

Finger, Claudia; Solga, Heike; Elbers, Benjamin

Article — Accepted Manuscript (Postprint)

Social inequality in admission chances for prestigious higher education programs in Germany: do application patterns matter?

European Sociological Review European Sociological Review

Provided in Cooperation with:

WZB Berlin Social Science Center

Suggested Citation: Finger, Claudia; Solga, Heike; Elbers, Benjamin (2024) : Social inequality in admission chances for prestigious higher education programs in Germany: do application patterns matter?, European Sociological Review European Sociological Review, ISSN 1468-2672, Oxford University Press, Oxford, Vol. 40, Iss. 6, pp. 1013-1029, <https://doi.org/10.1093/esr/jcae024>

This Version is available at:

<https://hdl.handle.net/10419/323384>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Social inequality in admission chances for prestigious higher education programs in Germany: Do application patterns matter?

Claudia Finger¹ (corresponding author), claudia.finger@wzb.eu

Heike Solga^{1, 2}, heike.solga@wzb.eu

Benjamin Elbers³, be2239@columbia.edu

¹ WZB: Berlin Social Science Center, Reichpietschufer 50, 10785 Berlin, Germany

² Freie Universität Berlin, Institut für Soziologie, Garystr. 55, 14195 Berlin, Germany

³ Leverhulme Center for Demographic Science, 42-43 Park End Street, Oxford OX1 1JD, United Kingdom

Acknowledgements: We thank the SfH for providing access to the field and to the register data, the CHE for access to the ranking data, and our student assistants (Julia Bersch, Birte Freer, Anna Hetz, Patrick Hölzgen, Viktoria Hünwaldt, Johanne Klindworth, Carlotta Rieble) for their great support during data collection and editing.

Funding acknowledgement: This research was supported by a grant from the German Science Foundation (Grant Number SO 430/13-1 / #398433179).

Ethical statement:

This research was approved by the WZB Ethics Committee (Ethics Review No. 2018/1/32)

Abstract

Research has shown that admission to prestigious higher education programs varies by social background (short SES). Access to these programs is characterized by high competition and often rather complex admission procedures. Thus, access may depend not only on students' performance and decisions to apply, but also on their application patterns: Where and how they apply, which may vary by social background due to differences in educational achievement, aspirations, and constraints. Using applications to highly prestigious medical programs in Germany, we examine whether admission chances are socially selective even among the positively selected group of applicants, and whether this is due to SES differences in application patterns or performance. Based on complete application register data, we identify application patterns through cluster analysis. We then use the resulting cluster model to predict cluster membership in the 2018 applicant cohort, for which we collected survey data with information on applicants' SES, preferences, and motivations. We find that application patterns vary primarily by applicants' performance (grades and test scores) and SES-specific geographic constraints. However, our multivariate analyses on admission chances show that application patterns do not mediate SES differences in admission chances. Instead, these differences are entirely due to SES differences in applicants' performance.

Keywords: higher education, social inequality, prestigious fields of study, application patterns, admission chances, primary and secondary effects

1. Introduction

Numerous studies conducted in various institutional contexts show that enrollment in prestigious higher education (HE) institutions or fields of study, such as law and medicine, is highly dependent on students' social background (Jerrim, Chmielewski and Parker, 2015; Reimer and Pollak, 2010; Triventi, 2013). Moreover, differences in the prestige and future earnings associated with study programs (in terms of majors or institutions) have increased over time (Arum, Gamoran and Shavit, 2007; Goldin and Katz, 2008). Thus, a better understanding of the reasons for unequal access to prestigious programs is important for advancing our knowledge of societal inequalities and for developing policies to address them.

Research has identified several social processes producing social inequality in access to prestigious programs, which can be analytically distinguished into social origin differences in performance (primary effects) and in educational decision-making (secondary effects) (Boudon, 1974). Primary effects address the fact that access to highly selective and prestigious programs requires outstanding performance and thorough preparation. Research has consistently shown that differences in parental support, as well as cultural and economic resources, translate into social background differences (hereafter referred to as SES differences) in school grades (or grade point averages, GPA) and test scores, which in turn influence admission chances (e.g., Buchmann, Condron and Roscigno, 2010; Zwick and Greif Green, 2007). Secondary effects relate to social inequality in educational decision-making—that is, in SES differences in how students and their parents evaluate the expected costs, benefits, and probabilities of success in HE, as well as their perceptions of their social and academic fit in programs at the top of the educational hierarchy (Erikson and Jonsson, 1996; Reay, Crozier and Clayton, 2010).

As a result of these two processes, many low-SES students opt out of the applicant pool for prestigious university programs and instead enroll in less selective tertiary and non-tertiary programs. Given these selection processes, should we still expect to find SES differences in admission chances to prestigious programs, and if so, why? Primary and secondary effects may continue to be relevant. Due to intense competition and merit-based selection, SES differences in performance may persist, although they are likely to be alleviated by prior performance-based (self-)selection. The continuing importance of secondary effects may be reflected in young adults' application patterns, that is, *where and how they choose to apply*. Given the fierce competition for access to prestigious fields, where excellent performance is a necessary but not always a sufficient condition for admission, application patterns may be decisive. At the same time, they may vary with applicants' social background due to different aspirations, constraints, or information and support from students' social networks, thereby contributing to social inequality in admissions.

Our study examines this largely unexplored mechanism of SES differences in application patterns and their role in generating inequalities in admissions to prestigious programs—vis-à-vis performance differences. Our research questions are: (1) Does social origin continue to affect admission chances to prestigious study programs among the highly selective applicant population? If so, (2) do differences in application patterns contribute to the SES difference in admissions, or (3) are performance differences the main driver even within this highly pre-selected group? Answering these research questions improves our understanding of social inequality in access to prestigious HE programs by incorporating and theorizing application patterns into Boudon's (1974) model of inequality in access to HE.

Empirically, we study the under-researched yet highly exemplary case of access to medical programs in Germany—also a prime example of a prestigious field of study elsewhere (Triventi, 2013). The German case is well suited for studying application patterns as a potentially inequality-enhancing mechanism in HE, providing insights that extend beyond

the German context. On the one hand, the German context shares similarities with other country contexts in two important features: a high degree of preselection of applicants to prestigious HE programs and a strong impact of meritocratic criteria on admissions. On the other hand, the German context exemplifies a system with low direct tuition costs (similar to, for example, Scandinavian countries) and highly complex admissions rules, including the possibility of access via a non-meritocratic “waiting quota” (for details and discussion, see Section 2). Together, these features provide a unique opportunity to examine the inequality-generating role of not only performance differences (primary effects), but also student application patterns (as part of secondary effects) that result from SES differences in (economic and cultural) constraints, as well as in navigation and strategies in a complex admissions system.

To answer our research questions, we use two new data sources: First, for identifying application patterns, we have the unique opportunity to use high-quality and complete application register data, providing coverage for the entire population of applicants to medical programs from 2012 to 2018. To this end, we apply the inductive (but theoretically informed) approach of cluster analysis.¹ Second, we use the identified clusters to predict cluster membership in the (self-administered) survey data from the 2018 applicant cohort and assess whether different application patterns reflect (SES-specific) aspirations, constraints, and strategies. This survey contains detailed information on these aspects and applicants’ social backgrounds—information not available in the register data. Finally, we run multivariate models to examine the role of application patterns vis-à-vis performance for social inequality in admission chances.

¹ We follow the growing number of studies that use inductive approaches to understand complex social processes (e.g., Bonikowski and DiMaggio, 2016; Lippert and Damaske, 2019;).

2. The German case

We now provide some information on the institutional context of access to German medical programs, and discuss why it is well suited for studying application patterns as a potential inequality-enhancing mechanism. As elsewhere, German medical programs are a prime example of a prestigious field of study (Triventi, 2013). They lead to high average earnings returns and grant access to one of the most prestigious professions (Finger et al., 2020). Compared to other fields, medical programs are the most selective programs in Germany, with an average admission rate of less than 25 percent of applicants (Finger, 2022) and a high overrepresentation of students with college-educated parents and a high degree of occupational inheritance (Lörz, 2012; Gröne et al., 2023; as e.g. in the Netherlands, van de Werfhorst, De Graaf and Kraaykamp, 2001).

Access to medical programs is characterized by several features. First, applicants to prestigious programs are highly pre-selected in terms of their social background and performance (GPA). In the more extensively studied Anglophone countries, this is due to high tuition fees for prestigious programs or institutions, mandatory admission tests (and the associated preparation costs), and application behavior adaptive to high competition (Buchmann et al., 2010; Hoxby and Avery, 2013; Jerrim et al., 2015; Pyne and Grodsky, 2020). The first two reasons do not apply to Germany: There are no tuition fees, only a small administrative fee² (similar to, e.g., Scandinavian countries; Thomsen et al., 2017), and tests are optional if used (see below). Thus, in Germany, direct cost considerations are less likely to discourage (high-achieving) low-SES students from applying to selective programs than in other countries.

