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Introduction

Horizontal gender segregation – the unequal distribution of men and women across occupations – is a well-known feature of many labour markets worldwide. Women more frequently work in health and service occupations, and men dominate manual, agriculture, crafts, and technical fields (Farkas, 2005). Female-dominated occupations involve non-manual tasks such as service professions, nursing, and childcare, while male-dominated occupations are typically characterised by manual or physically demanding tasks (Charles, 2003). Another significant divide between male-dominated and female-dominated professions refers to men's overrepresentation in science, technology, engineering, and mathematics (STEM) occupations (Cheryan et al., 2017; Jiang, 2021; Makarova et al., 2019). Internationally, segregation patterns in industrialized and post-industrialized countries are surprisingly uniform and persistent (Charles, 2003; Levanon & Grusky, 2016; Rosenfeld & Trappe, 2002). Horizontal gender segregation is related to vertical dimensions of gender inequality in terms of income, social status, and working conditions, making it a relevant explanandum from a social inequality perspective (Amuedo-Dorantes & La Rica, 2006; A. Busch, 2013a; F. Busch, 2020; Ludsteck, 2014).

Although gender segregation in the labour market may intensify across the life course as employees switch occupations and cross gender boundaries, a major portion of gender segregation is established at the very career entry (Guinea-Martin et al., 2018; Torre & Jacobs, 2021). Young people's educational and vocational choices early in their life course are highly gendered and function as a critical sorting mechanism, pre-structuring the allocation of individuals to gender-typical occupations. For example, young people's choices in vocational education and training (VET) are tightly linked to occupational gender segregation (Gundert & Mayer, 2012; Heiniger & Imdorf, 2018; Smyth & Steinmetz, 2015). In Germany, where access to occupations is strongly regulated and standardised, the nexus between VET and the labour market is particularly strong (Haasler & Gottschall, 2015). Educational choices in higher education are also related to the reproduction of gender-segregated labour markets, albeit to a weaker extent (e.g. Charles & Bradley, 2009; Smyth, 2005; Smyth & Steinmetz, 2008).

These early gender-segregated educational and vocational choices, in turn, are the result of a *career decision-making process* during which young people compare and choose among different career alternatives, spanning several developmental stages (Ginzberg, 1972;

Gottfredson, 1981; Super, 1980). The present dissertation focuses on two major stages of career decision-making to assess how gender segregation is reproduced as young people develop career expectations and implement a first career choice[1].

In the ***exploration stage***, young people develop career expectations[2] that are perceived as attainable and align with their vocational self-concepts (Super, 1988). Gender is the most salient aspect of the self and functions as a filter through which gender-atypical occupations are eliminated (Gottfredson, 2002). In addition, gendered expectations emerge because young people hold gender-specific vocational self-concepts (in terms of abilities, interests and career values) and because they may expect "social costs" related to entering gender-atypical professions (Gottfredson, 1981, 2002). The ***implementation stage*** is a second major stage of career decision-making. Since young people make career choices under imperfect information, they constantly reappraise their choices as they accumulate new information during their work experiences – potentially leading to the revision of their initial choice. When people switch from gender-atypical to more gender-typical occupations, gender segregation is reinforced (Torre & Jacobs, 2021). Reasons for dropout from gender-atypical occupations include a mismatch between vocational self-concept and occupation or the experience of social discrimination and hostile working climates related to the gender minority status (Spangler et al., 1978).

The process of gendered career decision-making is embedded in socio-cultural and institutional contexts. Young people establish their gender identities and learn about appropriate gender behaviour through social interaction and socialization (Carter, 2014; Ridgeway, 2009; Ridgeway & Correll, 2004; West & Zimmerman, 1987). Contexts also serve as a frame of reference for constructing and reflecting on their preferences and abilities through peer comparisons (Kelley, 1952). Finally, occupations per se can be conceptualized as cultural contexts through which gendered occupational identities and occupational gender stereotypes are established (Haupt & Ebner, 2020). Adopting a contextual perspective, this dissertation examines the relevance of socio-cultural and institutional contexts in young people's gendered career decision-making process. As an overall research aim, this dissertation describes contextual conditions *under which* and *through which* gender-segregated expectations and

[1] Both stages can be attributed to *supply-side* explanations for gender segregation, i.e. they focus on individuals career choices (Busch-Heizmann 2015). Demand-side processes of gender segregation that refer to gendered employer sorting, for example in the application process (Fernandez and Friedrich 2011, Imdorf 2012), are not part of this dissertation.

[2] Career aspirations, in general terms, refer to both *idealistic* aspirations (unconstrained wishes) and *realistic* aspirations or *expectations* (considering attainability and anticipated or experienced barriers and constraints) (Gottfredson 2002, Heckhausen and Tomasik 2002).

choices are formed in two stages of the career decision-making process. The following overall research question guides this dissertation:

> Under and through which (socio-cultural and institutional) contexts are gendered career expectations and career choices reproduced in young people's career decision-making process?

This dissertation is divided into two parts. Both parts address the two different stages of the career decision-making process and answer two distinct subquestions regarding the relevance of contextual conditions in the reproduction of gender-segregated expectations and choices:

Part I: Under which social and institutional contexts are gender-segregated career expectations formed?

First, the social construction of gender may be more or less salient in some contexts over others, producing variability in the extent to which young people's career decision-making is gendered. Context provides distinct gender belief systems and opportunity structures for gender-atypical careers. For example, gender gaps in occupational expectations vary according to aspects of the school environment (Legewie & DiPrete, 2014; Siembab & Wicht, 2020), across regions (Malin & Jacob, 2019), and across countries (Hägglund & Leuze, 2020; Hillmert, 2015; McDaniel, 2010, 2016). Extending this line of research, the first part addresses the question *under which* contexts gender-segregated expectations emerge in the exploration phase of the career orientation process. The focus lies on females' underrepresentation in STEM versus non-STEM fields, describing two different socio-cultural and institutional contexts under which the size of the gender gap in STEM expectations is amplified or weakened.

Part II: Through which social and institutional contexts are gender-segregated career choices reproduced?

Second, occupations represent cultural contexts in and of themselves, establishing gendered occupational identities, stereotypes and working climates (Haupt & Ebner, 2020; Shinar, 1975). For example, being the gender minority in a profession has been related to "chilly climates" and hostile working environments (Hall & Sandler, 1982; Kanter, 1977; Makarova et al., 2016). Occupations also represent institutions that provide gender-specific access to resources such as income, status and working hours (Bächmann et al., 2021; Damelang & Ebensperger, 2020; Leuze & Strauß, 2016). Since men and women, on average, differ in their career preferences, these institutional conditions may present barriers to remain in gender-atypical occupations.

Socio-cultural and institutional occupational contexts *through which* gendered dropout from vocational education and training (VET) is reinforced are at the centre of this part.

This dissertation uses Germany as a case study, a country characterized by a substantial degree of gender segregation in the labour market and the VET system in international comparison (Hillmert, 2015). Since Germany is further marked by relatively low occupational mobility over the life course, young people's career decision-making process occupies a central role in reproducing gender-segregated labour markets in the long-run.

This dissertation is structured as follows: **Chapter 1** presents the conceptual framework. It outlines theoretical explanations for gender-segregated career decision-making based on rational choice and socio-cultural theoretical perspectives. Then, it describes how the different subprojects of this dissertation approach the contextual embeddedness of gender-segregated career decision-making. **Chapter 2** and **Chapter 3** (Part I) investigate how gendered career-decision making is embedded in the school context. **Chapter 4** and **Chapter 5** (Part II) examine gendered dropout from vocational education and training (VET). **Chapter 6** gives a comprehensive summary, conclusion, and future research outlook.

Chapter 1

Conceptual Framework

1.1 Gender segregation in the labour market: why should we care?

Understanding under which and through which contexts gender-segregated career decisions are reproduced will help to better understand which policy measures could be effective to reach a more gender-balanced labour market. In the long run, reducing the degree of occupational gender segregation could also reduce social and economic inequalities linked to occupations. For example, previous research has shown that changing the gender composition in an occupation is (causally) related to a change in different working conditions (Bächmann et al., 2021; A. Busch, 2013a; Damelang & Ebensperger, 2020). Understanding how gender segregation might be reduced is relevant for at least four reasons:

(1) ***Gender segregation is related to economic disadvantages for women***: The gendered distribution across occupations is strongly connected to the vertical dimension of gender segregation, disadvantaging women in terms of income, status and leadership positions (Rubery & Fagan, 1995). Female-dominated occupations provide lower opportunities for career advancement (Granato, 2017; Hultin, 2003; Malin & Wise, 2018), lower monetary returns (Amuedo-Dorantes & La Rica, 2006; A. Busch, 2013a; F. Busch, 2020; Leuze & Strauß, 2009), and fewer opportunities for social mobility (Gundert & Mayer, 2012). Female-dominated occupations and educational programs are further connected to a higher risk of unemployment (Reimer et al., 2008) and lower social prestige (Kleinjans et al., 2017). Since female-dominated occupations provide fewer opportunities to work full-time (Althaber & Leuze, 2020), female employees experience higher underemployment rates, i.e. they work fewer hours than they desired (Acosta-Ballesteros et al., 2021).

(2) ***Gender segregation is related to social disadvantages for men***: Although male-dominated occupations provide, on average, better economic prospects, they are related to working conditions that inhibit the reconciliation of work and family. Male-dominated occupations are often characterised by pronounced overwork norms (Cha, 2013; Styhre, 2011) and masculine "ideal worker" expectations (Althaber & Leuze, 2020; Kelly et al., 2010; Schieman et al., 2009). For example, Kanji and Samuel (2017) have shown that male full-time

employees with a family often desire to work fewer than their actual working hours. Hence, workers in male-dominated occupations may experience disadvantages regarding the uptake of family responsibilities.

(3) ***Gender segregation contributes to a lack of workforce***: There is a general lack of workforce in many male-dominated and female-dominated occupations (Maier et al., 2016). The demand for the workforce is exceptionally high in male-typed technical, crafting, construction, and IT professions (Germany: Schirner et al., 2021; Thomä, 2014; Switzerland: Wunsch & Buchmann, 2019). There is a lasting demand for female-dominated professions in nursing (Hämel & Schaeffer, 2013; Jacobs et al., 2020; Neuber-Pohl, 2017) and primary education (Schilling, 2014). Opening these occupations for both men and women provides an opportunity to reduce the supply-demand incongruence in these fields and to avoid "wasted potential".

(4) ***Gender segregation poses barriers to an interest-based career choice***: The gender composition of occupations may prevent young people from entering careers that would be in line with their vocational interests and abilities. For example, young people may experience social discrimination as a gender minority (Kanter, 1977; Spangler et al., 1978) and social disapproval from significant others when entering gender-atypical careers (Eberhard et al., 2015). Career choices based on gender conceptions and stereotypes may lead young people to eliminate careers that would align with their vocational interests and abilities (Hadjar & Aeschlimann, 2015; He et al., 2019). Balancing the gender composition of occupations could therefore help to decrease gendered connotations and stereotypes linked to occupations, so that gender conceptions play less of a role in young people's career-decision process. Ultimately, career choices that match young people's vocational interests could lead to higher work satisfaction and more stable career trajectories (Hoff et al., 2020).

1.2 Gendered career-decision making

To understand under which and through which contexts gender-segregated occupational expectations and choices are formed, a theoretical understanding is necessary of why expectations and choices are gender-segregated in the first place. The allocation of individuals to occupations results from both individual decisions and external sorting by employers (Blau et al., 1956). Since the focus of this dissertation is on individual decision-making, theoretical explanations related to the formation of individual decisions will be discussed. I present a research framework that is based on an integration of rational choice theory (RCT) and socio-cultural perspectives. Rather than being distinct theoretical frameworks, both perspectives can complement each other in explaining gendered career decision-making.

Rational choice theories (RCT) frame career decisions as a rational process to choose a career that maximizes the subjective *utility*. For example, the rational choice model of educational decision-making (Breen & Goldthorpe, 1997; Jonsson, 1999) postulates that utility is evaluated based on the expected *success probabilities*, *costs* and *benefits* associated with a career. Similarly, expectancy-value theory (Eccles & Wigfield, 2002) describes career choices as the result of considering the *success expectancies* and the *value* associated with different career options. Values refer to intrinsic enjoyment, personal importance, perceived usefulness and relative costs in terms of effort.

The utility resulting from a career can also be described based on career theories that establish a successful career choice as one that matches one's vocational self-concept (Gottfredson, 1985; Super, 1988). The latter refers to individual preferences in terms of interests, abilities, personality, social status, and gender identity. Based on person-environment (P-E) fit theories, congruence between the vocational self-concept and the chosen occupation results in higher work satisfaction (Kristof-Brown et al., 2005; van Vianen, 2018). Holland's (1959) theory of career choice, more specifically, states that individuals seek congruence between their vocational interests and the task profile of an occupation. Thus, a career option that aligns with different aspects of young people's vocational self-concept provides a higher utility than one that does not align.

From a rational choice and matching perspective, gender-segregated expectations and choices thus emerge because male-dominated (female-dominated) occupations provide the highest utility for male (female) individuals. These gender-specific utilities, in turn, are the result of systematic gender differences in young people's vocational self-concepts and systematic differences between male-dominated and female-dominated occupations. In other words, gender-segregated career decision-making is established because men and women systematically differ in their vocational self-concepts and translate them into gendered occupational choices based on rational action principles. Importantly, gender-specific vocational self-concepts that guide rational career decisions are shaped by cultural and social influences, e.g. through socialization within the family and educational systems (Eccles, 1987; Polavieja & Platt, 2014; Xie & Shauman, 1997).

Since the number of potential career options is immense, human beings are restricted in their ability to collect and process information on all occupations and occupational attributes.

Theories of bounded rational decision-making (Rubinstein, 1998), therefore, suggest that people apply decision strategies to minimise cognitive effort and increase the speed of the process (for an overview of different career decision strategies, see Sauermann, 2005). For example, on a general level, the availability of occupations in the regional labour market may serve to restrict young people's choice sets (Flohr et al., 2020; Weßling et al., 2015). Gottfredson's (1981) theory of circumscription and compromise describes another decision strategy based on gender heuristics. In the *circumscription* phase, individuals will eliminate unacceptable occupations from further consideration, resulting in a "zone of acceptable alternatives" that is primarily narrowed down by occupational gender type and social status. People categorize occupations based on culturally embedded gender beliefs at a young age, eliminating occupations that do not align with their gender identity. The process of circumscription hence facilitates the career decision-making task by relying on simple heuristics of gender, excluding gender-atypical occupations from rational utility evaluations.

Gender is a central part of individuals' vocational self-concept and functions as a "critical filter" through which occupations are perceived, and career decisions are made (Ridgeway, 2009). Gender can be understood as a system of shared cultural beliefs that arise from socialization and that are constantly reproduced through social interaction (West & Zimmerman, 1987). As such, career choice serves to fulfil and express young people's gender identity (Charles & Bradley, 2009). Career choice based on gender-based heuristics implies that gender-atypical occupations that would match other aspects of young people's vocational self-concept (e.g. interests and abilities) will be eliminated solely because they are perceived as not aligning with their gender identity.

In the rational choice framework, socio-cultural influences can shape gendered career decision-making in yet another way. Gender-atypical careers are related to various "social costs" that stem from shared societal gender norms of how men and women should behave (Jonsson, 1999). For example, people might expect negative reactions from significant others (Eberhard et al., 2015) or experience difficulties in socially integrating as a gender minority (Kanter, 1977; Makarova et al., 2019). Consequently, even if a gender-atypical career would align with young people's vocational self-concept and gender identity, the anticipation or experience of social sanctions from significant others or within gender-atypical professions could re-orient young people to more gender-typal careers. According to Gottfredson (2002), when young people experience or anticipate such social barriers, they will commit *career compromise*.

Gendered career decision-making can thus be explained by three central factors: (i) the elimination of unacceptable career options by simple gender heuristics to simplify rational decision-making and to express one's gender identity, (ii) systematic gender differences in vocational self-concepts that are coined through gender socialization and guide rational career decision-making, and (iii) the anticipation or experience of "social costs" related to occupying a gender-atypical profession. Hence, socio-cultural influences and rational choice theory provide a comprehensive framework through which gendered career decision-making can be explained. In the next sub-chapter, I will present different theoretical explanations in more detail.

1.3 Theoretical explanations for gendered career decision-making

In the present chapter, theoretical explanations resulting from a comprehensive model of rational choice and socio-cultural perspectives in career decision-making will be presented in more detail. These explanations are related to gender differences in vocational self-concepts (abilities, ability perceptions, vocational interests and career values) and "the social costs" of gender-atypical careers (gendered working cultures and normative social influences).

Gender differences in abilities

Since male- and female-dominated occupations require different domain-specific skills and abilities, gender-specific abilities could explain gender-segregated career choices. Among 15-year-olds, the PISA study has repeatedly documented a slight male advantage in math skills across countries (OECD, 2010, 2013, 2016, 2019). Representative data from TIMSS also find consistent but small gender gaps in math skills in favour of boys among 4^{th} graders but not among 8^{th} graders (Mullis et al., 2020). More apparent advantages for male students have been documented in spatial reasoning (Lauer et al., 2019). Regarding skills in natural sciences, results from large-scale assessments are mixed and tend to find gender equity or even a female advantage in many countries (Mullis et al., 2020; OECD, 2013, 2016). On the other hand, female students tend to outperform boys in reading and verbal skills (OECD, 2010, 2013, 2016, 2019). They also show higher social and behavioural skills (DiPrete & Jennings, 2012). These gender differences in math, verbal and social skills have been attributed to innate biological differences and gender socialization (Casey & Ganley, 2021). However, since gender differences in skills are relatively small, they provide little explanatory power for gender-segregated career decisions (e.g. Wang et al., 2013).

Gender differences in ability perceptions

Beyond absolute gender differences in cognitive and non-cognitive skills, gender differences in the subjective perception of these skills (“ability self-concept”) have been documented, especially in male-dominated subjects. At the same ability level, female students perceive their mathematical skills as higher than their male peers (Correll, 2001). Empirically, gender-biased ability self-concepts in mathematics have been identified as significant predictors of gendered STEM choices (Ertl et al., 2017; Hägglund & Lörz, 2020; Jann & Hupka-Brunner, 2020; Wang et al., 2013). These gendered math self-concepts are cultivated through gendered beliefs about the masculinity of STEM subjects (Nosek et al., 2002; Steffens et al., 2010) which are transmitted and reproduced through socialization, e.g. teachers and parents (Gunderson et al., 2012; Heyder et al., 2019; Tiedemann, 2000).

Furthermore, rational choice theory suggests that students will rely on relative (rather than absolute) ability evaluations in a subject with respect to other subjects (Jonsson, 1999; Marsh & Hau, 2004). Even if a student displays strong mathematical skills, he or she may refrain from math-intensive occupations because he or she possesses relatively higher verbal skills. Female students show a comparative advantage in verbal domains compared to mathematics. However, this comparative advantage does not explain the gendered selection of STEM fields (Jonsson, 1999; Riegle-Crumb et al., 2012; van der Vleuten, 2021; but see: Breda & Napp, 2019).

Gender differences in vocational interests

Male and female students also have different vocational interests, that is, preferences for certain work tasks and activities. The Holland inventory (RIASEC, see Holland, 1959, 1997) describes vocational interests along six dimensions: realistic (R), investigative (I), artistic (A), social (S), enterprising (E), and conventional (C). A meta-analysis of empirical studies revealed that men show higher realistic and, to a lesser extent, investigative interests, whereas women show higher artistic and stronger social interests (Su et al., 2009). These gender differences can be related to men’s preferences for things-oriented professions and women’s preferences for people-oriented fields (e.g. in higher education: Barone, 2011; Cheryan et al., 2017). Vocational interests have been established as the most important explanation of gender-segregated occupational and educational choices in comparison to alternative explanations (Hägglund & Lörz, 2020; Ochsenfeld, 2016). However, not all students make educational and career choices that perfectly align with their vocational interests, pointing to the relevance of further theoretical mechanisms (Schelfhout et al., 2021).

Gender differences in career values

According to human capital theory, men and women thrive for different life goals (Becker, 1985). Based on a traditional understanding of gender, men are career-oriented and will occupy a "breadwinner role", whereas women take family responsibilities. Therefore, men's career values better align with male-dominated occupations that provide higher income and promotional opportunities. Men's higher income preferences are an important predictor of gendered educational and career choices (Alon & DiPrete, 2015; Busch, 2013b; Busch-Heizmann, 2015; Quadlin, 2020). On the other hand, women attach more importance to intrinsic values such as having an interesting job (Johnson & Mortimer, 2011) and altruistic values (Wegemer & Eccles, 2019). These career values align with jobs that allow the reconciliation of work and family, e.g. through part-time work (Bächmann et al., 2021). For example, women with strong fertility intentions more frequently enter female-dominated occupations (Kanji & Hupka-Brunner, 2015). Although there are tendencies of attenuation, traditional gender role concepts still largely prevail in Germany (Jurczyk et al., 2019).

Social costs

The previous explanations described systematic gender differences in young people's vocational self-concept. Under a rational choice perspective, gender-segregated career decisions can further be explained by the "social costs" associated with entering gender-atypical occupations (Jonsson, 1999). In the career decision-making process, occupations that do not align with gender may be eliminated when anticipating or experiencing various social costs, irrespective of whether these occupations would match young people's vocational self-concept.

Cultural gender norms prevail in societies and provide prescriptions for gender-appropriate behaviour. *Injunctive* gender norms refer to perceptions of what is approved by others as appropriate according to gender (Cialdini & Trost, 1998). Occupations are related to gender essentialist beliefs and stereotypes that men and women are fundamentally different in their skills and interests (Charles & Grusky, 2004) and that some fields are hence not suitable for men or women (Makarova et al., 2019; Nosek et al., 2002; Ridgeway & Correll, 2004). For example, male-dominated fields of study are often depicted as requiring male natural brilliance (Leslie et al., 2015). Cultural gender norms about appropriate male and female behaviour are transmitted through socialisation processes in the family and in broader social contexts (Charles & Bradley, 2009; Helbig & Leuze, 2012; West & Zimmerman, 1987). Violating these norms can lead to external social sanctions, i.e. negative reactions and lower social approval from significant others (Eberhard et al., 2015) and status loss (Brescoll et al., 2012). Working in gender-atypical jobs has also been related to "romantic costs" and disadvantages tied to partnership formation and stability (McClintock, 2020; Yu & Kuo, 2021). Therefore, since gender norms prevail in many societies, conformity with these norms can explain gender-segregated career decisions.

Cultural gender norms are also transmitted through gendered occupational cultures. Masculine fields have frequently been characterized as a "chilly climate" for women (Hall & Sandler, 1982; Seymour & Hewitt, 1999). In this sense, occupational cultures could reduce the sense of belonging of gender-atypical individuals through their adverse working cultures and a lack of same-gender role models in these occupations (Chan, 2016; Cheryan et al., 2009; Höhne & Zander, 2019). Gender minorities receive higher visibility and often operate under great pressure to conform, leading to lower professional role confidence (Cech et al., 2011). Occupational gender stereotypes could also lower the performance of gender minorities through processes of "stereotype threat" (Steele, 1997).

Descriptive gender norms transmit beliefs about appropriate gender behaviour based on observations of how people normally behave. Due to the gender-segregated structure of the labour market in Germany, young people often encounter employees in gender-typical professions within their social surroundings (Xie & Shauman, 1997). Based on social learning theory, young people mainly orient themselves to same-sex role models and learn gender-appropriate behaviour through observation (Johnson, 1963; Perry & Perry, 1975). For example, the parental transmission of occupations from father to son and mother to daughter explains gender differences in field of study choices (van der Vleuten, Jaspers, et al., 2018). The lack of gender-atypical role models provides little room for identification and may depress young people's feelings of belonging in gender-atypical professions (Olsson & Martiny, 2018; Steinke et al., 2022). Furthermore, since young people mainly observe and interact with same-gender parents and peers, they may possess more information about gender-typical occupations. This perspective is supported by research showing that exposure of men to female-dominated occupations through work experience increases the uptake of gender-atypical occupations (Hamjediers, 2021). Similarly, role model interventions presenting women in male-dominated STEM fields effectively increase female students' STEM interests (Breda et al., 2021; González-Pérez et al., 2020; Steinke et al., 2022).

1.4 The present study: contexts of reproduction

The theoretical framework presented before has shown that gendered career decision-making can be understood by the integration of rational choice and socio-cultural theory. Based on this comprehensive explanatory framework, the relevance of socio-cultural and institutional contexts in the career-decision making process will be illustrated in the following. Contexts such as young people's socio-cultural and institutional embeddedness occupy a central role in forming career expectations and choices (Rubery & Fagan, 1995). Socio-cultural contexts shape the extent to which prescriptive and descriptive gender norms are transmitted through gender belief systems and labour market structures (Charles & Bradley, 2009). Contexts can also be conceived as institutional opportunity structures providing learning experiences and opportunities for career development, e.g. through educational systems and school curricula (Allmendinger, 1989; McFarland, 2006) or regional labour markets (Hägglund & Leuze, 2020; Malin & Jacob, 2019). Occupations per se can be conceived as institutional contexts that provide access to opportunities and resources such as status, income and working conditions (Abraham et al., 2018; Damelang et al., 2018). Occupations also represent relevant socio-cultural contexts framing the experience of gender minorities through the construction of gendered working cultures, identities and stereotypes (Haupt & Ebner, 2020).

Hence, socio-cultural and institutional contexts are crucial dimensions in students' career decision-making process. This dissertation aims to advance the theoretical understanding of gender-segregated career decision-making by identifying *under which* and *through which* contexts gender-segregated choices are reproduced. It is divided into two parts that address different stages of the career-decision making process. Part I examines the exploration phase and provides an answer to the subquestion under which socio-cultural and institutional contexts gender-segregated career expectations are formed. Part II focuses on the implementation phase, answering the subquestion of how occupations as socio-cultural and institutional contexts shape gendered dropout from vocational education and training (VET).

Part I: Under which social and institutional contexts are gender-segregated career expectations formed?

The first part of this dissertation examines gendered career decision-making in the ***exploration phase***, during which young people gather and process information about occupations (Parsons, 1909). Career aspirations that emerge during the exploration phase can be considered realistic because occupations that do not align with young people's self-concepts, that are not attainable or that are associated with social costs are gradually eliminated (Gottfredson, 1981). The exploration phase hence involves career compromises, i.e. moving from idealistic aspirations (aspirations) to realistic aspirations (expectations). Depending on the social and institutional context young people are embedded, gender-atypical career options may have a higher or lower utility, shaping the extent to which gender maps onto young people's career decision-making process. Therefore, the first part of this dissertation asks *under which* contexts gender-segregated career expectations are formed in the exploration phase.

Contexts prescribe and transmit different gender belief systems (Ridgeway & Correll, 2004; West & Zimmerman, 1987). Gender norms may be more or less pronounced in some contexts over others, shaping the extent to which gender-atypical occupations are socially sanctioned. Contexts also function as opportunity structures, representing standards of comparison for evaluating themselves in reference to others and opportunities to learn (Solga & Mayer, 2008; Xie & Shauman, 1997). Hence, socio-cultural and institutional contexts can alter the utility of gender-atypical career options and can shape the extent to which gender serves as a "filter" through which career expectations are formed.

Previous empirical literature supports the view that socio-cultural and institutional contexts are related to gendered career decision-making. At the macro-level, countries with more egalitarian gender ideologies and higher degrees of gender segregation display smaller gender gaps in occupational STEM expectations (Charles & Bradley, 2002, 2009; McDaniel, 2016; but see: Stoet & Geary, 2018) and more significant gender gaps in attitudes toward math and science (Riegle-Crumb et al., 2016). Educational systems at the country level are weakly associated with the development of gendered career expectations (e.g. curricular standardization: Han, 2015, the provision of vocational education: Hillmert, 2015). Furthermore, regional labour markets are related to the gender gap in STEM expectations (Hägglund & Leuze, 2020; Malin & Jacob, 2019), providing different opportunities and constraints for implementing gender-atypical career choices.

At the school level, normative influences have been documented by several studies. For example, female students whose classmates and peers endorse traditional masculinity norms and math-related stereotypes perform worth in mathematics (Salikutluk & Heyne, 2017), display lower math self-concepts (Wolff, 2021), and develop lower STEM expectations (van der Vleuten, Steinmetz, & van de Werfhorst, 2018). Because of highly sex-segregated friendship networks at school, gendered educational choices are reproduced through social conformity influences (Raabe et al., 2019; Riegle-Crumb et al., 2006; Sinclair et al., 2014). From the perspective of opportunity structures, more extensive curricular and extracurricular offerings in STEM have been connected to a larger gender gap in STEM participation (Legewie & DiPrete, 2014). Schools also provide important relative comparison standards for evaluating individual self-concepts. For example, strong math and science achievement at the school level was related to larger gender gaps in STEM aspirations (Mann et al., 2015). Finally, the family is a crucial context through which normative influences are transmitted (Helbig & Leuze, 2012; van der Vleuten, Jaspers, et al., 2018).

The first part of this dissertation extends this literature by addressing the relevance of schools as socio-cultural spaces and opportunity structures that may facilitate or hinder the formation of gender-atypical career expectations. Schools have been identified as crucial contexts for the formation of gendered career expectations (Wicht & Ludwig-Mayerhofer, 2014). **Chapter 2** examines how the gender gap in STEM expectations varies across classrooms as normative and comparative reference groups, focusing on the socio-cultural dimension of contexts. **Chapter 3** investigates to what extent within-school curricular tracking in mathematics and sciences widens the gender gap in STEM expectations over time, emphasizing the institutional dimension of contexts. From a methodological point of view, contexts may have a moderating function in producing gender segregation. Both studies use an interaction term between the context under study and gender to analyse how gender-segregated expectations vary according to contextual conditions.

Part II: Through which social and institutional contexts are gendered dropout decisions formed?

The second part of this dissertation focuses on the relevance of contexts during the ***implementation phase***, a career stage that describes how young people proceed with their first career choice. Since young people make career choices under imperfect information, they constantly reappraise their choices as they accumulate new information during their work experiences – leading to the revision or maintenance of their initial choice. A revision of a gender-atypical career choice occurs because of two processes. First, gender segregation is reinforced when individuals in gender-atypical occupations experience a mismatch between their vocational self-concept and their occupation and switch to more gender-typical careers (Madsen et al., 2021; Torre, 2017). As such, occupations can be conceptualized as contextual opportunity structures that provide access to different bundles of tasks and institutionalized resources such as income, status or working conditions (Haupt & Ebner, 2020). Since men and women, on average, differ in their vocational self-concepts, these institutional conditions may present barriers to remaining in gender-atypical professions.

Second, apprentices in gender-atypical occupations may experience social costs linked to their gender minority status. Occupations represent crucial socio-cultural contexts through which gendered occupational identities, stereotypes and working climates are established. As such, occupational climates are often characterized by the exclusion of gender minorities (Hall & Sandler, 1982; Makarova et al., 2016), decreasing minority's role confidence (Cech et al., 2011) and sense of belonging (Cheryan et al., 2009). These social costs have been described in detail in Chapter 1.3.

Previous research has shown that dropout in firm-based vocational education and training in Germany is higher for apprentices in gender-atypical occupations (Rohrbach-Schmidt & Uhly, 2015). However, the processes involved remain unexplored. Part II of this dissertation, therefore, aims to answer the question *through which* socio-cultural and institutional contexts linked to occupations gendered career decision-making is reproduced. This part of the dissertation broadens the perspective by examining the career decision processes of both male and female apprentices. **Chapter 4** examines the dropout behaviour of apprentices in gender-atypical occupations. A focus lies on gender differences in the self-reported dropout reasons, conceptualizing occupations as both socio-cultural and institutional contexts that shape the experiences of gender minorities. **Chapter 5** takes a different angle and asks how gender-type career compromises (i.e. discrepancies between career expectations and attainted VET position) relate to apprentices' dropout decisions. The focus of this study lies on the social construction of gender and gendered occupational cultures as contexts of reproduction.

Table 1 gives an overview of the empirical studies that are part of this dissertation.

Table 1. Overview of empirical studies.

	Theoretical estimand			Empirical Estimand		
	Title	**Research question**	**Target population**	**Measurement (DV)**	**Measurement (IV)**	**Data**
The formation of gender-segregated occupational expectations (exploration phase)						
(1)	Gendered career expectations in context: The relevance of normative and comparative reference groups.	Does the gender gap in STEM expectations vary across classrooms with different normative and comparative reference groups?	Lower secondary school students in Germany.	STEM career expectations.	Gender, classroom composition, and their interaction.	NEPS, SC4.
(2)	Curricular differentiation and the gender gap in STEM expectations. Longitudinal evidence from the German case.	Is advanced course-taking in mathematics and natural sciences related to the (gendered) development of STEM expectations?	Upper secondary school students in Germany.	STEM career expectations.	Gender, advanced course-taking, and their interaction.	NEPS, SC4.
Gendered dropout from vocational education and training (VET) (implementation phase)						
(3)	Why do they leave? Examining dropout from gender-atypical Vocational Education and Training in Germany.	Do gender-atypical apprentices display a higher probability of dropout from VET? Do the reasons for dropout differ by gender minority status?	Apprentices in Germany.	Dropout from VET. Self-reported dropout reasons.	Gender, gender type of training occupation and their interaction.	NEPS, SC4.
(4)	Career compromises and dropout from Vocational Education and Training in Germany.	Does a gender type discrepancy between expected and attained occupation increase the probability of dropout from VET? Do both upward and downward discrepancies matter?	Apprentices in Germany.	Dropout from VET.	Gender type discrepancy between occupational expectation and training occupation.	NEPS, SC4.

Distinction between theoretical and empirical estimand based on Lundberg et al. (2021).

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Chapter 2

Gendered career expectations in context: the relevance of normative and comparative reference groups.

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Abstract

Although women are increasingly entering male-dominated careers, they remain strongly underrepresented in science, technology, engineering and mathematics (STEM) occupations. While previous explanations emphasize the importance of individual preferences or family socialization, less is known about how the school context contributes to these differences. This study aimed to examine the role of the classroom context as a frame of reference for students' career expectations, focusing on comparative and normative reference group effects. Building on gender socialization theory and rational choice models, I investigate whether these contextual effects affect students' occupational expectations in a gender-specific way. Drawing on a large representative sample of secondary school students in Germany, I find that the gender gap in students' STEM expectations varied according to classmates' mathematical confidence and the share of classmates expressing idealistic STEM aspirations. Female students less likely expected to work in STEM when their (male or female) peers showed high STEM aspirations and when their (female) peers were highly confident in mathematics. This study demonstrates that research on the explanation of gender differences in STEM expectations profits from incorporating frame of reference effects within schools and classrooms.

2.1 Introduction

A persistent subject of political and social concern is gender segregation in science, technology, engineering and mathematics (STEM) occupations, which can be observed in many European countries (Barone, 2011; Mann & DiPrete, 2013). Adolescence is a crucial developmental stage in which gender-specific preferences and aspirations for a future career start to form (Ceci & Williams, 2010). From an inequality perspective, understanding the emergence of gender-specific occupational aspirations is important since these early differences contribute to persistent inequalities in occupational choices and outcomes across the life course (Aisenbrey & Bruckner, 2008; Schoon & Parsons, 2002).

Previous research has largely focused on individual-level predictors of gendered occupational preferences, suggesting that the decision about which occupation to pursue is based on gender-specific ability perceptions (Nix et al., 2015; Sax et al., 2015), career and life goals (Busch-Heizmann, 2015), vocational interests (Ertl & Hartmann, 2019) or internalized gender stereotypes (Makarova et al., 2019) (for an overview see Wang & Degol, 2013; Yazilitas et al., 2013). However, these individual-level explanations do not acknowledge the external and social constraints adolescents may consider when forming their preferences.

