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Gendered processes in education

Exploring early sources of differing educational trajectories

Tünde Lénárd



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Academic dissertation for the Degree of Doctor of Philosophy in Sociology at Stockholm University to be publicly defended on Friday 30 May 2025 at 13.00 in Hörsal 11, Södra huset F (SU Frescati), Universitetsvägen 10.

Abstract

To contribute to our understanding of vertical and horizontal gender segregation in education, this dissertation addresses how gender differences in educational outcomes emerge. More specifically, it explores how the differences between women and men in school performance, competitiveness, educational program choices and educational attainment are formed by mechanisms like peer effects, confidence in own abilities and educational aspirations. The analysis builds on detailed individual-level data and captures said mechanisms fairly early, at the compulsory and upper secondary school levels.

Study I presents new evidence on gender peer effects on test scores using Swedish data containing the history of the gender composition of students' classrooms from grade 1 to 9. Results from school fixed effect models utilizing within-school variation in gender composition across classrooms show that girls have slightly higher and boys slightly lower test scores in a more female-dominated classroom, but effect sizes are small. The average effects also mask important non-linearities, with meaningful effects only impacting a few students in classrooms with very skewed gender distributions. Exploring the possibility of cumulative effects, the study shows that longer exposure to a certain classroom composition has a similarly small impact on test scores as contemporaneous effects.

Study II examines the association between confidence and competitiveness from a gender perspective using data from students in 53 Hungarian upper secondary classrooms. The study reproduces a common finding in the experimental literature according to which the gender gap in competition is partly explained by males being more (over)confident than females. It also uncovers a second mechanism, showing that even if both genders had the same level of confidence, a persistent gender difference in competition would remain in the realistic group. This result is robust across all specifications, challenging theories about the overconfidence of men driving the relationship between confidence and the female-male gap in competition.

Study III shows how academic self-concept and interests affect upper secondary program choices by disentangling their net effect from the effect of prior school achievement. It also analyzes if gender differences in these motivational factors contribute to the gender gap in upper secondary program choices and whether there are gender differences in how achievement, motivation and choices relate to each other. Results from structural equation models using survey data linked to Swedish register data indicate that the motivational factors do not only predict the choice outcomes well but they also explain a large part of the gender gap in STEM program choice. Besides, results suggest gender differences in how achievement forms the motivational factors.

Study IV examines the effects of educational aspirations in adolescence on educational attainment in young adulthood, exploring how these associations might differ across gender and immigrant background. Drawing on a nationally representative sample of Swedish youth, gender stratified fixed effect models show that high aspirations do not increase the risk of low education for immigrant background boys and girls. Instead, high aspirations boost the chances of getting tertiary education, particularly among immigrant-background women. However, aspirations explain little of the immigrant-native gap in educational attainment.

Keywords: *gender, school performance, competitiveness, educational choice, educational attainment.*

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Abstract of the dissertation

To contribute to our understanding of vertical and horizontal gender segregation in education, this dissertation addresses how gender differences in educational outcomes emerge. More specifically, it explores how the differences between women and men in school performance, competitiveness, educational program choices and educational attainment are formed by mechanisms like peer effects, confidence in own abilities and educational aspirations. The analysis builds on detailed individual-level data and captures said mechanisms fairly early, at the compulsory and upper secondary school levels.

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gap in STEM program choice. Besides, results suggest gender differences in how achievement forms the motivational factors.

Study IV examines the effects of educational aspirations in adolescence on educational attainment in young adulthood, exploring how these associations might differ across gender and immigrant background. Drawing on a nationally representative sample of Swedish youth, gender stratified fixed effect models show that high aspirations do not increase the risk of low education for immigrant background boys and girls. Instead, high aspirations boost the chances of getting tertiary education, particularly among immigrant-background women. However, aspirations explain little of the immigrant-native gap in educational attainment.

Sammanfattning (Summary in Swedish)

För att bidra till vår förståelse av vertikal och horisontell könssegregation inom utbildning, undersöker denna avhandling hur könsskillnader i utbildningsresultat uppstår. Mer specifikt utforskas hur skillnader mellan kvinnor och män i skolprestationer, konkurrensförmåga, skolval och utbildningsnivåer formas av mekanismer som kamrateffekter, självförtroende och utbildningsambitioner. Analysen bygger på detaljerade individdata och fångar dessa mekanismer tidigt, på grundskole- och gymnasienivå.

Studie I presenterar ny evidens om könsspecifika kamrateffekter på provresultat, baserat på svenska data som innehåller historik om könsfördelningen i elevernas klassrum från årskurs 1 till 9. Resultat från modeller med fixa effekter för skolor, som utnyttjar variation i könsammansättning mellan klassrum inom skolor, visar att flickor har något högre och pojkar något lägre provresultat i mer kvinnodominerade klassrum, men effekterna är små. Genomsnitteffekterna maskerar icke-linjära effekter, med betydelsefulla effekter endast för den lilla grupp av elever som finns i klassrum med mycket sned könsfördelning. Genom att undersöka kumulativa effekter visar studien att längre exponering för en viss klassrumsammansättning har en lika liten inverkan på provresultaten som samtidiga effekter.

Studie II undersöker sambandet mellan självförtroende och konkurrensförmåga ur ett könsperspektiv med hjälp av data från elever i 53 ungerska gymnasieklasser. I linje med den experimentella litteraturen på området visar våra resultat att könsskillnaden i konkurrens delvis förklaras av att män är mer (över)självsäkra än kvinnor. Resultaten visar också att även om båda könen hade samma nivå av självförtroende skulle en könsskillnad i preferensen för konkurrens kvarstå i den realistiska gruppen. Detta resultat är robust i alla specifikationer och utmanar teorier om att mäns höga självförtroende driver sambandet mellan självförtroende och könsskillnader i konkurrens.

Studie III visar hur akademisk självuppfattning och intressen påverkar val av gymnasieprogram givet effekten av tidigare skolprestationer. Studien analyserar också om könsskillnader i dessa motivationsfaktorer bidrar till köngapet i val av gymnasieprogram och om det finns könsskillnader i hur prestationer, motivation och val relaterar till varandra. Resultat från strukturella ekvationsmodeller med enkätdata matchade till svenska registerdata visar att motivationsfaktorerna inte bara predicerar utbildningsval väl, utan också förklarar en stor del av köngapet i val av STEM-program. Dessutom finner vi könsskillnader i hur prestationer formar motivationsfaktorerna.

Studie IV undersöker effekterna av höga utbildningsambitioner under ungdomsåren på utbildningsnivå i ung vuxenålder, och hur dessa samband kan skilja sig beroende på kön och invandrabakgrund. I ett nationellt representativt urval av svenska ungdomar visar könsspecifika modeller med fixa effekter att höga ambitioner inte ökar risken för låg utbildning för ungdomar med invandrabakgrund. Istället ökar höga ambitioner chanserna till högre utbildning, särskilt bland kvinnor med invandrabakgrund. Dock förklarar ambitioner bara en liten del av skillnaderna i utbildningsnivå mellan invandrare och infödda.

List of studies included in the dissertation

- Study I Get the balance right? How peer gender composition shapes educational outcomes, and when it matters
Revised & resubmitted to Sociology of Education
- Study II Competition, confidence and gender: shifting the focus from the overconfident to the realistic (with Dániel Horn and Hubert János Kiss)
Published in the Journal of Economic Psychology (2024, Volume 104, 102746)
- Study III Motivational factors and gendered program choice in upper secondary school – evidence from Sweden
Submitted manuscript
- Study IV High aspirations of boys and girls with foreign-born parents: More a help than a hindrance (with Carina Mood and Stephanie Plenty)
Manuscript

1. Introduction

In most of the developed world, women outperform men in terms of average school achievement and educational attainment, yet men and women make markedly different field of study choices leading to female underrepresentation in STEM and male underrepresentation in humanities and health sciences (Bertrand, 2020; OECD, 2024a). This dissertation aims to contribute to our understanding of these vertical and horizontal forms of gender segregation by addressing how gender differences in educational outcomes come about. More specifically, it explores how the gender gaps in school performance, competitiveness, school choices and educational attainment are formed by mechanisms like peer effects, confidence in own abilities and educational aspirations.