However, preselection is high in Germany due to the high degree of stratification and early tracking in the German school system. The system is characterized by performance-

² Less than € 1,000 per year (including student tickets for public transportation).

based sorting into different school tracks (Heisig and Matthewes, 2022), with a strong association with social origin (OECD, 2023). As a result, a strong social selection is evident in obtaining the university entrance certificate (*Abitur*) (Heisig, Elbers, and Solga, 2020; Powell and Solga, 2011). In addition, the German apprenticeship system serves as an attractive and low-risk alternative that diverts many low-SES high school graduates away from the HE pathway (Mayer, Müller and Pollak, 2007; Schindler and Lörz, 2012). Applicants to German medical programs are therefore expected to be a highly positively selected group, particularly if they come from low-SES families (Mare, 1980): Not only have they successfully completed high school, probably with an above-average GPA, but they have also chosen to apply not just to any field, but to the most selective one. Thus, in terms of both performance and motivation, German medical school applicants are generally comparable to applicants to elite HE programs in other countries (An, 2010; Anders, 2012; Boliver, 2013; Hoxby and Avery, 2013).

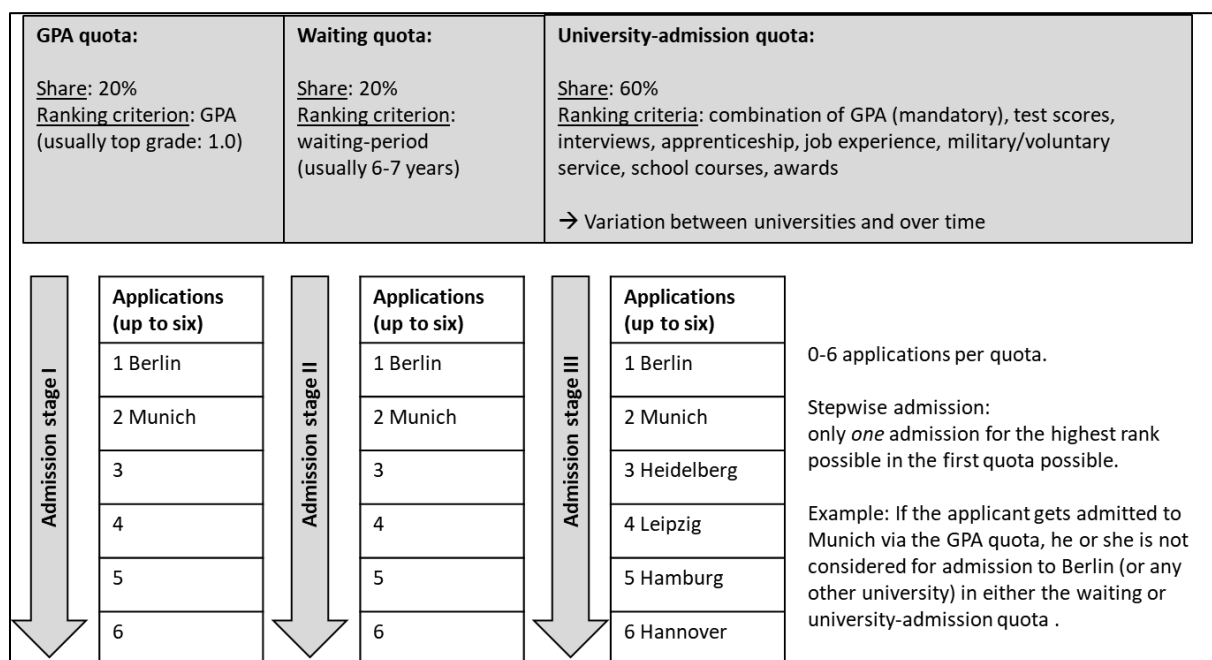
Second, as in elite HE programs around the world, admission to German medical schools is highly competitive and largely determined by “meritocratic” criteria, with GPA being the most important one, followed by test scores. Ultimately, strong SES differences in the preselection of applications, combined with the strong emphasis on merit-based admission criteria, may lead to small SES differences in admission chances among *applicants* (i.e., conditional on applications).

Third, however, SES differences may still persist even within the group of *applicants*, especially when admissions systems are highly complex and require information and navigational support from parents and social networks (Dynarski et al., 2023). Germany is an excellent case to study this because it is not confounded by cost considerations (see above).

The German admissions system is notable for its highly complex admissions rules. In contrast to other fields, admission to medical programs is centralized and administered by a central clearinghouse (*Stiftung für Hochschulzulassung, Sfh*). Until 2019, places were

allocated via two merit-based quotas (20% GPA quota, 60% university-admission quota) and one nonmerit-based quota (20% waiting quota). Applicants are free to apply via one, two, or all three quotas. In each quota, they can rank up to six universities (= programs), but each applicant can be admitted to only *one* program, starting with the highest ranked university in the GPA quota and descending to the last rank. The process continues with the waiting quota and ends with the last rank in the university-admission quota (see Figure 1; for more details on the allocation process, see Braun, Dwenger, and Kübler, 2007).

Figure 1: Central admission system for medical programs in Germany



Admission system until 2019, corresponding to the application/admission data used in this study. System has changed since 2020 in response to a decision of the Federal Constitutional Court (in 2017). Cities mentioned are examples.

Source: Authors' own depiction.

Several features of the admissions system are important for our research questions:

(a) The German admissions system is not strategy-proof, unlike admission systems relying solely on preference lists, such as in Ireland and Sweden (Delaney and Devereux, 2020; Hällsten, 2010), or where admission to each university or program is independent of applications and admissions to other programs, such as in the US or UK (Boliver, 2013; Hoxby and Avery, 2013). In Germany, application patterns beyond mere preference lists are

possible and sometimes necessary for a successful application (Braun et al., 2007). For example, a valuable strategy for applicants with strong institutional preferences and very high GPAs is to truncate the number of programs listed in the GPA quota (i.e., to rank only one university).³

(b) GPA and optional admission tests are important admission criteria: GPAs not only determine the GPA quota, but are also a mandatory criterion with the (relatively) highest weight in the university-admission quota, where universities are free to add additional criteria to rank applicants. In 2018, the most widespread additional criterion was test scores (used by 27 out of 35 programs). Importantly, these tests are optional—meaning that even if applicants apply to programs that use test scores, taking the test and submitting the scores is optional. The additional criteria potentially provide applicants with an opportunity to at least partially compensate for comparatively “poorer” GPAs.

(c) With the waiting quota, the German system includes a nonmerit-based criterion that is justified as an indicator of potentially strong motivation. It offers an admission opportunity for those with comparatively low GPAs. However, to secure admission through this quota, applicants must accumulate a high number of “waiting semesters” (14 semesters, or seven years, in 2018). Waiting semesters are defined as all half years after obtaining the Abitur (excluding periods during which applicants were enrolled in a *German* HE institution). No application or registration is required to begin the waiting time period.

In summary, similar to other countries, the applicant pool for medical programs is selective in terms of GPA and social background. However, unlike in other countries, where tuition costs constrain applicants, in Germany it is the complex and complicated admissions

³ More than three-quarters of applicants with GPAs high enough to be considered in the GPA quota, but who were not assigned, were admitted to their first-choice program via the university-admission quota (Braun et al., 2007, p. 14).

system that may contribute to the persistence of SES differences in admissions—making the German context a unique opportunity to examine the role of application patterns (beyond tuition fee constraints) as opposed to the role of performance differences. The most important admissions criterion is GPA, followed by test scores, paving the way for primary effects of social origins. Concerning secondary effects, most applicants have to compromise when deciding. Only those with very high GPAs (or a very long waiting time) can be comparably confident of admission, even to their preferred program. In contrast, all others need to be willing and able to compromise on other preferences and apply strategically to increase their chances of admission. However, despite detailed information available on the clearinghouse website, understanding the peculiarities of the application and admission process can be considered quite demanding. This may lead to social inequalities in navigating through the system and, ultimately, in admission chances.

3. Theoretical considerations on SES differences in admissions

In the highly competitive setting of admissions to prestigious study programs, SES differences may play a role in both performance (primary effects) and decisions (secondary effects). The latter is reflected in students' application behavior. However, especially in more complex admission systems, educational decisions include not only whether to apply, but also *how to apply*. Whether and how this generates social inequality beyond the preselection process into the applicant pool is one of our research questions. We therefore first discuss theoretical considerations on how different aspects of application patterns may contribute to social inequality in admissions. We then discuss the role of key admission criteria, providing theoretical explanations for why performance-related SES effects may exist even in highly selective applicant pools (our other research question), and the role of applicants' waiting time for SES differences in admissions.