Adolescents are embedded in varying social contexts, which provide them with normative cues about appropriate behaviour and represent a comparative frame of reference for their actions (Ross et al., 2011). Through these processes, social contexts convey information on the perceived accessibility and attainability of occupations, which adolescents incorporate in the formation of their occupational expectations (Gottfredson, 1981). Recognizing that occupational expectations do not merely reflect personal motivations for a particular career but are the result of perceived barriers and opportunities, understanding the social embeddedness of adolescents' career decision-making process deserves further attention. During adolescence, the school context represents the fundamental social space for social interaction and peer socialization. Therefore, research has been increasingly interested in understanding social influences on students' gendered career plans, for example, regarding interaction with peers (Raabe et al., 2019; Sinclair et al., 2014; van der Vleuten, Steinmetz,

& van de Werfhorst, 2018) and school composition (Legewie & DiPrete, 2014; Mann et al., 2015).

I contribute to this emerging line of research by looking more closely at the classroom context. I ask whether and to what extent the classroom environment structures students' STEM-related occupational expectations and whether these effects differ for male and female students. More specifically, I consider two characteristics of a 'STEM-related classroom climate'. As outlined by reference group theory (Kelley, 1952), classmates can serve a "comparative" and a "normative" function. Conformity represents the normative influence of the reference group and describes the process by which classmates adapt their preferences to those of their peers. I use the share of classmates expressing an occupational STEM aspiration to investigate this effect. The comparative function of reference groups means that students use their classmates as a target of social comparison to form evaluations about themselves, resulting in social contrast or social assimilation effects (Jonsson & Mood, 2008). Accordingly, being surrounded by classmates who express high confidence in their mathematical abilities may depress or enhance students' STEM expectations. Both classroom features, which I consider part of a 'STEM-related classroom climate', may shape the size of the gender gap in students' occupational expectations by influencing the perceived costs and success probabilities associated with entering a STEM career.

This study makes three significant contributions to the literature. First, it introduces classroom effects in studying adolescents' occupational expectations toward STEM. Previous research has either focused on comparative (Jonsson & Mood, 2008; Mann et al., 2015) or on normative reference group effects (Gabay-Egozi et al., 2015; Riegle-Crumb et al., 2006; van der Vleuten, Jaspers, et al., 2018) when investigating contextual effects on students' preferences for science and technology careers. Considering both effects jointly allows for an assessment of their relative contribution. Second, I link reference group effects to the gender gap in students' occupational expectations, thereby adding to the understanding of the gender-specific relevance of proximal social contexts (Legewie & DiPrete, 2012, 2014). If girls and boys differ in the way they engage in and respond to normative and comparative social influences, certain classroom contexts may amplify the emergence of gender differences in occupational expectations. Third, based on the assumption of gender homophily in social interaction, gender-specific reference groups are examined (McPherson et al., 2001).

2.2 Theoretical Framework

Motivated by the distinction between "normative" and "comparative" functions of social reference groups (Kelley, 1952), I will discuss two processes by which the classroom environment influences students' occupational expectations. Predictions about the gender-specific structure of these contextual effects are drawn from socialization-based theoretical approaches (Sewell, Haller, and Portes 1969) and rational choice models of educational decision-making (Jonsson, 1999). Both frameworks have been proven fruitful and complementary theoretical perspectives in understanding gender-specific educational and occupational decision-making (e.g., Gabay-Egozi et al., 2015). Socialization approaches understand students' gender-specific occupational preferences resulting from gendered socialization of cultural norms and values through significant others. The rational choice model of educational decision-making, on the other hand, conceptualizes individual aspirations as the result of individuals' evaluation of the anticipated costs, benefits and success probabilities of educational alternatives (Breen & Goldthorpe, 1997). Combining both perspectives, individuals use their gendered preferences as an action calculus to weigh the individually perceived costs, benefits and probabilities of success of different occupational options. In the following, I lay out how normative and comparative reference group effects may alter the perceived costs and success probabilities associated with pursuing a STEM career in a gender-specific way.

Normative reference groups and the gender gap in STEM expectations

The "Wisconsin Model of Status Attainment" adopts a socialization perspective on educational and occupational attainment. In this view, social influences through significant others like family and peers occupy a central role in the formation of occupational aspirations (Sewell et al., 1969). Conformity describes the process by which students adapt to the aspirations of their classmates. Since adolescents desire acceptance and recognition from their peers, they seek to reduce discrepancies between themselves and their classmates

(Festinger, 1954). Moreover, in the presence of classmates who aspire toward a STEM career, students' awareness and knowledge about these career paths are raised.

Since students mainly interact and form friendships with their same-sex peers, conformity influences are most relevant in same-sex social interactions (McPherson et al., 2001). Students are likely more aware of the preferences and values of their friends with whom they frequently interact and whose opinions and attitudes they value. Several studies investigating peer influence found that significant others' and ego's educational choices were related. For example, exposure to college-going friends or friends with college expectations increased ego's college choices and expectations (Fletcher, 2012, 2015; Giorgi et al., 2010). Students' and their best friends' curricular choices were also related (Gabay-Egozi et al., 2015).

From a socialization perspective, gender-essentialist beliefs about females' incompatibility with math and science domains are highly prevalent and constitute an important explanation for women's underrepresentation and underachievement in STEM fields (Makarova et al., 2019; Nosek et al., 2002). Importantly, these gender-belief systems are context-dependent. For example, gender gaps in educational and occupational expectations are more pronounced when cultural gender stereotypes are highly salient (McDaniel, 2010, 2016). From a rational choice perspective, working in a gender-atypical career can be considered "normative or social costs" that result from violating shared gender norms about appropriate male and female behaviour (Jonsson, 1999). Although it is socially more acceptable to exhibit gender-atypical behaviour for females than for males (Kreiger & Kochenderfer-Ladd, 2013), female students frequently experience "chilly" STEM classroom climates and a lack of social belonging that is primed by their peers (Hall & Sandler, 1982).

The presence of female STEM-oriented peers may alter the salience of gender roles in the classroom and may hence reduce the social costs of pursuing STEM careers as a woman. Female students who express aspirations for male-typed STEM careers could function as counter-stereotypical role models that reduce the normative costs associated with STEM careers (Olsson & Martiny, 2018). Consequently, STEM occupations will be considered attainable and normatively acceptable in the presence of same-sex students who express STEM aspirations. Previous evidence confirms that females are more likely to choose advanced mathematics coursework if their same-sex peers did so (Raabe et al., 2019) and that the endorsement of gender stereotypes within same-sex peer groups reduced females' participation in STEM fields (Frank et al., 2008; Riegle-Crumb & Morton, 2017). Based on these theoretical and empirical considerations on social conformity, females' should be more likely to express STEM expectations in classroom environments where other girls express an interest in STEM:

> **H1a (*female social conformity*):** Female students have higher STEM expectations in classrooms in which a higher share of female classmates display idealistic aspirations toward STEM occupations.

Relatedly, if more male students in a classroom aspire towards STEM, the stereotypical male connotation of mathematics and science is confirmed. Consequently, the social rewards related to confirming with their same-sex peers should increase for male students. Classrooms in which a higher share of male students express idealistic STEM aspirations should therefore increase male students' STEM expectations:

> **H1b (*male social conformity*):** Male students have higher STEM expectations in classrooms in which a higher share of male classmates aspires toward a STEM occupation.

Considering both effects, the gender gap in STEM expectations should be lower in classrooms in which a higher share of female classmates and a lower share of male classmates aspires toward a STEM occupation. The hypotheses above are formulated against the assumption that peer influence mainly operates among same-sex peers (McPherson et al., 2001). It should, however, be noted that cross-sex peer effects could further reinforce gender-segregated expectations by altering the gender-specific normative and social costs associated with STEM careers. For example, the presence of STEM-aspiring male peers could reduce female students' STEM expectations by confirming the stereotypical view that these fields are reserved for men, raising the normative costs associated with STEM. Similarly, the presence of female STEM-aspiring classmates could reduce the normative rewards for men by providing evidence of counter-stereotypical gender roles.

Comparative reference groups and the gender gap in STEM expectations

The previous explanation emphasized the contextual embeddedness of the normative costs and rewards of pursuing a STEM occupation. According to rational choice theory, students also employ their perceived prospects of success as a relevant criterion in educational and occupational decisions (Jonsson, 1999). For example, students more frequently select STEM courses and careers when they perceive their abilities in mathematics as high, a concept known as mathematical self-concept (Jacobs, 2005; Perez-Felkner et al., 2017; Sax et al., 2015). Social comparison theory predicts that adolescents form interpretations of their abilities based on inter-individual comparison processes with their social environment (Festinger, 1954). Accordingly, students use their significant others as a standard against which they assess and interpret their potential. In this perspective, students may expect that math-intensive occupations are not compatible with their abilities if they receive negative signals about their mathematical potential through social comparison with their confident classmates.

This *social contrast* mechanism aligns with the well-researched Big-Fish-Little-Pond effect (BFLPE), which entails that students in higher-achieving classrooms develop less favourable academic self-concepts[1] (Davis, 1966; Marsh et al., 2018). Building on this finding, studies have confirmed that equally achieving students make less demanding educational choices in higher-achieving than in lower-achieving schools (Jonsson & Mood, 2008; Mann et al., 2015; Rosenqvist, 2018). Being among the low achievers compared to their peers is furthermore associated with lower persistence in STEM majors at university (Fischer, 2017).

Alternatively, social comparisons with a reference group can serve a self-improving function (the social assimilation mechanism; Festinger 1954). Accordingly, individuals engage in social comparisons with slightly better-performing students to fulfil their need for self-enhancement and self-improvement. Upward comparisons with higher-achieving classmates can motivate students to work harder and keep up with their performance (Mussweiler et al., 2004). Competitiveness is thus an essential component of social comparison processes. In support of this perspective, Crosnoe et al. (2008) found that the achievement of friends and coursemates increased adolescents' course-taking in math. Likewise, Frank et al. (2008) showed that female students were more likely to opt for math courses the higher their same-gender coursemates' math achievement was. Acknowledging the assimilation function of reference groups, it is expected that students whose classmates are confident in mathematics more likely opt for math-intensive occupations. If a mathematically confident classroom climate reflects a higher level of competition and a math-supportive climate, students may thus anticipate higher success probabilities for math-related STEM occupations.

The comparative function of reference groups thus either involves *social contrast* or *social assimilation* effects. The response to a mathematically confident classroom climate may be gender specific. Female students tend to downwardly misperceive their mathematics and science skills, contributing to gendered educational decisions (Correll, 2001; Nix et al., 2015). They may therefore need stronger evidence of their individual mathematical potential in relation to their classmates. Consequently, female students set a higher threshold at which they perceive themselves as suitable for entering a STEM career. Since mathematics and science are part of a socialized masculine identity, male students are less vulnerable to negative signals from their classmates. Therefore, I expect female students to develop lower STEM expectations in mathematically confident classrooms:

> **H2a (*female social contrast*):** Female students display lower STEM expectations in classrooms characterized by strong mathematical confidence.

Boys are more inclined to behave competitively than girls. (Niederle & Vesterlund, 2007, 2011). Gendered competitiveness has been introduced as an explanation for gender differences in the choice of math and science tracks, given that STEM occupations are generally perceived as more competitive and demanding than non-STEM occupations (Buser et al., 2014). To the extent that a confident classroom climate is indicative of a competitive environment, male students may therefore be inspired by their mathematically confident peers to perform equally well or even better, thus facilitating the formation of STEM expectations. Female students, in contrast, will likely abandon their orientation toward these occupations in a competitive surrounding, leading to the following hypothesis:

> **H2b (*male social assimilation*):** Boys display higher STEM expectations in classrooms characterized by strong mathematical confidence.

Considering both hypotheses, the gender gap in STEM expectations should be larger in classrooms with a higher share of confident classmates. Again, since same-sex peers represent the most significant peers (McPherson et al., 2001), it could be expected that comparative reference group effects will be most pronounced in same-sex (in comparison to opposite-sex) reference group comparisons. These hypotheses will, therefore, be tested separately for male and female reference groups.

2.3 Data and Methods

Data

The empirical analyzes are based on representative data from the Starting Cohort 4 "School and Vocational Training: Educational Pathways of Students in Grade 9 and Higher," from the German National Educational Panel Study (NEPS) (Blossfeld & Roßbach, 2019; NEPS Network, 2021). Respondents were selected in a stratified cluster sampling design. First, schools were randomly selected and second, a sample of two classes was drawn within every school. I considered data on ninth graders, which have been collected in two subsequent waves during the 2010/11 school year. Information was provided by various sources, including students, parents and teachers.

The total sample comprised 16,425 ninth graders at German secondary schools, including students from regular schools and students at special-needs schools. Analyses are limited to the regular sample of 15,147 students because special-needs students lacked information about their occupational expectations. Among this sample, 38 % of students did not respond to the assessment of their occupational expectations. Missing information on the covariates was imputed through chained equation modelling (MICE) (Allison, 2009b; Little & Rubin, 2002), generating 15 complete data sets. The imputation model included all covariates, the dependent variables and auxiliary variables (e.g. type of non-response of occupational expectations). The regression analyses are restricted to cases for which the dependent variable was fully observed (Hippel, 2007). Because of the estimation strategy, the analytical sample was further restricted to schools for which two classrooms have been sampled. The final analysis sample was n_i= 8,711 students in n_s=458 schools and n_c=916 classrooms. A description of the variables for the pre-imputation sample is available in Table 1.

Table 1: Descriptive statistics (pre-imputation sample).

Variable	Obs	Mean	Std.Dev.	Min	Max
Occupational expectation					
STEM (hard)	8,711	.10	.30	0	1
STEM (hard & soft)	8,711	.15	.36	0	1
STEM (hard & soft & health)	8,711	.29	.45	0	1
Individual-level covariates					
mathematical self-concept	8,134	2.52	.93	1	4
occupational aspiration (STEM)	8,016	.12	.32	0	1
female	8,711	.51	.50	0	1
migration background	8,588	.13	.33	0	1
parents: STEM occupation	7,737	.20	.40	0	1
parents: highest educational degree	7,757	2.53	.72	1	3
parents: occupational status (ISEI)	7,737	53.10	20.37	11.56	88.96
grade (math)	8,477	4.00	1.03	1	6
grade (German)	8,526	4.13	.83	1	6
mathematical skills	8,354	.03	1.22	-4.37	4.62
reading skills	8,520	-.02	1.24	-4.75	3.3
science skills	8,318	.01	.10	-3.56	5.29
ICT skills	8,327	.02	.93	-3.30	3.57
Classroom-level covariates					
share: males with STEM aspiration	8,711	.15	.15	0	1
share: females with STEM aspiration	8,711	.03	.06	0	1
girls' average math self-concept	8,711	2.27	.42	1	4
boys' average math self-concept	8,711	2.75	.40	1	4
classroom size	8,711	18.09	6.1	1	33
share of male students	8,711	49.67	17.59	0	100
share of migrants	8,711	12.89	14.48	0	100

Source: NEPS, starting cohort 4. Own calculations.

Measures

STEM expectation. The dependent variable indicates whether students expected a STEM-related occupation. It was based on an open-ended question ("Based on everything you currently know, what kind of job will you most likely have later on?"). The answer to that question relates to the theoretical concept of 'realistic occupational aspiration', which is moduled by the perceived accessibility of occupations (Gottfredson, 1981). Responses were coded based on the four-digit level of the International Standard Classification of Occupations (ISCO-08). A dummy variable was created, which indicated whether students expected a STEM career or not. To acknowledge the heterogeneity within STEM occupations, "soft" (including e.g. biology), "hard" (e.g. engineering), and health-related STEM occupations are distinguished. The definition of STEM occupations used in this study is similar to the one adopted by the European Parliament (2015). The Appendix includes a detailed list of occupations treated as STEM (Table A1).

The central explanatory variables depict two aspects of a STEM-related classroom climate:

Normative classroom climate was operationalized by two variables indicating the share of female (male) students in the classroom expressing an idealistic aspiration to work in a STEM occupation. Classmates' aspirations were measured using the question: "Imagine you had all opportunities to become what you want. What would be your ideal occupation?". This question relates to the concept of an idealistic occupational aspiration, comprising students' unconstrained willingness and desire to work in this occupation (Gottfredson 1981). Responses were coded into STEM or non-STEM occupations and aggregated to the classroom level.

Comparative classroom climate was operationalized as the average mathematical self-concept among female and male students in the classroom. It was measured using a scale of three items, with students indicating their agreement with the following statements on a 5-points scale: "mathematics is one of my best subjects", "I learn quickly in mathematics", and "I've always been good at mathematics". Individual values on this scale were aggregated into a classroom average. In all cases of aggregation, the imputed dataset was used.

Variables from which classroom measures were constructed (mathematical self-concept and idealistic STEM aspiration) were also included as individual-level variables to ensure that classroom effects are separated from individual effects. Covariate selection was guided by theoretical arguments about which variables relate to students' occupational expectations and classroom climate, thus potentially confounding this relationship.

Academic performance was measured in two ways. First, students reported their teacher-assigned math and verbal grades from their official school report in the middle of ninth grade (coded such that 1: lowest grade, 6: highest grade). Second, students' performance was assessed through standardized test scores, capturing their competencies in math, reading, natural sciences and ICT (Lockl et al., 2020).

Information on parents' occupation and educational qualifications was included to account for processes of inter-generational transmission and gendered socialization. These variables were obtained from the parents' questionnaire and complemented with information from the students' questionnaire in case of missing data:

Parental STEM occupation. To account for processes of inter-generational transmission and socialization, I consider whether at least one parent worked in a STEM occupation.

Parents' highest educational degree distinguishes between low (Hauptschulabschluss), medium (Realschulabschluss), and high (Abitur, the German university entrance diploma).

Parents' highest occupational status is based on the Socio-Economic Index of Occupational Status (ISEI-08).

Migration background. At the individual level, I further consider students' migration background (distinguishing between students with and without German as a mother tongue). Research has shown that students with an immigration background are more likely to pursue STEM careers reflecting a comparative disadvantage in native language skills (Rangel & Shi, 2019).

Classroom composition. At the classroom level, basic demographic indicators are included: the share of female students, the share of students with migration backgrounds and classroom size.

Analytical Strategy

To test the hypothesis of a relationship between classroom climate and the gender gap in occupational expectations, I estimate linear probability regression models[2] (LPM), allowing for a direct interpretation of coefficients as marginal effects, reducing the bias of unobserved heterogeneity and increasing comparability between different model specifications (Mood, 2010). All standard errors were clustered at the school level to correct for dependency between observations within the same school.

When estimating contextual effects, bias may arise from unobserved variables at the school or neighbourhood level that are correlated with both the outcome variable and the predictors of interest. Schools and neighbourhoods might differ in terms of various compositional and organizational characteristics confounding the relationship between STEM-related school climate and students' career expectations. These characteristics include, for example, the socio-economic composition of the student body and neighbourhood, educational track, teacher quality or career counselling. Since not all of the potential confounders are observed and to eliminate as many biasing factors at the school level as possible, school fixed-effects models are used. This estimation strategy effectively compares individuals within the same school belonging to different classrooms, thus relying on within-school variation (Allison, 2009a).

At the centre of this study lies the relationship between classroom climate and the gender gap in students' career expectations. In the first set of models, I examine the overall associations between normative and comparative reference groups on students' STEM expectations. In the second set of models, I introduce a cross-level interaction between gender and the respective indicator of classroom climate, thus reflecting the context-dependent gender gap in STEM expectations.

2.4 Results

Overall, 10 % of the total analysis sample indicated that they expected to work in a (hard) STEM occupation. The data revealed substantial gender differences: among those students who formulated a STEM expectation, 84 % were male, and 17 % were female. The average mathematical confidence in the classroom was M_{male}=2.75 and M_{female}=2.27, varying between schools (SD_{male}=.332; SD_{female}=.354) and within schools (SD_{male}=.281; SD_{female}=.256). Regarding normative reference groups, on average, 14.5 per cent of male and 2.59 of female classmates expressed an idealistic STEM aspiration, varying between schools (SD_{male}=.120; SD_{female}=.047) and within schools (SD_{male}=.094; SD_{female}=.043). A larger part of the variation in classroom climate is located between schools, but there is also some considerable variation within schools, which provides a good basis for using school fixed-effects models.

Are reference groups associated with STEM expectations?

Table 2 displays the results of five linear probability models, calculating the probability of expecting a STEM occupation by features of a STEM-related classroom climate while controlling for individual and classroom variables. These models examine whether there is a general link between gender-specific reference groups and students' occupational expectations, irrespective of students' gender. For the sake of robustness, three different specifications of STEM occupations are considered as dependent variables (see Table A2 for the full results, Appendix). Individual-level occupational aspirations and mathematical self-concept are included to ensure that the effect of the aggregate context variables is not driven by students' individual values. The results reveal that for all model specifications, neither classmates' mathematical confidence nor classmates' STEM aspirations substantially relate to students' occupational expectations. Male classmates' math self-concept is, however, related to a higher probability to express STEM expectations including "soft" STEM subjects such as biology (see Table A2, Models 3 and 5), pointing to a general social assimilation effect.

Table 2. Results from linear probability models with school fixed effects. STEM (hard) expectations regressed on normative and comparative reference groups.

	Normative reference groups		Comparative reference groups		Joint model
	(1)	(2)	(3)	(4)	(5)
female	-0.040***	-0.040***	-0.111***	-0.110***	-0.036***
	(0.006)	(0.006)	(0.008)	(0.008)	(0.006)
STEM aspiration	0.515***	0.515***			0.517***
	(0.019)	(0.019)			(0.019)
mathematical self-concept			0.027***	0.029***	0.018***
			(0.005)	(0.005)	(0.004)
Normative reference groups:					
classroom: share of girls with STEM aspiration	-0.011				-0.024
	(0.065)				(0.071)
classroom: share of boys with STEM aspiration		-0.005			-0.004
		(0.029)			(0.029)
Comparative reference groups:					
classroom: boys' mathematical self-concept			0.018		0.020^{+}
			(0.013)		(0.011)
classroom: girls' mathematical self-concept				0.000	0.002
				(0.012)	(0.009)
observations	8,711	8,711	8,711	8,711	8,711
N (schools)	458	458	458	458	458
N (classrooms)	916	916	916	916	916

Source: NEPS, starting cohort 4. Clustered standard errors in parentheses. Control variables include migration background, parental STEM occupation, highest parental educational degree, parental occupational status, grades in math and German, math and verbal test scores, classroom size, and demographic classroom composition.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Does the gender gap in STEM expectations vary by classroom context?

The next set of models explores whether the gender gap in STEM expectations varies by classroom context. A cross-level interaction between the four gender-specific classroom variables and gender is introduced (results in Table 3). The multiplicative two-way-interaction term between classroom context and gender indicates whether boys and girls respond differently to their classroom environment. The main effect of average classroom achievement reveals the predicted change in the probability of expecting a STEM occupation for a one-unit increase of the contextual variable, given the gender variable takes the value 0 (male). Adding the interaction term to the main effect produces the predicted change for girls (coded as 1).

The displayed models are based on the narrowest definition of STEM as an outcome variable (see Table A3 in the Appendix for replication for broader STEM definitions). The first two models refer to normative reference groups and investigate conformity effects (distinguishing between male and female classmates). The last two models investigate comparative reference group effects, again distinguishing between male and female classmates. The fifth model considers all classroom effects jointly.

Models 1-4 show statistically significant interaction terms between gender and the contextual variables. Normative reference group effects are assessed in Models 1 and 2, revealing the effect of female and male classmates' idealistic aspirations on students' expectations. Model 1 shows that an increase in the share of female classmates with a STEM aspiration by one percentage point is associated with an increase in boys' probability of expecting a STEM occupation by 0.98 percentage points but a decrease in girls' probability by 1.41 points. This result clearly contradicts the hypothesis about a positive counter-stereotype effect from STEM-interested female classmates (H1a). Similarly, Model 2 shows that an increase in male classmates' aspirations by one percentage point is associated with an increase in boys' probability by 0.64 percentage points but a decrease in girls' probability by 0.51 percentage points, supporting the male social conformity hypothesis (H1b). Gender homophily is not supported for normative reference group effects. Interestingly, for boys, conformity effects are visible for both same-gender and opposite-gender comparisons.

Table 3. Results from linear probability models with school fixed effects. STEM (hard) expectations regressed on normative and comparative reference groups, gender-specific effects.

	Normative reference groups		Comparative reference groups		Joint model
	(1)	(2)	(3)	(4)	(5)
female	-0.032*** (0.006)	-0.018* (0.009)	0.133*** (0.038)	-0.009 (0.057)	0.135** (0.050)
STEM idealistic aspiration	0.518*** (0.019)	0.506*** (0.020)			0.510*** (0.020)
mathematical self-concept			0.033*** (0.005)	0.026*** (0.005)	0.021*** (0.004)
Normative reference groups:					
female#classroom: share of girls with STEM aspiration	-0.239* (0.110)				-0.202+ (0.114)
classroom: share of girls with STEM aspiration	0.098 (0.094)				0.075 (0.102)
female#classroom: share of boys with STEM aspiration		-0.115* (0.045)			-0.092* (0.045)
classroom: share of boys with STEM aspiration		0.064 (0.045)			0.054 (0.045)
Comparative reference groups:					
female # classroom: girls' mathematical self-concept			-0.106*** (0.017)		-0.057*** (0.014)
classroom: girls' mathematical self-concept			0.046** (0.015)		0.026* (0.012)
female # classroom: boys' mathematical self-concept				-0.037+ (0.021)	-0.006 (0.018)
classroom: boys' math self-concept				0.040* (0.019)	0.022 (0.017)
observations	8,711	8,711	8,711	8,711	8,711
N (schools)	458	458	458	458	458
N (classrooms)	916	916	916	916	916

Source: NEPS, starting cohort 4. Clustered standard errors in parentheses. Control variables: migration background, parental STEM occupation, parental educational degree, parental ISEI, grades, test scores, classroom composition

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Comparative reference groups are assessed in Models 3 and 4. Model 3 reveals that an increase by one additional scale point on female classmates' mathematical confidence is associated with a 4.6-percentage-point increase in boys' probability of expecting a STEM occupation, while such a shift leads to a decrease of 6 percentage points for girls. These gender differences are statistically significant at $p<0.001$. Providing a substantial interpretation of these effects, an increase by one between-school standard deviation in female classmates' confidence (SD=.354) is associated with a 1.63-percentage-point increase (1.14-percentage-point decrease) in boys' (girls') probability of expecting toward STEM. These findings confirm the female social contrast effect (H2a) and the male social assimilation effect (H2b). Regarding male comparative reference groups, no statistically significant gender differences emerge, and they are less substantial in size (Model 4). For example, an increase by one between-school standard deviation in male classmates' confidence (SD=.332) is associated with a 1.3-percentage-point increase in boys' probability of expecting STEM, but almost no change in female students' STEM expectations.

In the joint regression (Model 5), effect sizes from normative and comparative reference groups are altogether reduced, indicating that normative and comparative classroom effects are partially intertwined with one another. Some of the cross-level interactions between classroom and gender lose statistical significance (female normative reference groups). These gender differences can therefore not be generalized above the sample at hand. Linear predictions across different levels of classroom composition (from Model 5) are illustrated in Figure 1. Overall, normative classroom effects contribute to a widening of the STEM gender gap for both same-sex and opposite-sex reference groups. For example, in classrooms in which 45 per cent of boys express idealistic STEM aspirations (two standard deviations above average), a gender gap of about 5.3 percentage points emerges.

For comparative reference groups, a different pattern emerges. Female students display lower STEM expectations when their female peers (but not their male peers) express mathematical confidence. Hence, for female students, social contrast effects are restricted to same-sex comparisons, supporting predictions from gender homophily. In contrast, for male students, social assimilation effects are visible for both same-sex and cross-sex reference group comparisons.

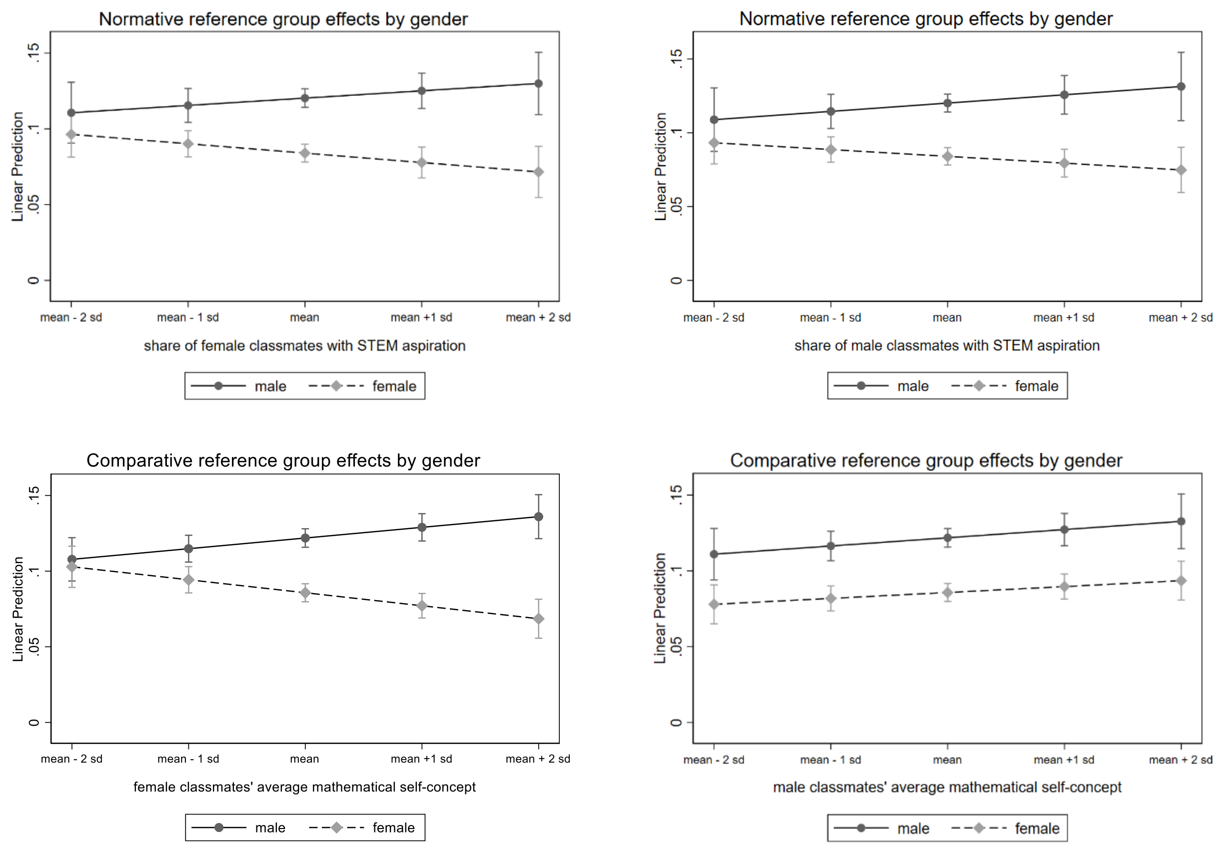

Figure 1: Normative and comparative classroom effects by gender. Results from Table 3, Model 5.

Replications of these results for different operationalizations of the dependent variable are displayed in the Appendix (Table A3). Direction and size do not considerably differ according to a narrower definition of STEM that includes soft fields such as biology or architecture; therefore, the interpretation is not substantially altered (Figure A1). However, when adding health occupations, the found gendered associations are washed out in terms of pattern, effect size and statistical significance (Figure A2).

2.5 Summary and Discussion

Occupational gender segregation is rooted in young people's career expectations. This study concentrated on the distinction between STEM and non-STEM occupational expectations, which is one of the most visible demarcation lines in occupational gender segregation.

Moving beyond individual-level factors, this study examined whether classroom contexts are associated with adolescents' occupational expectations. More specifically, it investigated whether normative and comparative gender-specific reference group effects were related to the gender gap in students' STEM expectations. Thereby, two separate works of literature and research traditions are connected, one on the development of aspirations (Schoon & Parsons, 2002) and the other on reference and peer group effects (Kelley, 1952; Riegle-Crumb & Morton, 2017).

Understanding how gender differences in occupational expectations emerge is important because early aspirations shape future engagement and inequalities in STEM careers (Correll, 2001; Schoon & Parsons, 2002). Building on the insights of frame of reference theory in relation to rational choice and socialization perspectives on the role of classmates to shape boys' and girls' occupational expectations, the goal of this study was to explore how two aspects of a STEM-related classroom climate are associated with the gender gap in occupational expectations. Specifically, this study considered classmates' idealistic aspirations toward STEM (normative reference group effects) and classmates' confidence in mathematics (comparative reference group effects), distinguishing between male and female reference groups.

Generally, the results of this study reconfirm that female students are less likely to expect to work in STEM occupations, even when they have comparable abilities and aspirations. Multivariate analyses of a representative sample of 9th graders in Germany suggest that classmates are essential sources of normative and comparative reference group effects. Both classroom environments were associated with the gender gap in STEM expectations. In the presence of mathematically confident and STEM-aspiring classmates, male students were generally more likely to express a STEM expectation, while female students had lower STEM expectations. As an overall result, the gender gap in STEM expectations is widened in classrooms with an overall STEM-oriented climate. These findings emphasize that female students are generally more negatively influenced by high-achieving and STEM-aspiring peers.

Regarding the gender of the reference group, this study only partly confirms that same-sex reference groups are more influential, as suggested by social homophily theory (McPherson et al., 2001). For female students, the detrimental social contrast effect was restricted to same-sex comparisons, supporting gender homophily. In contrast, male students showed a positive social assimilation effect in the presence of mathematically confident peers for both same-sex and cross-sex comparisons. For normative reference groups, the gender of the reference group did not make a difference. Females‘ (males‘) STEM expectations were depressed (enhanced) by the same-sex and opposite-sex normative reference groups to a comparable extent. These results contradict previous findings on the counter-stereotypical influence of female role models (e.g. Raabe et al., 2019; Riegle-Crumb & Morton, 2017).

Results are robust to the inclusion of several individual, family and classroom covariates, which might bias the association studied. Importantly, by applying school fixed effects models, (unobserved) school characteristics are taken into account, which previous studies dealing with the impact of school effects on occupational expectations did not consider. Thereby, the present study strengthens the robustness of previous findings relying on between-school effects (Mann et al., 2015; Mann & DiPrete, 2016).

These results are of theoretical importance because they show that the formation of occupational aspirations is embedded in socio-cultural school contexts. Understanding the processes generating gender inequality within schools is crucial for educators and policymakers alike so that adolescents’ career-decision-making-process can best be understood and guided. The present study emphasizes the need to address students' social embeddedness and orientation toward classmates in policy measures targeting the STEM gender gap.

2.6 Limitations and Future Research

This study is not without limitations. First, results could be biased in case of selection effects across classrooms. The results of Lorenz et al. (2020) increase confidence that influence effects usually play a greater role than selection processes when considering peer influences in relation to educational and occupational aspirations.

Second, social comparison processes might not only manifest themselves at the classroom level but also at more fine-grained levels of social interaction, e.g. regarding friendship groups and close friends (Lomi et al., 2011). Future research is needed to unravel how close friends and the broader classroom context jointly influence the career decision-making process of young people. For example, although this study found that female classmates' confidence depressed female students' STEM expectations, the positive influence of close friends could counteract this negative impact. Ultimately, a better understanding of the micro-channels generating the gender-specific influence processes found here would be a promising avenue for future research.