The analysis builds on detailed individual-level data and captures said mechanisms at the compulsory and upper secondary school levels. These school phases are when students in most countries have to make choices about school tracks and thus when gender segregation in educational pathways start to emerge, contributing to maintained segregation in post-secondary education and on the labor market (Kriesi & Imdorf, 2019). From a developmental perspective, the years of adolescence constitute a formative age when gender becomes a salient layer of identity (Galambos, 2004; Lobel et al., 2004) and students are most susceptible to gender stereotypes and peer influence (Laursen & Veenstra, 2021; Steinberg & Monahan, 2007).

The aim of this introductory chapter is to describe gender differences in education and to summarize potential explanations for these differences offered in the literature. As the dissertation is interdisciplinary touching upon topics explored not only in sociology but also in economics and psychology, I introduce different perspectives from these disciplines regarding mechanisms behind said gender gaps.

The literature review is built as follows. In section 2, I start by discussing the most widespread gender gaps in educational outcomes today: the gender gap in educational attainment and the gap in field of study choices, and the historical processes that led to them. Then, in section 3, I describe the theoretical foundations of gender identity used in sociology, psychology and economics: such as gender essentialism, social constructivism and the rationality assumption/rational choice theory. These theories are crucial to understanding how these disciplines approach the formation of gender differences in educational outcomes. In section 4, I turn to possible mechanisms that maintain vertical and horizontal gender segregation in

education, including gender differences in cognitive skills and school engagement, and gender differences in preferences and motivational beliefs.

Later sections discuss the country contexts of my four studies, and the data and methods used in the dissertation. The final sections summarize my findings and conclude.

2. Gender differences in education

2.1. The gender gaps today

Women across the developed world today are more likely to have a higher educational attainment than men: women are more likely to choose the academic upper secondary track as opposed to the vocational one, to finish upper secondary school and to obtain tertiary education than men (Bertrand, 2020; OECD, 2023a, 2024a). As a consequence, 54% of 25-34 year-old females have a tertiary degree across the OECD, while the corresponding share among males is only 41% (OECD, 2023a). This is referred to as vertical gender segregation in education.

On the other hand, horizontal gender segregation exists too, defined as when males and females choose different fields of study: women are underrepresented in STEM (science, technology, engineering and mathematics) fields across the OECD, with only 33 % of STEM tertiary graduates being female (OECD, 2023a). There are even bigger gender disparities in math-intensive fields within STEM: the share of female tertiary graduates in information and communication technologies (ICT) is 23%, and it is 28% in engineering (OECD, 2023a). Men, on the other hand, are underrepresented in some female-typical fields, such as health and welfare. Only 23% of tertiary graduates in these fields are male on average in the OECD countries (OECD, 2023a). These differences start to appear already in secondary school, where female students are often underrepresented in math and science courses or programs and overrepresented in humanities (Kriesi & Imdorf, 2019). Horizontal gender segregation in upper secondary education is particularly strong in countries with vocational education at this level because students are likely to choose gender-typical programs within the vocational track (Kriesi & Imdorf, 2019).

Gender segregation in education contributes to occupational gender segregation which leads to worse labor market conditions for women compared to men, including lower earnings, higher unemployment rate and less chance for upward mobility (Bertrand, 2020; Kriesi & Imdorf, 2019). The large gender disparities in STEM are particularly problematic because STEM

occupations (particularly those in technology and science) are high-paying occupations, where the gender pay gap is relatively narrow (Goldin, 2014).

2.2. Historical background

Historically, the gradually decreasing male advantage and the eventual female advantage in educational attainment can be explained by a steady increase in returns to education for women during the second half of the twentieth century, starting after World War II (Goldin et al., 2006). During these decades, women entered the labor market at a rapidly increasing pace as a result of more demand for labor, less discrimination, changing social norms regarding women's role in society and accessible contraceptive methods (Goldin et al., 2006).

Right after the war period, many women entered the labor market without suitable education, but the higher demand for labor led to women's educational attainment also catching up to men's, so much so, that by the 1980s the gender gap in educational attainment reversed to the advantage of women in the US and in much of Europe (Goldin et al., 2006; Van Hek et al., 2016). This reverse and the continued advantage in highest educational level among women compared to men is largely due to female students outperforming male students in most school subjects (Else-Quest et al., 2010; Voyer & Voyer, 2014) and women being less likely than men to choose the vocational track as opposed to the academic one (OECD, 2023a).

Parallel to these changes, the gender-based desegregation of many occupations and fields of study started to occur. Women started to move into higher paying occupations previously dominated by men, which also increased the demand for traditionally male-typical degrees among women (England, 2010). The desegregation of middle class occupations was much faster than that of working class jobs, and the same can be observed for different levels of education too, with gender desegregation of tertiary qualifications happening much faster than that of other, lower qualifications (England, 2010).

As a result of higher female labor market participation and educational attainment, and lower gender segregation in occupations and study fields, the gender wage gap has been on the decline (Bertrand, 2020). However, this process seems to be stalled as women still have lower median earnings than men, which has been primarily explained by two strands of phenomena.

One is focusing on why female-dominated occupations pay less than male dominated ones. Several mechanisms have been explored by the literature, such as the devaluation of female-typical work tasks, the female disadvantage in specialized human capital accumulation or

female-typical work-time arrangements (Grönlund & Magnusson, 2013; Leuze & Strauß, 2016; Ochsenfeld, 2016). In connection to the latter two, Bertrand (2020) also highlights the motherhood penalty. The birth of a first child has different effects on mothers' and fathers' earnings in the long run. Even in a gender-egalitarian country such as Sweden, mothers experience a larger negative effect on earnings than fathers (Kleven et al., 2019). Although it is important to keep these sources of inequality in mind when reading this dissertation, I will not dwell on these topics further as they only bear indirect relevance to the research I present.

Another driver of the gender pay gap is gendered educational choices. Although women are more likely than men to choose the academic path than the vocational one, and thus have a higher educational attainment than men (OECD, 2024a), weighing this up against the gender segregation in study fields we still find that women's educational and subsequent labor market decisions lead to lower financial returns than those of men (Bertrand, 2020). My dissertation focuses on differences in attainment and field of study choices and the mechanisms behind them.

3. Theoretical foundations of gender identity and gender similarities/differences

Social constructivism and gender essentialism are two theoretical perspectives that are mostly used in sociology and psychology when thinking about gender identity and differences between men and women. Theories in economics tend to be based on the rationality assumption which shows large similarities to rational choice theory in sociology also used to analyze gendered educational outcomes.

Essentialism is most widespread in evolutionary psychology and builds on the belief that men and women have essentially different traits which result from genetically inherited sex-specific psychological dispositions (Buss & Kenrick, 1998). These dispositions are seen as (near-) universal and not varying with context as evolutionary theorists believe they have been shaped by the reproductive pressure experienced by our ancestors. This pressure leads men to be more competitive and aggressive and women to be more protective of children (Wood & Eagly, 2002). As essentialism sees gender differences as predetermined at birth, it does not incorporate concepts such as stereotypes or socialization.

Social constructivism is a theoretical framework widely relied on in sociology and social psychology which sees gender differences as social constructs, resulting from social influences. In this tradition, gender functions as an institutionalized system of social practices that categorizes individuals as men or women (Ridgeway & Correll, 2004). People are socialized to belong in these categories (or roles) and act according to them in different social situations and contexts (Wood & Eagly, 2002). According to Ridgeway & Correll (2004), two key pillars uphold the gender system: widely shared cultural beliefs about gender and the social relational contexts in which these beliefs are enacted. Consequently, as social context varies, gender roles do too.

The first pillar is what the literature across the social sciences refers to as stereotypes. They are rather prescriptive in the constructivist framework, reinforcing commonly held beliefs about the traits and behaviors of women and men (Bertrand, 2020). These beliefs serve as the silent rules by which people define themselves and other individuals in social situations. As people anticipate being treated according to these rules, they also align their own behaviors and self-perceptions with them, thus turning cultural beliefs into internalized, identity-forming gender norms (Bertrand, 2020; Ridgeway & Correll, 2004).

