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Methodology of Educational Measurement and Assessment

Sabine Weinert
Gwendolin Josephine Blossfeld
Hans-Peter Blossfeld *Editors*

Education, Competence Development and Career Trajectories

Analysing Data of the National Educational Panel Study (NEPS)

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Education, Competence Development and Career Trajectories

Analysing Data of the National Educational Panel Study (NEPS)

Springer

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Sabine Weinert
Gwendolin Josephine Blossfeld
Hans-Peter Blossfeld

Contents

1 Introduction – Education, Competence Development and Career Trajectories 1
Hans-Peter Blossfeld, Gwendolin Josephine Blossfeld, and Sabine Weinert

Part I Competence and Skill Development: Individual Characteristics, Learning Environments, and Contextual Factors

2 Quality of Early Learning Environments: Measures, Validation, and Effects on Child Development 27
Sabine Weinert, Manja Attig, Anja Linberg, Franziska Vogel, and Hans-Günther Rossbach

3 The Emergence of Gender-Specific Competence Patterns and Decision Making During the Course of Educational and Job Careers in Germany 59
Loreen Beier, Alessandra Minello, Wilfred Uunk, Magdalena Pratter, Gordey Yastrebov, and Hans-Peter Blossfeld

4 Patterns and Predictors of Literacy and Numeracy Development During Adulthood: Insights from Two Longitudinal Assessment Surveys 87
Clemens M. Lechner

5 The Interplay Between Instructional Pace, Skill Externalities, and Student Achievement: An Empirical Assessment 113
David Kiss

6 Addressing Environmental and Individual Factors in Early Secondary School: The Roles of Instruction Techniques and Self-Perception 131
Jeffrey M. DeVries, Carsten Szardenings, Philipp Doebler, and Markus Gebhardt

7 An Illustration of Local Structural Equation Modeling for Longitudinal Data: Examining Differences in Competence Development in Secondary Schools 153
Gabriel Olaru, Alexander Robitzsch, Andrea Hildebrandt, and Ulrich Schroeders

Part II Educational Transitions and Pathways: Influencing Factors and Outcomes

8 Inequality in Educational Transitions During Secondary School: Results from the German National Educational Panel Study 179
Florian Wohlkinger and Hartmut Ditton

9 Alternative Routes to Higher Education Eligibility: Inclusion, Diversion and Social Inequality on the Way to Higher Education 205
Steffen Schindler and Felix Bittmann

10 Dropping Out of Higher Education in Germany: Using Retrospective Life Course Data to Determine Dropout Rates and Destinations of Non-completers 225
Nicole Tieben

11 Studying Influences of Socio-economic Contexts and Spatial Effects on Educational Careers 249
Steffen Hillmert, Andreas Hartung, and Katarina Weßling

Part III Vocational Training and Labour Market

12 Low-Achieving School-Leavers in Germany: Who Are They and Where Do They Go? 273
Anne Christine Holtmann, Laura Menze, and Heike Solga

13 Occupational Sex Segregation and its Consequences for the (Re-)Production of Gender Inequalities in the German Labour Market 295
Corinna Kleinert, Kathrin Leuze, Ann-Christin Bächmann, Dörthe Gatermann, Anna Erika Hägglund, and Kai Rompczyk

14 Employment-Related Further Training in a Dynamic Labour Market 319
Silke Anger, Pascal Heß, Simon Janssen, and Ute Leber

15 Regional Factors as Determinants of Employees' Training Participation 337
Katja Görlitz, Sylvi Rzepka, and Marcus Tamm

Part IV Individuals with Migration Background

16 Is the First Language a Resource, an Obstacle, or Irrelevant for Language Minority Students' Education? 349
Aileen Edele, Julian Seuring, Kristin Schotte, Cornelia Kristen, and Petra Stanat

17 Ethnic Differences in Social Capital Mobilization at the Transition to Vocational Training in Germany 369
Tobias Roth and Markus Weißmann

18 Gendered Occupational Aspirations: A Comparison of Young Native-Born and Turkish Minority Women 403
Manuel Siegert, Tobias Roth, and Irena Kogan

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Chapter 1
Introduction – Education, Competence Development and Career Trajectories



Hans-Peter Blossfeld, Gwendolin Josephine Blossfeld, and Sabine Weinert

Abstract A lifespan perspective on development and education and corresponding longitudinal studies have long been proposed scientifically in many disciplines. However, even in the 2000s, little was known about education as a lifelong process or about the cumulative and interactive effects of learning that takes place in different educational settings across the lifespan and comprehensive longitudinal studies were rare. The German National Educational Panel Study (NEPS) was therefore designed to provide longitudinal data on educational trajectories and competence development from infancy to old age, and to make it possible to examine inter- and intraindividual changes and pathways in relation to family, educational institutions, workplaces, private life, and individual characteristics of the target persons. The data also addresses the institutions of the German educational system such as crèches and preschools, primary and secondary schools, vocational training, tertiary education, and opportunities of further learning in adulthood. It further enables the analysis of relevant monetary and non-monetary returns to education over the life course. The chapter briefly introduces important features of the multi-cohort sequence design of the NEPS and discusses the relevance of longitudinal data. Furthermore, it outlines Germany as a special case by introducing specific features of the German education system as well as some international comparative findings. Finally, an overview of the following chapters is given.