Third, in the present study, social comparison effects in the domain of mathematics have been investigated. Since mathematics is viewed as a stereotypical masculine domain, female students might attach greater importance to comparisons with their peers in female-typed subjects, such as languages. Future research is needed to investigate whether the associations found here can be generalized across different disciplines. Finally, the findings from this study are limited by their cross-sectional nature, making it difficult to interpret the effects as causal. Future research should replicate these findings from a longitudinal perspective to better understand how the associations found in this study unfold over time. To achieve this research aim, longitudinal data about the evolution of classroom climates and occupational expectations is needed.

Endnotes

1. Studies concerned with the BFLPE have traditionally focused on classmates' achievement as standardised test scores measure. In the present study, I use classmates' mathematical self-concept, which captures how classmates express their confidence in their mathematical abilities and thus provides a more relevant social comparison standard. For example, it has been shown that students interpret the same individual academic performance differently (Möller & Pohlmann, 2010). Thus, using test scores as a contextual measure does not capture the subjective importance students attach to their abilities which they will ultimately convey to their classmates.
2. A linear probability model (LPM) is a linear regression model where the outcome variable is a binary variable: $Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} + u_{i\ coefficients}$. β_j can be interpreted as conditional probabilities, i.e. the change in the probability that $Y_i = 1$, holding constant the other k−1 regressors.

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Appendix

Table A1. Classification of STEM occupations (based on ISCO-08).

Occupation	**STEM hard**	**STEM soft**	**STEM health**
2 Professionals			
211 Physical and Earth Science Professionals	■		
212 Mathematicians, Actuaries and Statisticians	■		
213 Life Science Professionals		■	
214 Engineering Professionals (excluding Electrotechnology)	■		
215 Electrotechnology Engineers	■		
216 Architects, Planners, Surveyors and Designers		■	
221 Medical Doctors			■
222 Nursing and Midwifery Professionals			■
223 Traditional and Complementary Medicine Professionals			■
224 Paramedical Practitioners			■
225 Veterinarians			■
226 Other Health Professionals			■
251 Software and Applications Developers and Analysts	■		
252 Database and Network Professionals	■		
3 Technicians and Associate Professionals			
311 Physical and Engineering Science Technicians	■		
312 Mining, Manufacturing and Construction Supervisors	■		
313 Process Control Technicians	■		
314 Life Science Technicians and Related Associate Professionals		■	
315 Ship and Aircraft Controllers and Technicians	■		
321 Medical and Pharmaceutical Technicians			■
322 Nursing and Midwifery Associate Professionals			■
323 Traditional and Complementary Medicine Associate Professionals			■
324 Veterinary Technicians and Assistants			■
325 Other Health Associate Professionals			■
351 Information and Communications Technology Operations and User Support Technicians	■		
352 Telecommunications and Broadcasting Technicians	■		

Table A2. Results from LPM with school fixed effects (replication of Table 2 for different STEM definitions).

	STEM (hard & soft)					STEM (hard & soft & health)				
	Normative		Comparative		Joint	Normative		Comparative		Joint
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
female	-0.035***	-0.035***	-0.094***	-0.092***	-0.028***	0.135***	0.134***	0.084***	0.084***	0.140***
	(0.008)	(0.008)	(0.009)	(0.009)	(0.008)	(0.011)	(0.011)	(0.012)	(0.012)	(0.011)
STEM aspiration	0.453***	0.453***			0.452***	0.397***	0.393***	0.034***	0.036***	0.393***
	(0.019)	(0.018)			(0.019)	(0.019)	(0.019)	(0.008)	(0.008)	(0.019)
mathematical Self-concept			0.035***	0.039***	0.028***					0.027***
			(0.006)	(0.006)	(0.005)					(0.007)
Normative reference groups:										
classroom: share of girls with STEM aspiration	-0.057				-0.067	-0.203^{+}				-0.180
	(0.078)				(0.085)	(0.110)				(0.114)
classroom: share of boys with STEM aspiration		-0.003			0.003		0.026			0.033
		(0.039)			(0.041)		(0.050)			(0.053)
Comparative reference groups:										
classroom: boys' math self-concept			0.031*		0.035*			0.016		0.016
			(0.016)		(0.015)			(0.021)		(0.021)
classroom: girls' math self-concept				-0.014	-0.014				0.010	0.009
				(0.014)	(0.013)				(0.018)	(0.017)
Observations	8,711	8,711	8,711	8,711	8,711	8,711	8,711	8,711	8,711	8,711
N (schools)	458	458	458	458	458	458	458	458	458	458
N (classrooms)	916	916	916	916	916	916	916	916	916	916

Source: NEPS, starting cohort 4. Clustered standard errors in parentheses. Control variables include migration background, parental STEM occupation, highest parental educational degree, parental occupational status, grades in math and German, math and verbal test scores, classroom size, and demographic classroom composition.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A3. Results from LPM with school fixed effects, interaction between gender and classroom context (replication of Table 3 for different STEM definitions).

	STEM (hard & soft)					STEM (hard & soft & health)				
	Normative		Comparative		Joint	Normative		Comparative		Joint
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
female	-0.028**	-0.006	0.169***	-0.032	0.130*	0.153***	0.174***	0.367***	0.139^{+}	0.319***
	(0.008)	(0.012)	(0.045)	(0.065)	(0.061)	(0.013)	(0.017)	(0.065)	(0.082)	(0.090)
STEM aspiration	0.455***	0.441***			0.442***	0.403***	0.377***			0.383***
	(0.018)	(0.019)			(0.020)	(0.019)	(0.019)			(0.020)
math self-concept			0.044***	0.035***	0.032***			0.042***	0.034***	0.032***
			(0.006)	(0.006)	(0.005)			(0.008)	(0.008)	(0.007)
Normative reference groups:										
female#share of girls with STEM asp.	-0.204				-0.144	-0.521**				-0.452**
	(0.132)				(0.137)	(0.158)				(0.164)
classroom: share of girls with STEM asp.	0.036				0.002	0.034				0.031
	(0.103)				(0.112)	(0.122)				(0.128)
female#classroom: share of boys with STEM asp.		-0.149**			-0.133*		-0.208**			-0.173*
		(0.056)			(0.057)		(0.073)			(0.075)
classroom: share of boys with STEM asp.		0.088			0.087		0.152*			0.140*
		(0.054)			(0.056)		(0.063)			(0.065)
Comparative reference groups:										
female # classroom: girls' math self-concept			0.036*		0.017			0.063**		0.044*
			(0.018)		(0.016)			(0.020)		(0.019)
classroom: girls' math self-concept			-0.115***		-0.073***			-0.124***		-0.083**
			(0.020)		(0.018)			(0.028)		(0.028)
female # classroom: boys' mathematical				0.045*	0.024				0.028	-0.001
				(0.022)	(0.020)				(0.027)	(0.026)
classroom: boys' math self-concept				-0.023	0.014				-0.020	0.022
				(0.023)	(0.021)				(0.029)	(0.028)
Observations	8,711	8,711	8,711	8,711	8,711	8,711	8,711	8,711	8,711	8,711
N (schools)	458	458	458	458	458	458	458	458	458	458
N (classrooms)	916	916	916	916	916	916	916	916	916	916

Source: NEPS, starting cohort 4. Clustered standard errors in parentheses. Control variables include migration background, parental STEM occupation, highest parental educational degree, parental occupational status, grades in math and German, math and verbal test scores, classroom size, and demographic classroom composition. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Figure A1. Normative and comparative classroom effects by gender. Results from Table A3, model 5 (STEM hard & soft).

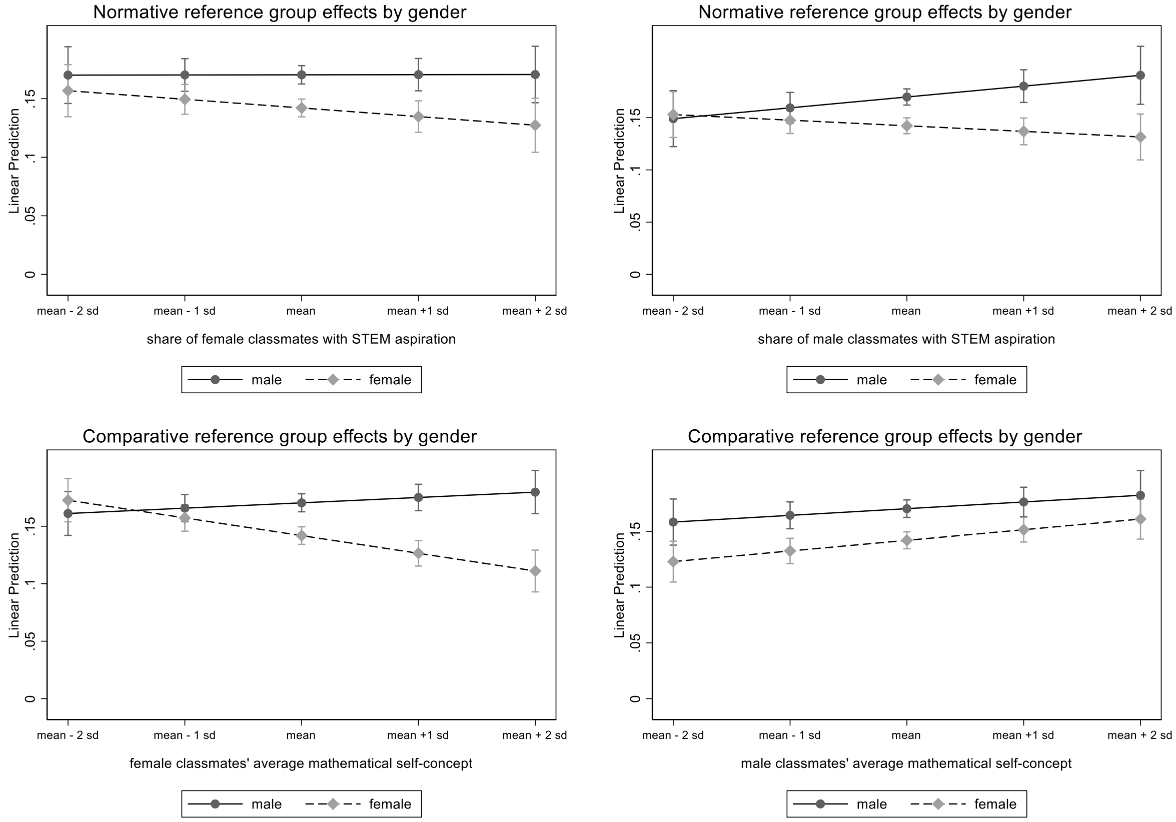
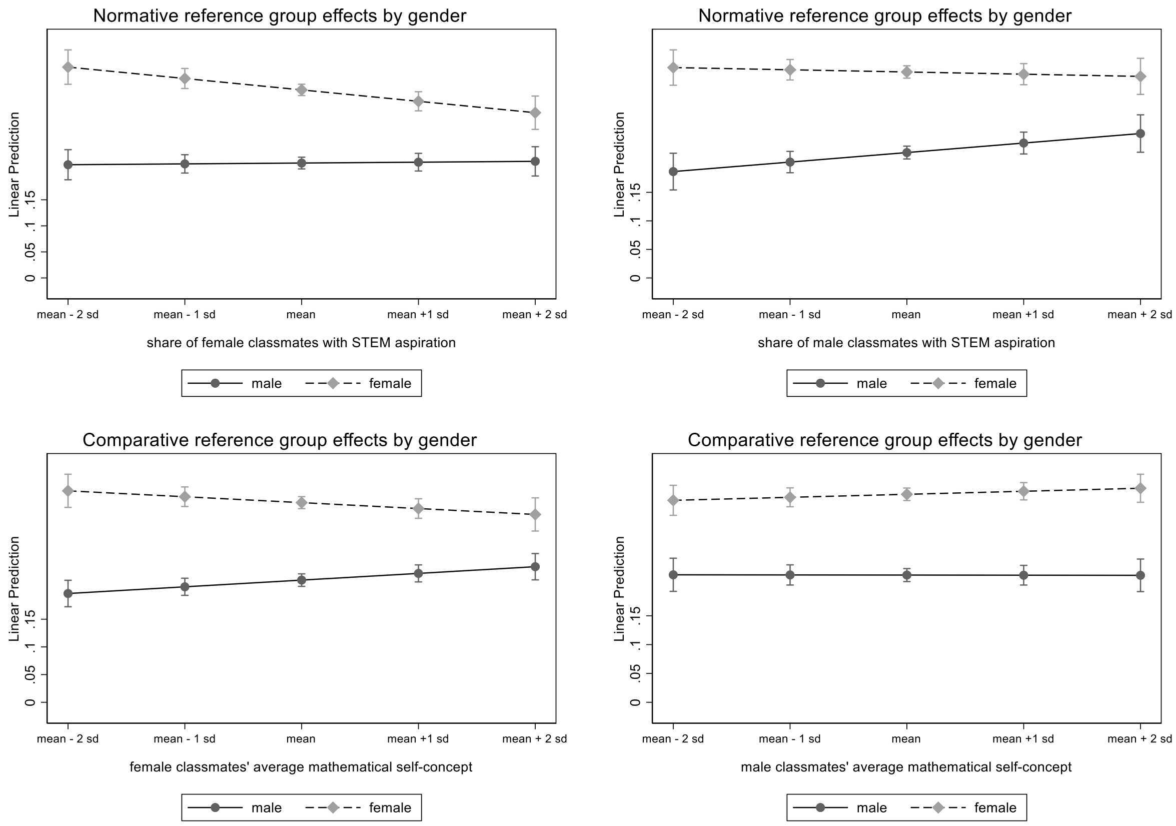


Figure A2. Normative and comparative classroom effects by gender. Results from Table A3, Model 10 (STEM hard & soft & health).



Chapter 3

Curricular differentiation and the gender gap in STEM expectations. Longitudinal evidence from the German case.

Abstract

Previous research has shown that gendered participation in STEM fields is strongly related to gender differences in advanced-course taking (ACT) in school. However, the theoretical link between ACT and subsequent gender segregation in the labour market remains unclear. The *selection perspective* suggests that students make curricular choices in line with their gender-typed occupational expectations. According to the *influence perspective*, exposure to advanced courses in mathematics and sciences promotes students' gendered STEM expectations. Using Germany as a case study, the influence of advanced course taking on the development of gender differences in STEM expectations is investigated for a large sample of upper secondary school students. Selection is taken into account through inverse probability of treatment weights (IPTW). Results show moderate influence effects for mathematics, physics and chemistry course-taking, but not for biology. Influence effects are not structured by students’ gender.

3.1 Introduction

It is well established that women hold lower aspirations for math-related fields and enter them at a lower rate. Across many industrialized countries, females make up the minority in many sciences, technology, engineering and math (STEM) fields of studies (Mann & DiPrete, 2013; Morgan et al., 2013). This gender gap is particularly pronounced in computer sciences, engineering and physics. Fields like chemistry, mathematics and biology display a smaller gender gap or even reach a gender balance in some countries (Barone, 2011; Cheryan et al., 2017). Young people develop gender-typed occupational and educational aspirations at an early age and translate these aspirations into gender-segregated occupational choices (Alm, 2015; Schoon, 2001, 2007; Schoon & Parsons, 2002). A vast amount of studies have investigated explanations for female students' lower STEM aspirations, including lower success expectancies (Ball et al., 2017), gender differences in career preferences and goals (Diekman et al., 2017), gender stereotypes (Makarova et al., 2019; Olsson & Martiny, 2018) and vocational interests (Gill et al., 2018). Importantly, gendered curricular choices in school have been established as the most crucial predictor of gender differences in post-graduation choices compared to alternative theoretical explanations (e.g. France: Herbaut & Barone, 2021; Italy: Barone & Assirelli, 2020; Germany: Hägglund & Lörz, 2020).

Many countries apply some form of horizontal (within-school) differentiation in secondary education, which allows students to focus on a set of core subjects at the advanced level. Previous research has shown that educational STEM choices in upper secondary education are related to post-graduation STEM choices (e.g. in the United States: Domina et al., 2019; Great Britain: Jacob et al., 2020; France: Stevanovic, 2014; Israel: Ayalon, 2002; Gabay-Egozi et al., 2010, 2015; and Germany: Jacob et al., 2020), hence functioning as a "critical filter" for gender-segregated labour markets (Ma & Johnson, 2008).

However, the empirical evidence leaves us with the research puzzle of *how* gender-segregated post-school choices are reproduced through educational choices in a tracked school system. STEM aspirations can be both a cause and a consequence of curricular choices: (1) According to the selection perspective, male and female students make educational choices in line with their pre-existing aspirations, preferences and skills. (2) According to the influence perspective, exposure to advanced courses in mathematics and sciences increases students' STEM career expectations by exposing them to intensive learning and socialization opportunities. This study examines whether students' advanced-course choices in mathematics and sciences influence the development of STEM expectations in upper secondary education and whether these influence effects are gender-specific, accounting for selection effects.

From a policy perspective, it is essential to know if gender-segregated career expectations are amplified through curricular influence processes. If continued participation in advanced STEM courses has the potential to effectively increase students' STEM aspirations, curricular modifications could provide a fruitful avenue to develop policy interventions aiming at increasing (female) students' STEM participation. Since women often drop out of STEM subjects despite good abilities in math or science (Correll, 2001, 2004; Sax et al., 2015), prolonged curricular exposure could be a promising solution for tackling gender differentials in the STEM pipeline. If, however, the association between curricular choice and STEM aspirations is a pure result of pre-existing selection processes, curricular policies would be misplaced.

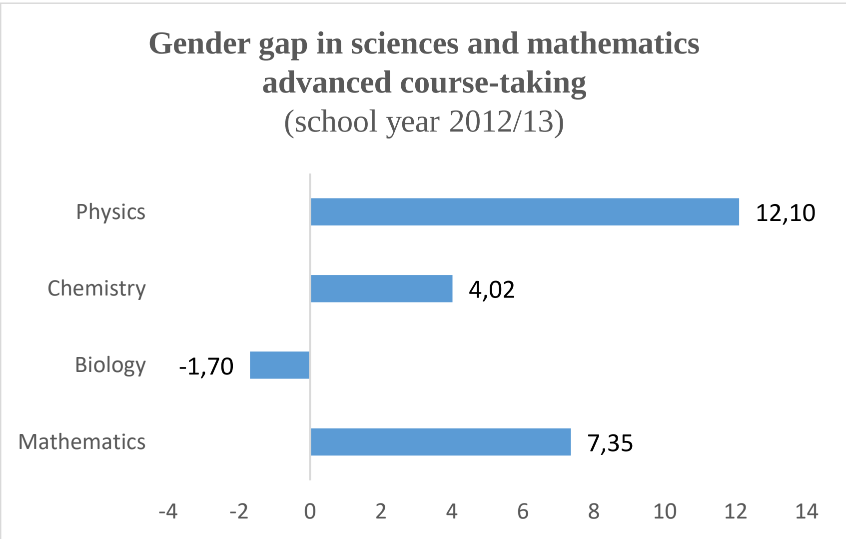
This study uses Germany as a case study where in many regions, students can select mathematics and natural sciences as advanced courses in upper secondary education, i.e. the two final years before graduation. Based on representative panel data on a cohort of students in upper secondary education, the influence of advanced course-taking on the development of STEM expectations is investigated, ruling out selection effects through Inverse Probability of Treatment Weights (IPTW). Germany is an interesting case study because it offers the opportunity to distinguish the effects of four different advanced courses: biology, physics, chemistry and mathematics. Furthermore, Germany's labour market is highly gender-segregated in international comparison, making it an interesting country context.

3.2 The German upper secondary school system

The German upper secondary school system comprises a vocational and a university-preparatory track. The focus of the present study is the university-preparatory track, which is generally offered at two school types (Gymnasium or comprehensive schools) and leads to the university-entrance diploma ("Abitur"). Upper secondary education is structured into an introductory stage, followed by a two-year specialization or "qualification phase". After the introductory stage, students enroll in at least two advanced courses (see Figure A1, Appendix). Advanced courses are taught at a greater temporal extent (at least four hours per week) than basic courses (usually two hours per week) and cover more advanced content. Advanced subjects are also part of the final written exams. Students must choose at least two advanced courses, and they can choose between mathematics, the natural sciences (biology, physics, chemistry) and non-STEM subjects such as languages or social sciences. Students may also combine mathematics with one of the sciences, or they may choose two non-STEM subjects.

The 16 German federal states provide different curricular regulations on whether STEM subjects are offered as elective or mandatory courses. In the school year 2012/2013, which is used for this study, mathematics and sciences were offered as elective advanced courses in half of the states. In the other eight states, it was offered as a mandatory advanced course, or it was only available as basic course (see Table A1 for an overview of these regulations). Advanced course choices are highly gendered, with male students more frequently choosing physics, mathematics and chemistry, whereas female students more often select biology. Figure 1 gives an overview of these gender gaps in advanced course-taking by subject based on comprehensive administrative data for Germany.

Figure 1. Gender composition of sciences and mathematics advanced courses in Germany.



Source: school statistics (Kultusministerkonferenz, 2013), own calculations.
Note: Displayed is the difference in percentage points between the share of male and female students who are enrolled in advanced courses among all same-sex students in the first year of the qualification phase (Q1) of the school year 2012/13. The computation of the gender gap is based on all federal states with elective advanced-course regulations. Due to data limitations, Bavaria was not included in the computation.

3.3 Theoretical Framework

Many countries apply horizontal curricular differentiation in secondary education, with students specializing in different subjects. Across countries, male students more often select mathematics and science subjects while women are overrepresented in languages (e.g. Netherlands: van der Vleuten et al., 2016; Germany: Nagy et al., 2006; Ireland: Smyth & Hannan, 2006; England: Henderson et al., 2018; Whitehead, 1996). These gender-typed educational choices translate into gendered post-school choices, e.g. choosing a math-intensive university major (Jacob et al., 2020; Nagy et al., 2006; Trusty, 2002). Gender differences in subject choice explain a large portion of the gender gap in higher education (e.g. Italy: Barone & Assirelli, 2020; France: Herbaut & Barone, 2021; Germany: Hägglund & Lörz, 2020). However, the direction of the relationship has not been established. It is an open question whether curricular choice promotes STEM interests or whether this association is purely driven by students' selection into advanced courses based on their prior aspirations, abilities or interests. In the following, both perspectives will be presented.

Selection of advanced courses

Educational choices in advanced courses can be explained by the expectancy-value model of educational choices (Eccles & Wigfield, 2002), pointing to the relevance of gendered *success expectancies* and *values*. (1) Success expectancies refer to students' beliefs about their performance in a subject. Previous research has documented gender differences in students' mathematical and science self-concepts in favour of males (Ertl et al., 2017; Goldman & Penner, 2016; Jansen et al., 2014). Notably, female students perceive their abilities in mathematics and sciences as lower, even if they have comparable skills to their male peers (mathematics: Correll, 2001; Mejía-Rodríguez et al., 2021; Wilkins, 2004; natural sciences: Jansen et al., 2014; Schilling et al., 2006; Wilkins, 2004).

(2) The value attached to a subject can be divided into different dimensions. For example, intrinsic values refer to subject-specific enjoyment. Gender differences in math and science interest and enjoyment are strongly related to gendered educational choices (Babarović, 2021; Ito & McPherson, 2018; Sakellariou & Fang, 2021). Furthermore, individuals consider the personal importance (attainment value) and the degree to which a subject relates to personal life goals (utility value). According to these latter dimensions, students consider their goals and aspirations when making educational choices. These value dimensions relate to the conceptualization of educational and career choices as gendered self-expressions (Cech, 2013). Previous research shows that occupational aspirations and interests influence educational decisions (Morgan et al., 2013; Pinxten et al., 2012). Since career aspirations are gender-segregated early in adolescence (Hägglund & Leuze, 2020; Hillmert, 2015; McDaniel, 2016), gendered career aspirations likely translate into gendered educational decisions. Overall, the presented theory suggests that advanced course-taking is primarily based on subject-specific skills, ability self-concepts, interests and occupational aspirations. Therefore, these (gender-

specific) selection effects should be taken into account to adequately separate selection from influence effects.

Advanced courses and the (gendered) development of STEM aspirations

Beyond the (gendered) selection effects presented above, influence effects may contribute to a widening of the gender gap in STEM expectations by the end of schooling. Previous studies have shown that school tracks are associated with the development of students' occupational aspirations. Prior studies have mainly focused on academic versus vocationally oriented school tracks, hence addressing the *vertical* dimension of curricular tracking. For example, students in academic tracks develop higher status aspirations (Basler & Kriesi, 2019; Lee & Byun, 2019) and more substantial investigative, social and enterprising vocational interests (Golle et al., 2019) in comparison to students in vocationally oriented tracks. Between-school tracking is also related to gender inequality, such that occupational aspirations are less gender-segregated in academic tracks (Basler et al., 2020; Siembab & Wicht, 2020).

Fewer studies have investigated how within-school tracking, i.e. the *horizontal* dimension of curricular tracking, is related to the development of students' occupational aspirations. Generally, advanced courses may promote subject-related occupational aspirations through exposure to (i) intensified instruction time and (ii) more demanding curricula, increasing the subject-specific opportunities to learn. Social Cognitive Career Theory (SCCT; Lent et al., 1994) posits that occupational choices are shaped by learning experiences, increasing students' skills, outcome expectancies and motivation. By exposing students to more intense learning opportunities in a subject, they have time to explore their capabilities, motivation and interest in these subjects.

Previous empirical studies addressing the link between STEM course-taking and (gendered) occupational aspirations can be divided into two strands of literature. The first strand of literature investigates the influence of curricular choices using curricular reforms in a quasi-experimental set-up. In Germany, several federal states have implemented curricular reforms in past years, introducing mathematics and sciences as mandatory courses at the advanced level. Based on before-after comparisons, three studies have investigated the consequences of a reform in the state of Baden-Württemberg on gender differences in STEM outcomes. Hübner et al. (2017) find that while the reform reduced gender differences in mathematical achievement, it did not increase females' uptake of STEM subjects in university. At the same time, the reform widened the gender gap in mathematical self-concept. Biewen and Schwerter

(2022), however, find that the reform increased the successful completion of STEM majors in university and the uptake of STEM occupations for men but not for women. Results from Görlitz and Gravert (2018) also point to male advantage. Using administrative data, the authors find that the reform increased male students' uptake of STEM subjects but not females'. Hübner et al. (2019) exploit a similar curricular reform in Thuringia. The reform did not change mathematics and science achievement but had harmful effects on mathematical self-concept for female students.

Curricular reforms have also been investigated in other countries. Mellander and Lind (2021) exploit two curricular reforms in Sweden in 1995 and 2006. Paradoxically, extending the math and science curriculum lead to a decrease in the share of students enrolling in and completing STEM subjects at the upper secondary level. In the U.S., intensification of mathematics in high schools was related to an increase in mathematical achievement and uptake of mathematics in later grades (Domina et al., 2014), an increase in STEM college completion (Jia, 2021), and a decrease of social inequalities in completion of some math-related subjects (Domina & Saldana, 2012). These authors did not, however, investigate gender influence effects. Broecke (2013) investigated the introduction of a curricular intensification reform in England to increase participation in science subjects. They found that male, but not female, students were more likely to choose science subjects in later grades after the reform. Joensen and Nielsen (2016), on the other hand, find that advanced high school mathematics lead female students into mathematics-intensive college degrees but had no such effect on male students.

Since the studies presented so far are based on before-after comparisons of different cohorts, they may be biased due to unobserved differences between the cohorts. Furthermore, within-person changes could not be identified by these studies. The second strand of literature compares differences between students in basic and advanced courses of the same cohort using panel data. These studies generally find that more advanced course placement promotes students' achievement in the U.S. (Attewell & Domina, 2008; Gamoran & Hannigan, 2000). In Germany, England and Ireland, students in STEM advanced courses have a higher probability of selecting STEM majors at university, and this association is the same for male and female students (Jacob et al., 2020). These studies consider selection effects via control variables, which is potentially connected to overcontrol bias (Elwert & Winship, 2014). As an exception, Warne et al. (2019) have taken selection effects into account through propensity score modelling, showing that the association between advanced mathematics placement and students' STEM career interest is mainly driven by selection effects, but that a weak association remains after taking into account pre-selection variables such as initial STEM aspirations. Triventi et al. (2021) find that attending scientific versus classical upper secondary tracks in Italy is associated with higher gains in math skills, accounting for selection effects through a difference-in-difference and weighting strategy. Taylor (2014) employs a regression-discontinuity design and shows that attending an additional mathematics class in U.S. high schools is associated with an increase in mathematical achievement. However, this effect does not translate into increased enrolment in mathematics courses in later grades.

These empirical results support the theoretical expectation that advanced course-taking could increase students' occupational expectations. It can, therefore, be expected that exposure to advanced courses in math and sciences will, on average, promote aspirations toward STEM in comparison to participating in basic courses.

> **H1 (*influence effect*):** Advanced course-taking in mathematics (sciences) is associated with an *increase* in students' STEM expectations.

Moreover, gender-specific effects may be expected. Some of the empirical studies above have investigated the gender-specific effects of mathematics and science course-taking on STEM outcomes. The overall majority have identified a male advantage (Biewen & Schwerter, 2022; Broecke, 2013; Görlitz & Gravert, 2018; Hübner et al., 2019), some have found gender-neutral effects (Hübner et al., 2017; Jacob et al., 2020) and only one study found larger effects for female students (Joensen & Nielsen, 2016). From a theoretical perspective, influence effects may be structured by gender for two reasons. First, previous research has shown that female students develop lower ability self-concepts and lower STEM expectations in high-performing classroom environments (Beckmann, 2021; Mann et al., 2015). This is because female students generally perceive their abilities as lower than their male peers and are sensitive to unfavourable upward comparisons with better-performing peers (Correll, 2001). Due to self-selection processes, advanced courses consist of high-performing classroom climates. Second, male students are overrepresented in mathematics and sciences advanced courses. Being the numerical gender minority has been related to performance pressures and discriminatory experiences (Kanter, 1977). Furthermore, a masculine classroom culture may strengthen the connotation of STEM subjects as masculine, providing little room for female identification with the subject through counter-stereotypical female role models (Riegle-Crumb et al., 2006). Such cultures of masculinity are more pronounced in physics and mathematics than in biology (Cheryan et al., 2017).

H2 (*gender-specific influence effect*): Advanced course-taking in mathematics (sciences) is associated with a larger *increase* in STEM expectations for male students than female students.

Gender segregated career expectations at the end of upper secondary education can hence be explained by three related processes that will be disentangled with this study: (1) gendered selection of STEM advanced courses (because of gender-specific interests, success expectancies and occupational aspirations), (2) a *general* influence effect of STEM course-taking on occupational expectations, and (3) a *gender-specific* influence effect of STEM course-taking. In the presence of gendered course-taking, influence effects may therefore widen the gender gap in STEM expectations over time.

3.4 Data and Methods

Data

The data come from the German National Educational Panel Study (NEPS), Starting Cohort 4 (Blossfeld & Roßbach, 2019; NEPS Network, 2021). These data follow a cohort of students from grade 9 onwards. The sample is restricted to students in the academic track of upper secondary education. Depending on the region and school type, the first year of the academic track corresponds to grade 11 (school year 2011/2012) or grade 10 (school year 2012/13). Most students of the present sample attended the first year of upper secondary education in grade 10 and graduate after grade 12.

Information has been collected at two time points: in the first year of upper secondary education, the introductory phase, students have not yet chosen their advanced courses (t_0). This wave hence provides baseline measures. The second time point corresponds to the last year of upper secondary education (t_1). At this time, students had already selected advanced courses and have attended it for almost two years. The sample was further restricted to federal states where curricular choice is elective for both mathematics and sciences. This is the case in 8 out of 16 federal states (see Table A1). The full analytical sample comprises n=1,977 students, including only those students with valid information on the dependent variable (STEM expectations) and the primary independent variable (advanced-course selection). Missingness on covariates was taken into account using multivariate imputation by chained equations with ten imputations (van Buuren & Groothuis-Oudshoorn, 2011).

Measures

Focal variables

The dependent variable refers to students' occupational expectations measured before curricular differentiation (t_0) and at the end of upper secondary education (t_1). It is based on students' answers to an open question: "Based on everything you currently know, what kind of job will you most likely have later on?". This operationalization refers to a realistic career aspiration that reflects anticipated attainability (Rojewski, 2004). The variable takes the value 1 if the students indicated a STEM occupation as defined by the Bundesagentur für Arbeit (2021). STEM occupations include mathematics and science, ICT, and technical and engineering occupations.

Advanced course choice. Based on students' answers about their curricular choices, four variables are created that indicate whether students attended the subject (mathematics, biology, chemistry, physics) as an advanced course. Since students may select more than one STEM subject, a second combined variable with five categories was constructed: (1) only non-STEM subjects, (2) mathematics & non-STEM, (2) physics or chemistry & non-STEM, (3) biology & non-STEM, (5) two or more STEM subjects (for example mathematics & biology).

Control variables

Control variables are used to construct the inverse probability of treatment weights. These variables include socio-economic and pre-entry characteristics that are theoretically associated with the selection of STEM courses and the development of STEM expectations.

Gender. Students' gender was coded such that males represent the reference group (0).

Socioeconomic status. Students from higher SES families choose more prestigious subjects (e.g. van de Werfhorst et al., 2003). As an indicator of socioeconomic background, the highest socioeconomic status (ISEI) of parents' occupation is used.

Parental STEM occupation indicates whether at least one parent works in a STEM occupation to account for intergenerational transmission effects (van der Vleuten et al., 2018).

Migration background refers to the migration history of students, differentiating between natives, first-generation and second-generation migrants (Olcyk et al., 2014).

Pre-entry skills in mathematics, sciences and reading were measured in grade 9 using standardized test scores (for details see Lockl et al., 2020).

Pre-entry mathematical and verbal self-concept was measured in grade 9 via three questions on a 4-point Likert scale (1: does not apply at all – 4: applies completely): (1) "I get good grades in mathematics/German", (2) "Mathematics/German is one of my best subjects", (3) "I have always been good at mathematics/German". From these items, a mean index was constructed.

Pre-entry vocational interests capture gender differences in vocational interests along the “things-people” divide (Su et al., 2009). Based on Holland's RIASEC codes, realistic (R) and social (S) interests were included, each measured by three items (e.g. social interests: “Looking after children or adults in need of help”; realistic interests: “Setting up or putting things together”). A description of the study variables is presented in Table 1.

Table 1. Description of study variables (pre-imputation sample).

Variable	Per cent	Mean	SD	Min	Max	N
STEM expectation (t_1)	24.10			0	1	1,540
STEM expectation (t_0)	23.77			0	1	1,977
Advanced course-taking						
mathematics	33.54			0	1	1,977
biology	19.07			0	1	1,977
chemistry	6.47			0	1	1,977
physics	6.32			0	1	1,977
Advanced course-taking (comb.)						
non-STEM subjects	50.37			0	1	1,977
mathematics & non-STEM	20.33			0	1	1,977
biology & non-STEM	12.04			0	1	1,977
physics/chemistry & non-STEM	2.63			0	1	1,977
multiple STEM subjects	14.26			0	1	1,977
Covariates						
female	59.89			0	1	1,977
parental occupation(ISEI)		63.06	18.26	14.21	88.96	1,946
parents' STEM occupation	13.61			0	1	1,977
natives	65.75			0	1	1,965
1st generation migrants	3.97			0	1	1,965
2nd generation migrants	30.28			0	1	1,965
skills: mathematics		0.60	1.19	-2.45	4.62	1,920
skills: reading		36.94	8.07	7	51	1,920
skills: sciences		0.48	0.97	-2.71	5.29	1,913
self-concept: mathematics		2.68	0.94	1	4	1,878
self-concept: German		3.10	0.60	1	4	1,888
interest: mathematics		2.18	0.83	1	4	1,839
interest: German		2.42	0.81	1	4	1,837
realistic vocational interest		2.66	0.96	1	5	1,860
social vocational interest		3.17	0.95	1	5	1,847

Source: NEPS SC4, own calculations.