According to the constructivist tradition, gender norms shape gender identity across generations through sociocultural influences, such as those from parents and teachers who play a crucial role in transmitting stereotypes to future generations (Bertrand, 2020; Butler & Hasenfratz, 2017). Gender identity is then present in most social contexts, sometimes allowing other prominent layers of identity—such as class, race, or occupational status — to take precedence (Ridgeway & Correll, 2004). Thus, the impact of gender identity depends on the social context.

The rationality assumption remains a key theoretical perspective in economics, despite growing interest in sociological topics like identity, norms, social interactions and contextual effects. It means that actors are assumed to be rational beings making utility maximizing decisions after weighing the costs and benefits associated with a given decision (Hedström & Stern, 2008). Taking a rationality-guided example of gender-specific educational choice as outlined by Altonji et al. (2012), males and females aim to choose educational programs with the highest utility within their set of feasible options. What might be feasible for them depends on innate abilities, preferences and an initial set of information including prior academic performance or resources available through school or parental background. The programs' skill requirements constrain choices.

There are different aspects in which this framework might resemble essentialist and constructivist views. For instance, own innate abilities and preferences are assumed to be initially unknown, but then they are gradually discovered through experience and interaction with the environment (Altonji et al., 2012). Having a certain level of innate abilities reflects essentialist views, while preferences being formed by experience and interactions taps into constructivism. The assumption that human capital increases with educational and labor market experience also aligns with constructivism (Altonji et al., 2012). Another point of comparison concerns the role of parents. On one hand, they are assumed to influence the child's educational choices through their own parental decisions which affect the child's educational/social experiences, preferences and performance (Altonji et al., 2012). This can be connected back to constructivism. But genetic (and cultural) factors from parents are also (although only implicitly) acknowledged in many models (Altonji et al., 2012), leaning somewhat towards essentialism.

Economic theories also address the issue of stereotypes affecting gendered choices. However, unlike constructivism, where stereotypes are viewed as prescriptive, economics often interprets them as manifestations of statistical discrimination (Bertrand, 2020). Statistical discrimination means that when people have to make decisions based on imperfect information, they fill in the gaps with rational beliefs about male or female traits based on available information on the actual (within-)gender distribution of these traits (Bertrand, 2020). It is also increasingly common to include gender identity in economic decision models, especially since the seminal work on the topic by Akerlof & Kranton (2000). They emphasize that being part of a certain social group (like gender) influences choices, because any deviation from the expected behavior of that group decreases utility through being in conflict with social norms or one's identity.

Besides economics being influenced by the notion that norms and identity affect behavior and choices, sociology is also influenced by rational choice theory. **Rational choice sociology** sees individuals as rational, utility maximizing actors actively making decisions based on costs and benefits associated with choice alternatives, weighted by the probability of success (Hedström & Stern, 2008; Jonsson & Erikson, 2000). Rational choice theory influences social mobility research most, but it is used in educational sociology too to analyze educational choices (Jonsson, 1999; Jonsson & Mood, 2008). Since gender differences in abilities and in the perceived costs and benefits of a choice alternative influence how women and men evaluate different educational pathways, gendered choices can be understood from a rational choice

point of view (Jonsson, 1999). Besides, as costs, benefits and probabilities for success can vary depending on the social context (Jonsson & Erikson, 2000), rational choice theory is often used alongside social constructivism.

4. Mechanisms

Mounting evidence across the social sciences argues that gender differences not only in field of study choices but also in educational attainment can be traced back to gender differences in the following (Bertrand, 2020; Delaney & Devereux, 2021; Kahn & Ginther, 2017; Kriesi & Imdorf, 2019; Stewart-Williams & Halsey, 2021):

- cognitive skills and school engagement,
- preferences (for fields, occupations, competitive situations),
- motivational factors (ability beliefs /self-concept, confidence, aspirations).
- macro-level opportunity structures

The first three sets of mechanisms are of course interdependent and, importantly, endogenous to gender stereotypes (Bertrand, 2020). Stereotypes might affect gender differences in skills, traits, preferences and motivational factors directly but they often work through gatekeepers like teachers or parents, or through peers (Kahn & Ginther, 2017; Kriesi & Imdorf, 2019). Lastly, macro-level opportunity structures in a given country impose context-dependent constraints on (gendered) educational choices (Guiso et al., 2008; Kahn & Ginther, 2017; Kriesi & Imdorf, 2019). The following subsections discuss these mechanisms in more detail and show if they reflect constructivist, essentialist or rationalist explanations of gender differences in educational outcomes.

4.1. Gender differences in cognitive skills and school engagement

According to Bertrand (2020), evidence suggests that on average, men and women may be more similar than different in various skills and traits, such as cognitive and communication skills or some social and personality traits. However, notable differences exist too. Girls tend to have higher average school performance (the closest proxy to cognitive skills widely used in analyses of educational outcomes) which extends to most subjects when using teacher graded performance measures (Voyer & Voyer, 2014). The most pronounced girl advantage is usually found in language courses (Voyer & Voyer, 2014). Standardized tests produce smaller differences and mixed findings regarding whether math abilities actually favor boys or girls, but the female advantage in literacy is consistent (Bertrand, 2020; Guiso et al., 2008; OECD,

2023b). Boys' disadvantage in literacy skills means a hindrance for them in terms of educational advancement, decreasing their upper secondary completion rates compared to girls (OECD, 2024e).

The higher average school performance of girls is associated with female students having higher average levels of non-cognitive skills associated with school engagement, like self-discipline or interest in learning¹ (Alivernini et al., 2019; Buchmann et al., 2008). They also tend to show less behavioral problems at school than boys (Buchmann et al., 2008; Delaney & Devereux, 2021). Considering that higher average performance and better discipline increase the probability of success in higher education, rational choice theory would predict girls to be more likely than boys to enter an upper secondary program granting university access, and then later, enter university (Jonsson, 1999; Jonsson & Erikson, 2000; Jonsson & Mood, 2008). In line with this, Delaney & Devereux (2021) suggest that gender differences in school engagement and behavior might be the reason behind girls getting higher teacher given assessment at given ability than boys. Moreover, Goldin et al. (2006) show that controlling for behavioral problems of boys can explain much of the female advantage in college attendance which suggests that behavioral differences in early adolescence significantly contribute to gender differences in educational attainment.

The literature tends to suggest constructivist explanations for these differences in school engagement and behavior. Peers and teachers are likely to reinforce gender-stereotyped norms according to which school resistance and disruptive behavior is typically considered masculine while working hard to learn at school is considered feminine (Legewie & DiPrete, 2012; Lundberg, 2020; Yavorsky & Buchmann, 2019). Reinforcement by peers might happen through pressure to conform to a gender-typical identity or social approval (Eberhard et al., 2015; Kessels et al., 2014). For example, boys are more likely than girls to be exposed to friends who show resistance to schooling (Figlio, 2007; Geven et al., 2017) which might contribute to gender differences in behavior. In addition, the better classroom behavior of girls might lead to positive teacher bias in their performance evaluations (DiPrete & Jennings, 2012), which can reinforce the thought of academic pursuits being typically feminine.

Peers also affect school performance directly. High ability peers tend to increase their classmates' performance in the primary and secondary school context through ability spillovers

¹ Psychologists refer to these skills as cognitive self-regulation, economists as non-cognitive or personality traits, and sociologists use terms like non-cognitive skills, social-psychological factors or engagement in schooling (see the summary of DiPrete & Jennings (2012)).

(Burke & Sass, 2013; Paloyo, 2020; Sacerdote, 2011). As female students outperform males at school, a strand of peer effects literature evolved suggesting that a higher share of female classmates increases individual school performance (see the seminal papers by Hoxby (2000) and Lavy & Schlosser (2011)). However, girls do not only differ from boys in their average performance but they also show better behavior and attitudes towards learning, which might facilitate a better learning climate for the whole class. This suggests that the gender composition of peers in the school context might affect student performance not only through abilities, but also through the learning climate (Lavy & Schlosser, 2011).