1.1 Introduction

A lifespan perspective on development and education and corresponding longitudinal studies have long been proposed scientifically in many disciplines (e.g., Baltes et al., 1980; Coleman, 1981; Elder Jr., 1974; Krupp, 2008; Mayer, 1990). However, even in the 2000s, little was known about education as a lifelong process or about the

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cumulative and interactive effects of learning that takes place in different educational settings across the lifespan and comprehensive longitudinal studies were rare. At that time, and after the so-called PISA (Program for International Student Assessment) shock in Germany, a National Educational Panel Study (NEPS) seemed a desirable tool to empirically investigate these issues and provide relevant data for national and international research. The nationally representative NEPS study was therefore designed to provide longitudinal data on educational trajectories and competence development from early childhood to old age, and to make it possible to examine inter- and intraindividual changes and pathways in relation to family, educational institutions, workplaces, private life, and individual characteristics of the target persons (Blossfeld & Rossbach, 2019). The data should also address the institutions of the German educational system such as crèches and preschools, primary and secondary schools, vocational training, tertiary education, and opportunities of further learning in adulthood. It should further enable the analysis of relevant monetary and non-monetary returns to education over the life course.

In July 2008, the German Research Foundation (DFG) approved both

- the establishment of the NEPS as a six-cohort panel study (see Fig. 1.1), which was originally funded by the German Federal Ministry of Education and Research (BMBF) and later located at the newly founded Leibniz Institute for Educational Trajectories (LIfBi) in Bamberg; and

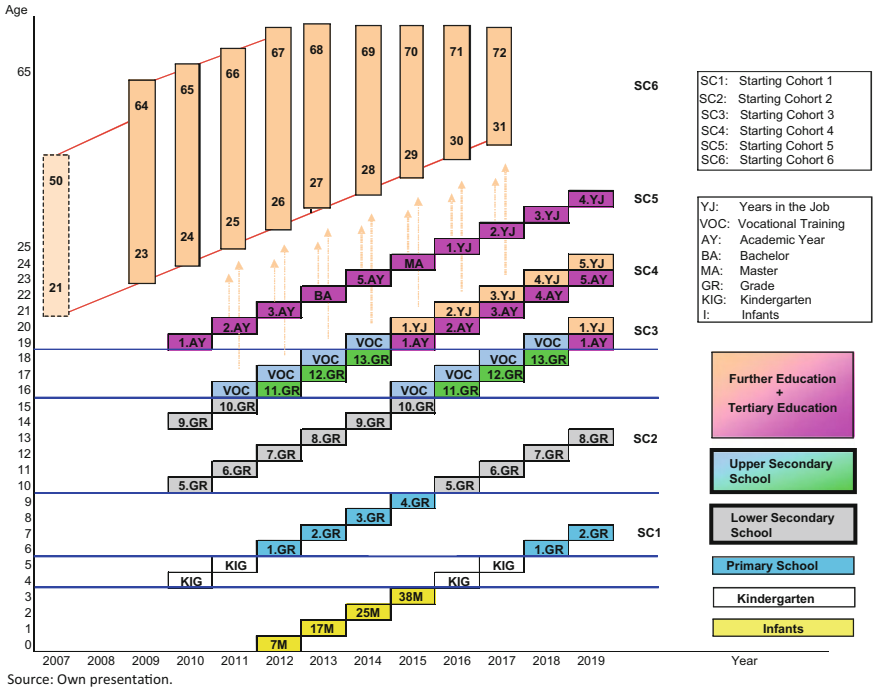


Fig. 1.1 The multicohort sequence design of the early NEPS. (Source: Own presentation)

- the setup of a DFG Priority Progamme (SPP 1646) 'Education as a Lifelong Process: Analyzing Data from the National Educational Panel Study (NEPS)' with the aim of using NEPS data, which were available to the international scientific community from early on, for the analysis of research questions as soon as possible.

