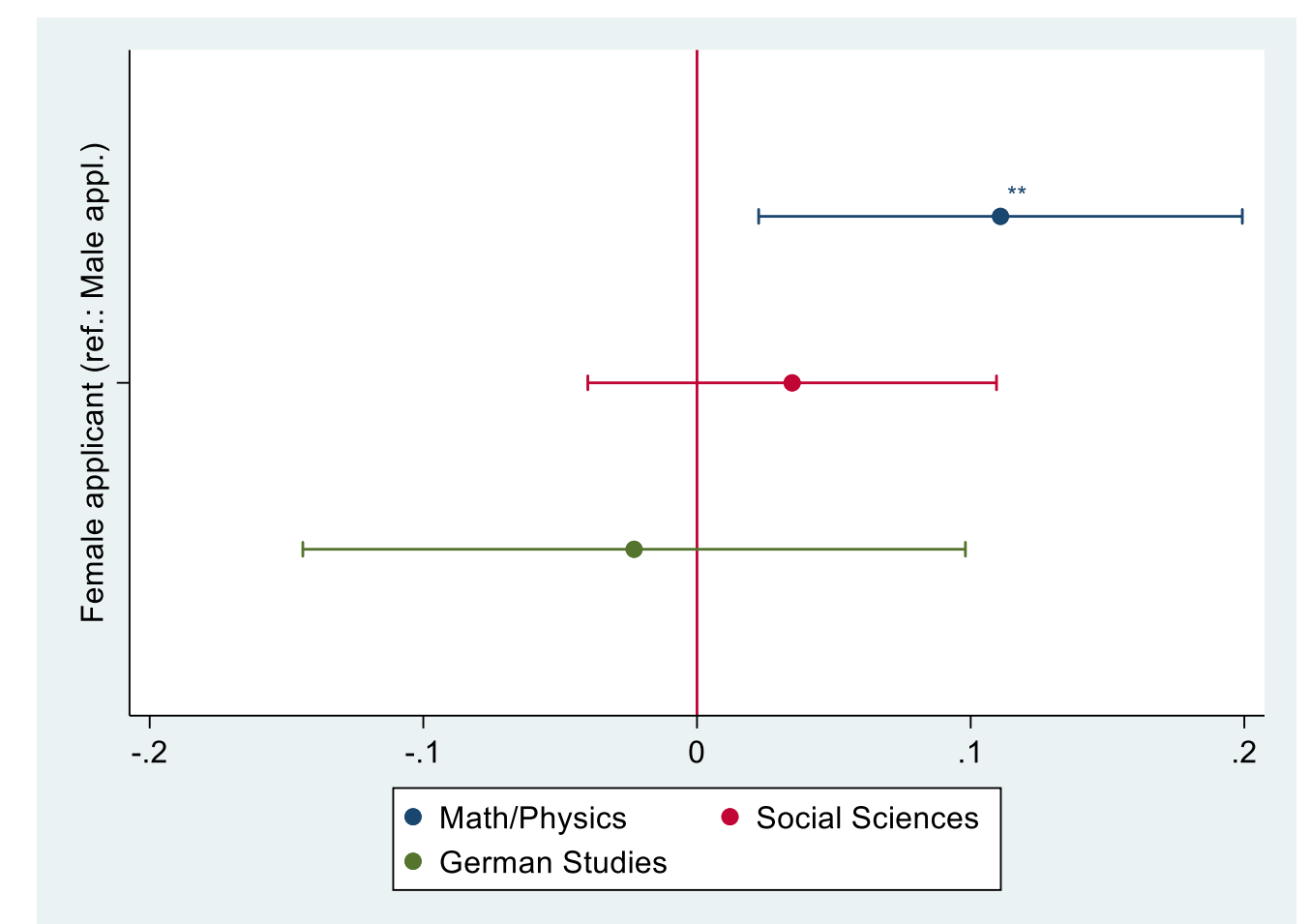
(A) Applicant's gender differences in the likelihood of being invited (solid lines) and of being perceived as qualified (dashed lines) **