Despite these theoretical considerations, precise estimates of the effect of peer gender composition on test scores has been lacking in the Western context, as most papers have relied on cohort gender composition instead of using the gender composition of students' classrooms (Briole, 2021; Hoxby, 2000; Lavy & Schlosser, 2011; Proud, 2014). **Study I** in this dissertation contributes by using full-population data with precise information on classroom assignment and by estimating the effect of classroom gender composition on test scores in 6th and 9th grades in Sweden. Moreover, the study also analyzes the cumulative effects of multiple years in a classroom with skewed gender composition (that is, highly dominated by either females or males). The possibility of cumulative effects was completely overlooked by previous studies despite its relevance based on the theory on human capital accumulation (Hanushek, 1979).

Besides contributing to gender differences in advancement in education, gender differences in abilities also contribute to horizontal gender segregation by influencing field of study choices of girls and boys. First it is important to note that gender differences in subject-specific school achievement have little explanatory power over choice disparities and they do not explain well the female underrepresentation in STEM (Friedman-Sokuler & Justman, 2016; Kahn & Ginther, 2017; Ochsensfeld, 2016). Given that many studies show little to no differences in average math skills this might not be surprising. However, men dominate among the highest performers, and they also tend to have higher mathematical *reasoning* abilities (Kahn & Ginther, 2017; OECD, 2023b; Stewart-Williams & Halsey, 2021) which might make them particularly suitable for STEM careers by increasing their probability of success. Besides, male students tend to have a comparative advantage in mathematics or other STEM-related subjects, meaning that their performance in these areas exceeds their performance in other areas related to humanities like languages, while the opposite tends to be true for females (Delaney & Devereux, 2021; Jonsson, 1999). These comparative differences tend to have a higher explanatory power than differences in average performance (Riegle-Crumb & Moore, 2013).

Based on the rational choice framework, even if average gender differences are small, having a comparative advantage in a domain increases the probability of success in that domain compared to other domains. Evidence suggests that comparative advantages account for up to a third of the gender gap in field of study choices on upper secondary level (Jonsson, 1999).

As a constructivist explanation, stereotypes may affect gender differences in subject-specific abilities and field of study choices (Brussino & McBrien, 2022). Gender stereotypes assert that men perform better in math while women are better in verbal skills. These stereotypes can create self-fulfilling prophecies working through parents, teachers and peers who might discourage girls to develop their skills in mathematics, physics or computer programming, while encouraging boys (Stewart-Williams & Halsey, 2021). There is evidence that parents and teachers often nurture skills in areas seen as gender-typical (Butler & Hasenfratz, 2017; Kahn & Ginther, 2017). Peer groups might also reinforce these norms. Boys perceive their friends as being more encouraging towards for instance studying STEM and discouraging towards studying gender-atypical subjects than girls, while high-achieving girls often downplay their achievement to avoid negative peer judgment (Butler & Hasenfratz, 2017). Moreover, as a result of internalized stereotypes, girls may invest less in skills considered atypical for their gender, believing these won't be rewarded (Bertrand, 2020).

A study by Guiso et al. (2008) illustrates the potential impact of self-fulfilling prophecies, showing a decrease in the male advantage in math performance (on the PISA test) when the World Economic Forum's Gender Gap Index (a measure for equality) is higher. In regions with higher gender equality, the math performance gap diminishes.

Although there is evidence on the social constructivist origins of gender differences in abilities (Brussino & McBrien, 2022), some researchers argue for biological factors being the main explanation, since many gender differences manifest early and appear across cultures, with hormonal differences already linked to some of them (Stewart-Williams & Halsey, 2021). Regardless of whether the discussed abilities stem mainly from nature or nurture, differences in abilities and traits do not fully explain gender differences in educational choices, suggesting that preferences and motivational factors may also play a significant role (Altonji et al., 2012; Bertrand, 2020; Delaney & Devereux, 2021).

4.2. Gender differences in preferences and motivational beliefs²

There are gender differences in occupational preferences that might contribute to gender differences in educational choices. Children start to attach gender stereotypes to occupations very early, even before the start of primary education (Brussino & McBrien, 2022). By secondary education, there are clear gender differences in occupational preferences of students that mirror these beliefs: most girls expect to work in health care or teaching occupations, while boys prefer male-typical occupations such as engineering professionals or mechanics, and importantly, they prefer STEM-related jobs more than girls do, even at similar performance levels (Brussino & McBrien, 2022). Furthermore, among adolescents with high cognitive abilities, males often prioritize monetary incentives and career development, while females tend to look more for work-life balance and family (Stewart-Williams & Halsey, 2021; Zafar, 2013). Occupational preferences along with occupational incentives significantly influence field of study choices at university and mediate much of the gender disparity in those choices (Altonji et al., 2012).

Competitive preferences also differ by gender. Male students prefer competition more than females (Markowsky & Beblo, 2022; Niederle & Vesterlund, 2007) which has already been linked to the gender gap in math- and science-intensive educational track choices as early as upper secondary school (Buser et al., 2014, 2017). Much of the competitiveness gap is explained by men being more risk-taking and more confident in their performance than women (Markowsky & Beblo, 2022). Based on PISA data, Brussino & McBrien (2022) argue that the gender gap in competitiveness is not preordained since confidence is shaped by gender norms in a country and there is between-country variance in how much girls and boys fear failure. Nevertheless, there is a male advantage in competition in almost all OECD countries, even though the data show considerable variation across countries in the absolute level of competitiveness of both genders (Brussino & McBrien, 2022).

Confidence has been a well established mediator of the gender gap in competitiveness (Markowsky & Beblo, 2022; Van Der Vleuten, 2023), but no studies have looked beyond this compositional mechanism in explaining how confidence relates to boys' stronger preference for competition. The prevailing explanation has tied higher competitiveness of boys to their higher overconfidence compared to girls. Relying on data from Hungary, **Study II** in this

² These are also often referred to as non-cognitive skills, especially in economics, see for instance in Sutter et al. (2019).

dissertation explores other mechanisms too, by asking if the gender gap in competition would still exist if girls and boys had the same level of confidence. By using a more refined measure of confidence than most of the literature, the paper identifies another confidence-related channel behind the competitiveness gap, suggesting that the higher overconfidence of boys is only part of the whole picture.

Although occupational and competitive preferences reflect traditional gender stereotypes, rational choice scholars argue that these preferences might also lead to utility maximizing educational choices. Men expecting to be primary earners might maximize their earning by choosing educational fields that lead to high-paying and competitive occupations such as those in STEM (Kriesi & Imdorf, 2019). Women expecting to have a family might minimize costs of care leave by choosing female-typical fields in anticipation of having an occupation with flexible time arrangement (Kriesi & Imdorf, 2019). They might also maximize potential benefits by choosing fields where they expect less discrimination against women.

Confidence in own abilities might also shape the educational choices and attainment of girls and boys directly, along with other motivational factors like aspirations. Gender differences in these factors are, however, somewhat contradictory. On the one hand, girls tend to be less confident in their abilities than boys – a finding confirmed by experimental studies defining confidence as believed performance (Buser et al., 2014; Dreber et al., 2014; Sutter & Glätzle-Rützler, 2015), and by psychology papers defining it as academic self-concept (Parker et al., 2018). Rational choice theory would predict that a lower subjective evaluation of own abilities leads to less ambitious educational choices and lower educational attainment because it decreases the perceived probability of success (Jonsson & Erikson, 2000; Jonsson & Mood, 2008). However, given the female advantage in school performance and educational attainment, it would be hard to reason for confidence being a predictor of the gender gap in entering academic upper secondary education or university.

On the other hand, despite their lower confidence, female students have markedly higher educational aspirations than males (Berrington et al., 2016; DiPrete & Buchmann, 2013), which already explains part of the gender gap in average school achievement in 8th grade and contributes to girls' further educational advancement (Fortin et al., 2015; Lundberg, 2020). The female advantage in aspirations in terms of highest aspired educational attainment can be understood from two perspectives. Gendered education-related beliefs and attitudes are shaped by the sociocultural norms of significant others (e.g. parents, teachers and peers) and the surrounding social environment (Bandura, 2006; Eccles & Wigfield, 2020; Wigfield & Eccles,

2000). Thus, first, females' higher educational aspirations can be understood from socialization processes (constructivist), where prevailing gender norms are internalized by boys and girls in line with their gender identity (Kessels et al., 2014; Mickelson, 1989). In contemporary society, gender-stereotyped norms exist with academic pursuits typically being considered as feminine and school resistance as masculine (Buchmann et al., 2008; Lundberg, 2020; Yavorsky & Buchmann, 2019). These internalized norms might contribute to the gender gap in educational aspirations.