Analytical Strategy

To estimate the effect of STEM course-taking on the likelihood of expecting a STEM occupation in the last year (t_1) of upper secondary education, logit regression models are used. *Model A* estimates the main effects of curricular choice on STEM expectations, including separate dummy variables for each STEM subject. *Model B* uses a combined measure of students' curricular choices to see whether attending more than one STEM subject at the advanced level makes a difference. An interaction term between curricular choice and gender is introduced in both models to assess gender-specific influence effects.

A causal interpretation of the association between curricular choice and occupational expectation is subject to two sources of confounding. First, omitted variable bias could occur in the presence of unobserved variables which affect both curricular choice and occupational expectations. Second, a reciprocal relationship might exist, meaning that students make curricular choices in line with their current occupational expectations. Accounting for selection effects in a regression-control framework could induce over control bias (Elwert & Winship, 2014). Therefore, selection effects a accounted for through inverse probability of treatment weights (IPTW) (Austin & Stuart, 2015). This reweighting technique creates a synthetic sample in which the take-up of advanced courses (the "treatment") is independent of the measured baseline covariates. First, the propensity of treatment participation is calculated based on the baseline covariates (Austin, 2011; Kainz et al., 2017). The propensity score is obtained by logistic regression of advanced course-taking in each subject (D=1) on observed baseline covariates X:

$$e = P(D = 1|X)$$

In a second step, inverse probability of treatment weights (IPTW) are constructed based on the propensity score. Gender is used as a stratification variable, to ensure that the groups are perfectly balanced with respect to gender. Depending on the "target population" of interest, different causal estimands can be obtained (Greifer & Stuart, 2021). The *average treatment effect* (ATE) is the average treatment effect for all individuals in the study sample, i.e. the difference in outcome had all individuals selected a STEM advanced course versus none of them. Therefore, both control and treatment units receive a weight that corresponds to the inverse of their treatment probability:

$$w_{ATE} = \frac{D}{e} + \frac{1-D}{1-e} \quad ,$$

As a robustness check, two other causal estimands will be presented. The *average treatment effect on the treated* (ATT) is the average treatment effect for those who selected a STEM advanced course in the sample. To obtain the ATT, the control group is reweighted to match the treatment group:

$$w_{ATT} = D + \frac{1-D}{1-e} \quad ,$$

with the treatment units receiving a weight of one and control units receiving the inverse of their treatment probability. The ATT reveals how students' occupational expectations would differ if students had not taken part in STEM advanced courses for those who selected an advanced course (the compliers).

The *average treatment effect on the control* units (ATC), on the other hand, describes the average treatment effect for those who did not select an advanced course in the study sample. ATC weights correspond to:

$$w_{ATC} = 1 + D \cdot \frac{1-e}{e} \quad ,$$

with the control units receiving a weight of one (the reference group) and treatment units receiving the inverse of their treatment probability. Treatment units with a low probability of selecting an advanced course will receive a higher weight in the analyses. This effect is helpful to answer the question of what would happen if those who do not currently select STEM advanced courses (the non-compliers) participated in them.

IPTW weights are obtained via the R package MatchThem (Pishgar et al., 2021). The propensity scores are averaged across the imputed datasets, and this average measure is used to construct the weights (Mitra & Reiter, 2016). The weights are then used in the regression models on the imputed datasets. Effects obtained from each imputed dataset are pooled together using Rubin rules.

Comparing these effect estimates (ATC and ATT) will draw a more nuanced picture of the effect of advanced course-taking on different subpopulations – on those who voluntarily select STEM courses (compliers) and on those who do not (non-compliers). For example, if the influence effect is restricted to non-compliers (ATC), inequality in occupational expectations could effectively be alleviated through an intensified mandatory mathematics and science curriculum. On the contrary, if the influence effect only applies to compliers (ATT), it will be more difficult to address inequality in occupational expectations through curricular modifications.

For the combined variable of advanced course-taking, inverse probability of treatment weights are calculated in a categorical-treatment framework (Lopez & Gutman, 2017). Recall that the categorical variable distinguishes four categories based on students' combined choice patterns: (1) mathematics & non-STEM, (2) biology & non-STEM, (3) physics or chemistry & non-STEM, (3) more than two STEM subjects as advanced courses. For the sake of parsimony, ATE-weights are constructed based on multinomial regressions of STEM advanced course-taking on baseline covariates. The non-STEM category is used as the reference treatment, i.e. the weights are constructed so that balance is achieved for each category compared to the non-STEM category. Balance is then assessed via pairwise comparisons of all treatment categories with the reference category.

3.5 Results

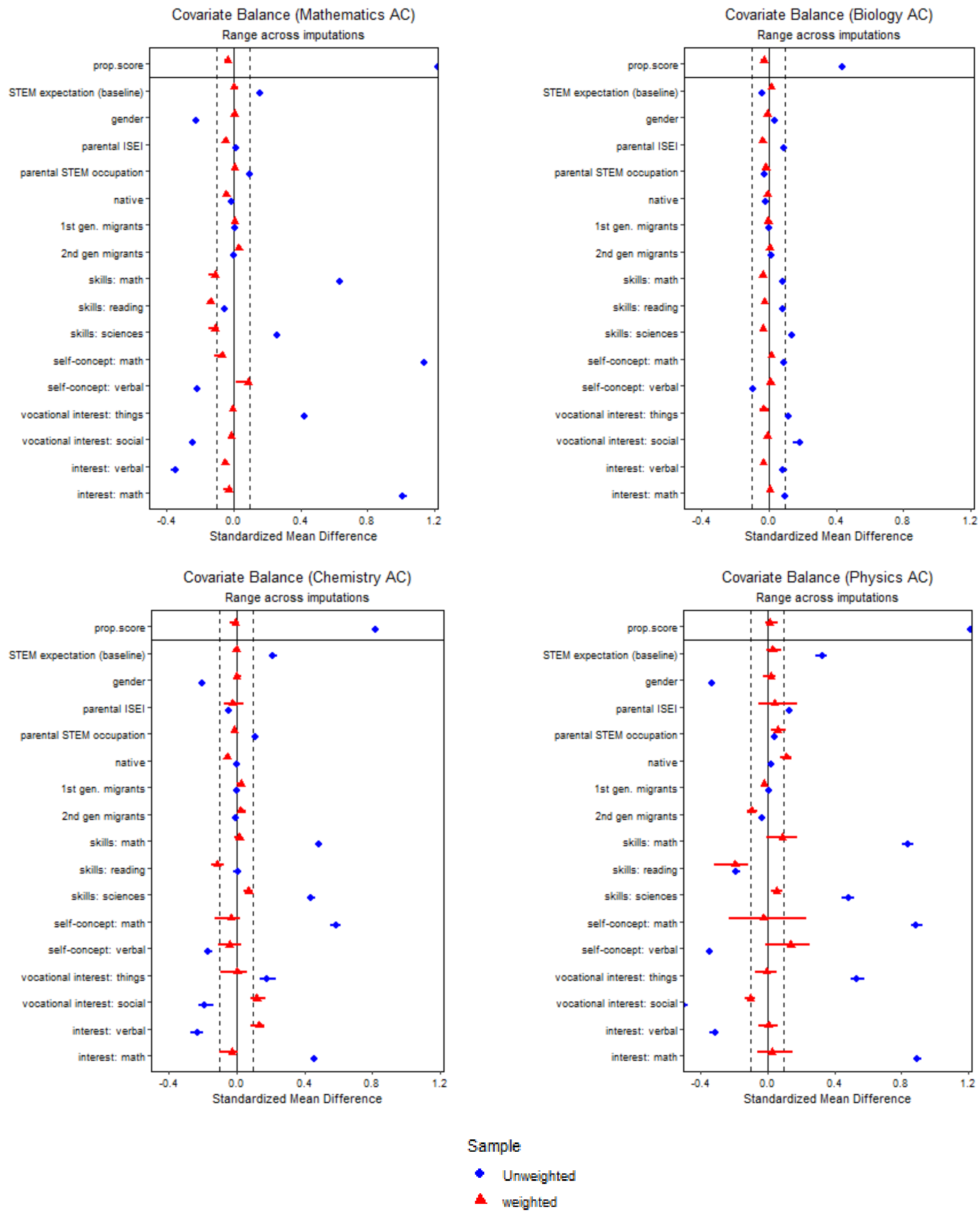
Selection into STEM advanced courses

First, selection effects based on the baseline covariates are inspected. Figure 2 displays the standardized mean differences in covariates used for the construction of the weights before and after IPTW. Displayed is the balance before and after using ATE-weights (for ATC and ATT-weights, see Figures A2 and A3).

Results from the standardized mean differences show that substantial gender differences exist between students who select STEM advanced versus those who do not (these selection effects are also reflected in a logistic regression of advanced course taking on covariates, underlying the construction of these weights, see Table A2 in the Appendix). Female students are underrepresented in mathematics, chemistry, and physics, but not in biology. Students with occupational STEM expectations more often select mathematics, chemistry, and physics as advanced courses, but not biology. Students in mathematics, chemistry, and physics courses display higher mathematical and sciences skills, a higher mathematical self-concept and subject interest, higher vocational things interests, and lower vocational social interests. In contrast, students in biology courses do not substantially differ from students in non-STEM advanced courses with respect to these variables. After adjustment, almost all covariates showed standardized mean differences within the 10% cut-off (the dashed line).

Selection effects for the combined variable of course-choice patterns reveal a similar picture (balance statistics are display in Figure A4 in the Appendix, the related multinomial regression of course-choice on covariates is displayed in Table A3). Selection of at least two STEM advanced courses is highly correlated with students' STEM expectations, math and science skills, math self-concept and interest, and vocational things interest.

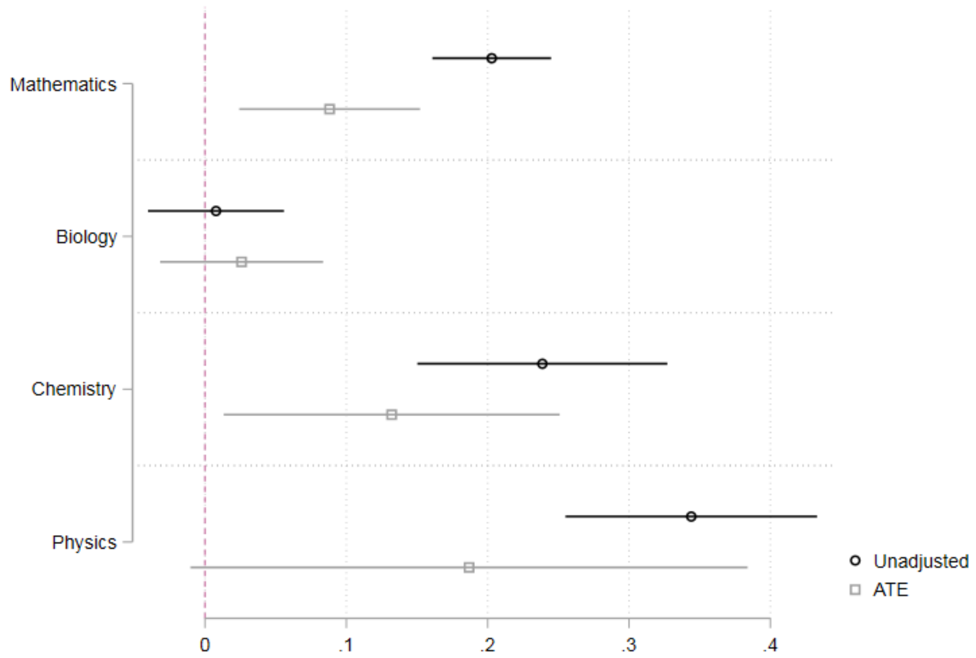
Figure 2. Standardized mean differences before and after IPTW adjustment (ATE).



Does advanced course-taking increase students' STEM expectations?

Is advanced course-taking in mathematics and sciences associated with an increase (or decrease) in students' STEM expectations? To assess this question results from Model A are presented, i.e. separate logistic regressions of STEM expectations (t_1) on STEM advanced course-taking. For each subject, two models are presented: a model without weights (the unadjusted model) and a model with ATE weights. Figure 3 displays the average marginal effects (the full regression models are displayed in Table A4 in the Appendix).

Figure 3. *Model A.* Average marginal predictions of mathematics and science advanced course choice on the probability of STEM expectations.

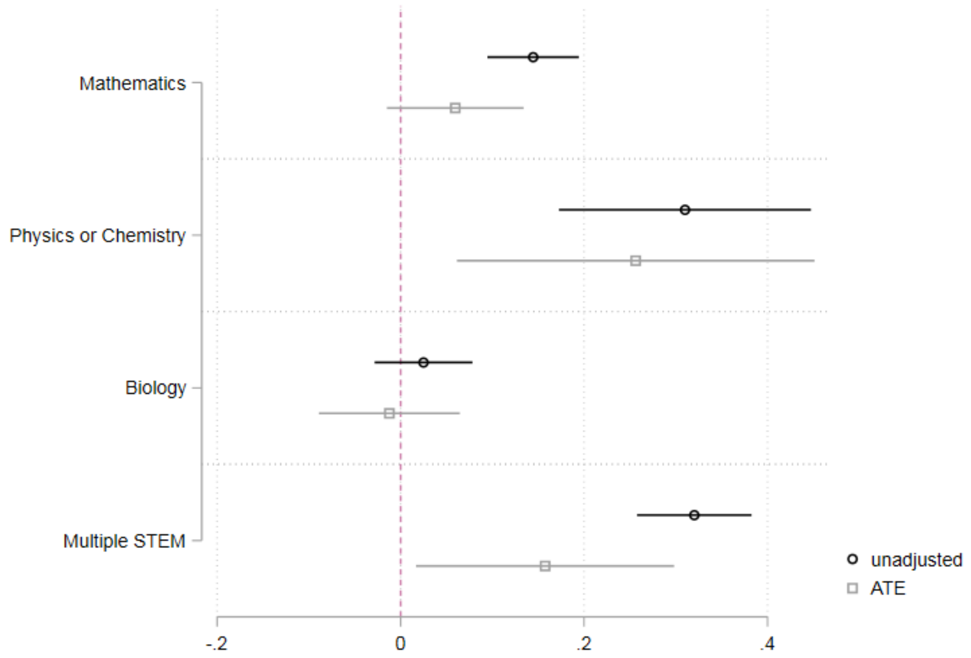


Students in STEM advanced courses display significantly higher STEM expectations at the end of upper secondary education than students in non-STEM advanced courses. The unadjusted associations show that, for example, students in mathematics have a 20.3 percentage point higher probability of expecting a STEM occupation, and students in physics show an increased probability by 34.4 percentage points. No differences are visible for biology courses. Accounting for selection into advanced courses through the inclusion of ATE-weights, these associations shrink but remain substantial in size. Participating in mathematics advanced courses increases students' probability of STEM expectations by 8.45 percentage points. Effect estimates for the natural sciences are even larger (chemistry: 13.5 points, physics: 19.3 points). The effects for mathematics and chemistry are statistically significant at the 5%-level. The effects for physics do not reach statistical significance, which can be related to the small number of students in physics.

Additionally, these effect estimates were separated into ATT and ATC estimands (the average marginal effects are displayed in Figure A5). Overall, no pronounced differences emerge between these effects. ATC estimates are slightly larger, meaning that students who do not select mathematics and science courses by choice would develop higher STEM expectations if they had been pushed into advanced courses.

In the next step, the influence effects of students' combined course-taking patterns are investigated (Model B). To this end, the outcome variable is regressed on the combined variable of advanced course-taking (Figure 4, full regression results are presented in Table A5, Appendix). Results show that even when accounting for combined course choices, substantial independent influence effects emerge. Again, effect sizes are reduced in comparison to the unadjusted results, and biology is not associated with any influence effects.

Figure 4. *Model B.* Average marginal predictions of mathematics and science advanced course choice (combined choice patterns) on the probability of STEM expectations.

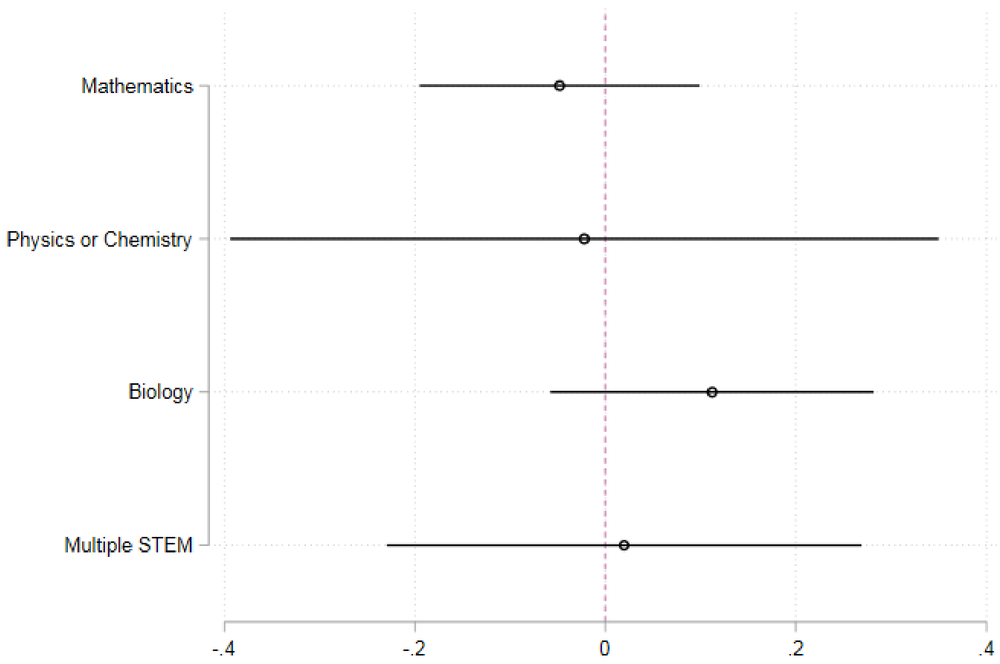


The largest (weighted) effect sizes emerge for participating in physics or chemistry in combination with a non-STEM subject. This choice pattern is related to an increase by 25.6 percentage points. Participating in multiple STEM courses at a time increases the probability by 15.7 percentage points. Both effects are significant at the 5%-level. In comparison to the previous models, influence effects for mathematics are smaller in size, suggesting that the influence effect from Model A was partially driven by combined course choice patterns.

Are influence effects gender-specific?

Next, gender differences are inspected. For this purpose, Model A and Model B are re-estimated with an interaction effect between gender and advanced course-taking. Full regression results can be found in the Appendix (Table A5 and A6). In both models, the interaction effect is not statistically significant. Therefore, the influence effects of STEM courses do not significantly differ for boys and girls. An inspection of the average marginal predictions for male and female students does not reveal substantial gender differences (see Figure 5). Female students display a slightly higher influence effect from biology course-taking in comparison to their male peers.

Figure 5. *Model B.* Contrasts by gender in the average marginal predictions of mathematics and science advanced course choice (combined choice patterns) on the probability of STEM expectations.



3.6 Summary and Discussion

The present study investigated the association between STEM advanced course-taking in German upper secondary education and expectations to work in STEM occupations. This study advanced previous international research by separating selection from influence effects based on within-person comparisons using representative panel data of one student cohort. Furthermore, it paid particular attention to gender-specific influence effects. This study revealed highly gender-segregated educational choices and occupational expectations.

Although this was not the primary focus of the present study, interesting results on the selection of advanced courses emerged. First, gender differences in course choices differed across subjects and were least pronounced for biology, supporting the view that STEM subjects are differently linked to gender conceptions (for a theoretical overview, see Cheryan et al., 2017). Results also corroborate previous studies showing that educational choices of mathematics and science subjects are based on the evaluation of subject-specific abilities, self-concepts and intrinsic interests (Germany: Nagy et al., 2006). Notably, STEM-related occupational expectations and vocational interests at baseline were related to the choice of advanced courses, which is in line with previous research that educational choices are guided by career plans (Davies et al., 2017; Morgan et al., 2013; Weeden et al., 2020). Future research using the same database could elaborate on the relative importance of gendered career plans as a separate theoretical mechanism for gender-segregated educational choices compared to skills, ability self-concepts and subject interests. Furthermore, results showed that selection effects were most pronounced in mathematics, physics and chemistry. Biology may be a subject that is less frequently selected as an active decision based on individual attributes.

The central aim of this study was to identify influence effects, taking into account the selection processes presented before. Notably, even when accounting for selection on observables, substantial influence effects on students' STEM expectations at the end of upper secondary education emerged. These effects were substantial in size for mathematics, physics and chemistry and combined course-choice patterns (between 10-20 percentage point increase in the probability to express a STEM expectation). Interestingly, the selection of biology courses was not related to an increase in students' STEM expectations, supporting the finding that STEM subjects are heterogeneous in terms of interests, skills and subject cultures (Barone, 2011; Cheryan et al., 2017). Overall, advanced courses can be identified as crucial opportunity structures for the development of career expectations.

Against theoretical predictions, no substantial gender differences emerged. Hence, previous empirical results finding that male students develop higher mathematics and science aspirations in light of curricular intensification were not supported (e.g. Biewen & Schwerter, 2022; Broecke, 2013; Görlitz & Gravert, 2018; Hübner et al., 2019). Overall, however, the present study suggests that influence effects contribute to widening the gender gap in STEM expectations at the macro-level. Because female students less frequently select mathematics, physics and chemistry advanced courses and because participation in these subjects is related to substantial increases in both male and female students' STEM expectations, the gender gap widens at the aggregate level (see also Pietrzyk & Erdmann, 2020). The gendered effect on STEM outcomes that previous studies have found based on cohort comparisons and curricular intensification reforms may reflect the changing pattern of gendered course selection in combination with a general influence effect from STEM course-taking rather than gender-specific influence effects. Furthermore, since the present study showed that ATC and ATT estimates were similar in size, a policy that targets both non-compliers and compliers could be fruitful. Establishing a mandatory math and science curriculum could be effective in increasing boys' and especially girls' STEM expectations.

3.7 Limitations and Future research

While this study found that advanced course-taking in mathematics and sciences is related to an increase in students' STEM expectations, different theoretical mechanisms could underly this effect. Understanding advanced courses as opportunity structures for skill development, students' subject-specific cognitive skills could be an important mediator (Long et al., 2012; Solga & Mayer, 2008). Alternatively, advanced courses may promote students' STEM expectations through social and cultural influences. For example, previous studies have established the pivotal role of social interaction with peers in developing occupational aspirations (Buchmann & Dalton, 2002). Identifying the mechanisms of the association between advanced course-taking and STEM expectations could also reveal potential gender differences that are concealed in the present models. For example, high-performing classroom environments could be detrimental to female students' self-concepts (Hübner et al., 2017) while at the same time increasing their domain-specific skills through learning opportunities.

Another limitation refers to the dependent variable, which refers to students' occupational expectations. Although occupational expectations are an important predictor of future occupational choices (Alm, 2015; Schoon, 2007), it remains unclear whether advanced courses also increase the likelihood of entering STEM occupations after graduation. Finally, future research could further disentangle STEM occupations into different domains, such as technical occupations or occupations related to natural sciences and mathematics. Due to the low number of students expressing a STEM expectation in total, the present study relied on a comprehensive measure. Since biology did not influence students' STEM expectations, it could be interesting to investigate whether biology is, for example, related to expectations toward health professions.

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Appendix

Figure A1. German school system (lower secondary education leading to upper secondary education) and timing of advanced-course taking.

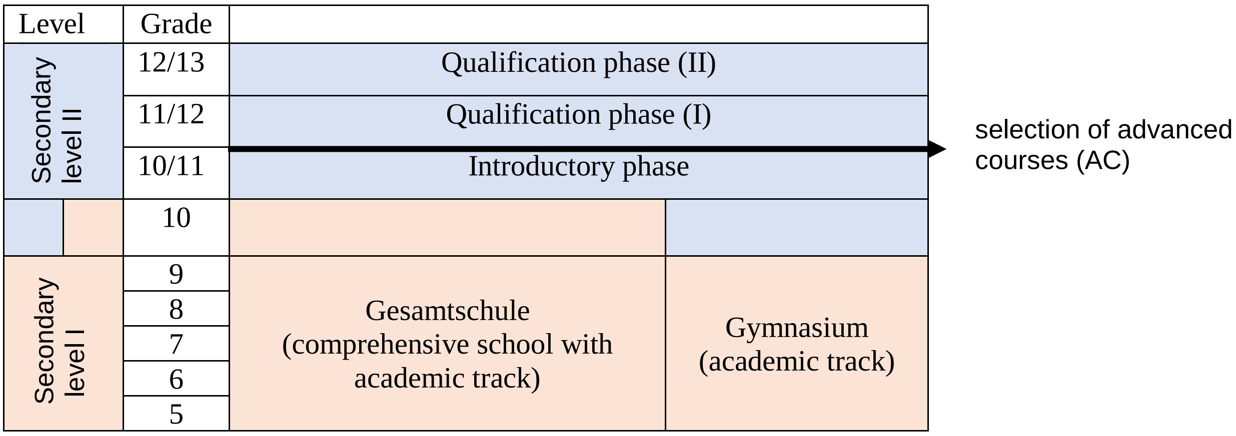

Figure A2. Standardized mean differences before and after IPTW adjustment (ATC).

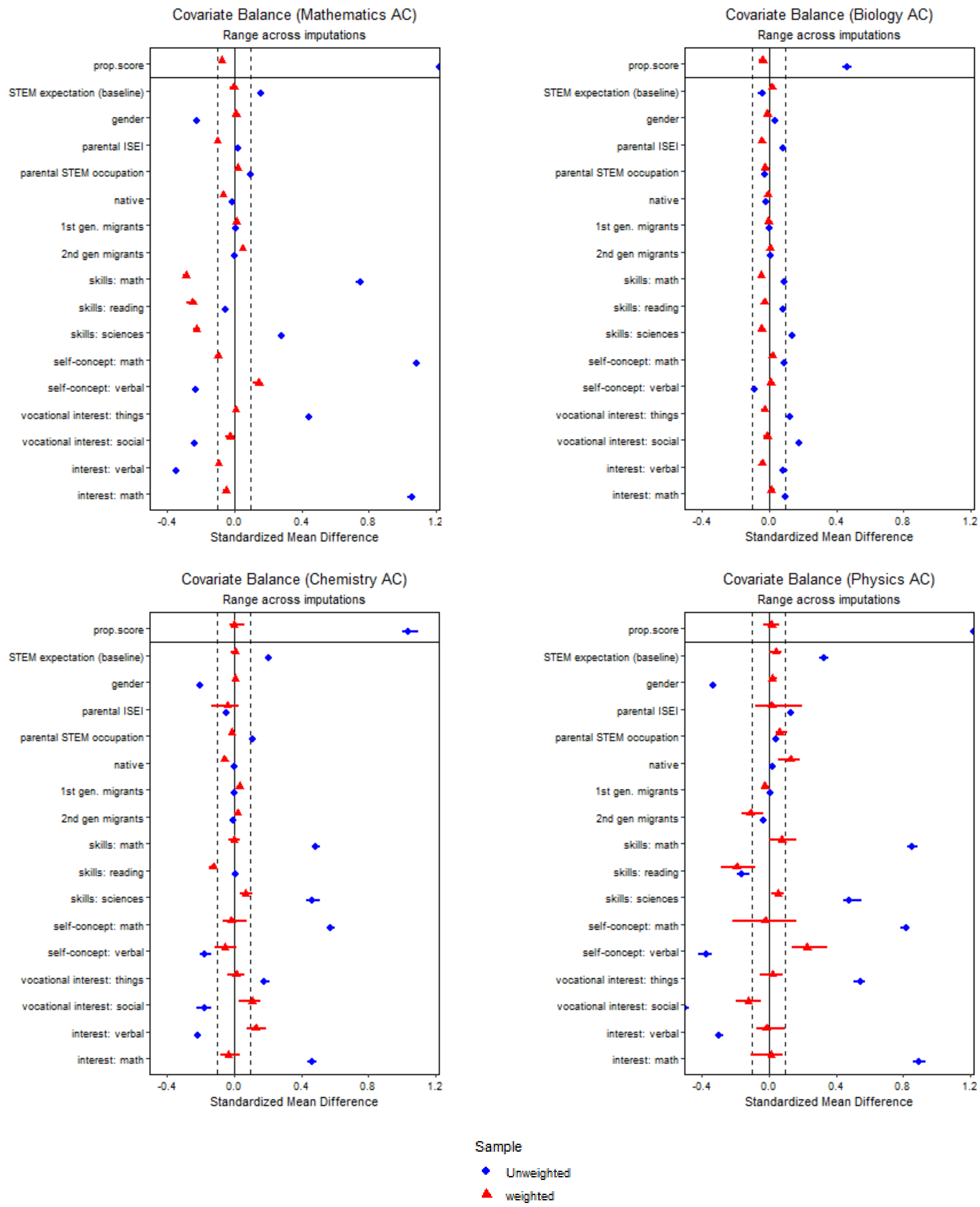

Figure A3. Predictors of STEM advanced-course choices before and after IPTW (ATT).

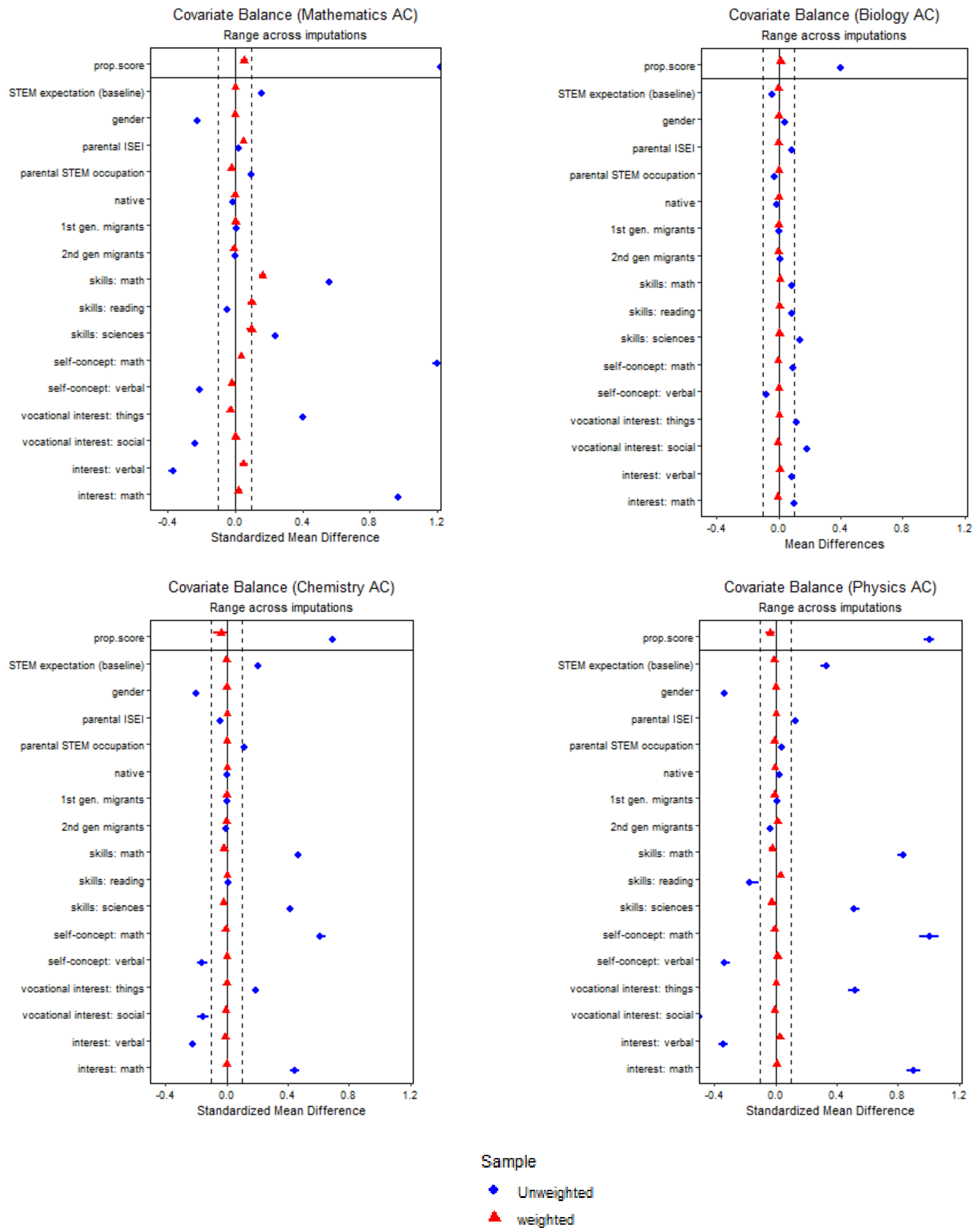

Figure A4. Standardized mean differences before and after IPTW adjustment (ATE), pairwise comparisons, combined variable of choice patterns.

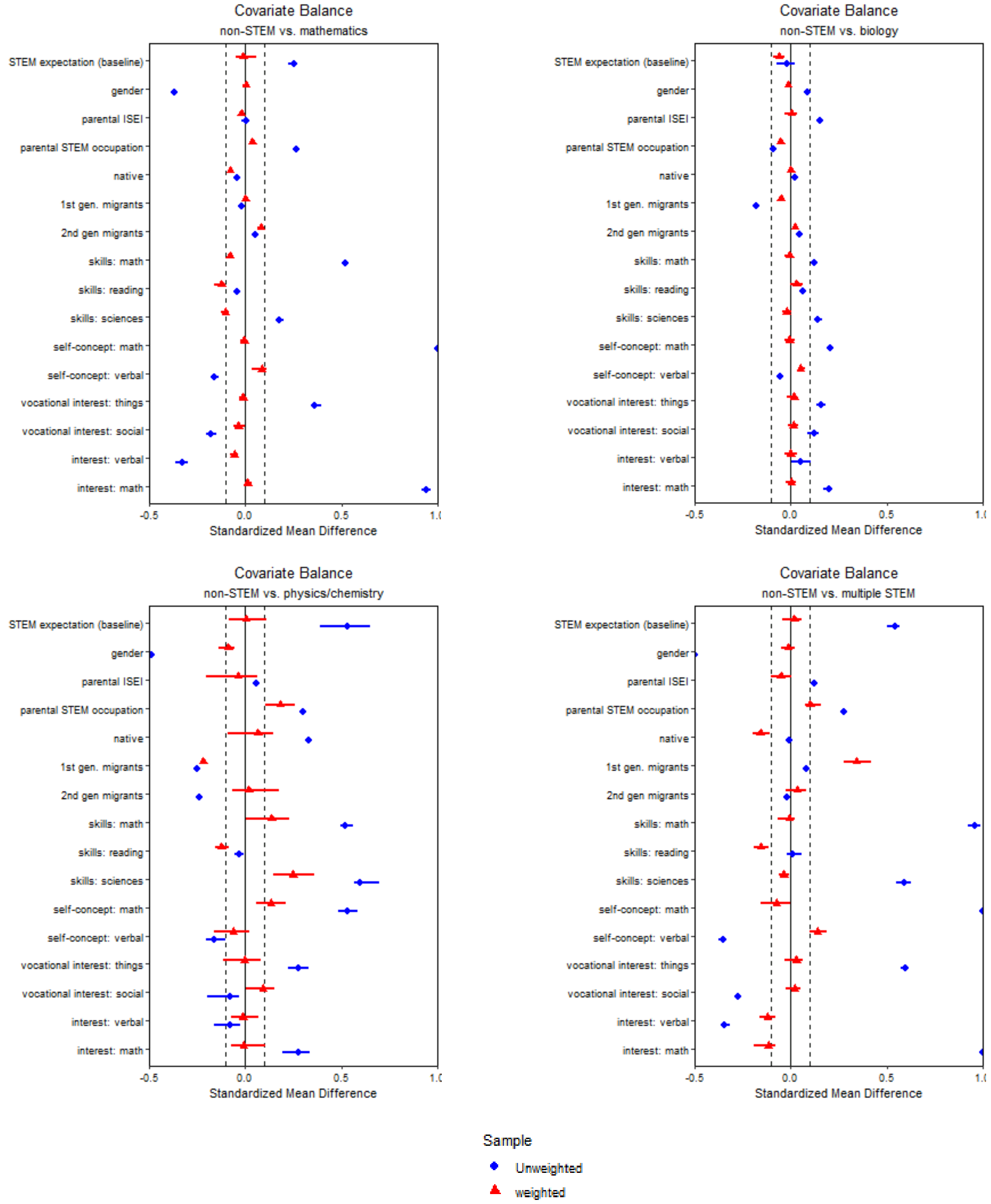

Figure A5. *Model A.* Average marginal predictions of mathematics and science advanced course choice on the probability of STEM expectations (unadjusted; ATE, ATC, ATT weighted).