Following approval by the DFG, the first wave of the NEPS Adult Cohort was conducted in 2009. In this dataset, retrospective data on the life histories of adults from the study 'Working and Learning in a Changing World' (ALWA) in 2007/08, were integrated into the NEPS design (see Fig. 1.1). In 2010, the first waves of preschool children aged about 4–5 years, secondary school children aged about 10 and 15 years, and first-year students at universities of applied sciences and traditional universities were surveyed in their educational institutions. In 2012/13, the NEPS was expanded to include a representatively drawn sample of newborns, with the first wave of the survey conducted in children's homes at about 7 months of age. Overall, about 60,000 target persons from these representative six starting cohorts were then followed up through annual sweeps. The annual panel surveys include competence tests and interviews with target persons and – at least for the younger cohorts – also interviews and questionnaires with parents and students' teachers and school principals as well as observational measures in the very early years. The NEPS database is an infrastructure facility for education and social sciences and each new wave of this panel study is made available to the scientific community as fast as possible (https://www.neps-data.de/Data-Center/Data-and-Documentation).

The main goal of the research programme of the DFG priority programme (SPP 1646) was to utilize the NEPS data for substantive analyses as quickly as possible, to test theoretical models from various disciplines (e.g., psychology, sociology, education, economics, migration and health research, and demography), and to gain insights into the development of competencies, the importance of learning environments, the processes of educational decision making, the particular constellations of competence acquisition/development among individuals with a background of migration, and the opportunities and risks of different educational pathways (https://spp1646.neps-data.de/). These processes could also be linked to data on monetary returns to education such as income trajectories, changes in job quality, occupational careers, and class mobility, as well as on non-monetary returns to education such as health status, family formation, demographic behaviour, socio-emotional, behavioural and personality development, social and political participation, and subjective well-being over the life course. As the dynamic analysis of educational processes has extremely accelerated in recent years (see Börsch-Supan et al., 2016), an important goal of SPP 1646 was also the development and application of advanced statistical methods for the analysis of (multilevel) longitudinal data (Blossfeld et al., 2016a).

This book presents results of 17 SPP 1646 research projects funded from 2012 to the present. It is organized as follows: After this introductory chapter discussing the strength of the NEPS longitudinal database for national and international research, the chapters presenting important findings of the SPP projects are divided into four thematic parts: (1) 'Competence and Skill Development: Individual Characteristics,

Learning Environments, and other Contextual Factors', (2) 'Educational Transitions and Pathways: Influencing Factors and Outcomes', (3) 'Vocational Training and Labour Market', and (4) 'Individuals with Migration Background'. The chapters thereby provide insights into education as a lifelong process from infancy until late adulthood.

1.2 The Relevance of Longitudinal Data for the Study of Education: Competence Development, Educational Pathways, and Careers Across the Life Course

In modern knowledge societies, education has become not only a key factor for individual productivity and economic growth, but also crucial for meeting the individual and societal challenges of a rapidly changing globalized world (Blossfeld et al., 2005). Moreover, in democratic societies, education is also an important prerequisite for active participation as reflective citizens (OECD, 2006). Equal educational opportunities for all social groups (such as social class, people with migration background, and gender) are therefore widely accepted as an important policy priority in all modern societies (OECD, 2006).

The results of the early PISA studies, however, have shown that large sections of German students at the end of their schooling were not only inadequately prepared for the challenges of a modern society, but the analyses also revealed a strong correlation between social background and competencies of students in Germany.

Cross-Sectional Versus Longitudinal Data Although several cross-sectional surveys such as PISA, the Trends in International Mathematics and Science Study (TIMSS), or the Progress in International Reading Literacy Study (PIRLS) in the 2000s provided important data on the distribution of students' competencies at the end of primary school and at age 15 in secondary school, they were merely individual snapshots reflecting the achievement situation at a particular age and are therefore of limited value in addressing the question of how educational outcomes were produced over time (Coleman, 1981). Thus, in the 2000s there was a strong desire to establish a study that collects longitudinal information on educational careers and competence development and traces individual trajectories over longer life spans (Börsch-Supan et al., 2016). The NEPS offers such data for Germany so that individuals' life history experiences in the past can be linked to their educational outcomes at later points in their lives so that one can better understand how those outcomes came about.

This longitudinal perspective has led to a crucial shift in the way educational researchers have approached issues of schooling, skills, competence, and attainment. It redirected attention on the processes of education and competence development and linked the changing institutional and social context to the unfolding of human learning in the life course (Baumert et al., 2014). It also serves as a bridge between psychological and sociological perspectives and between individual development and (changing) institutional and social contexts (Blossfeld & Rossbach, 2019).