Second, girls might have higher aspirations than boys, since they have more to gain from higher educational attainment than their male peers (rationalist). Research suggests that the relative return on education (income gain compared to those who do not have tertiary education) is higher for women than for men (Reisel, 2013; Seehuus & Strømme, 2024). Besides, high educational aspirations can also represent a strategy to avoid undesirable employment conditions of jobs not requiring higher education, such as low pay and less access to benefits (Chuan, 2020; Kriesi & Imdorf, 2019). Women might also gain more than men from investing in education not only in terms of better employment opportunities and income, but in terms of returns on health. Research has shown that the health improving effect of an additional year of schooling is greater for women than for men (Delaruelle et al., 2018; Ross & Mirowsky, 2010).

Study IV in this dissertation contributes to the literature on aspiration effects in education by bringing together the gender perspective with another strand of research, namely the one exploring the consequences of immigrant background students having higher educational aspirations compared to their native-background peers, often referred to as immigrant optimism. Despite their lower average achievement at school, higher aspirations of immigrant-background students are well documented using their revealed choices of academically more challenging tracks at given ability than native peers (Jackson et al., 2012; Rudolphi & Salikutluk, 2021) and their directly stated educational aspirations (Busse & Scharenberg, 2022; Dollmann, 2021). Study IV aims to make two contributions. First, it analyzes the aspiration by immigrant background effects not only on upper secondary completion (which have been the main focus of this literature so far, see Birkelund, 2020; Dollmann et al., 2023; Jonsson & Rudolphi, 2011; Tjaden & Hunkler, 2017), but it also looks at tertiary attainment, an outcome further along the educational career. Second, it also integrates the role of gender, which has been completely overlooked by studies on immigrant optimism.

Gender differences in confidence are a better predictor of horizontal than vertical gender segregation in education. Concentrating on subject-specific confidence measures, boys often

report higher self-concept in math and science than girls, while girls report higher self-concept in the verbal domain (Parker et al., 2018, 2020). These differences emerge in early childhood and continue to persist well into adulthood (Parker et al., 2020). Besides, boys often overestimate their present math performance (positive difference between beliefs and actual performance) even if their performance is the same or worse than that of girls (Ehrlinger & Dunning, 2003; Niederle & Vesterlund, 2007), while girls tend to underestimate theirs, with no such observation in female-typical domains (Butler & Hasenfratz, 2017). It is also found in the literature that boys tend to be more interested in math than girls, while girls report being more interested in verbal domains than boys (Parker et al., 2020).

These differences are partly the result of early socialization. Parents and teachers tend to encourage boys in STEM activities while discouraging girls to do the same (Butler & Hasenfratz, 2017; Kriesi & Imdorf, 2019). Based on Correll's (2001) biased self-assessment theory, stereotypes like the male advantage in math and science abilities and female advantage in languages affect adolescents' self-perceptions. Evidence suggests that this leads to gender-biased self-assessment of abilities and contributes to gender-typical educational aspirations in terms of field of study (Correll, 2001, 2004).

The sociological approach of Correll (2001) is mostly in line with Expectancy Value Theory (Eccles, 1983; Eccles & Wigfield, 2020, 2023), primarily used in psychology. It argues that educational performance and choices depend on students' expectancies for success and perceived value of a given task/outcome. Expectancies are often measured in terms of academic self-concept, while task values refer to importance, interests and subjective costs regarding a given choice alternative. Given that self-concept and task values, like interests, are gendered (Mejía-Rodríguez et al., 2021; Parker et al., 2018, 2020), gender differences in these motivational factors are expected (and have been shown) to contribute to gender-specific educational choices (Guo et al., 2015; Nagy et al., 2006).

One can deduce the importance of gendered motivational factors in making gender-specific field of study decisions from rational choice theory as well. Assuming rationality, the utility of an educational choice option depends on the student's perceived probability of success. Since subject-specific ability beliefs differ by gender, and thus affect the perceived probability of success in a gender-specific way, women and men may rank educational choice options differently (Jonsson & Erikson, 2000; Jonsson & Mood, 2008; Kriesi & Imdorf, 2019).

How subject specific academic self-concept and interests shape educational choices has been empirically tested mostly by using later outcomes than upper secondary school transition, like university major choice (Guo et al., 2015; Parker et al., 2012). Thus, we know little about how these motivational factors shape program choices at the upper secondary transition, which is the start of formal tracking in many countries. **Study III** in this dissertation contributes by analyzing how academic self-concept and interests in the math and verbal domains (net of the effect of achievement) influence the upper secondary program choices in Swedish upper secondary schools. It also looks at the choice between academic and non-academic tracks and the choice between STEM and non-STEM academic programs. The paper also explores gender differences in these relations and if the gender gaps in said choices are mediated by self-concept and interests.

Butler & Hasenfratz (2017) suggest yet another theoretical framework explaining how the interplay of various motivational factors leads to different educational outcomes for boys and girls. They argue that gender differences in motivational beliefs are associated with gender differences in goal-setting strategies in the following manner. Boys rather prioritize performance goals, emphasizing the role of natural ability over effort in success. Individuals implementing this type of goal-setting are inclined to attribute success to their own abilities but not to accept negative feedback or any responsibility for failures. They are also more willing to compete. On the other hand, girls typically adopt mastery goals, valuing effort over abilities, promoting learning and improvement, while also being more open to feedback.

These goal-setting strategies can be connected to two previously mentioned gender gaps documented in the literature. The first is the greater competitiveness of male students (Markowsky & Beblo, 2022; Niederle & Vesterlund, 2007) which is in line with them relying on performance goals. The second is the female advantage in educational aspirations (Berrington et al., 2016; DiPrete & Buchmann, 2013), which is in line with girls primarily setting mastery goals, since achieving a high educational attainment requires effort and perseverance.

4.3. Macro-level structural factors

As mentioned above, Guiso et al. (2008) show that the male advantage in math performance diminishes in countries with higher gender equality. A somewhat contradictory finding is that more gender equal and more developed countries have higher levels of horizontal gender segregation in secondary and tertiary education than less developed/ gender equal ones

(Charles & Bradley, 2009; Stoet & Geary, 2018), a phenomena often referred to as the gender equality paradox³.

A possible explanation provided to this paradox is that greater economic development and more equal access to resources in more gender equal countries takes the pressure off of women to go to occupations offering higher returns. In an environment with less risks and more opportunities, students tend to choose fields based on their comparative advantages which steers women away from STEM fields (Stoet & Geary, 2018). Research also suggests that a highly stratified upper secondary curriculum (particularly the high share of vocational enrollment and the specificity of vocational programs) along with a high number of available tertiary programs contribute to gender-typical field of study aspirations and increase the level of gender segregation in education (Kriesi & Imdorf, 2019). Charles & Bradley (2009) suggest that gender remains a central concept of identity even in developed Western countries, so the strong emphasis on individualist self-expression allows people to express their gendered self and develop preferences according to masculinity and femininity norms.

Opportunity structures and the level of gender-based discrimination in education and on the labor market might also influence gendered educational choices. Although – as Bertrand, (2020) and Stewart-Williams & Halsey (2021) point out – discrimination against women in STEM cannot be widespread enough to provide a stable explanation for gender differences in early educational choices. The literature is mixed, with some papers finding discrimination against women, some against men and some finding no bias at all (Bertrand, 2020; Stewart-Williams & Halsey, 2021). Nevertheless, prior expectations regarding discrimination can still influence field of study choices (Kahn & Ginther, 2017).

5. Country contexts

5.1. Sweden

In Study I, III and IV, I analyze gender differences in educational outcomes in Sweden, including school performance in comprehensive school, transition to upper secondary education and educational attainment. Here I present characteristics of the Swedish education system relevant to these outcomes.