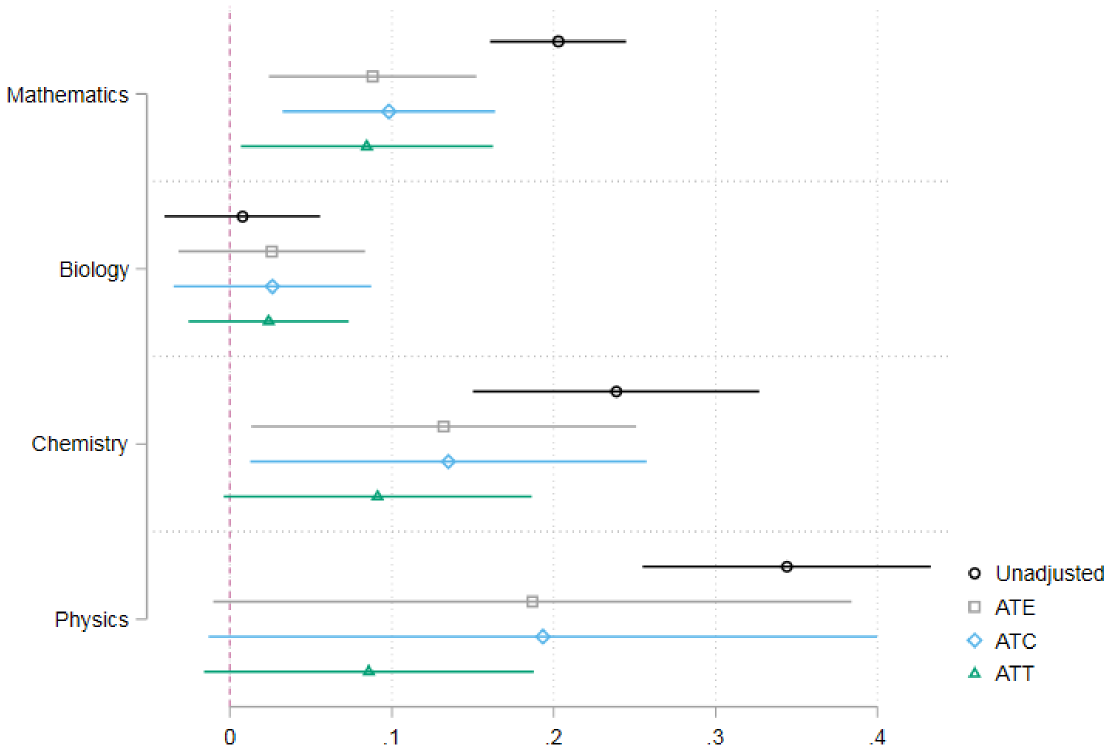

Table A1. Curricular regulations of upper secondary education in mathematics and sciences in the German states (school year 2012/2013).

State	**Elective advanced courses (AC)?**		**Included in the analysis sample?**
	Mathematics	**Sciences**	
Baden-Wurttemberg	no (mandatory)	yes	
Bavaria	yes	no (not offered)	
Berlin	yes	yes	yes
Brandenburg	no (mandatory)	no (mandatory)	
Bremen	yes	yes	yes
Hamburg	yes	yes	yes
Hesse	yes	yes	yes
Lower Saxony	yes	yes	yes
Mecklenburg Western Pomerania	no (mandatory)	no (mandatory)	
North Rhine-Westphalia	yes	yes	yes
Rhineland-Palatinate	yes	yes	yes
Saarland	no (mandatory)	no (not offered)	
Saxony	yes	yes	yes
Saxony-Anhalt	no (mandatory)	no (mandatory)	
Schleswig-Holstein	no (mandatory)	yes	
Thuringia	no (mandatory)	no (mandatory)	

Source: upper secondary education regulations of the states. *Explanations*: the sciences comprise the three subjects biology, chemistry and physics. If an advanced course is indicated as elective, this means that among these three subjects at least one can be chosen at the advanced level.

Table A2. Logistic regressions of advanced course-taking on covariates (selection effects).

	(1) Mathematics	(2) Biology	(3) Chemistry	(4) Physics
STEM expectation (baseline)	0.102 (0.65)	-0.244 (-1.28)	0.616** (2.60)	0.719** (2.67)
Female	-0.020 (-0.14)	0.137 (0.88)	-0.292 (-1.12)	-0.461 (-1.82)
Parental SES (ISEI)	-0.001 (-0.35)	0.004 (1.04)	-0.007 (-1.26)	-0.001 (-0.15)
Parental STEM occupation	0.354* (2.00)	-0.139 (-0.72)	0.331 (1.33)	-0.535 (-1.82)
1st gen. migrant	0.207 (0.70)	0.194 (0.65)	0.000 (0.00)	0.281 (0.54)
2nd gen. migrant	0.216 (1.67)	0.117 (0.90)	0.140 (0.67)	-0.001 (-0.00)
Skills: mathematics	0.271*** (4.10)	-0.011 (-0.15)	0.0481 (0.48)	0.391*** (3.93)
Skills: reading	0.006 (0.71)	0.009 (1.13)	0.008 (0.63)	-0.011 (-0.83)
Skills: sciences	-0.012 (-0.15)	0.162* (2.15)	0.321** (2.84)	0.031 (0.26)
Self-concept: mathematics	0.713*** (8.38)	0.069 (0.75)	0.354* (2.39)	0.303 (1.68)
Self-concept: German	-0.105 (-0.96)	-0.260* (-2.33)	-0.184 (-1.01)	-0.382* (-2.03)
Subject interest: mathematics	0.814*** (8.32)	0.043 (0.40)	0.214 (1.40)	0.621*** (3.65)
Subject interest: German	-0.505*** (-5.59)	0.040 (0.45)	-0.180 (-1.27)	-0.084 (-0.55)
Things-orientation	0.0415 (0.60)	0.143 (1.90)	-0.176 (-1.56)	0.051 (0.40)
People-orientation	-0.008 (-0.11)	0.178* (2.51)	0.120 (0.94)	-0.277* (-2.10)
Constant	-3.619*** (-6.68)	-2.659*** (-4.81)	-3.398*** (-3.61)	-3.132** (-3.15)
N	1,977	1,977	1,977	1,977

t statistics in parentheses. Robust standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A3. Multinomial regression of advanced course-taking on covariates (selection effects).

reference: non-STEM	(1) Mathematics	(2) Chemistry / Physics	(3) Biology	(4) Multiple STEM
STEM expectation (baseline)	-0.000 (-0.00)	0.869 (1.86)	-0.101 (-0.40)	0.365 (1.80)
Female	0.0382 (0.24)	-0.599 (-1.55)	0.297 (1.49)	-0.131 (-0.67)
Parental SES (ISEI)	-0.001 (-0.17)	-0.006 (-0.72)	0.007 (1.51)	-0.001 (-0.14)
Parental STEM occupation	0.411* (2.05)	0.340 (0.80)	-0.301 (-1.05)	0.160 (0.67)
1st gen. migrant	0.001 (0.00)	-12.79*** (-40.58)	-1.094 (-1.78)	0.554 (1.41)
2nd gen. migrant	0.268 (1.81)	-0.458 (-1.26)	0.128 (0.79)	0.302 (1.71)
Skills: mathematics	0.206** (2.69)	0.150 (0.87)	0.007 (0.07)	0.399*** (4.47)
Skills: reading	0.007 (0.77)	-0.000 (-0.02)	0.006 (0.65)	0.016 (1.53)
Skills: sciences	-0.004 (-0.05)	0.394* (2.38)	0.130 (1.29)	0.241* (2.21)
Self-concept: mathematics	0.766*** (7.62)	0.360 (1.52)	0.135 (1.20)	0.709*** (5.84)
Self-concept: German	-0.079 (-0.61)	-0.335 (-1.12)	-0.183 (-1.24)	-0.454** (-3.10)
Subject interest: mathematics	0.713*** (6.29)	-0.077 (-0.30)	0.185 (1.36)	0.961*** (7.20)
Subject interest: German	-0.449*** (-4.49)	0.053 (0.22)	-0.021 (-0.18)	-0.458*** (-3.74)
Things-orientation	0.040 (0.49)	-0.083 (-0.45)	0.146 (1.53)	0.098 (1.02)
People-orientation	0.005 (0.06)	0.295 (1.46)	0.102 (1.14)	0.048 (0.48)
Constant	-3.938*** (-6.20)	-3.292* (-2.28)	-3.112*** (-4.45)	-4.705*** (-6.20)
N	1,977	1,977	1,977	1,977

t statistics in parentheses. Robust standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A4. Logistic regressions of STEM expectations on advanced course-taking (*Model A*), main effects.

		Mathematics		
	(1)	(2)	(3)	(4)
	Unadjusted	ATE	ATC	ATT
AC	1.066***	0.476**	0.511*	0.451**
	(9.79)	(2.85)	(2.38)	(2.81)
constant	-1.588***	-1.361***	-1.588***	-0.973***
	(-21.60)	(-15.47)	(-21.60)	(-6.99)
		Biology		
	(5)	(6)	(7)	(8)
	Unadjusted	ATE	ATC	ATT
AC	0.0426	0.139	0.140	0.134
	(0.32)	(0.90)	(0.86)	(0.96)
constant	-1.173***	-1.190***	-1.173***	-1.265***
	(-19.93)	(-20.07)	(-19.93)	(-17.81)
		Chemistry		
	(9)	(10)	(11)	(12)
	Unadjusted	ATE	ATC	ATT
AC	1.096***	0.639*	0.664*	0.377
	(5.89)	(2.42)	(2.43)	(1.91)
constant	-1.252***	-1.198***	-1.252***	-0.533***
	(-22.39)	(-21.29)	(-22.39)	(-6.11)
		Physics		
	(13)	(14)	(15)	(16)
	Unadjusted	ATE	ATC	ATT
AC	1.530***	0.867*	0.920*	0.344
	(8.10)	(2.09)	(2.11)	(1.64)
constant	-1.289***	-1.195***	-1.289***	-0.103
	(-22.83)	(-20.84)	(-22.83)	(-0.95)

N=1,977. *t* statistics in parentheses. Robust standard errors. Displayed are Log odds.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A5. Logistic regressions of STEM expectations on combinations of advanced course-taking (*Model B*), main effects and gender-specific effects.

	Combinations of STEM advanced course-taking			
	(1) Unadjusted	(2) ATE	(3) Unadjusted	(4) ATE
Non-STEM (ref.)				
Mathematics	0.856***	0.337	0.820***	0.391
	(6.10)	(1.73)	(4.31)	(1.60)
Chemistry or Physics	1.568***	1.119**	1.257**	1.177*
	(5.37)	(2.72)	(3.19)	(2.25)
Biology	0.182	-0.0823	-0.029	-0.408
	(0.95)	(-0.32)	(-0.09)	(-0.99)
Multiple STEM subjects	1.609***	0.819**	1.236***	0.658*
	(10.85)	(2.65)	(6.22)	(2.15)
Female			-1.146***	-1.280***
			(-6.36)	(-5.46)
Female # Mathematics			-0.365	-0.0561
			(-1.20)	(-0.13)
Female # Chem. or Physics			0.310	-0.039
			(0.51)	(-0.05)
Female # Biology			0.460	0.676
			(1.16)	(1.35)
Female # Multiple STEM subjects			0.360	0.406
			(1.16)	(0.68)
constant	-1.723***	-1.363***	-1.050***	-0.702***
	(-19.56)	(-11.76)	(-8.28)	(-4.27)

N=1,977. *t* statistics in parentheses. Robust standard errors. Displayed are Log odds.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A6. Logistic regressions of STEM expectations on advanced course-taking (*Model A*), gender-specific effects.

		Mathematics		
	(1) Unadjusted	(2) ATE	(3) ATC	(4) ATT
AC	0.941***	0.531**	0.576*	0.493*
	(6.26)	(2.58)	(2.16)	(2.30)
Female	-1.072***	-1.201***	-1.072***	-1.220***
	(-7.14)	(-6.84)	(-7.14)	(-4.37)
Female # AC	-0.167	-0.0542	-0.019	-0.026
	(-0.73)	(-0.13)	(-0.06)	(-0.08)
constant	-0.952***	-0.743***	-0.952***	-0.504**
	(-8.86)	(-5.69)	(-8.86)	(-2.69)
		Biology		
	(5) Unadjusted	(6) ATE	(7) ATC	(8) ATT
AC	-0.0728	0.077	0.079	0.063
	(-0.38)	(0.33)	(0.32)	(0.31)
Female	-1.363***	-1.327***	-1.363***	-1.166***
	(-10.96)	(-10.55)	(-10.96)	(-7.35)
Female # AC	0.355	0.142	0.158	0.144
	(1.29)	(0.44)	(0.54)	(0.46)
constant	-0.484***	-0.508***	-0.484***	-0.620***
	(-6.01)	(-6.24)	(-6.01)	(-5.93)
		Chemistry		
	(9) Unadjusted	(10) ATE	(11) ATC	(12) ATT
AC	0.640**	0.256	0.245	0.255
	(2.63)	(0.84)	(0.97)	(0.86)
Female	-1.318***	-1.314***	-1.318***	-0.970***
	(-11.25)	(-11.16)	(-11.25)	(-4.99)
Female # AC	0.737	0.816	0.844	0.389
	(1.92)	(1.60)	(1.61)	(0.94)
constant	-0.560***	-0.521***	-0.560***	-0.165
	(-7.22)	(-6.69)	(-7.22)	(-1.63)
		Physics		
	(13) Unadjusted	(14) ATE	(15) ATC	(16) ATT
AC	0.845***	0.652*	0.721*	0.143
	(3.71)	(2.09)	(2.16)	(0.57)
Female	-1.298***	-1.327***	-1.298***	-0.756**
	(-11.02)	(-11.11)	(-11.02)	(-2.88)
Female # AC	1.273**	0.546	0.502	0.730
	(3.07)	(0.75)	(0.67)	(1.53)
constant	-0.597***	-0.513***	-0.597***	0.106
	(-7.57)	(-6.42)	(-7.57)	(0.82)

N=1,977. *t* statistics in parentheses. Robust standard errors. Displayed are Log odds.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Chapter 4

Why do they leave? Examining dropout from gender-atypical Vocational Education and Training in Germany.

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Abstract

This study investigates the dropout behaviour of apprentices in gender-atypical occupations. First, it is investigated whether gender-atypical apprentices drop out at a higher rate than their majority peers. Second, differences in the self-reported reasons for dropout among gender-typical and gender-atypical apprentices are examined. Analyzing the dropout behaviour in Germany, this article finds that gender-atypical apprentices, particularly males in female-dominated occupations, are more likely to leave their apprenticeship prematurely. Theoretical informative gender differences appeared in the self-reported reasons for dropping out: female minorities were more likely to drop out due to a lack of social integration; male apprentices in female-dominated occupations were more likely to drop out due to unfulfilled aspirations and low monetary returns. These results add to a deepened understanding of the experiences of apprentices in gender-atypical vocational education and training.

4.1 Introduction

Occupational gender segregation is a persistent characteristic of many European labour markets (Cohen, 2013; Levanon & Grusky, 2016; Smyth, 2005). Women are overrepresented in service, health and care occupations, while men more frequently choose technical occupations, and Germany is no exception (Gundert & Mayer, 2012; Hillmert, 2015). International research has shown that occupational segregation is one of the major causes of the gender wage gap (e.g. Amuedo-Dorantes & La Rica, 2006; Grønning et al., 2020; Ludsteck, 2014) and women's lower career advancement (Granato, 2017; Malin & Wise, 2018). Hence, uncovering the processes leading to gender-segregated labour markets is crucial from a social inequality perspective.

A large body of literature has emerged around the question of why men and women develop aspirations for and enter different occupations (Barone & Assirelli, 2020; Busch-Heizmann, 2015; Correll, 2004). In many apprenticeship systems, students' occupational choices are already highly gendered (e.g. Heiniger & Imdorf, 2018; Reisel et al., 2015). However, it is less well known how students proceed with these choices throughout their apprenticeship. Across countries, apprentices often leave their training occupation prematurely (e.g. Cerda-Navarro et al., 2017; Elffers, 2012; Fries et al., 2014). If apprentices in gender-atypical training occupations drop out at a higher rate than those in gender-typical occupations, gender segregation in the labour market is reproduced through early career revisions. Therefore, focusing on the early stage of the apprenticeship system provides additional evidence on how gender segregation is reproduced in the long run. Evidence for gendered processes during young people's apprenticeship – a time when occupational choices are most easily revisable – is mainly absent (for an exception see Haverkamp & Runst, 2015).

Theories of gendered work experiences suggest that apprentices in gender-atypical occupations have more harmful social and professional experiences than those in gender-typical occupations (England, 2010; Kanter, 1977). Moreover, gender-atypical career choices can result from structural barriers in the local labour market, leading to an imperfect match between apprentice and employer (Jovanovic, 1979; Sousa-Poza & Henneberger, 2004; Torre, 2018). Apprentices who enter gender-atypical occupations could thus be more likely to quit prematurely. The question thus arises as to *whether* and, if so, *why* apprentices are more likely to leave gender-atypical VET programs. Understanding why members of the under-represented gender prematurely leave their training occupation will provide a more comprehensive understanding of gendered attrition processes and thus guidance for developing effective policy measures for keeping both men and women in gender-atypical occupations. This article examines i) whether gender-atypical apprentices more frequently leave their training occupation than their gender-typical peers, and ii) whether gender-typical and gender-atypical apprenticeships differ in their self-reported reasons for dropping out.

This article suggests four theoretical mechanisms of gendered drop-out decisions: First, for male-dominated occupations, it can be expected that women will more frequently drop out due to lower levels of social integration, a mechanism rooted in theories of gendered workplace experiences (Acker, 1990). Second, drawing on gender stereotype threat theory (Steele, 1997), it is expected that women in male-dominated occupations will drop out more frequently due to professional difficulties than their male peers. Third, for female-dominated occupations, theories about gender-specific career preferences in educational decisions suggest that men primarily drop out due to perceived lower monetary returns (Jonsson, 1999). Fourth, for both male- and female-dominated occupations, minority gender dropout may occur because of unfulfilled occupational aspirations, an expectation based on viewing occupational choice as a matching process under uncertainties and labour market constraints (Gottfredson, 1981; Jovanovic, 1979).

Using longitudinal representative survey data on 5,188 apprentices from the German National Educational Panel (NEPS), which provides information on the self-reported reasons for dropping out, this article focuses on apprentices' progression through their first-chosen apprenticeship. Given that i) the German labour market is characterised by a stable amount of gender segregation in international comparison (Protsch & Solga, 2016), and ii) half of the population in Germany enters the VET system at some point in their life (Bundesinstitut für Berufsbildung, 2020), we use the VET system in Germany as a case study for analyzing gender-atypical dropout patterns.

4.2 The German vocational education and training (VET) system

In Germany, after graduating from secondary school, students may enter a vocational training program (for an overview, see Cedefop, 2020). The VET system is divided into a dual (or firm-based) track and a school-based track. In the dual-track, apprentices enter a working contract with a company, rendering them part of the employed population. Apprenticeship training is provided both through the host firm and at vocational schools. The dual-track provides training in over 320 recognized occupations[1]. In the school-based track, students attend full-time school-based vocational training in health, social work and education. In contrast to the dual-track, trainees in school-based training are not employed by a company and thus do not receive compensation. About 43 per cent of apprentices attended the school-based track in 2019 (Bundesinstitut für Berufsbildung, 2020).

Apprenticeship programs have a duration of between 2 and 3,5 years, after which students may take up a qualified occupational activity. Through apprenticeship, students attain highly delineated, occupation-specific and nationally recognized VET certificates which are tightly linked to the labour market (Euler, 2010; Halldén, 2015). Hence, occupational revisions are most easily realizable during VET rather than at later stages of the occupational career. High attrition rates in the VET system of about 25 per cent underline that attrition processes are a frequent strategy to correct undesired choices early in the occupational career (Beicht & Walden, 2013). Based on administrative data covering the dual track of the German VET system, Rohrbach-Schmidt and Uhly (2015) have shown that apprentices in gender-atypical training have a 1,5 times higher dropout risk than those in gender-typical occupations. Based on the same data, Kroll (2021) finds this difference is visible only for men in female-dominated occupations.

4.3 Theoretical Framework

Dropout from gender-atypical apprenticeships

Although men and women who entered gender-atypical apprenticeships have already surpassed barriers to these non-normative choices—and may differ from their opposite-sex peers in terms of skills, interests or motivation—apprentices' gendered workplace experiences may pose a threat. Following *tokenism theory* (Kanter, 1977), the proportional composition of an occupation shapes employees' workplace experiences. Accordingly, the numerical minority ('token') experiences greater visibility than the numerical majority ('dominants'), so gender becomes a salient social category. As a result, the minority often experiences performance pressure and social exclusion in workplace interaction. Empirical studies have documented such gendered attrition processes for adults' professional careers (Torre, 2014, 2017, 2018) and higher education (Mastekaasa & Smeby, 2008; Meyer & Strauß, 2019). Gender-atypical employees also display lower levels of job satisfaction (Jacobs et al., 2006).

Ackers' (1990, 2006) theory of gendered organizations focuses explicitly on the situation of female employees. In this view, male-dominated occupations are marked by a specific organizational culture, which disadvantages women via social interactions, hostile working climates and male-typed occupational identities. Empirical research indicates that women show higher attrition rates from male-dominated occupations over the life course in the United States (Jacobs, 1989; Torre, 2014, 2017). Based on semi-structured interviews, Makarova et al. (2016) further found that female apprentices often feel the "wrong sex" in male-dominated occupations in Switzerland. Another theoretical mechanism of why women leave male-dominated occupations at a higher rate has been attributed to reconciling work and motherhood (Cha, 2013; Madsen et al., 2021). However, since apprentices enter VET with an average age of 19.7 (Bundesinstitut für Berufsbildung, 2020), difficulties regarding work-family reconciliation might be less salient at this early career stage.

Regarding the pathways of men who enter female-dominated occupations, the "glass escalator" metaphor has been evoked to describe the phenomenon that males are usually treated favourably and more often proceed along with the promotional latter (Williams, 1992). According to this view, men anticipate the promotional advantages in female-dominated occupations, making them less likely to switch occupations (for supportive evidence, see Hultin, 2003; Malin & Wise, 2018). Contrary to this view, recent evidence suggests that this male advantage cannot be generalized but is limited to certain occupations and individuals (Snyder & Green, 2008; Williams, 2015). For example, Torre (2018) found that men exit female-dominated occupations more frequently than women in the U.S. This association was more pronounced in low-status jobs, which she explains by the fact that low-status occupations are more stigmatizing to male's identity. Since the present study is based on the VET system and thus overwhelmingly provides access to lower-status occupations (which do not require a higher education degree), one can assume that the "glass escalator" will be less relevant. Instead, higher attrition from female-dominated occupations can be assumed due to men's minority status. Qualitative research supports this claim, showing that male workers in care professions experience struggles with traditional male identity and gender stereotyping (Ajith, 2020; Clow et al., 2015; Heikes, 1991; Puerta, 2020).

Based on the theoretical arguments of gendered working experiences and the empirical evidence generally lending support to this view, it is expected that men and women in gender-atypical apprenticeships are more likely to drop out than their opposite-gender apprentices, net of individual differences:

> **H1a (*female minority dropout*)**: Female apprentices in male-dominated occupations drop out more frequently than their male peers.
>
> **H1b (*male minority dropout*)**: Male apprentices in female-dominated occupations drop out more frequently than their female peers.

Gender-specific reasons for dropout from gender-atypical apprenticeships

The self-reported reasons for apprentices' dropout are manifold, ranging from social conflicts, difficulty and quality of training or choice of an occupation that does not match apprentices' aspirations (Beicht & Walden, 2013; Mischler, 2014). These reasons may be structured by apprentices' minority status, such that apprentices of the minority gender are more likely to drop out due to specific reasons invoked by their gender-specific workplace experiences and conditions of entering an apprenticeship. Furthermore, some of these processes may be relevant for females in male-dominated occupations or males in female-dominated occupations.

<u>Social integration</u>

Social integration is an important predictor of continuing or dropping out of an educational or occupational field (Elffers et al., 2012). For example, Tinto's framework of student retention (Tinto 1975) describes students' integration with peers and faculty as a central aspect of the dropout process. A lack of social integration may be particularly relevant for apprentices in gender-atypical occupations. Given the preference for gender homophily in friendship formation (McPherson et al., 2001), women and men who work in occupations dominated by the opposite gender generally face lower opportunities to establish emotional bonds. Consequently, as Kanter (1977) proposed, the minority gender experiences feelings of alienation and social isolation.

Although both genders may thus have a higher dropout risk due to a lack of social integration, there are reasons to expect that this is primarily the case for women in male-dominated occupations. First, men are less sensitive to a lack of social integration because they generally place a lower value on being socially integrated (Budig, 2002). Second, devaluation theory suggests that as soon as females enter male occupations, these occupations will receive lower social status (England, 2010; Levanon et al., 2009). Consequently, men seek to protect their dominant position, which results in hostile and exclusionary practices toward the minority gender (Acker, 2006). This theoretical expectation also relates to the "chilly climate" metaphor evoked to describe exclusionary and discriminatory workplace experiences of women in male-dominated fields (Hall & Sandler, 1982). Supportive evidence suggests that women in male-typed occupations experience a less supportive work environment (Busch, 2013; Taylor, 2010).

> **Hypothesis 2 (*social integration*)**: Female students in male-dominated occupations have a higher probability of dropout due to a lack of social integration than their male peers.

Professional difficulties

According to Tinto (1975), academic integration is another central aspect of educational dropout decisions. In the context of apprenticeships, experiencing such "professional difficulties" in acquiring occupation-specific skills and competencies might also be connected to apprentices' minority status. This expectation is based on stereotype threat theory (Steele, 1997) which predicts that the salience of gender stereotypes leads to lower confidence and achievement on tasks that are not congruent with their gender. As such, men and women in gender-atypical work environments experience unconscious treatment or messages priming gender stereotypes related to natural abilities and competencies (Hadjar & Aeschlimann, 2015; He et al., 2019). Previous research has shown that females are particularly biased in their performance assessment in male-typed tasks (Correll, 2001). As such, professional difficulties are likely more conducive for females' attrition from male-dominated occupations (than for male apprentices from female-dominated occupations).

Moreover, employers generally devalued females' performance compared to male workers, especially on male-typed tasks (England, 1992). Employers give women less credit for their performance and employ higher evaluation standards (Heilman, 2001; Quadlin, 2018). Therefore, an increased risk to drop out due to professional difficulties will become especially visible for female students in male-dominated occupations. Consequently, women may perceive themselves as less capable of completing the tasks during their apprenticeship.

> **Hypothesis 3 (*professional difficulties*)**: Female students in male-dominated occupations have a higher propensity to drop out because of experienced professional difficulties than their male peers.

Monetary returns

Rational choice theory predicts that students make educational choices based on cost-benefit evaluations (Breen & Goldthorpe, 1997). Due to socialization, men and women employ different benefit criteria (Jonsson, 1999), with men anticipating their role as a breadwinner and thus placing greater emphasis on monetary returns. On the other hand, women prefer occupations that ensure a high degree of work-family reconciliation (Busch-Heizmann, 2015; Quadlin, 2020). Male-dominated occupations generally offer higher social status and prestige than jobs in female-dominated fields (England, 1992, 2010). This devaluation of female work, in turn, is reflected in markedly lower wages in female-dominated occupations (Blau & Kahn, 2000; Levanon et al., 2009). Once they enter working life, men in female-dominated occupations may realize that their apprenticeship is incompatible with their gender-normative career preferences tied to income[2]. Supportive evidence suggests that men in female-dominated occupations feel more strongly than their female colleagues that their wages are inadequate (Valet, 2018). Hence, the fifths hypothesis:

> **Hypothesis 5 (*monetary returns*)**: Male students in female-dominated occupations have a higher dropout probability due to anticipation of low monetary returns than their female peers.

Information deficiency

The match between individuals' aspirations – including their vocational interests (Holland, 1959) – and their desired occupation is critical for students' dropout decisions (Gottfredson, 1981; Jovanovic, 1979). Due to local labour market constraints and employer sorting, young people do not always attain an apprenticeship in their desired occupation. As they accommodate their aspirations with the local labour market demand, career decisions are often made under incomplete information. Such information deficiencies at the hiring stage have been connected to gendered attrition processes (Sousa-Poza & Henneberger, 2004; Torre, 2018). Accordingly, individuals who enter gender-atypical occupations may lack occupation-specific knowledge transmitted through their social environment or previous work experiences. Dropping out is a strategy to correct for such occupational mismatches. The finding from Beck et al. (2006) that women who entered a gender-atypical career lacked practical information about job requirements supports this view. Hence, men and women in gender-atypical occupations may realize that their apprenticeship does not align with their previous expectations. There are no theoretical reasons to expect that men and women differ in experiencing such information deficiencies.

> **Hypothesis 4 (*information deficiency*)**: Male (female) students in female-dominated (male-dominated) occupations have a higher probability of dropping out because of unfulfilled career aspirations than their male (female) peers.

4.4 Data and Methods

Data

This study aims to estimate gender minority/majority status differences in the probability of dropping out of Vocational Education and Training in Germany. This study uses survey data from the National Educational Panel Study (NEPS), Starting Cohort 4 (NEPS Network, 2021), covering a representative panel of students who attended the ninth grade of a general school in the autumn/winter 2010 (Blossfeld & Roßbach, 2019). Survey data were collected annually from 2010 to 2017, thus covering students' graduation from the general school system, their entry into VET and persistence therein (for details on selectivity and attrition, see Zinn et al., 2020).

The analytical sample was restricted to apprentices who entered VET after lower secondary education (which involves graduation with a lower or intermediate secondary school certificate after 9^{th} or 10^{th} grade) or upper secondary education (which involves graduation with the Abitur after 12^{th} or 13^{th} grade). Students who had missing values on their occupation and followed their apprenticeship abroad or part-time were excluded (n=219). Since an apprenticeship has a duration of a maximum of 3.5 years, the observation period was restricted to 42 months. The overall sample includes 7,160 individuals who are observed for, on average, 20.24 months (S.D. 13.15). Missing information on the covariates was imputed using multiple chained equations (MICE) with 20 imputation sets (van Buuren & Groothuis-Oudshoorn, 2011).

Measures

Dropout from VET. The dependent variable captures dropout (1) versus persistence or completion (0) for each month of the observation period. This information was based on apprentices' self-reported information about whether they were still in their first apprenticeship at the time of the interview. Dropouts are restricted to apprentices who indicated that they decided themselves to leave their apprenticeship (n=773). These "self-initiated" dropouts are used as the focus of analysis since they indicated a reason for this decision. Apprentices who dropped out because they had been dismissed by their employer or school (n=192) did not indicate a reason. They are, however, considered in a robustness check.

The gender composition of the apprenticeship was classified into three groups based on the representation of male and female employees in these occupations (Federal Employment Agency, 2014). Occupations with up to 30% of male (female) employees were classified as male-dominated (female-dominated) occupations, and occupations holding a share between 30%-70% of males and females are defined as gender-integrated occupations. As a robustness check, I also use a continuous measure of gender composition ranging from 0 to 100 (the share of male employees in an occupation).

Dropout reasons. This variable indicates – for self-initiated dropouts – the reasons for dropout ("A training can be terminated for various reasons. Please tell me for each of the following reasons whether it applies to you."). Four types of self-reported dropout events are distinguished[4]. The first event captures the *social integration* hypothesis and refers to dropping out because students "had difficulties with other people in training, e.g. trainers, teachers, colleagues or other apprentices". The second event captures the *professional difficulties* hypothesis and refers to dropout because "the training was too difficult". The third type of dropout takes up the theoretical argument that entering a gender-atypical occupation constitutes a compromise to their desired training occupation. Students dropping out for the following two reasons were compiled in this group: "because it wasn't my desired profession or because the profession was different than I had imagined" and "because I had received or have the prospect of a new training position". Finally, the fourth reason for dropout reflects the *monetary returns* argument. It describes students who stated that they dropped out because they were "unhappy with the money (they) received in training or would have earned later".

As can be seen from Table 1, dropout occurred most frequently because of unfulfilled aspirations, followed by social conflict, monetary returns and professional difficulties. Since students could indicate multiple of these reasons simultaneously, the percentages do not add up to 100%. Pairwise correlations of the dropout reasons are presented in Table A2.

Gender was coded such that male students represented the reference group (coded as 0).

Time intervals. The observation period of 42 months is divided into five time intervals based on the hazard of dropout (see Figure A2). The first four intervals comprise six months each, and a fifth interval comprises the third and fourth years. The first interval corresponds to the probation period of firm-based training, during which contracts are most easily terminated.

Covariates were included based on theoretical expectations about which variables are associated with dropout and selection into gender-atypical apprenticeships, thus taking into account potential sources of confounding.

The highest school certificate refers to the highest school-leaving certificate obtained prior to entering VET, distinguishing between lower (Hauptschulabschluss), medium (Realschulabschluss) and higher education (Abitur).

Parental socioeconomic status was included based on parents' highest International Socio-Economic Index of Occupational Status (ISEI-08). The information on parental occupations was derived from parents and – in the case of missing data – their children.

Grade point average. This variable indicates the grade point average on students' highest school-leaving certificate obtained before entering VET. Higher values represent higher achievements on a scale from 1-6.

Migration background. This variable distinguishes between natives, first-generation migrants, and second-generation migrants (see Olcyk et al., 2014).

Age at entry into VET. Age at entry into VET (in months) captures irregular and lengthy transitions into VET.

Firm-based training. This variable distinguishes between the dual and the school-based VET track, accounting for females more often selecting school-based training (Grønning et al., 2020).

East Germany was included to account for regional differences in VET markets and gender ideologies between East and West Germany.

Table 1 displays summary statistics for the variables.

Table 1. Descriptives of study variables (pre-imputation sample).