Education as a Lifelong Process In the 2000s, educational researchers have also emphasized the need to integrate all educational phases over the life course in longitudinal designs. Thus, compared to traditional educational research that focused mainly on students in schools, vocational training institutions, or the university, there was a strong desire to collect also longitudinal data on the period before and after these educational institutions. The influential Perry Preschool study provided evidence that supporting children from less privileged families in preschool institutions has a positive long-term impact on outcomes in adult life (Heckman & Masterov, 2007). Thus, the NEPS integrated the first years of life in the family, in early extrafamilial childcare, and in preschool institutions into the longitudinal design. The other major concern has been to include the increasing importance of lifelong learning in the NEPS longitudinal study. For members of the modern information and service economy, learning does not end with the attainment of a degree in the general education system, the vocational training system or the higher education system. Rather, after school they are required to continuously acquire new knowledge and skills throughout their adult lives. Accordingly, the NEPS also collected data on adults' learning trajectories and competence development during their professional careers, personal adult lives, and even after retirement.

Conceptional Principles of Life Course Research The design of the NEPS was shaped by five conceptional principles of life course research, as formulated by Glen H. Elder Jr. et al. (2004) (see Blossfeld & Rossbach, 2019): (1) focusing on long-term educational processes over the individual lifespan (across all the stages of education as a lifelong process); (2) considering individual educational pathways within their institutional and social embeddedness (e.g., within not only formal educational institutions but also non-formal and informal contexts such as the family, peer groups, and other social networks); (3) analysing decision-making processes in education in relation to the idea of agency, planning by individuals and creative, self-determined actors; (4) investigating the relevance of the time structure and timing of educational events and transitions and the consequences they have for the subsequent educational chances, pathways and success; and (5) distinguishing important dimensions of time such as age, cohort, and period influences as well as the relevance of different places (regional contexts, Federal States in Germany, East and West Germany, or specific neighbourhoods, localities, and residences).

The *first life course principle* means that educational research focuses on long-term individual development over the lifespan in its descriptions and analyses. Although a bio-social and lifelong perspective on development and learning is widely accepted in developmental psychology, researchers have often worked with the concepts of stages, progression, growth, differentiation, and evolution when studying learning processes. The resulting emphasis is on systematic development pathways over time. An innovative theoretical (and methodological) feature of the NEPS is that it suggests and opens up the possibility to formulate and empirically evaluate developmental models that track competencies at different stages of education and across the lifespan. In this respect, the NEPS assesses domain-general cognitive functions, the dynamics of domain-specific cognitive competencies with a

special focus on German-language competencies and reading literacy in particular, mathematical literacy, and scientific literacy. Furthermore, meta-competencies such as information and communication technologies (ICT) literacy and facets of meta-cognition and self-regulation are assessed and complemented by indicators of general knowledge and facets of socio-emotional, behavioural and personality development. And finally, educational stage-specific measures, such as observational measures in infancy or curriculum- or job-related competencies and outcome measures are included.

Sociological life course approaches, while incorporating also notions of individual development such as aging and growth, emphasize the importance of contextual influences on the temporal course of individual development. Consequently, important aspects of educational careers are the time-varying educational contexts that foster or hinder learning and educational progress. Learning contexts can be formal (e.g., school, apprenticeship, college), non-formal (e.g., on-the-job training, courses offered by sports clubs, music schools, and child and youth services), or informal (e.g., peers, media). The family is a particularly important informal learning environment systematically captured in the NEPS.

For social scientists, education as a lifelong process is therefore highly age-differentiated, as age often formally influences the passage through educational institutions. Primary and secondary schools in Germany are strictly graded by age. Curricula prescribe a certain number of hours of instruction, courses must be completed in a specific order, and there are deadlines for obtaining certificates. In Germany, there is a more informal age structuring after compulsory schooling in vocational training, tertiary and continuing education, so that the timing of stages and transitions is less standardized. In these less standardized life stages, it is therefore important to examine how individuals self-regulate their educational development.

The movement of individuals through the education system is a central focus of the NEPS. The concept of the career is used to refer to an individual's sequence of roles in this process. Kerckhoff et al. (1996) have suggested that the concept of educational career should be considered synonymous with educational trajectory. The conceptual tool of trajectory encompasses sequences of different qualitative states as well as continuous increases or decreases in quantitative characteristics of, e.g., competence development or competence trajectory. Educational careers often depend strongly on the structural features of the educational and employment systems and thus draw attention to the ways in which opportunity structures shape individual careers. The NEPS traces individuals' careers and transitions from early childhood through crèche and preschool, elementary school, lower and upper secondary education, postsecondary education (including vocational education and training as well as university education), entry into the labour market, subsequent job careers, and entry into new activities after retirement.