³ Falk & Hermle (2018) reproduces this paradoxical relationship between gender equality and the gender gap in non-cognitive skills. They find that the more gender equal a country is, the more women differ from men for instance in risk-aversion, patience, altruism or trust.

Sweden has a comparatively large welfare state and is one of the most gender-equal countries not only within the European Union but also worldwide (European Institute for Gender Equality, 2024; UNDP, 2024). The Swedish comprehensive school comprises grades 1-9 (primary and lower secondary levels), and is compulsory, standardized and non-stratified (Hällsten & Yaish, 2022). This means that tracking is not allowed in comprehensive school, and schools follow the same national curriculum. Students attend most lessons together with the same classmates.

Upper secondary school starts in grade 10. Students can choose between different academic (giving straight access to higher education) and vocational programs (Skolverket, 2020). The most common academic programs include programs in the natural sciences and the social sciences. Eligibility to the academic and vocational tracks is based on having passing grades in mathematics, Swedish, English, and other program-relevant school subjects in grade 9. Entry to programs is mostly based on choice, with a large majority of students attending their program of choice. Those who do not meet the eligibility criteria can enroll in one- or two-year-long introductory programs helping students to meet those criteria (Skolverket, 2020). Tertiary education programs are tuition-free, with upper secondary grades being the most important selection tool for programs in high demand.

Female students in Sweden perform equally well in mathematics as male students, but outperform them in reading (OECD, 2023b), and on average, have a higher school achievement than boys (Skolverket, 2023a, 2023b). Girls also have higher perceived reading competence than boys even controlling for actual performance (OECD, 2019), but they are less confident in and have more negative attitudes towards learning mathematics than boys (lower self-efficacy, self-concept, intrinsic motivation /interest/) (OECD, 2013). Regarding school attitudes, Swedish female students are more school-oriented than males (OECD, 2013).

At the transition to upper secondary education, female students are overrepresented among those choosing the academic track, and they are more likely than males to graduate from upper secondary school (Skolverket, 2023a, 2025). However, among those choosing academic programs in upper secondary school, female students are underrepresented in STEM-related programs compared to males (Skolverket, 2025). In line with field of study choice differences, male students expect more to work in STEM professions than girls, while a larger share of girls expect to work as health professionals than boys (OECD, 2019).

Moving on to tertiary education, almost two thirds of all new entrants in bachelor's programs are female (OECD, 2024d). Overall, more women than men attain a university degree while men are overrepresented among those with vocational upper secondary or post-secondary non-tertiary education (OECD, 2024d).

As seen from these gender differences, international trends in gendered educational outcomes outlined in the literature section apply to Sweden. Despite the high level of gender equality, gender stereotypes are also prevalent in the Nordic context (OECD, 2024c). Both girls and boys see girls as more empathetic and boys as more aggressive. Boys, however, are more prone to hold gender stereotypes such as men and women not being equally suitable to having a high paying job, boys being better at technology and making better leaders than girls, and women being more suitable to care for children, more sensitive and creative than boys. Boys also face more pressure from peers than girls to conform to gender typical norms (OECD, 2024c).

The Swedish setting provides an ideal context to analyze gender compositional effects in the classroom (Study I), as there is no ability tracking in the comprehensive school. This is important since any within-school grouping based on achievement could impact gender composition in classes. Furthermore, the availability of detailed classroom assignment data throughout the students' school career allows for the evaluation of gender peer effects not only in contemporaneous but also in a cumulative manner.

Sweden is also a good "lab" for analyzing gender differences in program choices right at the starting point of educational tracking: at the transition to upper secondary education (Study III). My main predictors, achievement, academic self-concept and interests, are measured before the program choice happens, and thus are not affected by self-selection into an educational track.

Lastly, the Swedish setting is also well suited to look at immigrant optimism from a gendered perspective. The country had high immigration during the last decades and consequently around a fourth of Swedish youth have an immigrant background (Jonsson & Mood, 2023). Despite immigrant background students having lower school performance on average than majority students, they have higher educational aspirations and often make more challenging upper secondary choices than their Swedish-background peers (Jonsson & Mood, 2023; Jonsson & Rudolphi, 2011). Using Swedish data, we can connect educational aspirations in adolescence to educational attainment in early adulthood and analyze if relatively high

aspirations are a help or a hindrance in the educational careers of women and men with foreign background parents.

5.2. Hungary

Study II looks at gender differences in competitiveness among Hungarian upper secondary students as a function of confidence in own abilities, risk aversion and school performance.

Hungary has single-structure primary and lower secondary schools (1st – 8th grade). Upper secondary education starts in 9th grade and typically lasts for 3-5 years depending on the program type. Students can attend academic upper secondary programs with matriculation exam (4 years), vocational upper secondary programs with matriculation exam (5 years) or vocational upper secondary programs without matriculation exam (3 years). Only the first two gives access to tertiary education. Students in primary and secondary education follow a national curriculum (OECD, 2024b).

Hungarian upper secondary education is tracked but the start of tracking is a bit more complex issue than in Sweden. Although – in general – there is no formal tracking in the first 8 years of education, in practice many schools have internal /informal specializations, such as specialized classes with an increased number of lessons in languages, math, arts, etc. (Horn et al., 2016). In addition, academic secondary programs start in some schools in 7th grade and even as early as in 5th grade. These programs (similarly to most other upper secondary programs especially the ones with matriculation exam) accept students based on previous grades and additional secondary entrance exams. Early tracked academic secondary programs typically skim off less than 10% of students on top of the ability distribution, but selection based on ability and social background is present in upper secondary education as a whole (Hajdu et al., 2022; Horn et al., 2016).

Girls are more likely than boys to go to an academic program and boys are more likely to go to a vocational program (they are particularly overrepresented in vocational programs without matriculation exam) (Hajdu et al., 2022). In upper secondary schools, boys perform better in mathematics, but girls outperform boys in reading (Hajdu et al., 2022; OECD, 2023b). As in Sweden, female students are more school-oriented and show more positive attitudes towards reading and more negative towards mathematics than male students (OECD, 2013, 2019). A significantly higher share of boys than girls want to have a career in STEM, while a larger share of girls than boys aspire to work as health professionals (OECD, 2019).

Importantly, girls report lower competitiveness and higher fear of failure than boys (a finding also applicable to Sweden) (OECD, 2019). Since the dataset used in Study II contains data on competitiveness, confidence and risk-taking with a relatively large sample size compared to other experimental studies (N=1088), it enables the detailed analysis of competitiveness even in subgroups based on gender or confidence. The availability of this data makes it compelling to study competitive preferences in Hungary, even though schools are highly selective. The nature of the data made it possible to control for much of this selectivity using class fixed effects, previous performance, test scores and family characteristics. We also find that within-class gender differences in controls resemble the gender differences in the Hungarian upper secondary student population. Besides, extensive robustness tests suggest high external validity.

6. Data and ethical considerations

The dissertation uses several already collected datasets for secondary analysis. Study I uses Swedish register data on multiple cohorts of 6th and 9th grade students covering their school performance (test scores), class composition and socioeconomic background. The data is part of a larger register-based project at the Swedish Institute for Social Research, titled “Interlocking inequalities: A multidimensional perspective on inequality in contemporary Sweden”. All data are managed and securely stored by Statistics Sweden, and remote access to registers was provided through their MONA platform. The project is covered by ethical approval from the Swedish Ethical Review Authority (Dnr 2019-02761 and addition Dnr 2022-00341-02).

Study II uses data gathered as part of a project I was working on at the Institute of Economics of the HUN-REN Centre for Economic and Regional Studies before starting the PhD program. The project aimed to explore how social gaps in non-cognitive skills are associated with educational inequalities in Hungary. During the data gathering process, the non-cognitive skills of Hungarian upper secondary students such as competitiveness, confidence in abilities and risk-taking were measured using computer-based experimental tasks. These were then linked to administrative data on school performance and parental background. The final database that I use for Study II does not contain ID codes for identification of students or schools. Besides, all administrative background variables have been standardized, categorized or imputed, and the majority of the answers from the experimental part of the data have been altered (for instance by creating composite indices using different answers) to further prevent

identification. I accessed this dataset through an online repository. An application for the secondary use of the data was submitted to the Swedish Ethical Review Authority which concluded that an ethical approval is not warranted as no sensitive personal data are handled (Dnr 2022-04216-01).