Variable	per cent	mean	sd	n_i(valid)
Dependent variables				
Dropout:				7,160
persistence	86.50			
dropout: self-initiated	10.84			
dropout: dismissal	2.68			
Reasons of self-initiated dropout:				773
dropout: social conflict	45.88			
dropout: demanding training	16.88			
dropout: unfulfilled aspiration	66.75			
dropout: monetary return	24.00			
Covariates				
Gender type of training occupation:				7,160
male-dominated	39.27			
gender-balanced	18.10			
female-dominated	42.63			
Gender type of training occupation (continuous)		50.14	35.64	7,160
Gender: female (ref. male)	47.18			7,160
Highest school-leaving certificate:				6,450
low (ref.)	26.78			
medium	48.60			
high	24.62			
School-leaving certificate: final grade (1: very good – 6: insufficient)		2.69	.54	6,134
Parents: higher education entrance diploma	58.27			6,187
Parents: highest occupational social status (ISEI)		19.42		6,278
Migration background:				6,816
Native	76.13			
1st generation	6.03			
2nd generation	17.84			
Age at entry into VET (in years)	17.89	1.43		7,160
Firm-based (ref. school-based) training	77.96			7,160
East (ref. West) Germany	13.89			7,158

Source: NEPS, SC4, own calculations based on the person dataset.

Analytical Strategy

Discrete-time logistic models are used to model apprentices' dropout probability in relation to the gender type of their apprenticeship (Allison, 1982). In these models, the time-dependency of dropout is modelled by dividing the observation period into time intervals. The model is performed on a person-period dataset, introducing time dummies to account for the time dependence of the dropout event. Thereby, right-censoring is accounted for, i.e. the incomplete observation of apprenticeship spells due to panel attrition. Right-censoring is a common problem with panel data that involves following students for several years and across educational transitions. Right-censoring amounts to 52,18 %. Importantly, right-censoring was not associated with students' gender, the main variable of interest. It was strongly correlated with students' educational degree and entry age. These associations can be explained by the fact that students with a high school diploma enter VET later and, therefore, have a shorter observation period in the apprenticeship system (see Figure A1).

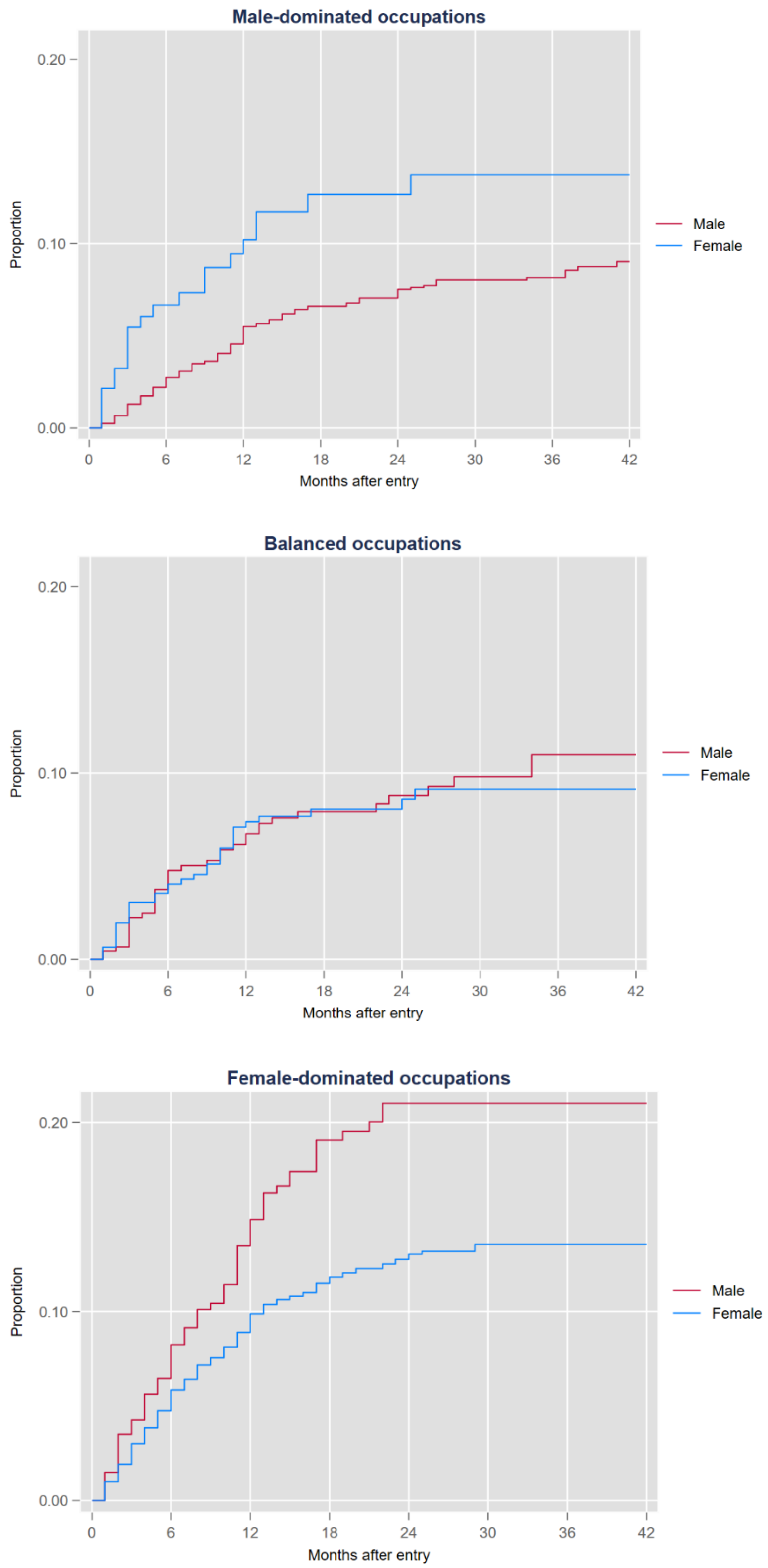
Two types of models are estimated. *Model A* is used to answer the research question of whether gender-atypical apprentices have a higher probability of dropping out. It is a discrete-time logistic model and includes apprentices' gender, the gender type of the occupation and an interaction term between both variables. Results will indicate whether apprentices who represent the minority gender display a higher likelihood of dropout than the majority gender. In *Model B*, four separate discrete-time logistic models are estimated, using each type of dropout as a separate dependent variable while treating other dropout types as competing events (i.e. censored). These models will reveal whether dropout from gender-atypical apprenticeships is associated with specific dropout reasons. In all models, confounding is accounted for through individual and apprenticeship-specific control variables.

4.5 Results

Do gender-atypical apprentices drop out more frequently?

In a first step, the Kaplan-Meier estimator estimates the proportion of students dropping out within a given number of months. This method does not require assumptions about how covariates change dropout occurrence. Figure plots the gender-specific cumulative incidence of dropout over time through the Kaplan-Meier method for each occupational group separately. Within male-dominated apprenticeships, minor gender differences emerge: 12.7 % of females compared to 6.6 % of male apprentices drop out within the first 18 months. In female-dominated apprenticeships, male apprentices experience a clear disadvantage compared to female peers. For example, within the first 18 months, 26% of male apprentices compared to 18% of female apprentices quit their training occupation prematurely. Such gender-specific dropout patterns are not visible in gender-balanced apprenticeships.

Figure 1: Kaplan-Meier cumulative failure probabilities (self-initiated dropout) by gender for male-dominated, female-dominated and balanced training occupations.



Results from the log-rank test for the equality of the survival curves support this interpretation (Wellek, 1993): the gender gap in survival is statistically significant in female-dominated at p<.001 and in male-dominated occupations at almost p<.05. In gender-balanced occupations, no gender gap emerges (see Table A1, Appendix). Interestingly, dropout is generally lower in male-dominated compared to female-dominated apprenticeships. This result points to the generally unfavourable working conditions in female-dominated professions, such as service, social, and health (Haasler & Gottschall, 2015; Krüger, 2003).

Second, multivariate results are presented. Results from the discrete logit model indicate whether the association between apprentices' minority status and dropout is robust to individual differences between majority and minority apprentices. Table A3 presents the full results of the first set of models (Model A), which includes an interaction term between apprentices' gender and the gender type of their occupation to model the association between gender minority status and dropout. The first model is the empty model, and the second model adds individual pre-entry covariates and type of apprenticeship. The third model uses a continuous measure of occupational gender type. For comparison, the same models are estimated for dropping out due to dismissal by employer or school.

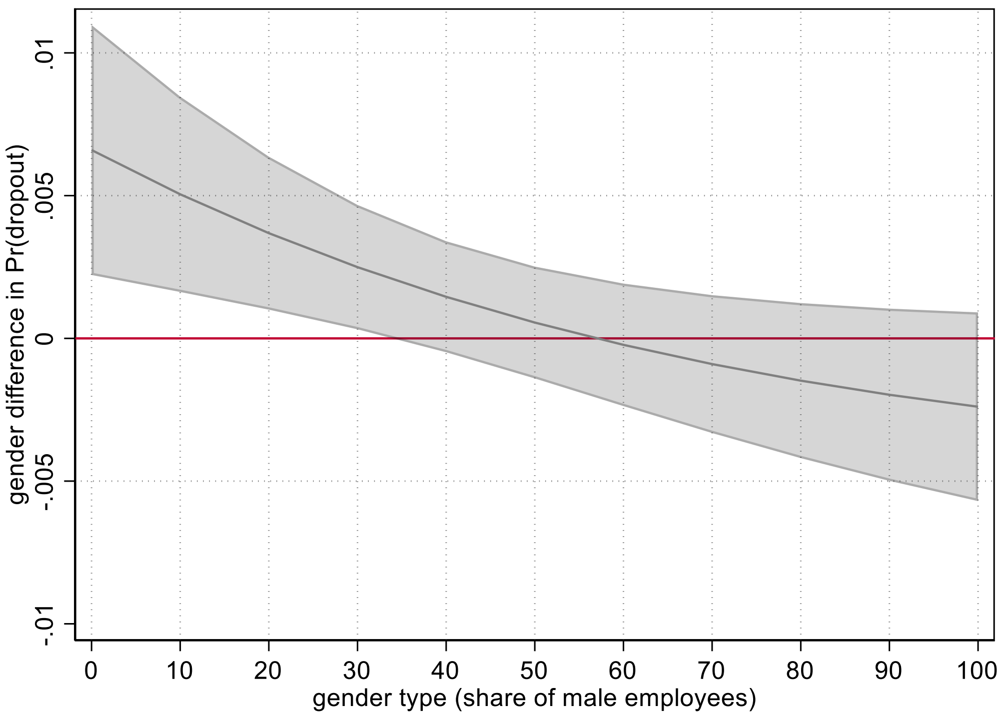
Table 2. Average marginal effects (discrete change) of gender on dropout probability.

	self-initiated dropout		dismissal	
	M1	M2	M3	M4
Male-dominated	0.002	0.002	-0.000	-0.000
	(1.55)	(1.73)	(-0.82)	(-0.56)
Balanced	-0.001	-0.000	-0.000	-0.000
	(-0.70)	(-0.41)	(-0.81)	(-0.40)
Female-dominated	-0.004**	-0.002**	-0.000	-0.000
	(-3.03)	(-2.59)	(-0.99)	(-0.48)
Controls		yes		yes
$N_{(individuals)}$	7,160	7,160	7,160	7,160
$N_{(months)}$	149,749	149,749	149,749	149,749

Results from Table A3. * p<0.05, ** p<0.01, *** p<0.001.
Displayed are average marginal effects for the first time interval, covariates at their mean.
Cluster robust standard errors (individuals) in parentheses.

The interaction term reveals statistically significant differences between gender minority and majority apprentices in (self-initiated) dropout (p<0.01). To allow for a substantial interpretation of these differences, Table 2 displays the average marginal effects of being female on the dropout probability by gender type of occupation for the first time interval. Overall, these results replicate the findings from the Kaplan-Meier curves: the dropout probability of females in male-dominated (female-dominated) occupations is 0.2 percentage points higher (0.2 points lower) than for males (Model 2). These gender effects are statistically significant only for female-dominated occupations. Comparing the empty and the full model further reveals that the inclusion of covariates slightly reduces the dropout probability, but does not substantially change this interpretation, i.e. even when selection processes are accounted for, gender minorities display a higher probability to drop out. In gender-balanced occupations, male and female apprentices drop out to a similar extent. Effect sizes should be interpreted against the background that the overall dropout probability is rather low (see Figure A2, Appendix). The results on dropping out due to dismissals reveal that gender minorities are not more likely to be dismissed by their employer or school.

Figure 2. Gender difference in the predicted probability of (self-initiated) dropout by continuous gender-type of occupation, first time interval.



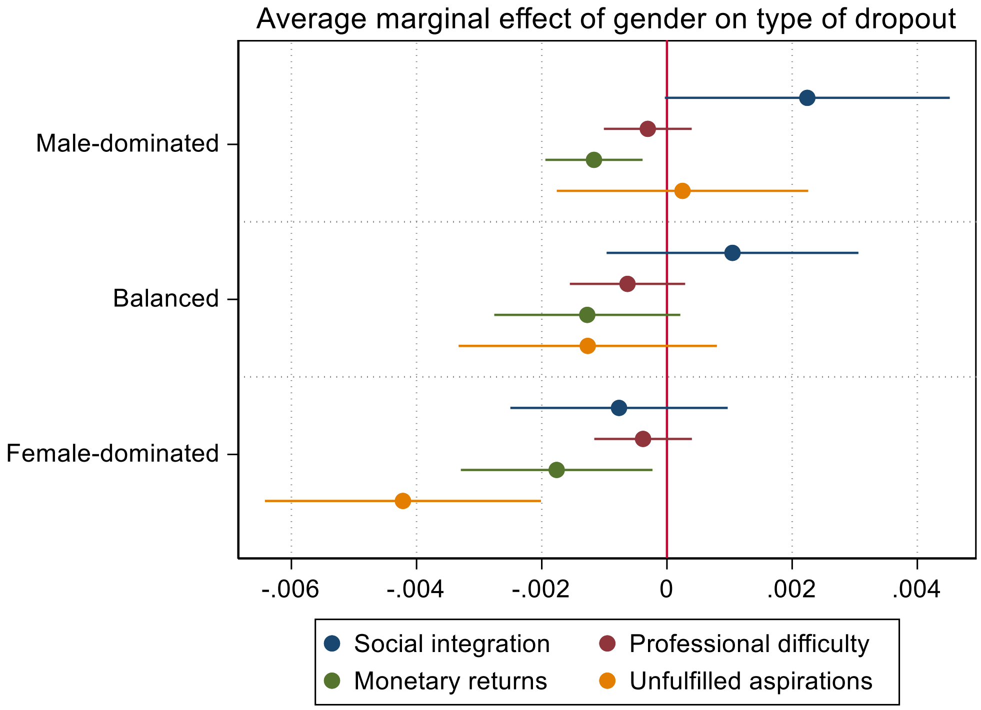
Notes: Results from Table A3, Model 3. Displayed is the contrast between male vs female apprentices in the probability of (self-initiated) dropout in the first time interval, covariates at their mean. Positive values refer to a higher dropout probability of male apprentices. 95%-confidence intervals.

To reach a comprehensive understanding of the association between minority status and dropout, Model 3 includes a continuous gender type measure. Figure 2 displays the gender difference in the predicted probabilities of dropout by gender type of occupation (i.e. the share of male employees). The gender difference in the predicted probabilities is significantly different from zero only in female-dominated occupations (with a share of up to 35% female employees). Male apprentices display a higher dropout probability as the share of female employees in their occupation increases. Hence, the skewness of the occupational gender composition makes a difference for apprentices' dropout decisions. Overall, the presented results confirm *hypothesis 1b* (Male apprentices in female-dominated occupations drop out more frequently than their female peers). *Hypothesis 1a (*Female apprentices in male-dominated occupations drop out more frequently than their male peers) is confirmed from a substantial perspective but does not reach statistical significance.

Do gender-atypical apprentices drop out for different reasons?

To assess whether minority and majority apprentices differ in why they quit their apprenticeship, separate logistic regressions are estimated for each type of dropout. Four sets of models are specified, treating each type of dropout as the dependent variable (and other dropout reasons as competing events, respectively). Figure 3 displays the average marginal effects (see Table A5, full results are displayed in Table A4, Appendix).

Figure 3. Average marginal effects (discrete change) of being female on different dropout types, by gender-type of occupation.



Notes: point estimates with 95-% confidence intervals. Covariates at their mean, first interval.

Results show that minority apprentices drop out for different reasons than gender majorities. The results for female apprentices in male-dominated occupations tend to support the social integration mechanism (*hypothesis 2*). Female students display a 0.2 percentage point higher dropout probability due to a lack of social integration than their male peers. The professional difficulties mechanism (*hypothesis 3*) is not supported: the dropout probability due to professional difficulties does not reveal any substantial gender difference. Interestingly, female apprentices in male-dominated occupations have a slightly lower dropout probability due to monetary returns than their male peers. Finally, men and women in male-dominated occupations also justify their dropout decision to a comparable extent with reference to unfulfilled aspirations.

For female-dominated occupations, a different pattern emerges. Male students more often justify their dropout decision with unfulfilled aspirations (0.4 percentage points difference) and monetary returns (0.2 percentage points difference) compared to female apprentices. These effects are statistically significant at the 5%-level and 0.1%-level. *Hypothesis 4* and *hypothesis 5* are therefore confirmed. No substantial gender difference emerges concerning the professional difficulties and social integration mechanism.

Finally, in gender-balanced occupations, only minor (up to 0.1 percentage point) gender differences in dropout reasons emerge, and these differences do not reach statistical significance. Overall, it is also noteworthy that while significant differences emerged for gender minorities *within* male-dominated and female-dominated occupations, only the gender gap in dropping out due to unfulfilled aspirations is also significantly different *across* occupations. Male apprentices in female-dominated occupations drop out significantly more often due to unfulfilled aspirations than male apprentices in male-dominated occupations.

4.6 Summary and Discussion

The present study addressed dropping out from gender-atypical apprenticeships in Germany. Previous research has mainly looked at gender differences in career choices but has neglected how students who eventually take up gender-atypical apprenticeships proceed with this choice. The aim of this study was twofold. First, dropping out from gender-atypical apprenticeships was described. Second, this study revealed the processes leading gender-atypical apprentices to dropping out, as reflected by the self-reported dropout reasons.

Results revealed that gender differences in dropping out are apparent in female-dominated and, to a smaller extent, in male-dominated apprenticeships. When accounting for selection effects based on observable covariates, female apprentices were slightly more likely to drop out from male apprenticeships, as prominent theories of gendered work experiences suggest (Acker, 2006; Kanter, 1977). The small effect size relates to the finding by Torre (2014) that female employees who start their career in male-dominated occupations have a higher probability of remaining in it than employees who switch to a male-typical occupation during their later occupational career.

Furthermore, the self-reported reasons for dropout were gendered: female students in male-dominated occupations more often relate their dropout decision to social conflicts with supervisors or colleagues than their male apprentices and less often to monetary concerns. This finding supports previous qualitative and small-scale case studies reporting hostile working climates for females in male-dominated occupations or educational fields (Hall & Sandler, 1982). Therefore, although gender differences in dropping out of male-dominated occupations were overall small, the reasons of dropout were highly gendered.

A more considerable gender difference was observed within female-dominated occupations, favouring the male gender majority. This finding contradicts the common argument of a "glass escalator", which might not be appropriate for the VET system (Budig, 2002; Williams, 1992). Again, gender differences in the reasons for dropout were observed: male apprentices more often experienced dropout due to unsatisfactory monetary returns and unfulfilled aspirations. This result suggests that female training occupations often represent a second-best alternative that male apprentices are willing to give up as soon as they can enter better-paying apprenticeships that align with their aspirations. In light of the gendered dropout reasons, male apprentices could be retained in female occupations by increasing the monetary returns. This result is also in line with educational studies showing that information about financial gains strongly relates to men's educational choices (e.g. Barone & Assirelli, 2020). Furthermore, since male students are generally underrepresented in career counselling, supporting informed career decisions for male students might be another effective policy measure to reduce gender minority dropout from female-typed occupations.

From an applied perspective, reducing the number of men and women leaving gender-atypical occupations is an important lever to reduce overall gender segregation, which is reproduced through dynamic attrition processes and occupational revisions across the life course (Guinea-Martin et al., 2018; Torre & Jacobs, 2021). Future research is warranted to analyse dropping out from gender-atypical VET in other countries. Germany is characterized by highly delineated occupations and little occupational mobility after completing VET; therefore, gender-atypical apprentices might develop different strategies to deal with their minority position in other countries.

4.7 Limitations and Future Research

This study provides several avenues for future research. First, although we could distinguish self-initiated dropouts from dismissals, the measurement of dropout reasons in the present study was restricted to individuals' perspectives. Even though the self-reported dropout reasons indicate the processes leading to dropout according to individuals' perceptions, employers' perspectives could provide an even deeper understanding of dropout behaviour. For example, apprentices might employ extrinsic reasons to avoid feelings of failure. Future research is needed to integrate apprentices' and employers' perspectives in the dropout process.

Second, while this study considered important reasons for dropout tied to apprentices' experiences *within* their occupation, future research should acknowledge the *external* barriers tied to persistence within gender-atypical careers. For example, previous research highlights the "need for social approval" as an essential precursor of career decisions (Eberhard et al., 2015) and the "social costs" associated with gender-atypical occupations (e.g., McClintock, 2020; Yu & Kuo, 2021). A perspective that combines internal and external barriers in the context of apprenticeship dropout, and compares both to one another, is warranted.

Third, it should be noted that this study did not investigate apprentices' educational and career pathways after dropping out. Due to the small number of dropouts and data limitations on their future pathways, I was not able to assess whether dropouts switched to more gender typical apprenticeships. To understand whether gendered apprenticeship dropout reproduces gender segregation at the aggregate level, future research should examine long-term occupational trajectories. Finally, future research could pay attention to possible cascade effects. If gender-atypical apprentices leave their vocational training, the gender ratio in the firm becomes increasingly skewed over time. Such processes could stimulate further gendered dropout and cascade effects due to imitation or social pressure. This study's occupational gender composition measure includes only the "survivors" and does not reflect such cascade effects.

Endnotes

1. The number of recognized training occupations is regulated by the Vocational Training Act (BBiG). BBiG § 90 Abs. 3 Satz 3. In 2010, the dual system comprised 348 occupations, in 2011/2012 344, in 2013 329, in 2014 and 2015 327 (BIBB, 2018).

2. The reversed argument applies to women in male-dominated occupations. Accordingly, they may drop out more likely because their occupation is not compatible with their gender-normative preferences of work-family reconciliation. However, since the data does not cover dropout reasons related to this theoretical argument (e.g. working conditions), this hypothesis cannot be empirically tested and was therefore not included.

3. This difference could be attributed to the fact that the present survey data also included the school-based track of the VET system, which is not covered by administrative data sources. Furthermore, dropout in the present survey was measured based on students' responses, while in administrative data, dropout is defined as the resolution of contracts (Uhly, 2015).

4. Using self-reported dropout reasons, the present study relies on a retrospective measure that captures students‘ evaluation of their dropout decision and how detrimental experiences during apprenticeship translate into behavioural consequences. A different approach could be to use prospective measures of the exact theoretical mechanisms. Unfortunately, not all theoretical mechanisms were measured prospectively in a comparable way in the data. Due to these data limitations, the analyses were restricted to the retrospective measure of the dropout decision.

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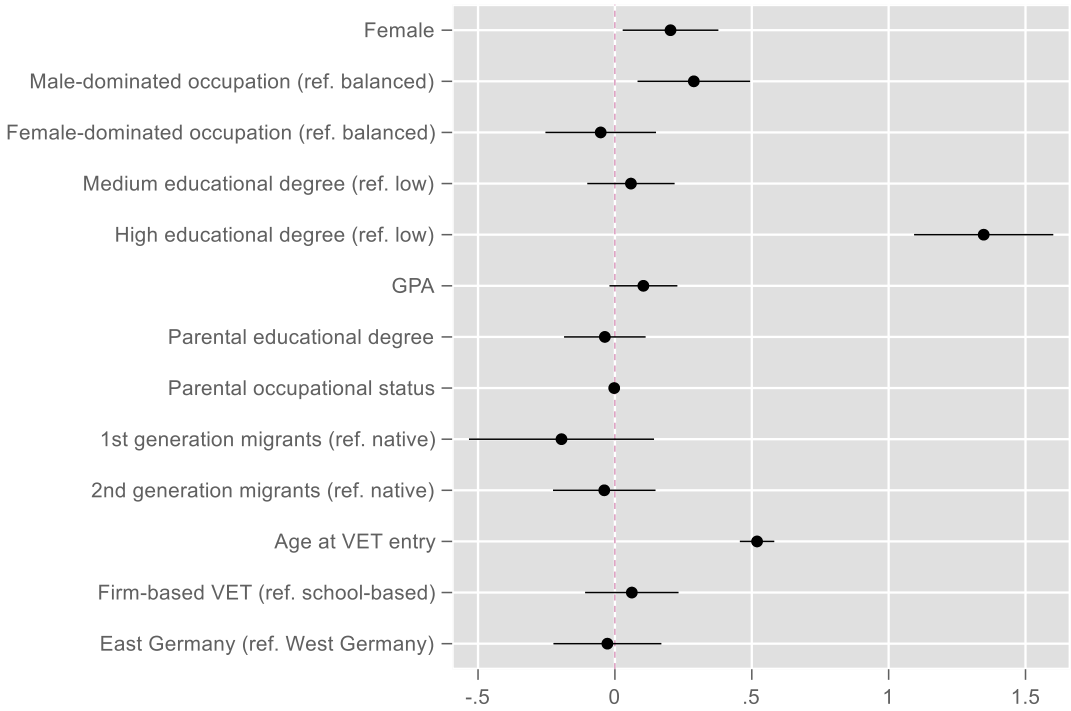
Appendix

Figure A1. Predictors of right-censoring.



Notes: results from a linear probability regression of right-censoring on covariates. n_i=4,795 (listwise deletion).

Figure A2. Smoothed hazard curve (self-initiated dropout).

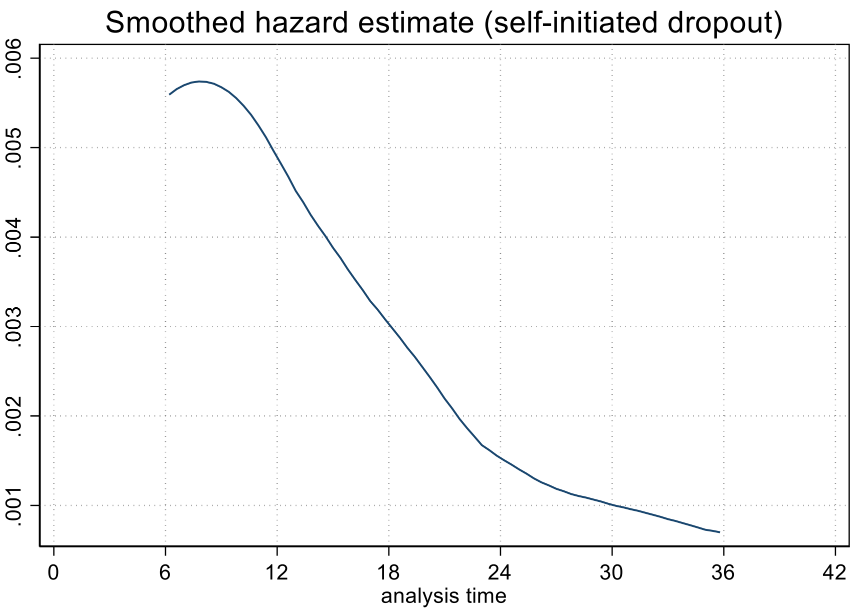


Table A1. Log-rank test for equality of survival functions (self-initiated dropout).

	Events observed	Events expected	chi2	Pr>chi2
		Male-dominated occupations		
Male	214	222.17	3.70	0.0545
Female	28	19.83		
		Gender-integrated occupations		
Male	64	60.17	0.49	0.4845
Female	57	60.83		
		Female-dominated occupations		
Male	104	76.74	12.03	0.0005
Female	306	333.26		

Source: NEPS, SC4. Own calculations.

Table A2. Pairwise correlation of different types of dropouts.

Variables	(1)	(2)	(3)	(4)
(1) social integration	1.0000			
(2) professional difficulty	-0.0288	1.0000		
(3) unfullfilled aspirations	-0.0356	0.0556	1.0000	
(4) monetary returns	0.0943**	-0.0197	0.2623***	1.0000

Source: NEPS, SC4. Own calculations. n=773.

Statistical significance levels: *p<.05, ** p<.01, ***p<.001.

Table A3. Full regression results from Model A (discrete logistic regressions).

	self-initiated dropout			dismissal by employer/school		
	(1)	(2)	(3)	(4)	(5)	(6)
Gender: female	0.366	0.425*	-0.471***	-0.364	-0.259	-0.142
	(1.80)	(2.06)	(-3.36)	(-0.70)	(-0.50)	(-0.48)
Gender type of occ. (ref. male-dominated):						
Balanced occupation	0.286*	0.436**		0.0576	0.392	
	(2.00)	(2.97)		(0.20)	(1.31)	
Female-dominated	0.927***	0.883***		0.616*	0.737**	
	(7.73)	(7.10)		(2.50)	(2.78)	
Gender##Gender type of occ.:						
Female # Balanced	-0.493	-0.500		0.0387	0.102	
	(-1.80)	(-1.81)		(0.06)	(0.16)	
Female # Female-dominated	-0.761**	-0.759**		0.104	0.137	
	(-3.26)	(-3.20)		(0.18)	(0.24)	
Gender type of occupation (cont.)			-0.012***			-0.010**
			(-7.05)			(-2.93)
Gender # gender type (cont.)			0.008**			-0.003
			(2.75)			(-0.43)
Highest school-leaving certificate (ref. low):						
Medium		-0.429***	-0.433***		-0.592***	-0.585***
		(-4.92)	(-5.00)		(-3.44)	(-3.41)
High		-0.902***	-0.917***		-1.986***	-1.971***
		(-6.11)	(-6.35)		(-5.01)	(-5.06)
School-leaving certificate: GPA		0.209**	0.214**		0.547***	0.546***
		(2.79)	(2.85)		(3.63)	(3.64)
Parent education: Abitur		-0.081	-0.081		-0.119	-0.121
		(-0.90)	(-0.91)		(-0.62)	(-0.63)

Table A3 (continued).

	self-initiated dropout			dismissal by employer/school		
	(1)	(2)	(3)	(4)	(5)	(6)
Parental socio-economic status (ISEI)		0.001	0.001		-0.001	-0.001
		(0.61)	(0.57)		(-0.11)	(-0.10)
Migration background (ref. native)						
1st generation migrants		0.319*	0.329*		0.137	0.138
		(2.30)	(2.38)		(0.49)	(0.49)
2nd generation migrants		0.330***	0.325***		0.002	-0.015
		(3.52)	(3.47)		(0.01)	(-0.08)
Age at entry into VET		0.076*	0.073*		0.148*	0.146*
		(2.31)	(2.23)		(2.49)	(2.46)
Firm-based training (ref. school-based)		-0.097	-0.093		0.508*	0.522*
		(-1.08)	(-1.04)		(2.36)	(2.44)
Time intervals (ref. 1st interval)						
2nd interval, first year	-0.264**	-0.258**	-0.259**	-1.354***	-1.355***	-1.355***
	(-3.12)	(-3.05)	(-3.05)	(-6.40)	(-6.40)	(-6.39)
3rd interval, second year	-0.972***	-0.954***	-0.953***	-1.735***	-1.729***	-1.727***
	(-8.27)	(-8.09)	(-8.08)	(-6.36)	(-6.30)	(-6.29)
4th interval, second year	-1.308***	-1.292***	-1.291***	-1.500***	-1.508***	-1.506***
	(-8.76)	(-8.60)	(-8.60)	(-5.48)	(-5.47)	(-5.46)
5th interval, third/fourth year	-1.873***	-1.857***	-1.852***	-2.942***	-2.973***	-2.969***
	(-11.23)	(-11.02)	(-10.99)	(-6.42)	(-6.49)	(-6.48)
Constant	-5.027***	-6.653***	-5.554***	-5.897***	-10.02***	-9.055***
	(-65.95)	(-11.57)	(-9.23)	(-42.08)	(-9.34)	(-7.86)
$N_{(individuals)}$	7,160					
$N_{(months)}$	149,749					

Displayed are log odds. *T*-statistics in parentheses. Cluster robust standard errors (individuals). * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A4. Full regression results from Model B (discrete logistic regressions).

	(1) Social integr.	(2) Prof. difficulty	(3) Mon. returns	(4) Unfulfilled as.
Gender: female	0.685*	-0.485	- 1.554	0.071
	(2.56)	(-0.67)	(-1.54)	(0.24)
Gender-type of occ. (ref. male-dom.)				
Balanced	0.376	0.557	0.588*	0.523**
	(1.67)	(1.68)	(2.18)	(3.04)
Female-dominated	0.785***	0.638*	0.955***	1.042***
	(4.08)	(2.06)	(4.28)	(7.23)
Gender##Gender-type of occ.				
Female # Balanced	-0.411	-0.171	0.902	-0.336
	(-1.09)	(-0.19)	(0.83)	(-0.91)
Female # Female-dominated	-0.851**	0.175	0.993	-0.650*
	(-2.62)	(0.22)	(0.96)	(-2.00)
School-leaving certificate (ref. low)				
Medium	-0.583***	-0.254	-0.642***	-0.262*
	(-4.64)	(-1.20)	(-3.58)	(-2.47)
High	-1.367***	-1.274**	-0.858**	-0.613***
	(-5.52)	(-2.60)	(-3.02)	(-3.37)
School-leaving certificate: GPA	0.276*	0.373	0.157	0.223*
	(2.50)	(1.81)	(0.91)	(2.40)
Parents: high school diploma	-0.043	-0.156	0.207	-0.067
	(-0.32)	(-0.64)	(1.11)	(-0.64)
Parental socio-economic status (ISEI)	-0.002	-0.003	0.004	0.003
	(-0.46)	(-0.43)	(0.80)	(1.05)
Migration background (ref. natives)				
1st Generation Migrants	0.0268	0.453	0.708**	0.369*
	(0.12)	(1.37)	(2.71)	(2.12)
2nd Generation Migrants	0.221	0.120	0.433*	0.476***
	(1.58)	(0.50)	(2.29)	(4.24)
Age at entry into VET	0.055	0.001	0.083	0.016
	(1.13)	(0.01)	(1.31)	(0.39)
Firm-based (ref. school-based) training	0.260	-0.708***	-0.212	-0.176
	(1.79)	(-3.46)	(-1.23)	(-1.63)
Time intervals (ref. 1st interval)				
2nd interval, first year	-0.254*	-0.472*	-0.032	-0.310**
	(-2.07)	(-2.14)	(-0.19)	(-3.02)
3rd interval, second year	-1.044***	-0.976***	-1.207***	-1.084***
	(-5.93)	(-3.37)	(-4.40)	(-7.31)
4th interval, second year	-1.680***	-0.984**	-1.084***	-1.374***
	(-6.59)	(-3.06)	(-3.75)	(-7.40)
5th interval, third/fourth year	-1.978***	-1.397***	-2.238***	-2.146***
	(-7.90)	(-4.18)	(-5.28)	(-9.36)
Constant	-7.238***	-6.790***	-8.190***	-6.151***
	(-8.72)	(-4.65)	(-7.20)	(-8.80)

$N_{(individuals)}$ = 7,160. $N_{(months)}$ =149,749. Displayed are log odds. *t* statistics in parentheses. Cluster robust standard errors . * *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001.

Table A5. Average marginal effects (discrete change) of gender on the probability of different types of dropout (Model B).