Life course research also emphasizes that the events and conditions of earlier stages of education often have an impact on later educational processes and outcomes. Dannefer (1987) introduced the so-called Matthew effect to the life course literature. This effect means that initial educational inequalities become more

pronounced over the life course. The Matthew effect is sometimes referred to as the cumulative disadvantage/advantage hypothesis (O'Rand & Henretta, 1999). This cumulative effect seems to be particularly important in the case of continuing education, since earlier education, training and achieved degrees entail further learning. Educational research has paid relatively little attention to the challenges associated with describing and explaining long-term educational trajectories because longitudinal data over long periods of life have rarely been available.

The *second life course principle* concerns the interdependence of lives over time, particularly in the family, where individuals are connected across generations through kinship ties and processes of intergenerational transmission (Moen & Hernandez, 2009). The NEPS provides data on long-term relationships between parents and children and how these relationships influence the educational careers of children, adolescents, and adults over the life course.

The 'linked lives' principle also refers to important relationships outside the family. These include the interactive influences of institutions such as crèche, preschool and school, neighbourhoods, and peers. Preschool education and care institutions as well as schools are important organizations with which children come into contact, and they constitute a large part of most children's lives. In the school environment, knowledge is constantly tested, evaluated, and compared with other students, and children develop a sense of their intellectual efficacy. Research has shown that self-efficacy beliefs formed early in life tend to be self-fulfilling, either encouraging or discouraging students from taking risks and engaging in new and challenging tasks (Marsh et al., 2006). Schools also provide a conductive environment for the emergence of peer groups. Bandura (1997) noted that peers are the most important reference group in late childhood and adolescence because of similarities in age and experiences. The NEPS can be used to examine the role of such social networks, specifically how individuals' educational and vocational decisions are shaped by interactions with others.

The *third life course principle* means that agency in human development and the idea that planned behaviour and intentions can influence processes and outcomes in the life course. From a psychologist's perspective, the self is at the core of human agency. For instance, Bandura's (1982) social cognitive theory of self-efficacy views humans not simply as reactive beings influenced by external events, but as acting, self-regulating, creative, and proactive beings. Self-efficacy refers to the perception of oneself as a causal agent in one's environment. Such beliefs are an important basis of action and interaction throughout life. Individuals are active agents in shaping their lives and make choices within the constraints of institutional and sociohistorical structures.

In sociology, the idea of agency is closely linked to the so-called theories of methodological individualism and rational action theory – that is, theories that assume that the macrolevel aggregates of educational inequality have to be reconstructed via the educational and occupational choices that individuals make under conditions of uncertainty over the life course. The NEPS can be used to examine the extent to which educational decisions such as early or late enrolment in preschool and school, choice of a secondary school pathway, choice of a profession, choice of a study course, continuing education, or participation in further training vary across socio-economic

groups and gender. These differences in educational choices can be found even if the levels of competence are comparable and are partly moderated by state-specific regulations in Germany. The NEPS thus allows to analyse the importance of class-specific educational aspirations, motivations, expectations of success, and cost assessments. In addition, it provides data for examining gender-specific development of subject choices in educational trajectories (courses in school, types of vocational training, choice of studies at tertiary education).

The *fourth life course principle* emphasizes that developmental consequences of life transitions vary depending on their timing in a person's life. It recognizes that the impact of life events depends on when they occur in an individual's life. Therefore, it is necessary to recognize single and multiple risks associated with the timing of transitions. These transitions result from the fact that the educational system consists of different types of institutions. In Germany, decisions about educational transitions, once made, are often difficult to revise. The most 'vulnerable' phases in an educational career in Germany are (a) the time of entry into crèche or preschool and into the formal school system, (b) the time of transition to secondary school ('Hauptschule', 'Realschule', or 'Gymnasium'), (c) the time of transition from secondary school to vocational training, higher education or the employment system.

The *fifth life course principle* of time and place states that individuals' educational careers are embedded in specific historical times and places. Life course research has demonstrated the necessity of embedding individual lives in these social and historical contexts. Life-course researchers often refer to a set of mechanisms such as the age-period-cohort model of social change. The age effect in this model means that individuals change with age due to a combination of biological, psychological, and social mechanisms. The period effect states that all individuals - regardless of their specific stages in the life course - are affected similarly by the same time-historical conditions. Finally, the cohort effect refers to a persisting change across successive (birth) cohorts, as specific groups of individuals experience historical conditions at different critical life-course periods or transitions in their lives (e.g., changing transition rules from elementary to secondary school that increase or decrease the opportunities to move to upper secondary school (Gymnasium), or changing labour market conditions at the time of entry into vocational training). The cohort sequence design of the NEPS, which follows repeated cohorts over longer periods of their lives (see Fig. 1.1), provides an appropriate way to identify age, period, and cohort effects. In addition, modern multilevel modelling techniques allow researchers to specify more precisely the complexities of time and social environment for educational processes.