3.1 The role of SES differences in application patterns

Few studies address the role of application patterns on social inequality in access to prestigious programs. They examine institutional characteristics in decision-making, including program reputation, selectivity, cost, labor market returns, and geographic distance (Delaney and Devereux, 2020; Hällsten, 2010; Hoxby and Avery, 2013), and specific application strategies, such as the number of applications and the inclusion of applications to less selective institutions as a “safety” option (Ayalon, 2007; Hoxby and Avery, 2013; Hurtado et al., 1997; Roderick, Coca and Nagaoka, 2011; Smith, 2014). Drawing on these studies, we discuss why we expect SES differences in application patterns.

Low-SES applicants are more likely to face constraints than their high-SES peers (Ball et al., 2002; Finger, 2016; Hällsten, 2010; Glaesser and Cooper, 2014; Niu and Tienda, 2008), potentially limiting their application choice set and leading to SES differences in application patterns. Common constraints such as tuition fees, study duration, workload, or unfamiliarity with the field can be excluded because they only vary between fields, not between medical programs in Germany. However, their application patterns may be *geographically constrained*. Distance from home, and thus whether students have to move to a distant city associated with social and economic costs, has been shown to be an important constraint, particularly for low-SES students (Hoxby and Avery, 2013; Spieß and Wrohlich, 2010; Turley, 2009).

While high-SES applicants may also prefer to study close to home, their *aspirations* to study a prestigious field like medicine may be stronger. They may consider graduating in such a field and entering related professions as crucial to reproducing their parents’ social status (especially if their parents are physicians themselves) (Lucas, 2001; Reimer and Pollak, 2010). Thus, they may be more willing to sacrifice their other preferences, such as residential location, to increase their chances of getting into medical school at all. They are also less constrained than their low-SES peers by the costs associated with moving to a distant city.

Institutional reputation and certain *admission criteria* (like admission tests) may also discourage low-SES applicants while attracting high-SES applicants (Reay et al., 2010). Differences in quality and prestige between programs are less pronounced in Germany than in more vertically stratified HE contexts (Winkler, 2014). However, programs perceived to have a high reputation (e.g., based on ranking indicators) may attract high-SES applicants, while low-SES students may anticipate greater competition for these programs, which may discourage them from applying (Almås et al., 2016). Moreover, admission tests may be more appealing to high-SES students, who have more resources for test preparation and achieving high scores (Buchmann et al., 2010). In contrast, low-SES students may even perceive test-based programs as a deterrent, despite the optionality of tests in the German context (see Section 2).

Furthermore, *informational constraints* may influence application behavior, contributing to SES differences in application patterns (Hoxby and Avery, 2013). Application processes require information and strategic knowledge that high-SES parents and their broader networks can provide to a greater extent, especially in an environment of high occupational inheritance. While high-SES applicants and their parents may easily understand and navigate complex and demanding application processes, their low-SES peers may have difficulty navigating the different options and rules, or may even overlook the need to be strategic.

These SES differences in (perceived) constraints and preferences may contribute to SES differences in application patterns. We therefore expect application patterns to be structured along applicants' cost constraints (most visible in the distance of the different program locations), aspirations (i.e., the importance of getting into prestigious programs), and preferences/aversions toward reputation and tests. Given that these factors partly depend on applicants' SES, application patterns are also likely to vary by SES. Moreover, even at a

given level of performance, aspirations, and (local) constraints, SES differences in application patterns may exist due to information asymmetries.

3.2 The role of SES differences in key admission criteria: performance and waiting time

In many countries today, admissions to HE programs rely heavily on performance measures, particularly students' GPAs and aptitude test scores, because such merit-based admission procedures promise to select HE students in both an efficient and legitimate way (Furuta, 2017). Despite critical voices (Grodsky, Warren and Felts, 2008; Soares, 2020; Zwick, 2019), the importance of test scores has increased in many countries, especially for admission to highly selective institutions and fields of study such as medicine (Alon, 2009, Dunleavy et al. 2013; Kozu, 2006; Puddey and Mercer 2014). In Germany, GPA is still the main criterion for admission to medical programs, but test-based admissions are becoming increasingly important. This gives rise to primary effects of social origin, as it is well established that high-SES students have both higher GPAs and higher test scores because they are better endowed with economic, cultural, and social resources (Berggren, 2007; Buchmann et al., 2010; Zwick, 2019; Zwick and Greif Green, 2007).

It is well known that the applicant pool for medical schools, the most selective field of study in Germany, is highly selective due to performance-based preselection (see Section 2): Among high school graduates who applied to medical programs in 2018, nearly 10 percent achieved the top GPA of 1.0 (the best grade in Germany), compared to 2 percent in the general population of high school graduates.⁴ This positive selection is likely to be less

⁴ These numbers are retrieved from the 2018 register data (medical school applicants) and annual data reports of the Standing Conference of the Ministers of Education and Cultural Affairs (all high school graduates): www.kmk.org/fileadmin/Dateien/pdf/Statistik/Dokumentationen/Aus_Abiturnoten_2018.pdf (retrieved 18 December 2023).

pronounced for high-SES applicants, who may be more likely to apply also with lower grades for reasons of status maintenance. Thus, among the selected group of applicants, the higher average GPA of high-SES students' may be less powerful in explaining inequality in admissions than it tends to be when the entire population of high school graduates is considered. However, high-SES students with GPAs that are likely to be insufficient for admission may attempt to compensate by taking more tests, including intensive test preparation, resulting in higher test scores and potentially higher admission chances.

The waiting quota is a rather unique feature of the German admission system (see Section 2).⁵ On the one hand, it may improve the admission chances of low(er)-achieving high-SES students with a long time horizon and strong resources (Hillmert and Jacob, 2003). On the other hand, it could also benefit low-SES students. It provides a re-entry opportunity for those who were diverted from the HE pathway years ago by entering into an apprenticeship (e.g., as a nurse or medical assistant) and later decided to pursue a university degree. Which of these two possibilities is true is still an open question. However, the answer to this question is also of interest beyond the German case because, depending on the answer, it may provide a policy approach for reducing inequality.

Finally, it is important to note that applicants' waiting time and performance (as key admission criteria) may not only directly affect their chances of admission, but may also contribute to different application patterns: Applicants with the highest GPAs or a very long waiting time can afford to be more selective about where and how often they apply, given their high likelihood of admission. In contrast, those who do not score high on these measures may adopt less restrictive, compensatory strategies, such as applying not only to certain (e.g.,

⁵ The centralized admission system in Norway also awards "age" points in one of its two quotas. SES differences were not examined (Sandsor, Hovdhaugen and Bockmann, 2022).

nearby) locations. Thus, SES differences in application patterns may also be associated with (potential) differences in performance and waiting times.

4. Data and methods

4.1 Data and sample selection

We employ two data sources. First, we use application register data (provided by the central clearinghouse) covering the entire population of applicants to medical programs in Germany for the winter terms 2012–2018 (almost 300,000 applicants in total). This is a unique data source for the German context where individual-level register data of the education system are usually not available. Moreover, available large-scale survey (panel) data of high school and university students do not include detailed information on application behavior and admission decisions. Thus, these important steps in the transition process (Roderick et al., 2011) constitute a black box for the German context that we aim to open. The register data contain information on application patterns (ranked universities in each quota), admissions, socio-demographic variables (gender, age, zip code), and applicants' performance (GPA, test scores) and waiting time. Because the register data cover the entire population and have a large sample size, they are an excellent source to detect the full range of application patterns (see Section 4.2.2).⁶ However, they do not contain information on applicants' SES.

Therefore, to examine SES differences in admissions, performance, and application patterns, we rely on survey data from medical school applicants. Through the clearinghouse, we invited all applicants for the winter semester of 2018 to participate in an online survey, first after the application deadline (wave 1, August 2018) and again after the admission

⁶ We excluded applicants who already completed a HE degree (3%) or who were admitted via a special military quota (0.5%), as different application rules apply to these groups. Applicants living outside Germany were also excluded because no zip code, and therefore no distance measures, are available for them (0.3%).

decisions (wave 2, November 2018). 17 percent of all applicants completed the first panel wave⁷, of which around 60 percent also participated in the second panel wave. We collected detailed information on social background, aspirations, constraints, performance indicators, application patterns (as we were not permitted to link the survey data to the register data), and the final application outcomes.

To address selective survey participation, response patterns, and panel attrition, we applied weights to all results from the survey data. Weights are constructed based on the full 2018 population register data and incorporate gender, age, federal state of high school graduation, GPA, waiting time (all categorical), and quota-specific admission rates. We excluded respondents with missing information on the programs ranked in the three quotas (9%) and their postal code (mostly residents outside Germany, 13%), as these variables are included to detect application patterns (see Section 4.2.2), or on the weighting variable (< 1%). This leaves 3,470 cases for analyses based on wave 2 (i.e., considering admission chances). Table B1 (see Online Supplement) shows that our weights do well in balancing the weighting variables, which seems especially important with respect to applicants' GPA, gender, and admission rate.