Study III and IV use the Swedish part of the CILS4EU (Children of Immigrants Longitudinal Survey in Four European Countries) survey dataset linked to Swedish register data. The CILS4EU survey aims to provide data on structural, cultural and social integration of students with immigrant background. Among other topics, it measures various aspects of school achievement, school motivation and aspirations of a representative sample of the Swedish student population (in grade 8 and 9). These measures were linked to register-based variables on socioeconomic background, upper secondary school choices and educational attainment. The data were stored and accessed on a safe server provided by Stockholm University. The use of CILS4EU and the matched survey-register data is covered by ethical approvals Dnr 2010/1557, 2015/1877 and 2022-00320-02 from the Swedish Ethical Review Authority (and its relevant legal predecessor).

Besides taking precautions to ensure secure access to and prevent unethical use of data analyzed in this dissertation, further ethical considerations are needed regarding the interpretation and dissemination of the findings. Results might contribute to the maintenance of gender stereotypes, especially if unintended oversimplifications happen to make these findings actionable for policymaking or known to non-scientific audiences.

Although gender differences exist in numerous regards, Bertrand (2020) emphasizes that gender differences are actually smaller than differences within gender in many traits. As researchers, we have a responsibility to highlight how similar men and women are in their skills, preferences and choices too. This is important because the publication bias that favors significant differences might reinforce gender differences that reflect stereotypes. Thus, researchers need to be careful when interpreting findings and need to explain the line of causality (if there is any) in a way that is understandable for a broader audience and prevents misinterpretation.

This issue is particularly relevant to Study I, where I find very small effects of class gender composition on students' test scores. Although I find some evidence suggesting that gender composition may matter for test scores in a non-homogenous and non-linear way for female and male students, the effects are almost negligible for the range of gender distributions that

the vast majority of students experience. Thus, extra care should be taken not to overstate the results, as based on this study, gender composition is not something that policy should focus on when targeting test score differences.

7. Methods

The studies in this dissertation use diverse statistical modeling techniques to analyze individual level data, see Table 1 for a summary.

Three studies, Study I, II and IV use the fixed effect modeling framework (Wooldridge, 2013). In each case, school or classroom fixed effects are applied utilizing the nested nature of the data. I use this technique as a tool to minimize endogeneity bias that often threatens estimates when modeling the relationship between individual-level characteristics and outcomes in education. One potential source of endogeneity is selection into schools and classes based on shared characteristics, meaning that the same characteristics of students determine school/classroom assignment and educational outcomes. Another source is omitted variable bias which leads to endogenous estimates if an omitted variable is correlated with a predictor and the outcome too.

Table 1. Summary of methods used in the dissertation

	Study I	Study II	Study III	Study IV
Topic	The effect of classroom gender composition on test scores in 6 th and 9 th grades	Competitiveness, confidence and gender in upper secondary school	Motivational factors and gendered upper secondary program choice	Aspirations and educational attainment, by immigrant background and gender
Main methods	<ul style="list-style-type: none"> • Gender stratified fixed effect models 	<ul style="list-style-type: none"> • Fixed effect models • Kernel-based propensity score matching 	<ul style="list-style-type: none"> • Structural equation modeling 	<ul style="list-style-type: none"> • Gender stratified fixed effect models

School fixed effects mitigate these threats by controlling for time-invariant, observable and unobservable factors that might lead to endogenous sorting into schools (for instance urban/rural location, private status of schools). Classroom fixed effects, beside controlling for

these school-level characteristics, also control for (observable and unobservable) time-invariant classroom characteristics that might correlate with predictors and outcomes in the analysis, such as classroom composition, educational track or teaching/grading culture. To further mitigate selection and omitted variable bias, relevant individual characteristics (with within-school or within-class variation) can be controlled for. After controlling for even the unobserved, time-invariant factors determining selection and for individual background characteristics, the main endogeneity threat in the fixed effect framework would be if within-school (or in case of classroom fixed effects, within-class) differences in students' characteristics potentially predicting outcome differences remained unaccounted for.

The identification strategy of Study I involves further considerations specific to peer effect research to identify the effect of classroom gender composition on test scores. Besides selection, another challenge faced by observational peer effect studies is the reflection problem (Manski, 1993). The reflection problem refers to the difficulty of separating exogenous/contextual peer effects (the effect of peers' characteristics on ego's outcomes) and endogenous peer effects (the effect of peers' outcomes, like performance, on ego's outcomes). It can be overcome by measuring peer effects using a preassigned characteristic of peers, like in the case of Study I, gender. Individual gender and peer gender composition cannot affect each other in my data, so if only using this one peer characteristic, the reflection bias is eliminated. It could be reintroduced, however, by controlling for average peer achievement, as peers' and ego's achievement affect each other simultaneously. Consequently, the effect of the peer achievement control would be a biased estimate, and, as the gender composition effect partly runs through peer achievement, it would potentially lead to a biased gender peer effect estimate too. Thus, in Study I, I capture the full extent of the gender compositional effect in one parameter (the share of female classmates), acknowledging that beside the contextual effect it may incorporate an endogenous part running through peer performance.

Study II combines the fixed effect framework with matching techniques to identify the mechanisms behind gender differences in competitiveness. Fixed effect models are first used to assess if confidence in abilities explain (mediate) the gender gap in competition. To assess if confidence also moderates said gender gap, we use two approaches. The first is a regression approach (with fixed effects) either with interactions of gender and confidence, or by running separate models and evaluating the gender gap within subgroups by confidence level. In the second approach we use kernel-based propensity score (PS) matching to match female and male students based on their background variables. After estimating propensity scores for

students using the PS model, we use an outcome regression (or regression adjustment) to estimate the competitiveness gap between the two matched groups, applying the propensity scores obtained from the PS model as weights. Combining PS matching with a regression adjustment leads to doubly robust estimations, meaning that it is sufficient to correctly specify either of the PS or the outcome model to obtain an unbiased estimate for the competitiveness gap (Funk et al., 2011). For the purpose of analyzing moderation, the interaction between gender and confidence can be included in the outcome regression, or the whole matching can be done within subgroups by confidence (both are applied and compared in the paper).

The last study to use the fixed effect framework is Study IV, which estimates if stated educational aspirations in adolescence influence educational attainment in early adulthood for girls and boys by immigrant background. It accounts for class- (and thus, school-level) observed and unobserved factors that might lead to similar aspirations and/or educational attainment among classmates.

Study III applies structural equation modeling (SEM) to perform path analysis. It explores if motivational factors like academic self-concept and interests affect upper secondary program from a gendered perspective. The SEM framework can estimate a complex set of relationships between variables – or in practice, multiple equations – simultaneously (West et al., 2012). Path analysis is a form of SEM where only observed variables are included. Coefficients in all equations are estimated at once, accounting for interdependencies between them such as correlations between variables feeding into various equations within the SEM model. As such, I model not only how the educational outcomes are influenced by motivational factors, but also how the motivational factors are formed by prior school achievement and social background, while also allowing school achievement and social background to affect the educational outcomes directly. To test if in this complex set of relationships are equal across groups, one might apply multigroup SEM. I use this to test if the relationships in my structural model are moderated by gender. An important advantage of the SEM framework is the possibility to calculate indirect effects, that is effects mediated by other variables. I utilize this feature to calculate the indirect effect of gender on program choice running through achievement, academic self-concept and interests.

8. Study summaries

Study I - Get the balance right? How peer gender composition shapes educational outcomes, and when it matters

This paper presents new evidence on gender peer effects on school performance using unique Swedish data containing the history of the gender composition of students' classrooms from grade 1 to 9. Results extend the literature by providing evidence on linear and nonlinear effects, and by exploring the possibility of cumulative effects. The analysis uses school fixed effects, but with the added advantage of observing within-school variation in gender composition not only across cohorts but also across actual classrooms.