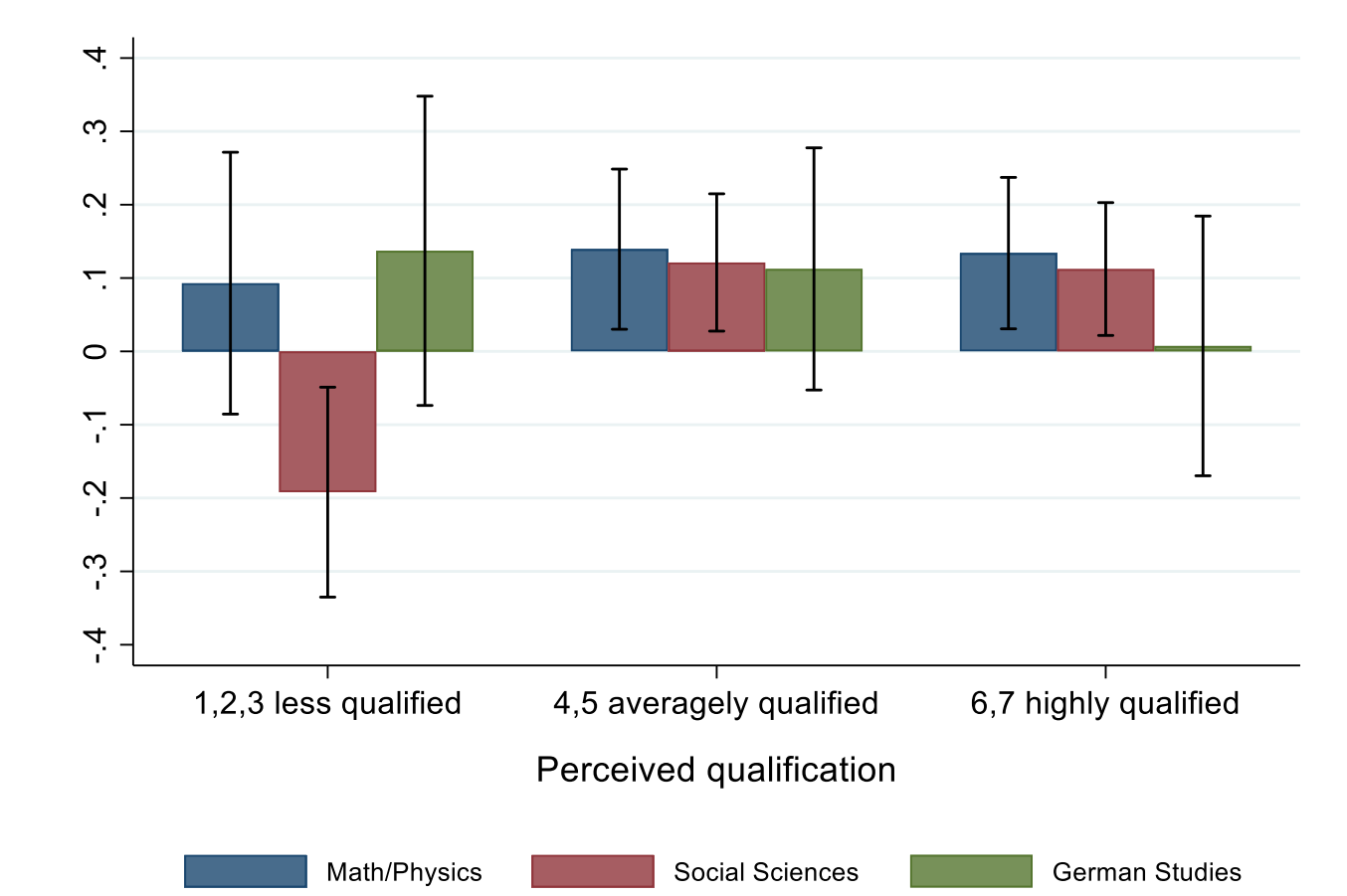
(1) No female disadvantage in being perceived as competent and being invited for a job interview for an assistant professorship position in Math/Physics

The quotes were translated into English by the researchers
** Models include all dimensions

(B) Applicant's gender differences in likelihood of being invited when perceived as equally qualified **



(C) Applicant's gender differences in the likelihood of being invited by perceived qualification (AME) **



(2) Invitation is mainly based on perceived qualification – no to very small advantages for female applicants

- Female advantage in being invited goes beyond and above advantage in being perceived as competent but is very small and does not change the „game“
- Main message: no gender biases at this stage