4.2 Analytical strategy

4.2.1 Examination of SES differences in admission chances (survey data)

To address our research questions on social inequality in admission chances to prestigious HE programs and whether SES differences in application patterns and performance contribute to this inequality, we followed several empirical steps. First, we explored how applicants' social background relates to their admission chances, application patterns, performance, and waiting

⁷ This response rate is comparable to a large-scale representative online survey of German university students (Becker, Baillet and Weber, 2019, p. 20).

time. Second, because our outcome is binary (receiving an admission offer or not), we estimated a series of logistic regressions and calculated average marginal effects (AME) to facilitate interpretation and comparison of point estimates across models (Mood, 2010). We ran these models on the full sample and afterwards on a restricted sample that excludes those who qualified for admission by their waiting time (because performance does not matter for these applicants).

We measure social background by parental education, distinguishing between applicants with no, one, or two college-educated parents.⁸ Performance is measured by applicants' GPA, ranging from 1.0 (excellent) to 4.0 (just passed). To account for potential nonlinearity in the association between GPA and admission, we created GPA-quintiles. The second performance indicator is whether applicants participated in the most prominent admission test for medical schools (see Section 2) and their test scores (same scale as GPA). Waiting time is measured in semesters, and we distinguish between those with long waiting times (at least 10 semesters) and those with no or shorter waiting times.⁹ Lastly, to identify application patterns, we conducted a cluster analysis, which we explain in the following.

4.2.2 Cluster analysis to detect application patterns (register data)

⁸ Since the medical profession is very prone to micro-class immobility (Lörz 2012; van de Werfhorst et al., 2001), we replaced this measure with parental occupation (at least one parent working as a physician or not). However, parental education seems to be the more relevant SES dimension for admission chances (and many further variables); parental occupation is much less influential (results available from the authors upon request).

⁹ The necessary waiting time required to be preselected for the waiting quota was 14 semesters in 2018. However, this is not a predefined threshold but depends on the demand. Therefore, applicants do not know in advance how many semesters of waiting time they will actually need in a given year.

We use the 2012–2018 application register data, enriched with additional institutional-level variables such as institutional reputation or selection criteria, to detect different application patterns using theoretically informed cluster analysis. Performing the cluster analysis on the large register data covering the entire population (rather than on the much smaller and more selective survey data) allows us to detect the full variation in application patterns. The complexity of the decision-making required by the German admission system for medical schools (see Section 2) impedes a purely deductive approach of building application patterns. However, we deliberately chose the clustering variables based on our theoretical expectations about what matters for application patterns (Section 3). It is important to note that we are interested in identifying different types of applications, not of applicants. Therefore, our clustering variables do not include individual characteristics (such as GPA, age, or gender), but only variables about how and where students apply.

Clustering variables: We include variables that are indicative of applicants' preferences, constraints, aspirations, and strategies. First, we measure potential social and material *mobility costs* as a constraining factor by including distance measures between the applicants' postal code and the postal codes of the ranked universities. Second, we include an indicator of the reputation of the ranked universities to measure *prestige preferences versus perceived "fit" constraints* (Reay et al., 2010). Third, we approximate *testing constraints versus preferences* (or strategies). Fourth, we approximate *strategies aimed at increasing admission chances at specific locations versus at any location* (no matter where). The latter may indicate a very strong aspiration to study medicine at any costs, while the former may (also) indicate mobility constraints or prestige and testing preferences. However, applicants who are well-informed, strategic, and confident enough to take some risk may try to combine the two: increasing admission chances at their preferred location by truncating the first two quotas, while maximizing admission chance in the last quota by ranking the maximum

number of universities (Braun et al. 2007). Table 1 describes and explains the clustering variables.

Clustering method: Cluster analyses include a wide variety of techniques. For our study, specific requirements guide the selection of relevant clustering algorithms: (1) the algorithm needs to handle categorical variables well, and (2) it needs to run reasonably fast on our large dataset. The second requirement precludes some popular hierarchical clustering approaches, or any approach that relies on the computation of a complete distance matrix. We therefore chose for the K-prototypes clustering algorithm, an extension of the K-means clustering algorithm, because it fulfills both requirements (Huang, 1998). Based on fit measures, we settled on a clustering model with six clusters. For more information on the K-prototypes algorithm and cluster fit, see Online Supplement, Section A.

We use the six-cluster model resulting from the register-data-based cluster analysis to predict the cluster membership of the 2018 applicant cohort based on the survey data. This allows us to relate application patterns to variables contained in the survey data, such as applicants' SES, their performance, as well as their stated aspirations, constraints, and strategies.

Table 1: Description of variables used in the cluster analysis

Variables and operationalizations	Explanations and justification
Mobility (cost) constraints	
Average distance to first ranks	Direct financial and opportunity costs (i.e., administrative fees and program length) do not vary among medical programs in Germany.
Average distance (in km) of applicant's postal code to postal codes of first-ranked programs	Therefore, the main cost factor is the distance from home, which determines whether applicants have to move out of their parents' home and leave their familiar environment.
Maximum distance	The average distance of the first-ranked universities indicates applicants' "mobility preference," while the maximum distance, including all the programs the applicant chose to rank, indicates their "mobility willingness."
Maximum distance (in km) from applicant's postal code to postal codes of all programs ranked by applicant	
Prestige preferences vs. "fit" constraints	
Average reputation of first ranks	Institutional prestige has been identified as an important factor in deciding whether to apply to certain institutions (Reay et al., 2010).
Average reputation of applicant's first-ranked universities, based on the ranking indicator "research reputation" (CHE Ranking 2012-2018)	In the German context, differences between universities in terms of institutional prestige and quality are comparatively small. However, vertical differentiation is increasing due to some recent developments in the HE sector (Horstschräer, 2012; Winkler, 2014). To measure institutional prestige, we utilized the most prominent German HE ranking conducted by the Center for Higher Education (CHE) since 1998. ^{b)} While it does not provide an overall ranking of programs, it does publish scores for different indicators (often differentiating between the top, middle, and bottom group). We used the indicator "research reputation of the university," derived from a survey of professors in the respective fields. They were asked to name five universities they considered to be leading in research, excluding their own university. The indicator measures the percentage of professors naming a certain university.
Testing constraints vs. preferences	
Share of ranked test-based programs	This variable is included for two reasons: (i) Ranking of test-based programs and submitting test scores can be used by applicants to increase their admission chances. (ii) Achieving high(er) test scores requires test preparation. Both the knowledge of the strategic value of tests and the (informational and financial) resources for good test preparation leave room for SES differences in application behavior.
Share of programs ranked by applicant in the university-admission quota that use test scores as admission criteria (0 to 1)	
Strategies to maximize general vs. location-specific admission chances	
Number of applications	Previous research has shown that the number of applications, their width, and their consistency vary between applicants and partly influence admission chances (Ayalon, 2007; Hoxby and Avery, 2013; Smith, 2014).
... in GPA quota (0-6)	
... in waiting quota (0-6)	
... in university-admission quota (0-6)	In our study, neither major (medicine) nor institutional type (university) varies across applicants. However, applicants may differ in the number of programs ranked in the three quotas and the consistency of the ranked programs across quotas. While some may spread their applications across many institutions, others may have a more limited choice set of institutions. These are important indicators of underlying aspirations, constraints, and strategies (e.g., maximizing general admission chances by ranking as many programs as possible versus maximizing admission chances to a specific program by truncating the first two quotas) (Braun et al., 2007).
First rank similarity	
Same first-ranked university in all quotas used (0-1); equals 1 if only one quota is used	
Quota similarity	
Similarity of applicant's ranking lists in the three quotas, based on the pairwise Jaccard similarity (0 to 1) ^{a)}	

Notes: ^{a)} Given two sets A and B, the Jaccard similarity index is defined as the number of elements in the intersection of A and B divided by the number of elements in the union of A and B. If the two sets are identical, then the index is 1. If no elements are shared between the two sets, the index is 0.

^{b)} For more information on the CHE Ranking, see: <https://ranking.zeit.de/che/en/ueberdasranking> [accessed: 26/09/2022].

5. Findings

5.1 Overview of application patterns

Before presenting our main findings on SES differences in admission chances, we briefly introduce the six application patterns. To this end, Table 2 summarizes how applicants' constraints, preferences, aspirations, and strategies, as well as their levels of performance and waiting time, manifest themselves in different application patterns. This generic and simplified summary is based on detailed descriptive statistics on the distribution of the clustering variables and various survey variables over the clusters (see Online Supplement, Table B2 for the distribution of clustering variables based on the register data and Table B3 for the distribution of survey variables).

In a nutshell, the six clusters show distinct patterns regarding applicants' performance, waiting time, constraints, and strategies. We identified two clusters, “the constrained high achievers” (C1) and “the constrained returners” (C2), in which applicants with a strong attachment to their hometown (and thus geographically constrained applications) are overrepresented. Their application pattern is thus not well suited to maximizing general admission chances, but rather to maximizing admission chances at specific institutions. Their above-average performance (C1) and waiting time (C2) may give them an advantage in gaining admission despite their constraints.