	Social integration	Professional difficulties	Monetary returns	Unfulfilled aspirations
Male-dominated	0.0022	-0.0003	-0.0012**	0.0002
	(0.053)	(0.416)	(0.003)	(0.815)
Balanced	0.0011	-0.0006	-0.0013	-0.0013
	(0.307)	(0.177)	(0.092)	(0.226)
Female-dominated	-0.0008	-0.0004	-0.0017*	-0.0040***
	(0.387)	(0.337)	(0.033)	(0.000)
$N_{(individuals)}$		7,160		
$N_{(months)}$		149,749		

Results from Table A4. * p<0.05, ** p<0.01, *** p<0.001.
Displayed are average marginal effects for the first time interval. Covariates at their mean.
Cluster robust standard errors (individuals) in parentheses.

Chapter 5

Career compromises and dropout from Vocational Education and Training in Germany.

Co-authored with Alexandra Wicht and Matthias Siembab.

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Abstract

This study investigates the relevance of career compromises (i.e., the discrepancy between the expected and attained training position) for dropping out of vocational education and training (VET), focusing on compromises in terms of social status and gender type. Drawing on predictions from rational choice and cultural theory, we pay particular attention to the direction of compromises, i.e. upward and downward compromises. Using longitudinal data on 3,548 apprentices from the German National Educational Panel Study (NEPS, Starting Cohort 4), results from discrete event history models show that both dimensions of compromises are crucial for VET dropout. In particular, downward gender-type discrepancy increase apprentices' dropout probability. These findings draw attention to the role of pre-entry VET policies, such as career counselling, in minimizing the incidence of career compromises.

5.1 Introduction

Countries with an apprenticeship-based vocational education and training (VET) system often facilitate smooth transitions to the labour market (Barbieri et al., 2018; Kogan, 2019). Having obtained an apprenticeship is then key to a successful school-to-work transition (Masdonati et al., 2010) which, in turn, leads to relatively stable occupational careers and avoids unemployment (Ainsworth & Roscigno, 2005; Manzoni et al., 2014; Müller et al., 1998; Solga, 2008). At the same time, however, apprenticeship dropout constitutes a prevalent phenomenon in many VET systems (e.g. Switzerland: Filliettaz, 2010; Negrini et al., 2016; e.g. Germany: Neuber-Pohl, 2021; Schmid & Stalder, 2012). In Germany, for example, 25 per cent of apprenticeship contracts have been terminated each year prematurely over the past decades (Uhly, 2015).[1] This is of particular concern as dropping out of VET can have severe consequences for young people's later lives, such as a high "labour market vulnerability", stigmatization, and lower social status (Solga, 2008). Moreover, training dropouts come along with costly losses of resources at the level of companies (Wenzelmann & Lemmermann, 2012). To take targeted educational policy measures to prevent dropping out from VET, it is therefore of particular interest to identify their precursors.

Previous research has found manifold predictors of apprenticeship dropouts (e.g. Uhly, 2015). The majority of studies highlight the relevance of individual characteristics (e.g. school-leaving certificates, migration background; see e.g. Beicht & Walden, 2013; Bessey & Backes-Gellner, 2015; Rohrbach-Schmidt & Uhly, 2015; Stalder & Schmid, 2016), financial resources (Bessey & Backes-Gellner, 2015; Seidel, 2019) and structural characteristics of occupations and training firms (Christ, 2013; Rohrbach-Schmidt & Uhly, 2015; Uhly, 2015).

Another important strand of research focuses on the role of young people's career choices in predicting VET dropout. While some studies attribute dropouts to poorly informed career decisions (Beinke, 2010; Uhly, 2015), other studies take into account that career choices are made against the backdrop of various constraints that often require *career compromises*, i.e. there is a discrepancy between students' occupational aspirations and the apprenticeship they enter (Ahrens et al., 2021; Gottfredson, 2002). The relevance of career compromises is reflected in the higher dropout rates of young people who did not obtain an apprenticeship in their desired occupation (Beicht & Walden, 2013). Studies further show that employees who perceive that their job does not match their expectations have lower job satisfaction and more often change their job (Kalleberg & Mastekaasa, 2001; Turnley & Feldman, 2000).

While these findings suggest that not attaining one's career aspirations may lead to dissatisfaction and dropout, the present study addresses two crucial research gaps that remain: (1) First, it is not yet fully understood which dimensions of career compromise matter. Previous research has examined the consequences of different compromises separately, e.g. compromises related to intrinsic aspects of the field of work (e.g. Taris et al., 2006) or compromises in terms of social status (Creed & Saporta, 2003; Hardie, 2014). In line with Gottfredson's (2002) theory of circumscription and compromise and previous findings on key dimensions of career compromises (Ahrens et al., 2021), we examine the relevance of social status and gender-type compromises for young people's decision to dropout from VET. (2) Second, this study investigates whether the direction of compromise matters to the dropout of VET. While the majority of previous studies have examined downward discrepancies (i.e. a lower attained SES than expected), from the perspective of cultural theory, however, upward discrepancies might also increase apprentices' dropout risk.

We use Germany as a case study – a country with a strong degree of social and gender stratification in the labour market (Allmendinger, 1989; Charles & Grusky, 2004) and a strong linkage between the VET system and the labour market, i.e. career compromises have long-term implications. To this end, we use longitudinal data on 3,548 apprentices from the German National Educational Panel Study (NEPS, Starting Cohort 4), providing detailed information on young people's career expectations and the VET position they attained after general schooling as well their dropout behaviour.

5.2 Theoretical Framework

Career compromise and dropout from VET

Previous research examines potential consequences of career compromises mostly from a socio-psychological perspective: *Self-discrepancy theory* (Higgins, 1987) and *multiple discrepancies theory* (Michalos, 1985), for example, generally consider the realization of one's goals and preferences as the primary source of self-satisfaction and feelings of success. Both theories identify the perceived discrepancy between preferences and attainment as a central predictor of one's psychological well-being and satisfaction. Not attaining goals and preferences invokes negative emotions such as disappointment, dissatisfaction, self-criticism, or frustration.

The expectation that career compromises have negative consequences generally finds support in the existing empirical evidence. Not attaining career aspirations is associated with lower psychological well-being and higher levels of distress (Carr, 1997; Creed & Blume, 2013; Hardie, 2014; Tsaousides & Jome, 2008; for contradictory evidence regarding educational expectations see Reynolds & Baird, 2010). Studies investigating career outcomes found that unmet aspirations are associated with lower levels of career satisfaction, work adjustment and work motivation (Ashforth & Saks, 2000; Creed & Gagliardi, 2015; Irving & Montes, 2009; Tsaousides & Jome, 2008; Turnley & Feldman, 2000). Career compromise was further related to increased sick absence and risk of unemployment (Carr, 1997; Gjerustad, 2016; Gjerustad & Soest, 2011).

In this context, a dropout from VET can be understood as a means to dissolve discrepancies and associated negative feelings. Apprentices who make career compromises are, thus, likely to have a higher risk to leave their apprenticeship (to improve upon their situation). Empirical evidence on the returns to job mobility supports this expectation and shows that a job change is often accompanied by an improvement in terms of job satisfaction, organizational commitment, income and status (e.g. Gesthuizen & Dagevos, 2008; Kalleberg & Mastekaasa, 2001; for apprenticeships see Schmid & Stalder, 2012). Moreover, studies suggest that career compromises are associated with a higher probability of searching for a new job and higher rates of turnover (Creed & Saporta, 2003; Pearson, 1995; Taris et al., 2006). Concerning apprentices, analyses for Germany found that not attaining one’s desired training occupation was associated with higher dropout from VET (Beicht & Walden, 2013).

While the research presented thus far has shown that career compromises can be associated with VET dropout, it remains unclear which *dimensions* of compromise are relevant in this context. To approach this question, Gottfredson’s (1981, 2002) *circumscription and compromise theory* can be made fruitful. Accordingly, career choice serves to establish one’s vocational self-concept, that is, one’s vocational identity and social role in society (Super, 1957). Already during early childhood, individuals learn to categorize occupations along two major dimensions: *gender type* and *social status*. During their socialization process, young people form career orientations by comparing their vocational self-concept to these core dimensions. As the career choice decision draws nearer, they may have to make career compromises, i.e., adapt their career orientations to perceived real-life opportunities and constraints. In this context, strong compromises regarding gender type are usually considered a greater threat to one’s self-concept than compromises regarding social status (Gottfredson, 2002). Descriptive evidence confirms that in Germany, career compromises are mainly characterized by social status and gender type and that compromises are made in both upward and downward directions (Ahrens et al., 2021).

Sociological theory can make a significant contribution to explaining compromises regarding the social status and gender type in more detail. In the following sections, we will thus establish a link between these dimensions of compromise and VET dropout from a mainly sociological perspective. Moreover, we discuss whether these compromises should exhibit either a directional or a nondirectional relationship to VET dropout behaviour.

Social status compromise

With regard to discrepancies in social status, *theories of (bounded) rational educational decisions* (e.g. Boudon, 1974; Breen & Goldthorpe, 1997) suggest that young people's career expectations are the result of cost-benefit considerations and that they evaluate their career attainment primarily based on expected benefits: the higher the social status of the VET position attained compared to their expectations, the higher the value young people attach to it[2]. Moreover, the *level of aspiration theory* (e.g. Starbuck, 1963) considers the level of aspirations as a reference point for feelings of success and failure. The lower the attainment with respect to this reference point, the more negative emotions individuals feel – and vice versa (Heath et al., 1999). This theoretical perspective hence highlights the detrimental effect of falling below the expected social status, which relates to a loss of resources such as income, power, and social recognition.

Empirical studies investigating such downward discrepancies find that not attaining the aspired social status is related to an increased risk of developing mental health problems (Carr, 1997) and higher rates of sickness absence (Gjerustad & Soest, 2011). Gjerustad (2016) further found that attaining a lower social status than expected increased the risk of unemployment. If the social status of the attained VET position falls below the expected one, negative emotions arise that increase the risk of dropping out of VET. Conversely, attaining a VET position that confers a higher social status than expected should be associated with more positive emotions and a lower dropout risk. This corresponds to a directional linear relationship between status discrepancy and dropout:

> **H1a (*directional social discrepancy*)**: Attaining a VET position with a lower (higher) social status than expected is associated with a higher (lower) probability of dropping out.

Alternatively, a cultural theory perspective suggests that not only downward but also upward discrepancies could be detrimental. Following Bourdieu's (1979) notion of *habitus*, upward discrepancies in terms of social status should lead to dissatisfaction and thus a higher risk of dropout. Habitus comprises individuals' patterns of perception, interpretation, and action that are shaped by social categories such as social class and gender (see also Colley et al., 2003). Individuals express their class membership through certain aesthetics, attitudes, speech, and social networks and, in this way, constantly reproduce their social position. Previous studies have shown that when social class habitus and context do not correspond, feelings of ambivalence, insecurity, and unease emerge (Sennett & Cobb, 1972), e.g. regarding the situation of working-class students at university (Reay, 2005). Therefore, in the presence of an occupational social habitus, attaining a higher social status than expected could lead to feelings of not belonging in their social position. Furthermore, exceeding the expected social status could result in feelings of overload due to the higher effort, responsibility, and workload required in that occupation. This is because higher status occupations often require more complex and cognitively demanding tasks in comparison to low-status occupations.

Previous studies that explicitly consider both downward and upward discrepancies in social status have found mixed results. Gjerustad and Soest (2012) have documented a curvilinear relationship between status discrepancies and anxiety symptoms, suggesting that both upward and downward compromises are detrimental. However, they found a linear relationship between status discrepancies and depressive symptoms. Irving and Montes (2009) have shown that exceeding expectations in terms of skill development and monetary compensation were associated with a reduction in job satisfaction, supporting the theoretical argumentation provided above. Hardie (2014) also finds that both exceeding and falling short of social status expectations is related to lower well-being. Carr (1997), however, finds that surpassing one's expected social status does not result in different levels of mental health in comparison to meeting them. The cultural perspective hence suggests a nondirectional relationship between social status compromises and dropout:

> **H1b (*nondirectional social discrepancy*)**: Attaining a VET position incongruent with one's expected social status is associated with an increase in the dropout probability (irrespective of whether the attained VET position exceeds or falls short of the expected social status).

Gender type compromise

Concerning compromises regarding gender type, the concept of *tokenism* by Kanter (1977) frames the experiences of individuals who are minorities in their workplace or occupation (Busch, 2013; Kanter, 1977; Taylor, 2010; 2016). A key finding is that the more skewed the gender ratio in an occupation, the more attention the minority (token) group receives from the dominant group. As a result, minorities often operate under greater pressure to perform. This is often accompanied by a less supportive work climate (Busch, 2013; Taylor, 2010), higher physical stress (Taylor, 2016) and even a higher probability of early contract cancellation (Rohrbach-Schmidt & Uhly, 2015). Such negative repercussions are less pronounced for individuals in more balanced work settings and for individuals who belong to an occupational majority (Kanter, 1977). Thus, the more gender-atypical the attained VET position relative to their expectations, the lower young people's satisfaction with their VET position, which should lead to a higher dropout risk. Conversely, young people should be more likely to be satisfied and at a lower risk of dropping out if they attain a VET position that is equally or more gender-typical than their previous career expectations. Empirical evidence on gender-type compromises is missing.

> **H2a (*directional gender-type discrepancy*)**: Attaining a VET position that is less (more) gender-typical than expected is associated with an increase (decrease) in the probability of dropping out.

Again, an alternative theoretical expectation can be made against the backdrop of cultural theory. Studies have coined the term *gender habitus* to refer to the social construction of gender and the different gender-specific behaviours and expectations that are perceived as typically feminine or masculine (Behnke & Meuser, 2001; Schwiter et al., 2011). Gender habitus is thus a critical filter by which occupations are perceived, and career expectations are established. This is also reflected in the gender-typed connotations of different work tasks, such that manual and technical work is often perceived as "masculine", whereas social and caring work is coined as "feminine" work. Gender is, therefore, another important part of the occupational habitus of the individual.

Importantly, gender habitus can be understood as a continuum of different more or less rigid expressions of femininity and masculinity (Behnke & Meuser, 2001). That is, some individuals adhere to traditional gender norms, constructing men and women as highly distinct social categories, while others express a less rigid construction of gender. Consequently, young people who enter occupations that are not congruent with their expected gender habitus will experience "habitual insecurity". The salience of gender and the gender continuum is also visible in the structure of the German labour market: although most occupations can be described as either typical male or female, there is strong variability in the extent to which occupations are skewed towards gender. Occupations, thus, may not only be perceived as "too gender-atypical" (as argued above) but may also be conceived as "too gender-typical" in relation to one's expected gender habitus.

> **H2b (*nondirectional gender-type discrepancy*)**: Attaining a VET position incongruent with one's expected gender type is associated with an increase in the dropout probability (irrespective of whether the attained VET position is more or less gender-typical than expected).

5.3 Data and Methods

Data

This study uses the German survey data from the NEPS, Starting Cohort 4 (SC4), version 10.0.0, doi: http://dx.doi.org/10.5157/NEPS:SC4:10.0.0 (Blossfeld & Roßbach, 2019; NEPS Network, 2021). The NEPS-SC4 survey includes a representative sample of students attending ninth grade at regular schools in Germany and covers students' transition from the general school system to the VET system and their further courses therein. The first survey was carried out in the classroom via paper-and-pencil interviewing (PAPI) in autumn 2010 (Wave 1), followed by a second survey in spring 2011 (Wave 2). From tenth grade onwards, students were surveyed annually in the classroom via PAPI (Waves 3–8). Persons who had left the general education system were interviewed biannually (Waves 3–6) and later annually (Wave 7 onwards) using computer-assisted telephone interviewing (CATI). Data from wave 1 to wave 10 are used.

The analytical sample includes students who graduated from general secondary school after lower or upper secondary education (usually with a lower [Hauptschulabschluss] or intermediate [Realschulabschluss] secondary school certificate after grade 9 or 10 or with the German university entrance qualification [Fachhochschulreife/Abitur] after grade 12 or 13). 7,388 individuals entered VET after graduating from general schooling. Individuals with missing values on their career expectations or VET position attained were excluded since these are the primary variables of interest (n=2,390).[3] From the remaining sample, apprentices who entered VET abroad or on a part-time basis were excluded (n=21). The final analytical sample included 3,548 apprentices with 77,808 months (organized in a person-month dataset). Individuals are observed, on average, for 21.94 months (S.D. 12.98).

Measures

Focal variables

Dropout from VET. The dependent variable captures apprentices' dropout from their first full-qualifying VET position (0: no dropout, 1: dropout), which is based on apprentices' self-reported, retrospective information monthly. Apprentices were asked if they prematurely quit their apprenticeship and, if so, whether this was a deliberate decision or whether they had been dismissed by their employer or school. Because the latter type of dropout does not involve a deliberate dropout decision, we defined these cases as censored. Apprentices who followed their VET until the end but did not pass the final exam were not considered dropouts. VET episodes lasting longer than 40 months (which approximates the average maximum duration of VET in Germany) were truncated and treated as right-censored to avoid noise in the analyses due to a small number of artificial dropouts at late observation points.

Career compromises. The different types of career compromise were constructed based on students' career expectations measured before entering the VET system ("Think about everything you know right now. Which profession do you think you will actually have later?"). Career expectations were measured (annually or bi-annually) from grade 9 to the end of schooling. Based on all available measures, the following temporal restrictions were imposed: career expectations were used if they were measured at least 12 months and no more than 24 months before entering the VET system.

A social status compromise was measured based on the International Socio-Economic Index (ISEI), which takes values between 16 and 90 (Ganzeboom et al., 1992). The compromise measure refers to the discrepancy between the ISEI of apprentices' career expectations and their attained VET position. The value 0 indicates that there is no compromise, while positive values refer to upward compromises (i.e. apprentices attained a higher social status than expected), and negative values describe downward compromises (i.e. apprentices attained a lower social than expected).

Gender type compromise was constructed based on the share of same-sex employees in both the expected and attained occupation (employment statistics of the Federal Employment Agency, 2014). A continuous discrepancy measure is used, with a value of 0 indicating that apprentices attained their expected gender type. Positive values refer to deviations toward occupations with a higher share of one's gender and negative values toward occupations with a lower share of one's gender. There was a positive correlation between the absolute values of gender-type and social status discrepancies, r=.32, p=.000 (see also Figure A1 in the Appendix).

Control variables

Gender was coded such that men represented the reference group.

Migration background distinguishes three categories: no immigration background, 1st generation immigrants, and 2nd generation immigrants. The variable is based on information on students' country of birth as well as the country of birth of students' parents and grandparents (Olczyk et al., 2014). First-generation immigrants are those individuals who were born in Germany, and second-generation immigrants are those individuals who were born in Germany but whose parents were both born outside of Germany.

Educational qualification refers to the highest school leaving qualification attained before entering VET, distinguishing between low (Hauptschulabschluss, the reference category), medium (Mittlere Reife), and high (Fachhochschulreife/Abitur) educational qualifications.

Grade point average obtained in the highest school leaving qualification, ranging from 1 (very good) to 6 (insufficient).

Parental SES was measured by the highest ISEI (Ganzeboom et al., 1992) of parents' occupations. Values range from 11.74 to 88.96.

Type of Training refers to the apprentices' statements about their training type. In Germany, there are two types of VET, which are either firm-based or school-based. The variable was coded such that firm-based training represented the reference group.

Career compromises in the field of work were measured based on the German Classification of Occupations (KldB 2010) and the constructs of occupational sectors and segments (Matthes et al., 2015). These classifications group occupations at varying levels of similarity in terms of vocational tasks, competencies, and knowledge (Paulus & Matthes, 2013). Based on the occupational level at which discrepancies between expected and attained apprenticeship occur, four different types of field of work compromises are distinguished: (i) *no compromise*: there is no discrepancy at the most detailed level of “occupational sub-groups”, the reference category), (ii) *weak compromise* (discrepancy at the level of “occupational main groups”), (iii) *moderate compromise* (discrepancy at the level of “occupational segments”) and (iv) strong compromise (discrepancy at the level of “occupational sectors”). We use field of work as a control variable because gender-type and social status compromises usually go hand in hand with field of work compromises.

Distance between measuring expectations and the start of apprenticeship was used to account for differences in the time when students’ career expectations were measured (between 12–24 months before entering the VET system).

Duration of training refers to the time apprentices already have spent in training in four categories, 1^{st} half-year (reference category), 2^{nd} half-year, 2^{nd} year, and after 2^{nd} year.

East or West Germany accounts for regional differences in labour market structures within Germany.

Table 1 shows the descriptive statistics of the analytic sample.

Table 1. Descriptive statistics.

Variables	Mean/per cent	sd	min	max	N(valid)
Dependent variable					
Dropout from VET	9.86		0	1	3,548
Career compromise					
Social status	-6.88	17.27	-70.57	58.97	3,548
Gender-type	2.63	24.61	-92.91	92.61	3,548
Field of work			0	1	3,548
No compromise (ref.)	27.71				
Weak compromise	21.79				
Moderate compromise	19.67				
Strong compromise	30.83				
Time-dependency					
Time			0	1	3,548
1st half-year (ref.)	17.36				
2nd half-year	10.82				
2nd year	71.82				
Controls					
Gender: female	49.89		0	1	3,548
Migration background			0	1	3,520
German (ref.)	78.61				
1st generation migrant	5.09				
2nd generation migrant	16.31				
Highest parental ISEI	48.50	19.26	11.74	88.96	3,182
Educational degree			0	1	3,360
Low (ref.)	16.43				
Medium	57.20				
High	26.37				
Grade point average (GPA)	2.65	0.52	1	4.5	3,210
East Germany (ref. West)	15.74		0	1	3,544
Dual training (ref. school-based)	77.00		0	1	3,548
Distance (start of apprenticeship - time of expectation measure)	15.01	3.31	12	24	3,548

Note: N(valid) refers to the total of individuals with valid information. Descriptive statistics of the time-constant variables are calculated based on the person dataset only.

Analytical Strategy

To investigate associations between the different types of compromises when entering VET and dropout from training, discrete-time event history models are used (Allison, 1982). The model corresponds to a binary logistic regression model. The dependent variable is the transition probability from state 0 (being in VET) to state 1 (dropping out from VET). The transition probability is defined as the log-odds for the conditional probability of dropping out at time t_i. Since the transition probability depends on the processing time (i.e., the duration of training that has already passed), a piecewise-constant modelling strategy is used, where the transition probability is assumed to be constant only within particular time intervals (Blossfeld & Rohwer, 2002). To map this, we included controls for process time intervals (see the section on 'Control variables'). The logistic model for the conditional discrete time to event is as follows:

$$\ln\left(\frac{P(t)}{1-P(t)}\right) = a(t) + bX + \ bX(t)$$

The level of analysis corresponds to person-months, not persons. To address the resulting problem of non-independence of person-month observations, cluster-robust standard errors were obtained using a Huber-White sandwich estimator (Williams, 2000). In all models, gender, migration background, parental SES, educational qualification, GPA, duration of the training, region, and type of training were included as covariates to rule out the possibility that differences between compromises and dropouts are in part due to differences in those variables. As a robustness analysis, we further include the field of work compromises to rule out the possibility that the effect of gender type and social status compromises on dropout is partly driven by compromises related to other occupational characteristics which are related to dropout behaviour (Rohrbach-Schmidt & Uhly, 2015).

We applied multiple imputations to deal with missing values in control variables (Little & Rubin, 2002). We excluded students with missing information in our focal independent variables measuring compromises (N=3,796). We used sequential imputation by chained equations to create 20 datasets. The imputation model encompasses all variables of our analyses models as well as auxiliary variables, including the occupational sector and the processing time in months.

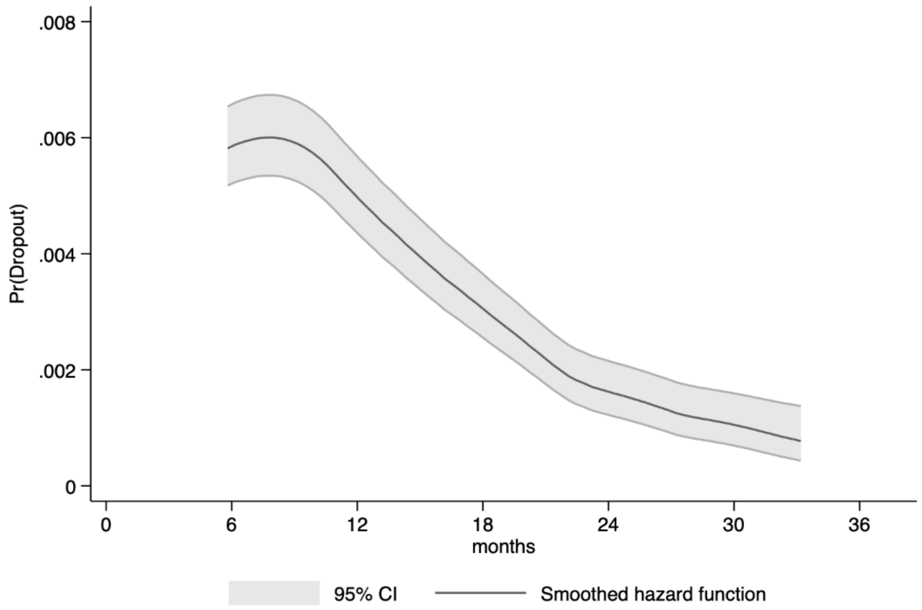
To examine the directionality of the association between dropout and compromises on gender type and social status, we used piecewise regression. This allowed us to separately assess the intercept and slope of downward and upward compromises in predicting dropout. To this end, we artificially split the sample at the threshold of zero (no compromises) and ran two models: One model predicted dropout by downward compromises when no compromises and upward compromises were set to zero. The other model predicted dropout by upward compromise with no compromise and downward compromise set to zero. In all models, we account for the time dependence of the relationship between dropout and compromises by using interaction terms between compromises and training duration. The consideration of time dependence is important because the opportunity costs of dropping out increase with the duration of training (G. S. Becker, 1962; Patzina & Wydra-Somaggio, 2020).

While the results from our analytical strategy provide important clues about the association between career compromise and dropout, they remain correlational. Since we cannot adjust for potential unobserved confounders, no causal interpretation is possible.

5.4 Results

Our descriptive analyses show that about 10 per cent of apprentices make a conscious decision to drop out of their training early. Figure 1 shows the hazard function of dropping out of training with 95 per cent confidence intervals. The hazard function gives the estimated probability of dropping out of training as a function of the time spent in training in months.

Figure 1. Smoothed hazard curve of dropout probability.

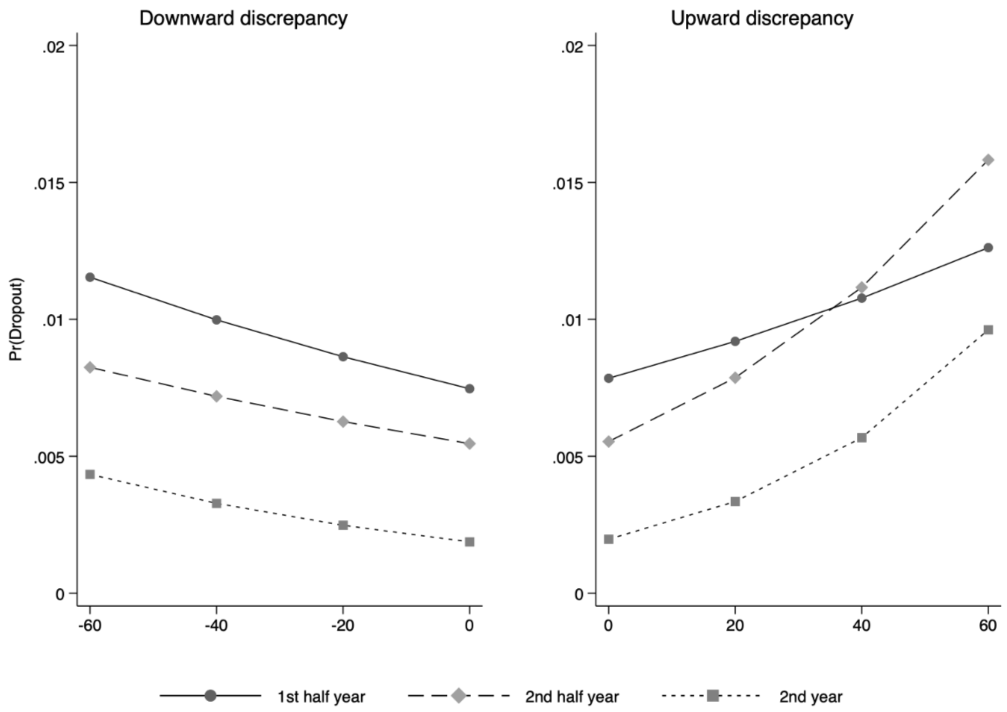


Given the overall low number of trainees in our sample who drop out of their training, the hazard function shows that the probability of dropping out is relatively low at all observed time points. In the first year, the dropout probability increases, with the increase levelling during the second half of the year. The highest dropout probability is estimated for month 6 (0.009, S.E. 0.001) and month 12 (0.011, S.E. 0.002). From the second year on, the dropout probability decreases at a relatively constant rate.

Are career compromises in social status associated with dropout?

Figure 2 shows the results of our piecewise models on the relationships between dropping out of VET and upward and downward compromises in social status. We report the predicted absolute probabilities of dropping out at certain observed levels of compromise and for three different time intervals (1st half-year, 2nd half-year, and 2nd year and longer). Full logistic regression results, including the associations between dropout and control variables, can be found in Table A1 of the Appendix.

Figure 2. Association between social status discrepancies and dropout (by time interval).



Note: results from two piecewise linear regressions of dropout on social status discrepancies (see Table A1).

The results reveal two interesting patterns: First, consistent with Hypothesis 1b, a u-shaped relationship emerges between social status compromises and dropping out of VET. That is, both upward and downward compromises are associated with increasing dropout behaviour. The larger the discrepancy in social status between expectation and VET, the higher the probability of dropout. Effect sizes are larger for upward discrepancies. For example, in the second half-year, apprentices who experience an upward compromise of 34.5 ISEI points (which corresponds to 2 S.D. in social status compromises and an exemplary shift from occupations in real estate marketing or management to sales occupations) have a 1 percentage point higher probability of dropping out, while the same level of downward compromise is associated with a 0.6 percentage point increase.

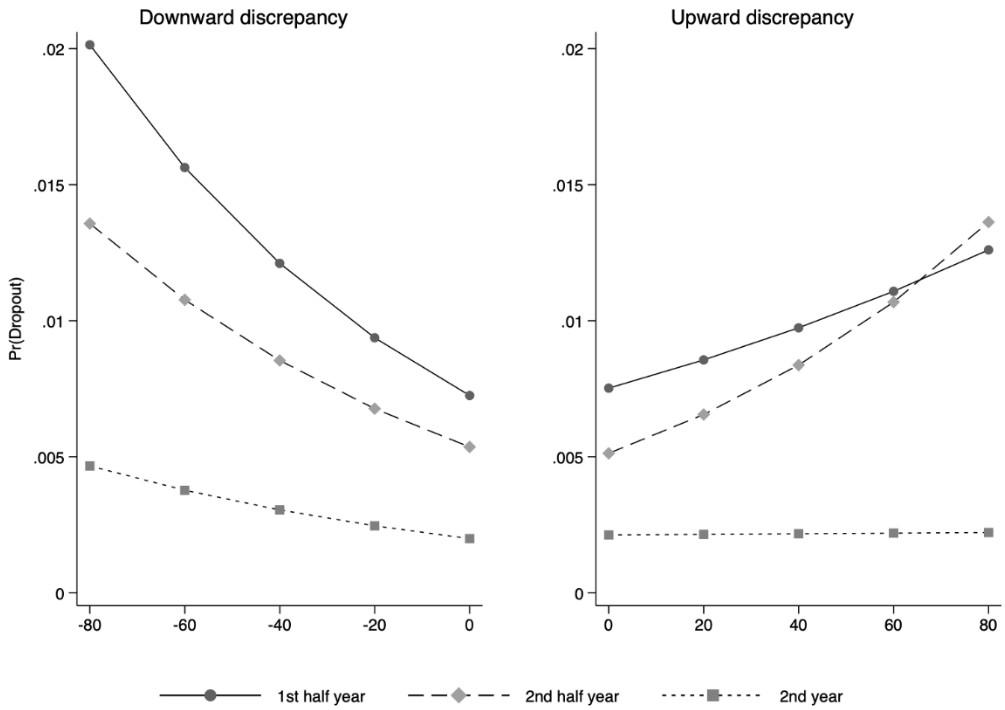
Second, time dependence is found in the relationship between dropout and social status compromises, with downward compromises slightly more likely to be associated with dropping out of VET in the first half-year. The time dependence is even more pronounced for upward compromises. Strong upward compromises in social status are more strongly associated with dropout in the 2nd half-year and longer durations than in the first half-year. We can rule out the possibility that this pattern is an artefact arising from a few observations. Overall, however, it should be noted that while the estimated probabilities are statistically significant (at least $p < 0.05$), the differences in the association between compromise and dropping out between time intervals are not (see Table A1). This could be due to the overall low number of dropout observations.

Are career compromises in gender type associated with dropout?

Like the results presented previously, Figure 3 shows the results of our piecewise models on the relationships between dropping out of VET and upward and downward compromises in gender type. Full logistic regression results, including the associations between dropout and control variables, can be found in Table A1 of the Appendix.

The pattern for the association between gender type compromises is similar to that for social status compromises. Both increasing upward and downward compromises are associated with higher dropout probabilities, confirming hypothesis 2b, and these associations are time-dependent, with dropout probabilities highest in the 1st half-year in VET. However, the curve for downward compromises is much steeper than that for upward compromises. For example, an upward compromise of 24.5 percentage points (which corresponds to about 2 S.D. in gender-type compromises) is associated with an increased dropout probability by 0.8 per cent in the first half-year, while the same downward shift is associated with an increased dropout probability by 0.9 per cent. Moreover, there is almost no difference in the relationship between upward and downward compromises and dropouts after the 1st year in VET. While the estimated probabilities are statistically significant (at least $p < 0.05$), only the main association between dropout and downward compromises, i.e., the association for the 1st half-year, is statistically significant at the 1 per cent level (see Table A1).

Figure 3. Association between gender type discrepancies and dropout (by time interval).