Conclusion

- Barriers especially for female early-stage researchers due to:
 - practice of internal recruitment
 - (subjective) ideas of excellence and project needs
 - gender stereotypes
- Discrimination at the transition to assistant professorships does not seem to take place:
 - quantitative results show when equally qualified women apply for assistant professorship they have good chances being invited
 - qualitative results show good chances for women are also assumed and not only perceived as being performance-based but traced back to the use of affirmative action policies
- Findings indicate:
 - internalization of affirmative action policies for appointment procedures for professorships
 - greater formalization (e.g. officially structured hiring processes with defined and transparent recruitment criteria) lead to fewer gender biases

Future research

- Focus on reasons for drop-outs of women at early stages of academic careers

References

Berryman, S. E. (1983). *Who Will Do Science? Trends and Their Causes in Minority and Female Representation among Holders of Advanced Degrees in Science and Mathematics. A Special Report*. New York.

Bryant, G. (1984). *The Working Woman Report*. New York (New York): Simon and Schuster.

Fiske Susan, T., Cuddy Amy, J. C. and Glick Peter, X. J. (2002). A model of (often mixed) stereotype content: Competence and warmth respectively follow from perceived status and competition. *Journal of personality and social psychology*, 82, 878–902.

Gérhahni, K., Kulic, N. and Liecht, F. (2021). *Double standard? Co-authorship and gender bias in early stage academic hiring*. Lausanne: University of Lausanne.

Glaser, Barney G. & Strauss, Anselm L. (1967). *The Discovery of Grounded Theory. Strategies for Qualitative Research*. New Brunswick, London: Aldine.

GWK (2021). *Chancengleichheit in Wissenschaft und Forschung*. 25. Fortschreibung des Datenmaterials (2019/2020) zu Frauen in Hochschulen und außer-Hochschulischen Forschungseinrichtungen. Bonn.

Heilman, M. E. (2012). Gender stereotypes and workplace bias. *Research in organizational behavior*, 32, 113–135.

Henningsen, L., Horvath, L. K. and Jonas, K. (2021). Affirmative Action Policies in Academic Job Advertisements: Do They Facilitate or Hinder Gender Discrimination in Hiring Processes for Professorships? *Sex roles*, 86, 34–48.

Husu, L. (2004). Gate-keeping, gender equality and scientific excellence. In: European Commission (Eds.), *Gender and excellence in the making. Workshop "Minimising Genderbias in the definition and measurement of scientific excellence"*. Florence, 23-24 October 2003 (S. 69–76). Luxembourg.

Kahlert, H. (2013). Why so few? In: Strid, Sola, Husu, Liisa (Eds.). *GEXcel Work in Progress Report Volume XVII: Proceedings from GEXcel themes 11–12 visiting scholars; gender paradoxes in changing academic and scientific organisation(s)*. Linköping University.

Klammer, U., Altenslädter, L., Petrova-Stoyanov, R. & Wegryzn, E. (2020). Gleichstellungspolitik an Hochschulen. Was wissen und wie handeln Professorinnen und Professoren? Opladen, Berlin, Toronto: Verlag Barbara Budrich.

Mayring, P. (2021). *Qualitative Content Analysis. A Step-by-Step Guide*. Thousand Oaks: SAGE Publications Ltd.

Ooms, W., Wraker, C. and Hoop, C. (2018). Moving up the Ladder: Heterogeneity Influencing Academic Careers Through Research Orientation, Gender, and Mentors. *Studies in Higher Education*, 44, 1269–1289.

Ridgeway, C. L. and Bourg, C. (2004). Gender as status: An expectation states theory approach. In Eagly, A. H., Beall, A. and Sternberg, R. (Eds.). *The Psychology of Gender*. New York: The Guilford Press, pp. 217–241.

Williams, W. M. and Ceci, S. J. (2015). National Hiring Experiments Reveal: 2: 1 Faculty Preference for Women on STEM Tenure Track. *Proceedings of the National Academy of Sciences*, 112, 5360–5365.

Wolfram, A. (2018). Excellence as a Gender-Biased Concept and Effects of the Linking of Excellence with Gender Equality. *International Journal of Gender, Science and Technology*, 10(1), 88–107.

Picture: <https://www.fu-berlin.de/en/sites/nu/excellence-strategy/proposals/math/index.html>