Two clusters, “the strategic returners/waiters” (C3) and “the strategic preference maximizers” (C4), apply in a very strategic way and follow a dominant strategy (i.e., truncation) to maximize admission chances at their preferred location while also ensuring a high overall admission chance. C3 applicants, with the second longest average waiting time, can be characterized as a “waiting cluster,” albeit less constrained and more strategic than C2 applicants. In contrast, C4 applicants, with the second highest GPA and test scores, appear

to consist largely of highly strategic and confident applicants with a clear preference for a particular institution but also the willingness to attend medical school elsewhere.

The remaining two clusters, “the open searchers with strong preferences” (C5) and “the open searchers with weak preferences” (C6), rank many programs in all quotas in a geographically unconstrained manner. While C5 applicants aim to secure admission to their preferred university but show a willingness to compromise, C6 applicants have by far the lowest preferences for specific institutions, but a very pronounced aspiration to study medicine. Neither cluster is characterized by (on average) many waiting semesters or high performance. They appear to compensate for this and to increase their admission chances through rather low regional constraints and, in the case of C6, high test participation rate.

Table 2: Description of application patterns identified by means of a cluster analysis

	Constrained high achievers (C1)	Constrained returners (C2)	Strategic returners/waiters (C3)	Strategic preference maximizers (C4)	Open searchers with strong preferences (C5)	Open searchers with weak preferences (C6)
Mobility constraints ^{a)}	Geographically constrained (smallest application radius)	Geographically constrained	Geographically less constrained	No mobility constraints	No mobility constraints	No mobility constraints (widest application radius)
Prestige and testing constraints/preferences	Not constraining (high reputation and test-based programs are often ranked) But below-average test participation	Avoiding test-based programs	Not constraining (average importance)	Above-average test participation	Not constraining (average importance)	Reputation least important Highest test participation rate
Strategy: to increase general vs. location-specific admission chances ^{b)}	Strong preference for specific institutions	Strong preference for specific institutions	Preference for specific institutions, but not constraining (i.e., willing to deviate)	Strong preference for specific institutions, but not constraining (i.e., willing to deviate)	Strong preference for specific institutions (i.e., consistent ranking of first choice across quotas), but not constraining (no truncation, exploit all quotas)	No preference for specific institutions
Aspirations (self-reported)	Location more important than to study medicine	Location more important than to study medicine Late development of medicine aspiration	Strong aspirations to study medicine	Strong aspirations to study medicine	Strong aspirations to study medicine	Strong aspirations to study medicine
Performance	Highest performance (GPA & test scores)	Lowest performance (GPA & test scores)	2 nd lowest performance (GPA)	2 nd highest performance (GPA & test scores)	2 nd highest GPA, but 2 nd lowest test scores	Average performance
Waiting time	Short waiting time	Longest waiting time	2 nd longest waiting time	Shortest waiting time	2 nd shortest waiting time	Average waiting time

Notes: Generic summary based on Tables B2 and B3 (in Online Supplement).

^{a)} *Geographically constrained*: focus their applications on very close institutions, proximity to home is crucial, low willingness to move; *less constrained*: preference for close university, but wider radius; *not constrained*: wide application radius, proximity to home is not important or somewhat important, but willingness to move.

^{b)} *Strong preference for specific institutions*: low # of applications, very consistent ranking, “alternative” applications (abroad) unlikely; *strong preference for specific institutions, but not constraining*: truncate GPA and waiting quotas, exploit last quota, very consistent rankings, “alternative” applications (abroad) comparatively likely; *preference for specific institutions, but not constraining*: truncate GPA quota, exploit other quotas, less consistent rankings; *no preference for specific institutions*: exploit ranking options in all quotas, least consistent rankings, “alternative” applications (abroad, private institutions) most likely, to increase general admission chances for *any* medical program most important.

5.2 SES differences among medical school applicants

To assess whether SES differences exist within the highly selective group of medical school applicants, we begin with some descriptive findings. Table 3 shows that, even within this highly selective group, applicants with two college-educated parents (hereafter: high-SES applicants) are 6 percentage points (pp) more likely to be admitted than applicants with no college-educated parents (hereafter: low-SES applicants). This difference corresponds to 24 percent of the overall admission rate (25%). A closer look at the three quotas reveals that admitted high-SES applicants are much more likely to receive an admission offer via the two merit-based quotas (89%) than low-SES applicants (67%), who have a better chance of admission through the waiting quota.

Correspondingly, we find considerable SES differences in key admission criteria. Despite performance-based preselection, low-SES applicants have a lower average GPA than high-SES applicants (by 0.22 GPA points, or 0.35 of a standard deviation (SD)). The marked differences in the GPA quintile distribution also reflect this. High-SES applicants are also more likely to participate in admission tests (by 7.5 pp) and achieve higher test scores (by 0.34 standardized test scores). In contrast, low-SES applicants are 10 pp more likely to have a realistic waiting time of 10 semesters or more.

The pronounced SES difference in GPAs may be partly due to low-SES applicants' overrepresentation among those with a very long waiting time (and presumably poorer grades). We therefore differentiate the sample by waiting time (less than 10 semesters versus at least 10 semesters). As expected, those with long waiting times have considerably poorer average GPAs than those with shorter or no waiting times (0.82 SD). Among the latter, high-SES applicants still have higher GPAs, but the SES difference is substantially smaller (0.24 SD) than observed in the full sample. In contrast, among applicants with long waiting times, the SES difference is even reversed, and almost 50 percent of the high-SES applicants

belong to the lowest GPA quintile and thus have almost no chance of admission through the merit-based quotas.

Table 3: SES differences in admissions, key admission criteria (performance and waiting time), and application patterns

	Parental college education			
	No parent	One parent	Two parents	Total
Admission				
Overall admission (all quotas)	21.7	24.3	27.7	24.9
Admitted via ... (if admitted) ^{a)}				
... GPA quota	6.2	14.1	14.2	12.0
... waiting quota	31.6	19.5	9.9	18.6
... university-admission quota	60.7	65.4	74.7	68.2
Key admission criteria				
GPA ^{b)}				
GPA (mean)	2.05 (0.63)	1.93 (0.62)	1.83 (0.60)	1.93 (0.62)
Top GPA-quintile (1.0-1.3) (%)	14.6	19.3	21.9	18.9
Bottom GPA-quintile (2.5-4.0) (%)	22.6	18.9	13.9	18.0
Admission test (TMS)				
Test participation (%)	37.4	42.5	44.9	41.9
Mean (z-standardized) test scores (if participated)	-0.27 (0.96)	-0.15 (0.94)	0.07 (1.01)	-0.10 (0.99)
Waiting time ^{c)}				
Mean waiting time (in semester)	4.7 (6.7)	4.1 (5.8)	3.0 (4.7)	3.8 (5.73)
Realistic waiting time (%)	21.3	17.9	11.0	16.2
GPA of applicants with no realistic waiting time (< 10 semesters)				
Mean GPA	1.90 (0.58)	1.84 (0.59)	1.76 (0.56)	1.82 (0.58)
Top GPA-quintile (1.0-1.3) (%)	18.5	22.8	24.5	22.3
Bottom GPA-quintile (2.5-4.0) (%)	14.6	15.3	10.6	13.2
GPA of applicants with realistic waiting time (≥ 10 semesters)				
Mean GPA	2.37 (0.58)	2.14 (0.60)	2.50 (0.68)	2.33 (0.63)
Top GPA-quintile (1.0-1.3) (%)	5.8	5.4	0.0	4.3
Bottom GPA-quintile (2.5-4.0) (%)	38.5	31.5	48.3	38.6
Application patterns				
Constrained high achievers (C1)	15.0	15.8	12.7	14.4
Constrained returners (C2)	13.8	12.0	9.3	11.7
Strategic returners/waiters (C3)	14.5	12.6	11.0	12.5
Strategic preference maximizers (C4)	18.5	20.1	24.5	21.3
Open searchers with strong preferences (C5)	13.1	13.3	15.6	14.1
Open searchers with weak preferences (C6)	25.1	26.2	26.4	25.9
N (observations)	1,003	1,058	1,409	3,470

Notes: Standard deviations in parentheses. Missing values (item non-response): test participation ~ 1%, test scores (if participated) ~ 5%.

^{a)} Difference to 100% (of 1.2%) due to some cases admitted by lottery (final step of wait-listed candidates) and social hardship.

^{b)} Applicants' GPA potentially ranges from 1.0 (top) to 4.0 (bottom).

^{c)} Applicants' waiting times range from 0 to 76 semesters. "Realistic waiting time" is defined as at least 10 semesters. The waiting time necessary to be preselected for the waiting quota was 14 semesters in 2018. However, this is not a predefined threshold, but depends on the demand in a given year.