Educational Processes of Migrants Finally, migration processes have increased their importance for education in recent decades. Ethnic or national origin, migration biography and their contextualization (in particular, the language spoken in the family, relations to the country of origin, integration in ethnic communities and networks, religious orientations) are significantly related to educational choices and competence development beyond the mechanisms of social inequality. One focus of the NEPS is therefore the assessment of migrant students' knowledge and competencies in the language of their parents' country of origin. Majority and minority

language acquisition provide a major approach for explaining success in education and in the labour market. The NEPS initially focused on two migrant groups in Germany, migrants with a Turkish background and ethnic German immigrants from the former Soviet Union. However, NEPS also addresses new waves of migration in Germany in recent decades and their characteristics.

1.3 Germany as a Special Case

Cross-national comparative studies have shown that educational disparities by social background are still quite common across industrialized societies (Becker & Schulze, 2013; Blossfeld et al., 2016a; Breen & Müller, 2020; Duru-Bellat & Suchaut, 2005; Horn, 2009; Marks, 2005; Olczyk et al., 2021; Shavit & Blossfeld, 1993). However, these studies also demonstrate that the German education system is a particularly unequal institution. It is characterized by (1) a comparatively low participation of children under age 3 in preschool institutions, although this has changed somewhat in recent years, (2) the great importance of early tracking at age 10 or 12 (i.e. the assignment of students to different types of secondary schools, namely 'Hauptschule', 'Realschule', and 'Gymnasium'), (3) the strong stratification of the general school system that makes it difficult or even impossible to revise the early educational choices, (4) the relatively rigid 'dual system' that dominates the vocational training system, and (5) the comparatively low participation rates in formal or informal adult learning (see Blossfeld et al., 2014, 2015b, 2016b, 2017). Since the NEPS and the SPP 1646 projects in this book focus on Germany, we briefly discuss the specific features of the German education system as well as some international comparative findings.

Early Childhood Education and Care In Germany, investment in early childhood education was not on the political agenda until the 2000s, as parental care was seen as falling outside the scope of public policy. As a result, parents were regarded as largely responsible for passing on early competencies and knowledge to their own children. Nonetheless, in the early 2000s about 90% of a birth cohort in Germany attended preschool at the age 4–5 (Statistisches Bundesamt, 2008). Since several US longitudinal studies of children from very disadvantaged families have shown in the 2000s that early educational investments can effectively increase children's cognitive and socio-emotional skills and even change their long-term educational and labour market prospects (Barnett, 1995; Heckman, 2006), a massive reorientation of German public policy toward more formal childcare rapidly transformed the German preschool educational settings, especially for children under age 3. In particular, during the last 15 years, the growing demand for early child education and care (ECEC) for children under the age of three led to the enactment of laws and the expansion of childcare infrastructure for infants and children in Germany (see Weinert et al., 2016 for a brief description). Furthermore, in 2013, the legal right to institutional ECEC was expanded to include 1-year-old children. Accordingly, the

actual use of childcare for young children under the age of three rapidly changed in Germany: Between 2005 and 2013, the childcare rates for the under 3-year-olds increased from 7% to 23% in the Western states of Germany and from 36% to 47% in the Eastern states, which have their own distinct tradition and infrastructure concerning ECEC (Kreyenfeld & Krapf, 2016). In 2015, the nation-wide care rate amounted to 32.9% with mean values of 28.2% for the Western and 51.9% for the Eastern states (Statistisches Bundesamt, 2016). However, despite rising rates of early education, a child's family still is the first and often only environment for developmental processes during the first years of life. In particular, an early use of extrafamilial childcare is substantially related to the socio-economic status of the family (see below). With an attendance rate for 3- to 6-year-olds of 93.6% in Germany, almost every child in this age group has some ECEC experience. The rate for the under-3s is 33.1% (2.2% for 0- to 1-year-olds, 36.6% for 1-to 2-year-olds and 61.9% for the 2- to 3-year-olds; German Federal Statistical Office, 2017).

In a cross-national study, Blossfeld et al. (2017) examined families' childcare decisions, the role of early parental involvement and care for educational success and achievement gaps, and the consequences of early education and care for social inequalities in educational opportunities over the life course across 12 countries. This comparative study showed that not only does the availability and quality of childcare vary across countries (and over time), but there are also large cross-national differences in the diversity *of childcare options and services*. For instance, while early childhood education in the United States varies widely in quality (e.g., Vandell & Corasaniti, 1990) and is highly market based (Kamerman & Waldfogel, 2005), early childhood programs in Europe tend to be much more standardized through government regulation, and the services offered are more homogeneous and are provided more widely (Spiess et al., 2003). Nonetheless, the organizational characteristics of childcare systems vary considerably even within Europe due to diversity of country-specific social and educational policies.