In contrast to what is often suggested in the literature, Study I shows that gender composition does not have a uniform impact for boys and girls. Girls have slightly higher and boys slightly lower test scores in a more female-dominated classroom, but effect sizes are very small and mask important non-linearities, mainly impacting students in classrooms with skewed gender distributions. As, in practice, very few school classes will have such skewed gender distributions, these effects will have negligible overall effect on a school cohort in a co-educational and comprehensive school system.

The cumulative analysis shows largely the same tendencies as the contemporaneous one for both genders: girls tend to benefit from a longer exposure to female majority in class, while the effects for boys are rather negative. Longer exposure to male majority showed less robust results, with a weak tendency of positive effects on males' test scores. Cumulative effects have an impact of similar magnitude on students' test scores as contemporaneous effects. However, given that estimates from the Swedish context are likely lower bounds of the effects from less gender equal and tracked systems, research in other contexts might particularly benefit from not only focusing on the test taking environment, but also on the effects of the longer-term learning environment.

All in all, the rather small effect sizes I estimate suggest that in a gender equal and comprehensive school context, classroom gender composition ought not be a primary parameter informing policy, except perhaps when imbalances are large and sustained over time. The findings also indicate that we might have been thinking about gender peer effects in a limited way by assuming linearity and by overlooking cumulative effects.

Study II - Competition, confidence and gender: shifting the focus from the overconfident to the realistic

(with Dániel Horn and Hubert János Kiss, published in the Journal of Economic Psychology, 2024, Volume 104, 102746)

This study examines mechanisms between confidence and competitiveness from a gender perspective. The gender gap in competitiveness is argued to explain gender differences in later life outcomes, including career choices and the gender wage gap. A prevalent explanation in papers building on experimental settings attributes this gap in competition to males being more (over)confident than females (in the paper this is referred to as the compositional channel).

While Study II using data on Hungarian upper secondary school students in 53 classrooms reproduces this finding, it also uncovers a second, potentially more impactful channel through which confidence might contribute to the gender gap in competitiveness: the preference channel. To disentangle the two channels, we propose a more precise measure of confidence based on if the subjects' believed performance rank is higher, coincides with or is lower than their actual performance in a real-effort task. We label categories of this Guessed - Actual Performance (GAP) difference as overconfident, realistic or underconfident, respectively. We find no gender difference in competition in the over- and underconfident subgroups. In contrast, we find a substantial gender gap among realistic students, who accurately evaluate their performance. Female students in the realistic group are 14 percentage points less likely to compete compared to males. This finding is robust across all specifications, challenging previous theories about the compositional effect imposed by more overconfident men being the main driver of the relationship between confidence and the gender gap in competition.

Consequently, although increasing females' overall confidence (as previously recommended) may be helpful in closing the gender gap in competition, Study II reveals a more complex picture. Even if women had the same confidence levels as men, differences in competitiveness would still remain in the realistic group. The study refers to the latter difference as the preference channel due to a noticeable trend: higher performance increases the likelihood of engaging in competition among realistic students, but males and females have different benchmarks above which they prefer to compete. Male students become more competitive when their performance is just above the median, while females only adopt a competitive preference when they believe they are among the top performers. All in all, the possibility of this second channel suggests that policies aimed at closing the gender gap in competition would

not only benefit from increasing girls' confidence in general, but also from specifically fostering a more competitive attitude among girls who perform above the median.

Study III - Motivational factors and gendered program choice in upper secondary school – evidence from Sweden

Study III extends the literature on the role of academic self-concept and interests in educational decisions. These motivational factors have already been linked to gender differences in educational choices primarily at the post-secondary level. However, our knowledge on how they form decisions at the transition to upper secondary education is scarce.

Study III first shows how subject-specific self-concept and interests affect upper secondary program choices by disentangling their net effect from the effect of prior school achievement. Second, it also analyzes if gender differences in these motivational factors explain the gender gap in upper secondary program choices (mediation) and whether there are gender differences in how achievement, motivation and choices relate to each other (moderation). The study uses survey data linked to Swedish register data and applies structural equation models to perform path analysis. Two outcomes are analyzed: the choice between academic and non-academic programs, and the choice between STEM-related and non-STEM related academic programs. Subject-specific self-concept and interests are measured in two domains, in math and in Swedish (the latter representing the verbal domain).

Results indicate that academic self-concept and interests during lower secondary education play a significant role in influencing educational choices at the transition to upper secondary school. The motivational factors do not only predict the choice outcomes well but they also explain a large part of the gender gap in STEM program choice. In particular, girls' higher self-concept and interest in Swedish and lower self-concept in math compared to boys significantly contribute to their underrepresentation in STEM programs. Besides, results indicate moderation effects too. While, to some extent, gender moderates how self-concept and interests affect choices, moderation is more relevant in the formation of self-concept and interests (that is, how achievement affects the motivational factors).

Based on the results of this paper, policies targeting students' educational program choices, and importantly, the gender differences in these choices may wish to intervene already before the transition to upper secondary school. By this time, gender differences appear in students' self-concept and interests. Results also suggest that interventions and studies on STEM may

benefit from considering multiple disciplines simultaneously, as focusing only on math grades and motivation might miss important cross-disciplinary effects.

Study IV - High aspirations of boys and girls with foreign-born parents: More a help than a hindrance

(with Carina Mood and Stephanie Plenty)

Immigrant-background students tend to have markedly higher educational aspirations despite having lower school performance than their native-background peers. If this advantage in aspirations is a help or a hindrance in their educational careers, has mostly been analyzed in terms of upper secondary outcomes, and most of the relevant literature has ignored the role of gender. Study IV examines the effects of high educational aspirations in adolescence (age 15) on educational attainment in young adulthood (aged 25). The study does not only look at upper secondary attainment (low education), but also uses the probability of getting tertiary education (high education) as an outcome, further along the educational career. Besides, it also explores how the association between aspirations and educational attainment might differ across gender and immigrant background. The analysis draws on a large nationally representative sample of Swedish youth, and uses interactions and gender stratified regression models with classroom fixed effects.

Results show that high aspirations do not increase the risk of low education for immigrant background boys and girls. Instead, they boost immigrant youth's chances of getting tertiary education, particularly for women. However, aspirations explain little of the immigrant-native gaps in educational attainment. High aspiring Swedish-background students are also more likely to get tertiary education, but results also show that too high ambitions might lead to an increased probability of not finishing upper secondary education for Swedish-background boys.

The findings of this paper suggest that concerns that the higher aspirations of immigrant background students set them up for failure are unwarranted.

9. Concluding remarks

This dissertation explored mechanisms behind gender gaps in different educational outcomes such as school performance, competitiveness, educational program choices and educational attainment. As gender segregation in educational choices/pathways start to emerge in lower

and upper secondary education (Kriesi & Imdorf, 2019), the studies in this dissertation all focused on this educational stage. The years of adolescence also constitute a formative age when gender becomes a salient layer of identity (Galambos, 2004; Lobel et al., 2004) and when students might be particularly susceptible to gender stereotypes. This makes adolescence an ideal context to study gender differences and gender(ed) effects in education.

My studies contribute to various strands of literature, from peer effects through experimental assessment of preferences to the literature on school motivation/educational expectations. In the Swedish context, Study I shows that the effects of class gender composition on achievement in compulsory school are small but heterogeneous by gender, and might also be cumulative. Besides, Study III suggests that achievement has gender-heterogeneous effects on academic self-concept and interests, contributing to gender differences in the mean level of these motivational factors. These differences then explain a considerable part of the gender gap in upper secondary STEM program choice. Education-related attitudes do not only have short term implications but according to Study IV, also affect educational attainment on the longer term: high-aspiring students are more likely to get tertiary education, particularly among immigrant-background females. In the Hungarian context, Study II shows a robust gender gap in competitiveness among those students who do not over- or underestimate their performance, but evaluate it realistically.

Although these studies cover a wide variety of topics related to gender segregation in education, I know that much work remains to be done to understand all aspects of the phenomenon. But given the high complexity of how educational outcomes are formed (by skills, motivational factors, social norms, the peer/family/school/media and cultural context, etc.), I believe that every step (or study) is important to get us closer to understanding how gendered educational trajectories develop.

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