Source: Online Survey of 2018 medical school applicants (waves 1 and 2), weighted (see Section 4.1), authors' calculations.

Turning to secondary effects, supplementary analyses show little SES differences in the strength of medical aspirations, but applicants do differ in their geographic constraints: Low-SES applicants are more likely to report that proximity to home is an important reason for choosing a university (13 pp) (see Online Supplement, Table B4). In addition, high-SES applicants are more likely than low-SES applicants to value the reputation of universities (5 pp), to strategically rank test-based programs (10 pp), to apply to medical schools abroad (11 pp), to receive support from family members in the application process (31 pp), and to have a family member with test-taking experience (18 pp).

How do these SES differences manifest in application patterns? Overall, SES differences in application patterns are not very pronounced (Table 3). However, there are interesting variations that are mostly in line with theoretical expectations about SES-specific constraints and strategies: High-SES applicants are slightly underrepresented in clusters C1-C3 (the clusters with a focus on nearby universities and/or the waiting quota) and slightly overrepresented in the unconstrained and/or strategic clusters C4-C6. The SES difference is most pronounced among the “strategic preference maximizers” (C4) (6 pp) – the cluster with the overall most strategic application patterns. For reasons of status maintenance, we also examined differences in application patterns by parental occupation. Table B5 (in the Online Supplement) indicates that children of physicians are less likely to belong to the “constrained high achievers” (C1), but indeed more likely to belong to the strategic clusters. However, they are not only more likely to belong to the “strategic preference maximizers” (C4), but also to the “strategic returners/waiters” (C2)—in this case, most likely indeed to be “waiters”.

In summary, despite strong preselection, admission rates are much higher for high-SES applicants than for low-SES applicants, especially in the merit-based quotas. Correspondingly, we find higher average GPAs, test participation rates, and test scores for high-SES applicants. These patterns suggest that primary effects are at work even in this selective group. In contrast, the waiting quota seems to advantage low-SES applicants, who on average have a higher

number of waiting semesters. Although application patterns vary according to SES-specific constraints and strategies, there is quite some SES heterogeneity within clusters, with no clear dominance of high- or low-SES applicants in any application pattern. Next, we examine whether application patterns—as a condensed expression of applicants’ constraints, preferences, and strategies—can still explain some of the observed SES differences in admission chances, or whether SES differences in performance are the main driver.

5.3 Multivariate findings on determinants of admission chances

Table 4 presents the results of a series of logistic regressions. The first model (M1) shows the bivariate difference of 6 percentage points in admission chances between applicants with no and two college-educated parents. As model M2 indicates, application patterns do not contribute to explaining this pronounced SES difference. However, they are strongly related to admission chances. The constrained but high-achieving C1 (the reference category) has by far the highest chances of admission, followed by the “constrained returners” (C2)—with many applicants having very long waiting times, which seems to compensate for their comparably poor values on the merit-based criteria. In contrast, C6 applicants have the lowest admission chances (27 pp lower than C1), suggesting that their unconstrained application pattern and high test taking rate cannot compensate for otherwise fairly average GPAs and waiting time. However, the explanatory power of application patterns is rather low (Pseudo- R^2 of 4%).

In contrast, applicants’ GPA and test participation/scores have a much higher explanatory power (Pseudo- R^2 of 32%) and they fully mediate the SES difference in admission chances (M3). Already applicants from the second GPA quintile have a 58 pp lower admission chance than those from the top quintile. Moreover, test participation with above-average test scores increases admission chances by 27 pp (compared to nonparticipants).

These patterns do not change when both performance and application patterns is included in M4 and additionally waiting time in M5. The coefficients of application strategies disappear or even reverse when controlling for the performance and waiting variables. This is consistent with our finding that both are reflected in application patterns (see Section 5.1). Interestingly, after controlling for applicants' performance and waiting time (or more precisely, after controlling for their GPA, as additional analyses show), the waiting cluster C2 and the strategic cluster C4 have higher admission chances than the high-achieving cluster C1, demonstrating once again that the advantageous position of C1 applicants is mainly driven by their superior GPA.

These findings do not change when we restrict the sample to those who are unlikely to be admitted through the waiting quota (< 10 semesters waiting time) (Online Supplement, Table B6). Among more recent high school graduates, the SES difference in admission chances is even more pronounced (9.2 pp, or almost 40 percent of the overall admission rate of 23% in this group), because a larger share of low-SES applicants with relatively high admission chances through the waiting quota has been excluded. The SES difference is also substantially reduced after introducing GPA and test scores (2.6 pp remain, possibly due to SES differences in further admission criteria, such as participation in civil service programs).

Table 4: Logistic regressions on admission chances (AME)

	M1	M2	M3	M4	M5
Parental education					
(ref.: No college-educated parent)					
One college-educated parent	0.026 (0.018)	0.026 (0.018)	-0.012 (0.015)	-0.012 (0.015)	-0.011 (0.014)
Two college-educated parents	0.060*** (0.018)	0.069*** (0.017)	-0.008 (0.014)	-0.004 (0.014)	-0.006 (0.013)
Application pattern					
(ref.: Constrained high achievers (C1))					
Constrained returners (C2)		-0.123*** (0.032)		0.157*** (0.025)	0.097*** (0.022)
Strategic returners/waiters (C3)		-0.201*** (0.030)		0.020 (0.022)	0.012 (0.020)
Strategic preference maximizers (C4)		-0.183*** (0.027)		-0.001 (0.018)	0.042* (0.019)
Open searchers with strong preferences (C5)		-0.239*** (0.028)		-0.028 (0.020)	-0.010 (0.019)
Open searchers with weak preferences (C6)		-0.274*** (0.025)		-0.026 (0.018)	-0.012 (0.018)
GPA and admission tests					
GPA quintiles (ref.: top: 1.0-1.3)					
2nd: 1.4-1.6			-0.583*** (0.022)	-0.571*** (0.022)	-0.564*** (0.021)
3rd: 1.7-2.0			-0.685*** (0.019)	-0.681*** (0.020)	-0.722*** (0.016)
4th: 2.1-2.5			-0.688*** (0.020)	-0.693*** (0.020)	-0.762*** (0.016)
Bottom: 2.6-4.0			-0.584*** (0.024)	-0.614*** (0.024)	-0.730*** (0.018)
Test participation^{a)}					
(ref.: Nonparticipants)					
Participated with below-average scores			0.024 (0.024)	0.045** (0.015)	0.007 (0.015)
Participated with above-average scores			0.267*** (0.020)	0.290*** (0.020)	0.218*** (0.018)
No information on test participation/scores ^{b)}			0.080* (0.034)	0.093* (0.035)	0.048 (0.030)
Waiting time (ref.: No waiting time)					
Some waiting time (1-9 semesters)					0.0560** (0.011)
Realistic waiting time (≥ 10 semesters)					0.293*** (0.020)
Pseudo- R ²	0.00	0.04	0.32	0.34	0.38
Observations	3,470	3,470	3,470	3,470	3,470

Average marginal effects (AME), standard deviations in parentheses.

^{a)} Only Test for Medical Studies (TMS) considered. Four medical programs apply different test formats, but we do not have information on these tests in the data. When including proxy measures, the findings do not change.

^{b)} 34 missing values for test participation and 84 for test scores.

Source: Online Survey of 2018 medical school applicants (waves 1 and 2), weighted, authors' calculations.

6. Discussion

One central finding of our study is that, even in the highly selective group of medical school applicants, social inequality in admission chances is pronounced: high-SES applicants are

more likely to be admitted than their low-SES peers. Despite strong preselection processes, substantial performance differences persist between high- and low-SES applicants (in terms of GPA, test participation, and test scores). SES differences in application patterns are most evident in the trade-off between geographic constraints and strategies to maximize general admission chances: Low-SES students are overrepresented in geographically constrained application patterns, while high-SES applicants are overrepresented in application patterns that use the maximum number of applications in a geographically unconstrained (and partly strategic) manner. Despite these associations, there are no clear SES-specific application patterns. Correspondingly, in our multivariate analyses, we found that SES differences in performances (primary effects), rather than in application patterns (secondary effects), largely mediate SES differences in admission chances.

Our finding that geographic constraints are important for low-SES applicants suggests that low-SES students living in (rural) areas without a nearby medical program may be less likely to apply. In many other contexts with greater vertical stratification of HE institutions, geographic distance constraints of low-SES students may have an even stronger impact on SES differences in admissions to prestigious programs than in Germany. Although geographic distance is the main constraining factor for low-SES applicants to medical schools in Germany, as our study has shown, German universities and programs (within the same field) are fairly homogeneous in terms of prestige and low direct tuition costs. Thus, there is no risk that the nearest university—potentially the only viable option for many low-SES students—will also be an expensive or elite one, which in other contexts (such as the US) may further limit the choice set of low-SES applicants and contribute to lower application and ultimately admission rates.