The study by Blossfeld et al. (2017) first examined parental engagement, which focuses on physical care, the promotion of intellectual skills and social behaviour or, more generally, the investment of time and material resources in children. Results from the NEPS Newborn Cohort Study showed early associations between the family's socio-economic status (SES) and maternal interaction behaviour as well as a mutual interrelation between maternal and child behaviour in early mother-child interaction (Weinert et al., 2017) and allows insights into the early emergence of SES-related disparities in early child development (see also Attig & Weinert, 2020). Based on the cross-national comparison, it was concluded that in all analysed countries educational inequalities in the family are created and maintained very early in a child's life – long before school age. In a recent six country comparison study with harmonized data across countries, the home learning environment was the only measure that significantly explained SES-related gaps in all child outcomes and across all countries under study (Volodina et al., 2022).

In addition to parental care, the Blossfeld et al. (2017) study considered two other main forms of childcare: *informal and formal childcare*. Informal care includes a variety of actors who care for the child, such as grandparents, other relatives, friends,

neighbours, and babysitters. Formal childcare refers to institutional forms of care, such as public or private nurseries. The authors were particularly interested in whether and to what extent the decisions about different forms and times of childcare are influenced by maternal education, household wealth and income, as well as parental social class in different countries. The general results (including Germany) show that families with a lower social position rely more heavily on parental care, while families with a higher social position more often rely on formal or informal childcare. A general result is also that parents enrol their children earlier when the quality of institutional care is high and prefer to wait when the quality is low. Several country-specific case studies in Blossfeld et al. (2017) were able to assess the short and longer-term consequences of children's experiences of early formal care. For example, a German study on preschool children born in 2005/06 provided evidence that earlier enrolment in a centre or group-based care (day care centres, crèches, or playgroups) is associated with higher linguistic competencies at age five for all children (Dämmrich & Esping-Andersen, 2017). With respect to facets of socio-emotional development, the effects of very early ECEC are less clear and vary across different ECEC systems/characteristics (see e.g., Linberg et al., 2020). NEPS data allow to study the joint effects and interactions of the home learning environment and the use of ECEC while considering other influential factors (such as family structure, SES, health) for different outcome measures (e.g., Linberg et al., 2020) as well as for explaining the emergence of SES-related gaps in an international comparison (Volodina et al., 2022).

In Blossfeld et al. (2017), several country-specific studies examined also the role of the quality of preschool centres or the quality of specific programs in offsetting the early disadvantages of children from lower social background. They found a strong correlation between the quality of preschool institutions and the growth of cognitive and so-called 'non-cognitive' skills among disadvantaged children.

The main theoretical conclusions of the cross-national comparative study by Blossfeld et al. (2017) on the effects of early childcare drawn by the authors were: (1) that all young children benefit from early childcare (general elevator effect), (2) that disadvantaged children profit more than children from advantaged parental homes (interaction effect), and (3) that social achievement gaps between children from unequal social backgrounds (caused by the family effect) are only moderately reduced by attending early education and care institutions. The fast expansion of early childcare and education institutions in Germany since the early 2000s was therefore an important step forward. However, not only should access to formal childcare be improved at earlier age, but also quality of these services offered in these institutions should be ensured. In terms of the quality of preschools, Germany still ranks in the middle internationally.

Early Tracking After Primary School Blossfeld et al.'s (2017) country-specific studies on early childhood education and care have made it clear that students' academic performance at school entry is closely related to their family background in all countries. Schools in modern societies have two important goals: (1) to provide all students with a common foundation of competencies for full participation in

society and socio-economic life, and (2) to sort and select students according to their abilities and different life goals (Van de Werfhorst & Mijs, 2010). As a result, sooner or later in the school career in modern societies, students are sorted in different school types, educational tracks, achievement groups, curricula, or subjects (see Blossfeld et al., 2016b). In the literature, the two ideal-typical approaches to sorting in secondary education are described as tracking and comprehensive schooling. In countries with comprehensive school systems, students remain together until around age 16 and are offered different curricula, resulting in a complex differentiation of the educational landscape in these schools. Germany is a country with a traditionally rigid system of early tracking (at age 10 or 12) in the transition from primary to secondary school. This organizational feature of the German education system makes parents' school decisions and primary school teachers' (achievement-based) recommendations an important event in the school careers of German students. Research in sociology of education in Germany is therefore examining the role of students' academic performance and social background (or migration) characteristics for individuals' educational transition probabilities from primary to upper secondary school.