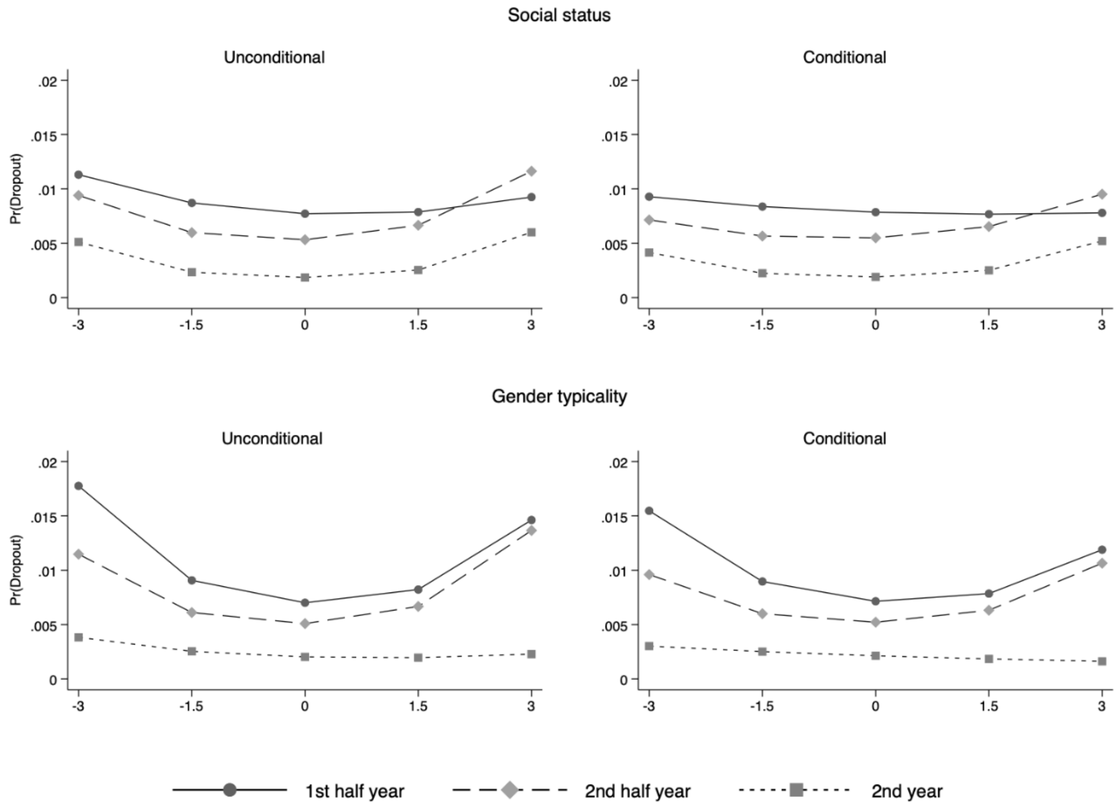


Note: results from two piecewise linear regressions of dropout on gender type discrepancies (see Table A1).

Which type of compromise matters more for dropouts?

Figure 4 shows the comparative results for the relationship between dropouts and compromises in social status and gender type. In each case, a u-shaped relationship was modelled for the estimation by considering a linear and a quadratic term of the z-standardized compromise variables. We estimated an unconditional and a conditional model in which we account for compromises in the field of work. Such compromises are assumed to be related both to tasks associated with social status and gender type and to unobserved occupational characteristics involved in compromises. Full regression results of the z-standardized and non-standardized logistic regression models can be found in Table A2 and A3.

Figure 4. Comparisons of associations between gender type and social status discrepancies and dropout (by time-interval).



Note: results from four linear regressions of dropout on social status and gender type discrepancies, curvilinear specification (see Table A2 and A3). In the conditional models, the field of work compromise is included as a covariate.

Looking at unconditional models reveals that the predicted probabilities of dropout are similar for compromises in social status and gender type in the 2nd half-year and after the 1st year. Regarding the 1st half-year, however, the dropout probability is strongest for gender type compromises, especially for downward compromises, while social status compromises are rather weak correlated with dropout. This pattern weakens but persists when controlling for field of work compromises. Hence, social status and gender-type compromises do not simply reflect compromises related to specific occupations or occupational groups, but they are independently associated with apprentices' dropout behaviour.

5.5 Discussion

Summary

This article aimed to shed light on the relevance of career compromises for dropping out of VET, focusing on two types of compromises that some apprentices must accept when entering VET: compromises related to social status and gender type. As a major contribution to previous literature, we assessed not only the extent but also the direction of these compromises. Using representative and comprehensive longitudinal data on apprentices' first full qualifying training position and their career expectations one year before entering VET, substantial associations between compromises and dropout behaviour were found. In line with previous theorizing and research (Creed & Blume, 2013; Hardie, 2014), both types of compromises were crucial for dropout behaviour.

Although some of the correlations are small, it is noteworthy that both upward and downward discrepancies in gender-type and social status increased apprentices' dropout probability. These associations could not be reduced to occupational compromises related to changes in the field of work (i.e., reflecting different working tasks or required skills), pointing to the importance of a cultural dimension of gender-type and social status compromises. The existence of an occupational habitus tied to social status and gender is hence supported by our results (Bourdieu, 1979; Colley et al., 2003).

In line with Kanter's (1977) tokenism approach and theories of gendered working cultures (Bourdieu, 1979; Colley et al., 2003), downward gender compromise turned out to be a particularly strong predictor of VET dropout. This is also in line with Gottfredson's (2002) theory of circumscription and compromise, identifying gender type as the most salient aspect of individuals' self-concept. This study further shows that dropout decisions are time-dependent, pointing to the lower opportunity costs at earlier time points (Patzina & Wydra-Somaggio, 2020).

Limitations and Future research

The present study certainly has limitations. Albeit our study is one of a few that can identify dropout as a conscious decision and thus maps individual agency, we do not distinguish which educational or career path the young people chose after dropping out. To comprehensively understand the consequences of compromise, future research should address whether young people drop out of the vocational education system altogether or whether they take an educational path that may be more in line with their previous expectations (Beicht & Walden, 2013; Bessey & Backes-Gellner, 2015).

Second, the specific mechanisms underlying the relationship between compromises and dropouts remain an open question for future research. Our results support the existence of occupational cultures tied to gender and social status. Hence, social integration within occupations or feelings of belonging might identify as potential mediators. Furthermore, job or income satisfaction and the inability to cope with the training requirements or expectations from significant others may mediate the association between occupational compromises and VET dropouts. Multi-group comparisons could shed light on whether the reported relationships vary across individual, social, or contextual characteristics, such as gender, social status, resources, type of training, or regional labour market demand. For example, for some apprentices, it might be easier to change apprenticeship in the presence of detrimental compromises.

Third, results should be interpreted against the background that gender type and social status compromises overlap, i.e. apprentices usually experience both types of compromise at a time (or none of them). Because of this multicollinearity, we cannot estimate the incremental relationship between compromises in social status and dropout and compromises in gender type and dropout since no compromise on one variable means no compromise on the other. Results based on all compromise variables can be found in Table A4 in the Appendix.

Finally, there are limitations to the present approach to operationalizing career compromise. We measured career expectations one year before entering the VET system, hence capturing compromises based on early expectations. Using students' actual VET applications instead of career expectations might capture a different aspect of career compromise. It is an open question whether such compromises yield stronger associations with dropout (because applications are more goal-oriented than expectation) or weaker effects (because applications potentially are less well aligned with young people's vocational self-concept due to adaptions to labour market demands).

Conclusion

Our study builds on an important strand of the literature on the consequences of compromises in the transition from school to work and extends it in two ways: first, it examines the relationship between deliberate dropout from VET and different types of compromises on key occupation-related dimensions, social status, and gender, providing a more nuanced picture of the consequences of unmet occupational expectations. Second, we examine the directionality of the association between such compromises and dropping out.

Both upward and downward compromises in social status and gender type predict dropout from VET. This finding illustrates that occupational compromises must be understood as a multifaceted phenomenon that cannot be reduced to the binary distinction between "met" and "unmet" expectations, nor downward compromises in social status. The finding that both upward and downward gender type compromises are related to training dropout strengthens the concept of habitus as a continuum that may include more or less rigid expressions of social status and gender (Behnke & Meuser, 2001; Bourdieu, 1979). Moreover, this study suggests that young people who face structural barriers to pursuing their expectations nonetheless exhibit high levels of agency when their expectations go unfulfilled and may seek a training position that is more suitable for them.

On a more general level, our findings relate to the phenomenon that young people's expectations have become more concentrated in a small number of occupations, which might not always be realistic and attainable (Mann et al., 2018). From a policy perspective, therefore, it may be useful to establish effective counselling strategies that help young people not only in realizing their expectations but also guide them in exploring and identifying alternative occupational niches that best suit their conceptions of themselves in terms of social status and gender (Rochat, 2015).

Endnotes

1. More precisely, around half of these dissolutions can be considered as rather unproblematic revisions of educational decisions, with young people changing occupations and remaining within the VET system, while the other half involve leaving the VET system (Bessey & Backes-Gellner, 2015; Uhly, 2015). Nevertheless, the term „dropouts“ in this article refers to both groups.

2. These cost-benefit considerations also include other factors, such as potential costs and the expected probability of success. However, we focus on social status, which we consider a central benefit.

3. Students that were excluded because they did not provide information on their expected occupation or the attained VET position (n=1,765) were mainly male, had a migration background, and were more often from the lowest school type. A majority of these students (n=1,632) did not indicate an occupational expectation during school; therefore, these students cannot experience a career compromise and are thus not informative for the theoretical perspective taken in this study.

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Appendix

Figure A1. Scatterplot of the association between social status compromise and gender type compromise.

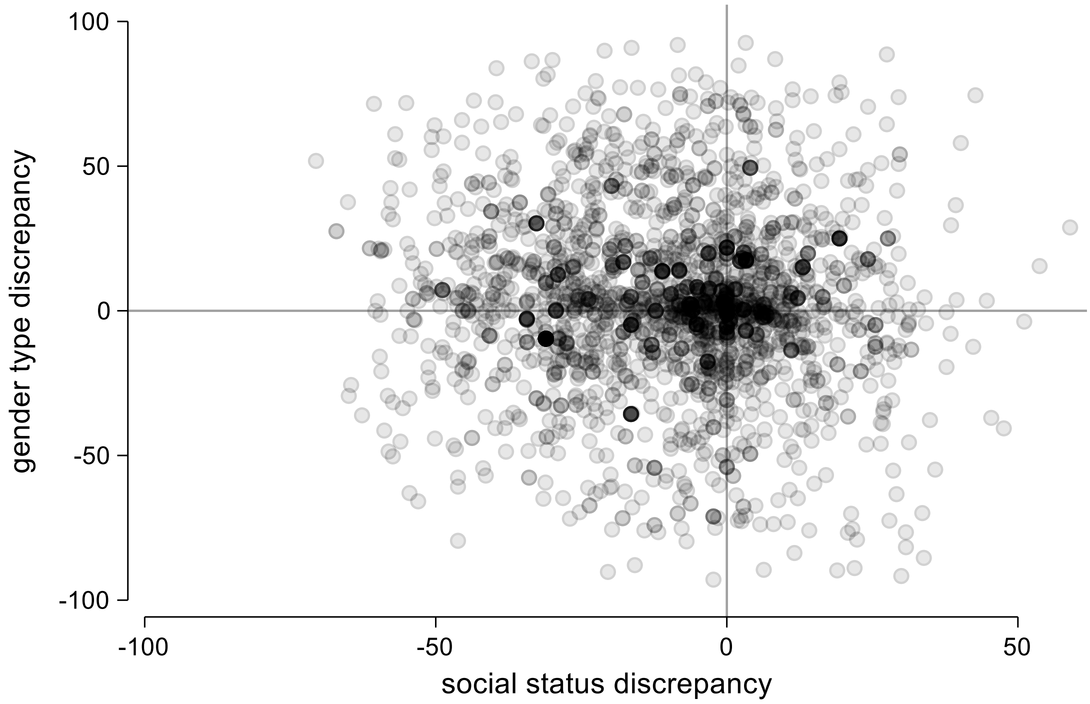

Table A1. Dropout regressed on compromises in gender type and social status, piecewise models, full results, logit coefficients.

	Gender typicality				Social status			
	upward		downward		upward		downward	
	β	**S.E.**	**β**	**S.E.**	**β**	**S.E.**	**β**	**S.E.**
Discrepancy	0.0065	[0.0043]	**-0.0130**	**[0.0042]**	0.0080	[0.0098]	-0.0073	[0.0051]
Time, ref. 1st half-year								
2nd half-year	**-0.3862**	**[0.1480]**	**-0.3044**	**[0.1443]**	**-0.3519**	**[0.1382]**	**-0.3155**	**[0.1560]**
2nd year	**-1.2701**	**[0.1554]**	**-1.2991**	**[0.1505]**	**-1.3899**	**[0.1485]**	**-1.3902**	**[0.1649]**
Time x discrepancy, ref. 1st half-year								
2nd half-year x discrepancy	0.0058	[0.0062]	0.0012	[0.0072]	0.0097	[0.0157]	0.0004	[0.0083]
2nd year x discrepancy	-0.0060	[0.0081]	0.0023	[0.0073]	0.0186	[0.0161]	-0.0067	[0.0086]
Female, ref. male	**0.2427**	**[0.1203]**	**0.2735**	**[0.1172]**	**0.2475**	**[0.1194]**	**0.2287**	**[0.1195]**
Ethnicity, ref. German								
1st Generation Migrants	**0.6357**	**[0.1946]**	**0.5502**	**[0.2040]**	**0.6386**	**[0.1953]**	**0.5983**	**[0.1965]**
2 nd Generation Migrants	**0.4597**	**[0.1430]**	**0.4592**	**[0.1432]**	**0.4604**	**[0.1433]**	**0.4497**	**[0.1426]**
Educational degree, ref. low								
Medium	**-0.6489**	**[0.1428]**	**-0.6178**	**[0.1436]**	**-0.6407**	**[0.1430]**	**-0.6439**	**[0.1428]**
High	**-0.7878**	**[0.2198]**	**-0.7784**	**[0.2206]**	**-0.7746**	**[0.2198]**	**-0.8397**	**[0.2223]**
GPA	**0.2442**	**[0.1143]**	**0.2574**	**[0.1132]**	**0.2564**	**[0.1138]**	**0.2627**	**[0.1140]**
East Germany, ref. West	**0.2948**	**[0.1388]**	**0.2955**	**[0.1387]**	**0.2938**	**[0.1385]**	**0.2952**	**[0.1389]**
VET type, ref. school-based	**-0.3597**	**[0.1302]**	**-0.3643**	**[0.1274]**	**-0.3278**	**[0.1283]**	**-0.3308**	**[0.1321]**
Flag	-0.0057	[0.0248]	-0.0076	[0.0246]	-0.0056	[0.0247]	-0.0033	[0.0245]
Highest parental ISEI	0.0051	[0.0034]	0.0052	[0.0033]	0.0052	[0.0034]	0.0047	[0.0034]
Constant	**-5.1783**	**[0.5486]**	**-5.2540**	**[0.5420]**	**-5.2078**	**[0.5468]**	**-5.2545**	**[0.5458]**
Largest FMI	0.2109		0.2158		0.2125		0.2157	
Average RVI	0.0431		0.0433		0.0431		0.0438	

Cluster robust S.E., 20 imputations, N(person-months) 77,808, values marked in bold are statistically significant at least at $p < 0.10$.

Table A2. Dropout from VET regressed on compromises in gender type, full results, logit coefficients.

Gender-type compromise	unconditional				conditional			
	β	**S.E.**	**B**	**S.E.**	**β**	**S.E.**	**B**	**S.E.**
Discrepancy	-0.0024	[0.0025]	-0.0331	[0.0586]	-0.0027	[0.0025]	-0.0447	[0.0593]
Discrepancy^2	**0.0002**	**[0.0000]**	**0.0938**	**[0.0237]**	**0.0001**	**[0.0001]**	**0.0721**	**[0.0292]**
Time, ref. 1st half-year								
2nd half-year	**-0.3297**	**[0.1449]**	**-0.3218**	**[0.1455]**	**-0.5395**	**[0.3080]**	**-0.5315**	**[0.3083]**
2nd year	**-1.2389**	**[0.1535]**	**-1.2449**	**[0.1527]**	**-1.4002**	**[0.2972]**	**-1.4068**	**[0.2976]**
Time x discrepancy, ref. 1st half-year								
2nd half year	0.0026	[0.0042]	0.0625	[0.0965]	0.0026	[0.0042]	0.0621	[0.0955]
2nd year	-0.0017	[0.0050]	-0.0534	[0.1185]	-0.0018	[0.0050]	-0.0595	[0.1191]
Time x discrepancy^2, ref. 1st half year								
2nd half-year	0.0000	[0.0001]	0.0072	[0.0394]	0.0000	[0.0001]	0.0021	[0.0495]
2nd year	-0.0001	[0.0001]	-0.0518	[0.0502]	-0.0001	[0.0001]	-0.0681	[0.0621]
Female, ref male	**0.2910**	**[0.1179]**	**0.2911**	**[0.1179]**	**0.2836**	**[0.1169]**	**0.2837**	**[0.1169]**
Ethnicity, ref. German								
1st Generation Migrants	**0.5686**	**[0.2033]**	**0.5690**	**[0.2033]**	**0.5252**	**[0.2022]**	**0.5257**	**[0.2021]**
2nd Generation Migrants	**0.4655**	**[0.1431]**	**0.4659**	**[0.1431]**	**0.4361**	**[0.1436]**	**0.4365**	**[0.1436]**
Educational degree, ref. low								
Medium	**-0.6229**	**[0.1436]**	**-0.6234**	**[0.1436]**	**-0.6187**	**[0.1439]**	**-0.6192**	**[0.1439]**
High	**-0.7537**	**[0.2196]**	**-0.7546**	**[0.2196]**	**-0.7717**	**[0.2200]**	**-0.7726**	**[0.2200]**
GPA	**0.2420**	**[0.1133]**	**0.1282**	**[0.0602]**	**0.2204**	**[0.1142]**	**0.1168**	**[0.0607]**
East Germany, ref. West	**0.2982**	**[0.1392]**	**0.2982**	**[0.1392]**	**0.2830**	**[0.1391]**	**0.2831**	**[0.1391]**
VET type, ref. school-based	**-0.3616**	**[0.1275]**	**-0.3615**	**[0.1275]**	**-0.3407**	**[0.1276]**	**-0.3406**	**[0.1276]**
Flag	-0.0085	[0.0246]	-0.0237	[0.0689]	-0.0120	[0.0244]	-0.0335	[0.0684]
Highest parental ISEI	0.0053	[0.0033]	0.1003	[0.0625]	0.0051	[0.0033]	0.0957	[0.0624]
Field of work compromise, ref. no								
weak compromise					0.1849	[0.2535]	0.1848	[0.2535]
moderate compromise					0.2669	[0.2559]	0.2669	[0.2559]
strong compromise					**0.4133**	**[0.2492]**	**0.4133**	**[0.2492]**

Table A2 (continued).

	unconditional				conditional			
	β	**S.E.**	**B**	**S.E.**	**β**	**S.E.**	**B**	**S.E.**
Time x weak, ref. 1st half year								
2nd half year					0.4055	[0.4097]	0.4055	[0.4097]
2nd year					0.4125	[0.4063]	0.4127	[0.4063]
Time x moderate, ref. 1st half-year								
2nd half year					0.2057	[0.4217]	0.2057	[0.4217]
2nd year					0.0285	[0.4382]	0.0286	[0.4382]
Time x strong, ref. 1st half-year								
2nd half year					0.2252	[0.4129]	0.2253	[0.4129]
2nd year					0.2463	[0.4125]	0.2463	[0.4125]
Constant	**-5.2454**	**[0.5428]**	**-4.4825**	**[0.1829]**	**-5.3295**	**[0.5671]**	**-4.6867**	**[0.2543]**
Largest FMI	0.2097		0.2084		0.2117		0.2105	
Average RVI	0.0362		0.0362		0.0250		0.0250	

Cluster robust S.E., 20 imputations, N(person-months) 77,808, values marked in bold are statistically significant at least a t $p < 0.10$.

Table A3. Dropout from VET regressed on compromises in social status, full results, logit coefficients.

Social status compromise	**unconditional**				**conditional**			
	β	**S.E.**	**B**	**S.E.**	**β**	**S.E.**	**B**	**S.E.**
Discrepancy	-0.0006	[0.0057]	-0.0340	[0.0780]	-0.0014	[0.0054]	-0.0295	[0.0746]
$Discrepancy^2$	0.0001	[0.0001]	0.0316	[0.0358]	0.0000	[0.0001]	0.0089	[0.0363]
Time, ref. 1^{st} half-year								
2^{nd} half-year	**-0.3420**	**[0.1431]**	**-0.3741**	**[0.1452]**	**-0.5391**	**[0.3081]**	**-0.5732**	**[0.3103]**
2^{nd} year	**-1.4020**	**[0.1504]**	**-1.4374**	**[0.1539]**	**-1.4059**	**[0.2972]**	**-1.4439**	**[0.3019]**
Time x discrepancy, ref. 1^{st} half-year								
2^{nd} half year	0.0063	[0.0088]	0.0699	[0.1208]	0.0065	[0.0084]	0.0777	[0.1159]
2^{nd} year	0.0079	[0.0095]	0.0611	[0.1306]	0.0083	[0.0090]	0.0678	[0.1248]
Time x $discrepancy^2$, ref. 1^{st} half-year								
2^{nd} half-year	0.0002	[0.0002]	0.0441	[0.0527]	0.0001	[0.0002]	0.0367	[0.0564]
2^{nd} year	**0.0003**	**[0.0002]**	**0.0910**	**[0.0543]**	0.0003	[0.0002]	0.0910	[0.0575]
Female, ref male	**0.2322**	**[0.1195]**	**0.2323**	**[0.1195]**	**0.2398**	**[0.1182]**	**0.2399**	**[0.1182]**
Ethnicity, ref. German								
1^{st} Generation Migrants	**0.6046**	**[0.1971]**	**0.6053**	**[0.1971]**	**0.5490**	**[0.1960]**	**0.5496**	**[0.1959]**
2^{nd} Generation Migrants	**0.4484**	**[0.1432]**	**0.4488**	**[0.1432]**	**0.4223**	**[0.1438]**	**0.4227**	**[0.1438]**
Educational degree, ref. low								
Medium	**-0.6417**	**[0.1432]**	**-0.6423**	**[0.1432]**	**-0.6352**	**[0.1436]**	**-0.6358**	**[0.1435]**
High	**-0.8200**	**[0.2214]**	**-0.8211**	**[0.2214]**	**-0.8163**	**[0.2213]**	**-0.8173**	**[0.2213]**
GPA	**0.2602**	**[0.1143]**	**0.1379**	**[0.0607]**	**0.2223**	**[0.1152]**	**0.1177**	**[0.0612]**
East Germany, ref. West	**0.2974**	**[0.1389]**	**0.2974**	**[0.1389]**	**0.2817**	**[0.1387]**	**0.2818**	**[0.1387]**
VET type, ref. school-based	**-0.3174**	**[0.1301]**	**-0.3173**	**[0.1301]**	**-0.3143**	**[0.1288]**	**-0.3141**	**[0.1289]**
Flag	-0.0032	[0.0245]	-0.0089	[0.0686]	-0.0101	[0.0244]	-0.0284	[0.0684]
Highest parental ISEI	0.0045	[0.0034]	0.0864	[0.0637]	0.0046	[0.0034]	0.0872	[0.0635]
Field of work compromise, ref. no								
weak compromise					0.2143	[0.2602]	0.2143	[0.2602]
moderate compromise					0.3061	[0.2597]	0.3062	[0.2597]
strong compromise					**0.5948**	**[0.2266]**	**0.5949**	**[0.2266]**

Table A3 (continued).

	unconditional				conditional			
	β	**S.E.**	**β**	**S.E.**	**β**	**S.E.**	**β**	**S.E.**
Time x weak, ref. 1st half-year								
2nd half-year					0.4125	[0.4128]	0.4125	[0.4128]
2nd year					0.2967	[0.4093]	0.2968	[0.4093]
Time x moderate, ref. 1st half-year								
2nd half-year					0.1937	[0.4319]	0.1937	[0.4319]
2nd year					-0.1021	[0.4364]	-0.1020	[0.4364]
Time x strong, ref. 1st half-year								
2nd half-year					0.2152	[0.3801]	0.2153	[0.3801]
2nd year					-0.0916	[0.3916]	-0.0915	[0.3916]
Constant	**-5.2330**	**[0.5447]**	**-4.3673**	**[0.1874]**	**-5.3200**	**[0.5692]**	**-4.6513**	**[0.2560]**
Largest FMI	0.2155		0.2142		0.2131		0.2119	
Average RVI	0.0371		0.0371		0.0251		0.0252	

Cluster robust S.E., 20 imputations, N(person-months) 77,808, values marked in bold are statistically significant at least at $p < 0.10$.

Table A4. Dropout regressed on compromises in gender type, social status and field of work, full results, logit coefficients.

	full conditional model			
	β	**S.E.**	**B**	**S.E.**
Social status compromise				
Discrepancy	-0.0022	[0.0053]	-0.0404	[0.0736]
Discrepancy^2	0.0000	[0.0001]	0.0058	[0.0361]
Time x discrepancy, ref. 1 st half-year				
2 nd half year	0.0067	[0.0083]	0.0821	[0.1152]
2 nd year	0.0089	[0.0092]	0.0756	[0.1261]
Time x discrepancy^2, ref. 1st half-year				
2nd half-year	0.0001	[0.0002]	0.0357	[0.0560]
2nd year	0.0004	[0.0002]	0.0935	[0.0591]
Gender type compromise				
Discrepancy	-0.0028	[0.0025]	-0.0458	[0.0591]
Discrepancy^2	**0.0001**	**[0.0001]**	**0.0726**	**[0.0292]**
Time x discrepancy, ref. 1 st half-year				
2 nd half year	0.0027	[0.0042]	0.0640	[0.0952]
2 nd year	-0.0017	[0.0050]	-0.0596	[0.1197]
Time x discrepancy^2, ref. 1st half-year				
2nd half-year	-0.0000	[0.0001]	-0.0003	[0.0491]
2nd year	-0.0001	[0.0001]	-0.0774	[0.0640]
Time, ref. 1st half-year				
2nd half-year	**-0.5386**	**[0.3082]**	**-0.5660**	**[0.3107]**
2nd year	**-1.4043**	**[0.2972]**	**-1.4519**	**[0.3026]**
Female, ref. male	**0.2749**	**[0.1169]**	**0.2750**	**[0.1169]**
Ethnicity, ref. German				
1st Generation Migrants	**0.5123**	**[0.2044]**	**0.5129**	**[0.2044]**
2nd Generation Migrants	**0.4297**	**[0.1435]**	**0.4301**	**[0.1435]**
Educational degree, ref. low				
Medium	**-0.6231**	**[0.1443]**	**-0.6236**	**[0.1442]**
High	**-0.7948**	**[0.2210]**	**-0.7957**	**[0.2210]**
GPA	**0.2270**	**[0.1147]**	**0.1202**	**[0.0610]**
East Germany, ref. West	**0.2885**	**[0.1392]**	**0.2885**	**[0.1392]**
VET type, ref. school-based	**-0.3172**	**[0.1276]**	**-0.3170**	**[0.1276]**
Flag	-0.0106	[0.0243]	-0.0298	[0.0680]
Highest parental ISEI	0.0047	[0.0033]	0.0887	[0.0629]
Field of work compromise, ref. no				
weak compromise	0.1572	[0.2615]	0.1572	[0.2615]
moderate compromise	0.2417	[0.2608]	0.2418	[0.2608]
strong compromise	0.3855	[0.2547]	0.3856	[0.2547]
Time x weak, ref. 1st half-year				
2nd half year	0.4170	[0.4158]	0.4171	[0.4158]
2nd year	0.3599	[0.4112]	0.3600	[0.4112]
Time x moderate, ref. 1st half-year				
2nd half year	0.2003	[0.4329]	0.2003	[0.4329]
2nd year	-0.0250	[0.4397]	-0.0249	[0.4397]
Time x strong, ref. 1st half-year				
2nd half year	0.2148	[0.4248]	0.2148	[0.4248]
2nd year	0.1483	[0.4290]	0.1484	[0.4290]
Constant	**-5.3569**	**[0.5664]**	**-4.6817**	**[0.2558]**
Largest FMI	0.2132		0.2120	
Average RVI	0.0209		0.0209	

Cluster robust S.E., 20 imputations, N(person-months) 77,808, values marked in bold are statistically significant at least at $p < 0.10$.

Chapter 6

Discussion

6.1 What have we learned?

The present dissertation investigated gender inequalities in young people's career decision-making process from a contextual perspective. It addressed two crucial stages of career decision-making: the formation of occupational expectations (the exploration phase) and the decision to remain in vocational education and training (the implementation phase).

Part I: Under which social and institutional contexts are gender-segregated career expectations formed?

The first part of the dissertation assessed the contextual variability of gendered career decision-making, analysing the extent to which school contexts (as socio-cultural spaces and opportunity structures) are associated with gender differences in STEM expectations. Both studies revealed that school contexts shape the size of the gender gap in young people's STEM expectations. **Chapter 2** showed that in classrooms characterized by high mathematical confidence and a high share of STEM-aspiring students, the gender gap in STEM expectations widens to the favour of male students. These results point out that schools function as comparative reference contexts that provide students' with relative cues about their abilities. Normative reference group effects pointed in an unexpected direction since female students expressed lower STEM expectations in the presence of STEM-aspiring classmates, irrespective of their classmates' gender. A positive effect from counter-stereotypical female role models was not supported. **Chapter 3** highlighted the role of upper secondary curricular tracks as opportunity structures to develop STEM expectations. It showed that attending advanced courses in mathematics, chemistry, and physics increased the STEM expectations of both male and female students. Although these influence effects were not gender-specific, results suggest that the aggregate gender gap in STEM expectations widens due to the gendered selection of advanced courses.

The first two studies show that school contexts are related to gender differences in students' STEM expectations, supporting the relevance of schools as social and institutional contexts for gendered career decision-making (Legewie & DiPrete, 2014). However, both studies point in different directions regarding the sensitivity of male and female students to contextual influences. These different findings may emerge because both studies differ in the school contexts under study. While the first study investigated the social composition of classrooms as normative and comparative frames of reference, the second study looked at a context that is characterized by both a different student composition and institutionally-embedded opportunity structures through more intense learning content. Furthermore, both studies relied on different age groups, i.e. students in grade 9 and students from grade 10 to 12. Research suggests that adolescents become more resistant to peer influence throughout adolescence, which could explain why the first study found gender-specific effects and the second did not (Steinberg & Monahan, 2007; Sumter et al., 2009). Finally, these differences could be attributed to the fact that the second study was restricted to the academic school track, which is characterized by more gender-egalitarian aspirations in comparison to vocationally oriented school tracks (Siembab & Wicht, 2020).

In line with Gottfredson (1981, 2002), these results confirm that gender is a central dimension in the formation of career expectations. Importantly, results suggest that gender differences in career expectations emerge in line with individuals' social and institutional embeddedness. Even when female students express idealistic aspirations for STEM occupations, they often do not translate these aspirations into expectations, as shown in Chapter 1. Chapter 2 adds a longitudinal perspective and shows that gendered career expectations are malleable to a certain extent, even at later stages in the life course. Overall, (gendered) career compromises and the adaption of expectations in line with social and institutional constraints is an essential aspect of the career decision-making process. These findings are in line with recent studies on the development of career aspirations and expectations (e.g. Kleinert & Schels, 2020; Schels & Abraham, 2021).

Part II: Through which social and institutional contexts are gendered dropout decisions formed?

The second part of this dissertation addressed whether gendered career decision-making is visible in the implementation phase of the career decision-making process. The association between occupations as social and institutional contexts and gendered dropout decisions was assessed. **Chapter 4** examined the dropout behaviour of gender-atypical apprentices, paying particular attention to self-reported dropout reasons. This study revealed that the gender type of an occupation constitutes an essential context for apprentices' dropout decisions. Irrespective of individual differences, minority gender students were more likely to quit their apprenticeships. Theoretically informative gender differences in the dropout reasons appeared: While female students were more likely to drop out due to a lack of social integration, male students dropped out because of unfulfilled aspirations and a lack of monetary returns. This study revealed the importance of social costs regarding the workplace climate that female gender minorities in male-dominated occupations often experience. Furthermore, results show that male gender minorities quit their apprenticeship because female-dominated occupations do not align with their vocational self-concept in general and their monetary preferences in particular. These findings support the theoretical mechanisms related to career values and social costs outlined in Chapter 1.3. Hence, occupations constitute meaningful institutional contexts that provide varying opportunities to fulfil young people's career preferences. These results feed into the discussion of gendered attrition and turnover that have mainly focused on later career stages (Madsen et al., 2021; Malin & Wise, 2018; Torre, 2014, 2017, 2018; Torre & Jacobs, 2021). Focusing on the very career entry, this subchapter complements previous findings by testing in more detail the theoretical mechanisms linked to dropout from gender-atypical occupations.

Chapter 5 investigated gendered processes in apprenticeship dropout from a different angle. It took up the finding from the previous study that dropout is often the result of unfulfilled aspirations. To this end, this chapter assessed how discrepancies between young people's pre-entry career expectations and their attained VET position related to their dropout decisions. This study again supported the role of occupations as socio-cultural contexts through which gender is constructed. Notably, both upward and downward gender type discrepancies were related to a higher dropout probability. These results support the view that occupations provide gendered working cultures and that occupations violating young people's gender identity (and social identity) will be abandoned (Cech, 2013).

Overall, both studies support the view that occupations do not only represent bundles of tasks and skills but must be understood as cultural and institutional contexts (Haupt & Ebner, 2020). First, results from both studies support the view of occupations as cultural spaces through which gendered identities and gender-typed working cultures are established. As such, results are consistent with the conception of career choice as "gendered self-expressions" (Cech, 2013). Second, results from Chapter 4 also feed into the institutional perspective, according to which occupations provide different resources, such as income and status, which are unequally distributed across male-dominated and female-dominated occupations (Busch, 2020; Damelang et al., 2018; Grønning et al., 2020).

6.2 Recommendations for Future Research

The present dissertation opens several avenues for future research. First, while the studies of this dissertation revealed that schools and workplaces are critical contexts under and through which gender-segregated career-decision making is reinforced, future research could unravel the underlying processes in more detail. For the first part of this dissertation, it would be interesting to see whether contexts have a direct influence on the development of (gendered) STEM expectations or whether the context effect is mediated via students' skill development, ability self-concepts or anticipation of social costs from peers. Testing these mechanisms could uncover further gender differences in the processes through which contextual influences operate.

Similarly, in the second part of this dissertation, the mechanisms that drive contextual influences could be examined in more detail. For example, future research could elaborate on the prospective experiences of apprentices that drive their dropout decisions. Although retrospective self-reported dropout reasons, as used in Chapter 4, give important insights into gendered attrition processes, these reasons may not accurately reflect apprentices' experiences due to recall bias or social desirability bias. Building on the finding that female apprentices in male-dominated occupations frequently related their dropout decision to social conflicts, a future research could separate i) gendered exposure to adverse social working climates and ii) gendered sensitivity to negative working climates of apprentices or employees in gender-atypical occupations. Relatedly, future research should examine whether the association between gender type compromises and dropout that emerged in Chapter 5 is mediated by perceptions of working cultures being incongruent with apprentices' gender conceptions, as proposed by our theoretical arguments.

It should also be noted that the second part of this dissertation cannot give a final answer to the question of whether gender segregation is reproduced through gendered dropout and switching behaviour. Both studies addressed apprentices' decision to quit their apprenticeship but not which occupational or educational pathways they followed afterwards. Due to data limitations, this question could not be addressed sufficiently. Future research is needed to trace the occupational trajectories of young people who enter vocational education and training and then decide to drop out. Assuming that career choices are guided by the match between vocational self-concept and occupation, gender-atypical dropouts are expected to switch to more gender-typical occupations that align with their career preferences and provide better opportunities for social integration. Similarly, it is expected that apprentices who drop out due to gender type discrepancies will switch to occupations more aligned with their gender identity.

Although this study revealed that career expectations are still malleable in secondary and upper secondary education and that students may revise their choices once again, students' aspirations and expectations were already highly gendered in grades 9 and 10. Only a small share of students expressed expectations of or entered gender-atypical occupations, showing that socialization in young people's earlier life course is an essential source of gender segregation. Future research could identify how gender-segregated career decisions are reproduced at earlier time points. Although subject-specific curricular differentiation is most strongly institutionalized at the upper secondary level in the German school system, individual subject choices are frequently already implemented at the beginning of secondary schooling. This involves, for example, the choice of computer science as an optional subject (Schwarz et al., 2021; Thomas & Yomayuza, 2014). Hence, future research could investigate whether students' early curricular profiles are associated with gendered career expectations in the long run.

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