Given our interest in application patterns as an underexplored mechanism of secondary effects, we focused on *applicants* rather than all high school graduates. Thus, selection processes into the applicant pool are not considered in our study. Therefore, while our

analyses do not suggest that secondary effects are central among applicants, it is important to acknowledge that they may strongly influence the decision of whether or not to apply to prestigious programs in the first place. For example, SES differences in perceived probability of successfully entering and graduating from a prestigious program may lead to social origin differences in applying. However, unlike in countries with high tuition fees for prestigious HE programs, low-SES children in Germany are not discouraged from medical programs because of direct study costs.

One limitation of our study of application patterns, however, is that our data on applicants to *public* medical schools in Germany did not allow us to capture the full range of strategies used by high-SES applicants to circumvent the selective central admission system. When we recode our dependent variable to include admissions to foreign or private medical schools (see also Online Supplement, Table B3), the SES difference in admissions increases from 6 to 11 percentage points (results are not shown, available on request from the authors).¹⁰

7. Conclusions

Research has consistently shown that access to prestigious study programs varies by social background due to differences in students' educational performance and decisions. However, because access to these programs is highly competitive, access may also depend on students' application patterns, that is, *where and how they apply*. We investigated this largely unexplored mechanism and the role of SES differences in application patterns vis-à-vis performance differences for social inequality in admission chances to the highly prestigious

¹⁰ Our sample is restricted to those who *also* applied in Germany (because only then are applicants in our data). This is likely to underestimate the extent of SES differences in application and enrollment abroad. Especially high-SES applicants with poor GPAs are known to apply *only* to programs abroad that are less selective but charge high fees (Gerhards and Németh, 2015).

medical programs in Germany. Access to German medical programs is very well suited to study application patterns as a potentially inequality-enhancing mechanism in HE: Similar to other countries, the applicant pool is selective in terms of both GPA and social background, and admissions are mainly based on meritocratic criteria. However, the German context allows for the study of the effects of a complex and complicated admissions system that requires application patterns that go beyond mere preference listing.

Our German findings suggest that when merit-based criteria are central to admission processes, SES differences in performance (primary effects) are the main driver of unequal admission chances (of applicants)—even when the admission system requires navigation skills and rewards certain application strategies. Our findings are thus in line with research showing that performance-based admission is socially selective—despite its perceived objectivity and legitimacy—as “merits” crucially depend on resources, and privileged groups are better equipped to meet these requirements (Alon, 2009; Buchmann et al., 2010). Despite this criticism, our study suggests that merit-based admission systems prevent low-SES students, who apply to prestigious programs despite high competition and complicated admission rules, from facing double disadvantages when admission procedures are complex. Strategies beyond optimizing one’s own qualifications appear to be of minor importance. However, it would be rash to dismiss all criticism: The complexity of the admission system may discourage low-SES students from applying in the first place, presumably especially those with low levels of support, information, and navigation skills.

The German case is also an interesting example for an admission system that partially grants access based on nonmerit-based criteria. Our findings can thus inform debates in countries such as the US that use(d) quotas for social minorities to mitigate inequalities in access to elite programs. In contrast to explicit preferential treatment of applicants on the basis of ascribed characteristics, the nonmerit-based quota in Germany refers to students’ waiting time—a characteristic that theoretically anyone can “achieve.” This is similar to the

Norwegian system, where students can accumulate “age points” that are then combined with mainly merit-based criteria into admission scores (Sandsor et al., 2022). In Germany, however, 20 percent of places are *exclusively* allocated through the waiting quota, which provides access opportunities even for high school graduates with the lowest GPAs—an opportunity that is indeed used by low-performing high-SES applicants. By and large, however, the waiting quota seems to offer mainly a reentry opportunity for low-SES applicants (30% of all admitted low-SES applicants are admitted through this quota). Thus, this nonmerit-based admission criterion somewhat compensates for the strong social selectivity of the merit-based quotas and increases student diversity by providing students with reentry opportunities. However, Germany implemented a major reform of the central admission system in 2020. One of its elements is the abolition of the waiting-time quota—the only admission criterion in our study that favored low-SES applicants.

Also in the light of the other reform elements, it is likely that social diversity in medical school will decrease in the future. The GPA quota has been raised from 20 percent to 30 percent, and a new “aptitude quota” (10%) has been introduced, which must not include GPA as a criterion. As a result, all medical programs now use admission tests (still optional) as one of the selection criteria. Based on our findings, we see that even optional tests contribute to social inequality, at least in their current form. Thus, this development stands in stark contrast to the test-optional movement in the US, which has led to de-emphasizing test scores in the admission process with the aim of increasing student diversity, among other reasons (Bennett, 2022; Furuta, 2017). Similarly, the other important reform element—namely, the introduction of a preference ranking that makes admission less dependent on ranking decisions and underlying strategies—is unlikely to reduce social inequality in admission chances, given our finding of the centrality of applicant’s performance compared to application patterns.

Not only in Germany, but also in many countries, admission systems are under critical scrutiny and reforms are being called for and implemented. One main criticism is that admission processes often contribute to a socially selective student body (e.g., Boliver, 2013; Soares, 2020). We contribute to this debate by showing that it is not the complicated admission system and resulting application patterns and strategies that disadvantage low-SES *applicants*. Rather, our results support previous findings that it is merit-based selection that favors already advantaged groups (Alon 2009).

However, to draw more comprehensive conclusions, future research should assess the indirect effect of complex admission rules on students' decisions to apply in the first place. Thus, the findings and limitations of our German study on the role of application patterns suggest several avenues for future comparative research. These include exploring SES differences in performance and constraints on application patterns in high-tuition systems, examining the impact of SES differences in application patterns on admission chances in strategy-proof versus non-strategy-proof admission systems (like the German system)—to assess the importance of admission system complexity for SES differences—or comparing SES differences in enrollment in prestigious HE programs due to SES differences in admission chances among applicants relative to SES-dependent decisions for or against applying to such programs in the first place.

References

- Almås, I., Cappelen, A. W., Salvenes, K. G., Sørensen, E. Ø. and Tungodden, B. (2016). Willingness to Compete: Family Matters. *Management Science*, 62(8), 2149–2162.
- Alon, S. (2009). The evolution of class inequality in higher education: Competition, exclusion, and adaptation. *American Sociological Review*, 74(5), 731–755.
- An, B. P. (2010). The relations between race, family characteristics, and where students apply to college. *Social Science Research*, 39, 310–323.
- Anders, J. (2012). The link between household income, university applications and university attendance. *Fiscal Studies*, 33(2), 185–210.
- Arum, R., Gamoran, A. and Shavit, Y. (2007). More inclusion than diversion. Expansion, differentiation, and market structure in higher education. In Shavit, Y., Arum, R. and Gamoran, A. (Eds.), *Stratification in higher education*. Stanford, CA: Stanford University Press, pp.1–35.
- Ayalon, H. (2007). College application behavior: who is strategic? Does it help? *Higher Education*, 54(6), 885–905.
- Ball, S. J., Davies, J., David, M. and Reay, D. (2002). ‘Classification’ and ‘Judgement’: Social class and the ‘cognitive structures’ of choice of higher education. *British Journal of Sociology of Education*, 23, 51–72.
- Becker, K., Baillet, F. and Weber, A. (2019). *21. Sozialerhebung. Daten- und Methodenbericht*. Hannover: FDZ-DZHW.
- Bennett, C. T. (2022). Untested Admissions: Examining Changes in Application Behaviors and Student Demographics Under Test-Optional Policies. *American Educational Research Journal*, 59(1), 180–216.
- Berggren, C. (2007). Broadening recruitment to higher education through the admission system. *Studies in Higher Education*, 32(1), 97–116.
- Boliver, V. (2013). How fair is access to more prestigious UK universities? *The British Journal of Sociology*, 64(2), 344–364.
- Bonikowski, B. and DiMaggio, P. (2016). Varieties of American Popular Nationalism. *American Sociological Review*, 81(5), 949–980.
- Boudon, R. (1974). *Education, opportunity, and social inequality*. New York: Wiley.
- Braun, S., Dwenger, N. and Kübler, D. (2007). *Telling the truth may not pay off: an empirical study of centralized university admission in Germany*. IZA Discussion Paper, No. 3261. Bonn: IZA.
- Buchmann, C., Condrón, D. J. and Roscigno, V. J. (2010). Shadow education, American style: test preparation, the SAT and college enrollment. *Social Forces*, 89(2), 435–461.
- Dunleavy, D. M., Kroopnick, M. H., Dowd, K. W., Searcy, C. A. and Zhao, X. (2013). The Predictive Validity of the MCAT Exam in Relation to Academic Performance through Medical School. *Academic Medicine*, 88(5), 666–671.
- Delaney, J. M. and Devereux, P. J. (2020). Choosing differently? College application behavior and the persistence of educational advantage. *Economics of Education Review*, 77, Article 101998.

- Dynarski, S., Nurshatayeva, A., Page, L. C. and Scott-Clayton, J. (2023). “Chapter 5: Addressing nonfinancial barriers to college access and success: Evidence and policy implications.” In Hanushek, E. A., Machin, S. and Woessmann, L. (Eds) *Handbook of the Economics of Education* (Volume 6). Amsterdam: Elsevier, pp. 319–403.
- Erikson, R. and Jonsson, J. O. (1996). Introduction: Explaining class inequality in education: the Swedish test case. In Erikson, R. and Jonsson, J. O. (Eds.), *Can education be equalized?* (pp. 1–64). Boulder, CO: Westview Press.
- Finger, C. (2016). Institutional Constraints and the Translation of College Aspirations into Intentions. *Research in Social Stratification and Mobility*, 46(Part B), 112–128.
- Finger, C. (2022). (Mis)Matched college aspirations and expectations. The role of social background and admission barriers. *European Sociological Review*, 38(3), 472–492.
- Finger, C., Solga, H., Ehlert, M. and Rusconi, A. (2020). Gender differences in the choice of field of study and the relevance of income information. *Research in Social Stratification and Mobility*, 65, Article 100457.
- Furuta, J. (2017). Rationalization and Student/School Personhood in U.S. College Admissions. *Sociology of Education*, 90, 236–254.
- Gerhards, J. and Németh, B. (2015). Ökonomisches Kapital der Eltern und Medizinstudium im Ausland. *Berliner Journal für Soziologie*, 25, 283–301.
- Glaesser, J. and Cooper, B. (2014). Using Rational Action Theory and Bourdieu’s Habitus Theory Together to Account for Educational Decision-making in England and Germany. *Sociology*, 48(3), 463–481.
- Goldin, C. D. and Katz, L. F. (2008). *The Race between Education and Technology*. Cambridge, MA: Harvard University Press.
- Grodsky, E., Warren, J. R. and Felts, E. (2008). Testing and Social Stratification in American Education. *Annual Review of Sociology*, 34, 385–404.
- Gröne, O.R., Huelmann, T., Hampe, W. and Emami, P. (2023). German physicians and medical students do not represent the population they serve. *Healthcare*, 11 (2), 1662.
- Hällsten, M. (2010). The structure of educational decision making and consequences for inequality: A Swedish test case. *American Journal of Sociology*, 116(3), 806–854.
- Heisig, J. P., Elbers, B. and Solga, H. (2020). Cross-National Differences in Social Background Effects on Educational Attainment and Achievement. *Compare*, 50(2), 165–184.
- Heisig, J. P. and Matthewes, S. H. (2022). No Evidence that Strict Educational Tracking Improves Student Performance through Classroom Homogeneity. *Zeitschrift für Soziologie*, 51(1), 99–111.
- Hillmert, S. and Jacob, M. (2003). Social inequality in higher education. *European Sociological Review*, 19, 319–334.
- Horstschräer, J. (2012). University rankings in action? The importance of rankings and an excellence competition for university choice of high ability students. *Economics of Education Review*, 31(6), 1162–1176.
- Hoxby, C. and Avery, C. (2013). The missing “one-offs”: The hidden supply of high-achieving, low-income students. *Brookings Paper on Economic Activity*, Spring 2013. Washington: Brookings Institution Press, 1–65.

- Huang, Z. (1998). Extensions to the k-means algorithm for clustering large data sets with categorical values. *Data Mining and Knowledge Discovery*, 2(3), 283–304.
- Hurtado, S., Kurowski, K., Briggs, C. and Rhee, B.-S. (1997). Differences in college access and choice among racial/ethnic groups. *Research in Higher Education*, 38(1), 43–75.
- Jerrim, J., Chmielewski, A. K. and Parker, P. (2015). Socioeconomic inequality in access to high-status colleges. *Research in Social Stratification and Mobility*, 42, 20–32.
- Kozu, T. (2006). Medical Education in Japan. *Academic Medicine*, 81(12), 1069–1075.
- Lippert, A. M. and Damaske, S. (2019). Finding Jobs, Forming Families, and Stressing Out? Work, Family, and Stress among Young Adult Women in the United States. *Social Forces*, 98(2), 885–914.
- Lörz, M. (2012). Mechanismen sozialer Ungleichheit beim Übergang ins Studium. In Becker, R. and Solga, H. (Eds.), *Soziologische Bildungsforschung*. Sonderheft 52 der Kölner Zeitschrift für Soziologie und Sozialpsychologie (pp. 302–324). Wiesbaden: VS Verlag für Sozialwissenschaften.
- Lucas, S. (2001). Effectively maintained inequality: education transitions, track mobility, and social background effects. *American Journal of Sociology*, 106(6), 1642–1690.
- Mare, R. D. (1980). Social background and school continuation decisions. *Journal of the American Statistical Association*, 75(370), 295–305.
- Mayer, K. U., Müller, W. and Pollak, R. (2007). Germany: institutional change and inequalities of access in higher education. In: Shavit, Y., Arum, R. and Gamoran, A. (Eds.), *Stratification in Higher Education*. Stanford, CA: Stanford University Press, pp. 240–265.
- Mood, C. (2010). Logistic regression: why we cannot do what we think we can do, and what we can do about it. *European Sociological Review*, 26(1), 67–82.
- Niu, S.X. and Tienda, M. (2008). Choosing colleges: Identifying and modeling choice sets. *Social Science Research*, 37, 416–433.
- OECD (2023), *PISA 2022 Results (Volume I): The State of Learning and Equity in Education*. Paris: OECD Publishing, <https://doi.org/10.1787/53f23881-en>.
- Powell, J. J. W. and Solga, H. (2011). Why are Participation Rates in Higher Education in Germany so Low? Institutional Barriers to Higher Education Expansion. *Journal of Education and Work*, 24(1), 49–68.
- Puddey, I. B. and Mercer, A. (2014). Predicting Academic Outcomes in an Australian Graduate Entry Medical Programme. *BMC Medical Education*, 14(1), no. 31. doi:10.1186/1472-6920-14-3.
- Pyne, J., and Grodsky, E. (2020). Inequality and Opportunity in a Perfect Storm of Graduate Student Debt. *Sociology of Education*, 93(1), 20-39.
- Reay, D., Crozier, G. and Clayton, J. (2010). ‘Fitting in’ or ‘standing out’: Working-class students in UK higher education. *British Educational Research Journal*, 36(1), 107–124.
- Reimer, D. and Pollak, R. (2010). Educational expansion and its consequences for vertical and horizontal inequalities in access to higher education in West Germany. *European Sociological Review*, 26(4), 415–430.
- Roderick, M., Coca, V. and Nagaoka, J. (2011). Potholes on the road to college. *Sociology of Education*, 84(3), 178–211.

- Sandsor, A.M.J., Hovdhaugen, E. and Bockmann, E. (2022). Age as a merit in admission decisions for higher education. *Higher Education*, 83, 379–394.
- Schindler, S. and Lörz, M. (2012). Mechanisms of social inequality development: Primary and secondary effects in the transition to tertiary education between 1976 and 2005. *European Sociological Review*, 28, 647–660.
- Smith, J. (2014). The effect of college applications on enrollment. *The B.E. Journal of Economic Analysis & Policy*, 14(1), 151–188.
- Soares, J. A. (ed.) (2020). *The Scandal of Standardized Tests*. New York: Teachers College Press.
- Spieß, C. K. and Wrohlich, K. (2010). Does distance determine who attends a university in Germany? *Economics of Education Review*, 29(3), 470–479.
- Thomsen, J.P., Bertilsson, E., Dalberg, T., Hedman, J. and Helland, H. (2017). Higher education participation in the nordic countries 1985–2010. *European Sociological Review*, 33(1), 98–111.
- Triventi, M. (2013). Stratification in higher education and its relationship with social inequality: A comparative study of 11 European countries. *European Sociological Review*, 29(3), 489–502.
- Turley, R. N. (2009). College proximity: mapping access to opportunity. *Sociology of Education*, 82(2), 126–146.
- Winkler, O. (2014). Exzellente Wahl. Soziale Selektivität und Handlungsorientierungen bei der Wahl von Spitzenbildung im Hochschulbereich. *Zeitschrift für Soziologie der Erziehung und Sozialisation*, 34(3), 280–296.
- van de Werfhorst, H. G., de Graaf, N. D. and Kraaykamp, G. (2001). Intergenerational resemblance in field of study in the Netherlands. *European Sociological Review*, 17(3), 275–293.
- Zwick, R. (2019). Assessment in American Higher Education: The Role of Admissions Tests. *The ANNALS of the American Academy of Political and Social Science*, 683(1), 130–148.
- Zwick, R. and Greif Green, J. (2007). New Perspectives on the Correlation of SAT Scores, High School Grades, and Socioeconomic Factors. *Journal of Educational Measurement*, 44, 23–45.