Stratification of Secondary Schools Despite increasing permeability between the main secondary school types in Germany ('Hauptschule', 'Realschule' and 'Gymnasium') in the last decades and a rising proportion of students attending comprehensive schools, early track assignment in the German secondary school remained difficult to revise (Blossfeld, 2018; Zielonka, 2017). Secondary school in Germany is still characterized by a comparatively high degree of stratification. Only after the successful acquisition of a lower secondary degree ('Hauptschulabschluss' or 'Mittlere Reife') is access to higher education opened up by the introduction of new second-chance educational pathways; for example through the establishment of specialized secondary schools (so-called 'Fachoberschulen' and 'Berufsoberschulen') and the introduction of professional colleges ('Fachhochschulen') next to the traditional universities (see Blossfeld et al., 2015a) in the German higher education system. Analysing the links between social background and pathways through traditional 'Gymnasium' and the various forms of second-chance education is a promising topic.

Vocational Training and Education Vocational training is organized very differently in modern societies (Blossfeld, 1992). It takes place in general schools, vocational schools, training centres, the so-called dual system, or in the form of simple on-the-job training at the workplace. The different forms of vocational training have different weight in national training systems. In France, for example, most vocational education takes place in the general educational system, while in the Netherlands and Sweden vocational training is mainly provided in vocational schools. In Italy, the United Kingdom and the United States many school leavers enter the workforce directly and acquire vocational qualifications through on-the-job training at the workplace. In Germany, Denmark, and other German speaking countries, the 'dual' apprenticeship system is the dominant type of vocational training leading to a clear institutional separation between general education and

vocational training. The 'dual system' combines in plant training with part-time vocational school.

The growing popularity of the German dual training system in industrialized countries is due to the fact that this system is able to offer a pragmatic compromise of theoretical learning in part-time schools and workplace-related experience for a large number of occupations. In this system vocational experiences are not only simulated in school but gained in the real work situations (Blossfeld, 1992). On the other hand, young people can also acquire a broader theoretical understanding of their occupational activities through more general education in part-time vocational schools, enabling them to behave flexibly as occupational requirements change rapidly over the working life and the lifespan of occupations is shortened.

Compared to other vocational training forms, the German dual system has an additional major advantage: It enables a large number of young people to make a smooth transition from the general school to the employment system because it serves as a bridge. This leads to comparatively low youth unemployment rates in the countries with a dual system (Blossfeld, 1992).

Empirical studies have shown that in Germany the proportion of unskilled workers in each generation is strongly linked to economic and demographic conditions at the time when young people are leaving school and seeking training. In times of economic crisis, the likelihood then increases that a high proportion of young people will not find a training place and will remain unskilled. In the German system it is however difficult for these unskilled workers to take up vocational training later in life, even if the macroeconomic situation has changed. As a result, the proportion of unskilled workers in these generations tends to remain stable throughout the rest of their working lives (Blossfeld, 1992). This is considered a great weakness of the German dual training system.

Another weakness is that in the course of educational expansion, upper secondary school and university degrees have become an increasingly important factor for access to higher-level, planning and managerial jobs and have devalued the experience of dual training and professional careers. In this way, vocational training in the dual system is threatened to lead to a dead end in career.

Adult Learning In modern globalized societies, it is becoming increasingly important to keep employees' skills constantly up to date throughout their professional and private lives. It is therefore no longer appropriate for education to take place exclusively at the beginning of the life course in preschools, schools and vocational training institutions. In most modern societies, the primary policy focus with regard to adult learning has therefore been to increase participation rates.

Blossfeld et al. (2014) used longitudinal data from 13 countries to examine cross-national patterns of participation in various adult education activities and their effects on individual labour market trajectories using a life course approach. They focused on labour market-related learning because of the central role of employment in modern societies and examined formal and non-formal adult learning. Formal adult education is learning that leads to recognized certificates that can also be earned along the typical educational career path and often takes place in formal

educational institutions. In contrast, non-formal adult education consists of (often) shorter training courses and is often at least partially sponsored by employers. Nevertheless, non-formal adult education can also be certified, but these certificates are not as widely recognized qualifications as those in formal education.

In Germany, the majority of individuals (about 70% in the sample) never re-enter any kind of structured and more formalized education or training after labour market entry. In cross-national comparison, in particular with Scandinavian countries, this is a relatively high proportion. Additionally, those 30% who receive education or training after their labour market entry mainly participated in occupation-specific training, which is usually certified. This fact is not surprising since the German labour market is well-known for holding certificates in high regard. It must be noted that such occupational training in adult life is mainly occupation-specific add-on training and hence does make it difficult for persons to change their occupational field. Instead, such training 'only' complements persons' initial vocational training certificates. Entries into educational programs that would allow persons to significantly upgrade their initial educational level (by aspiring to a higher secondary schooling degree or by entering tertiary education) are very rare once persons have left the educational system for more than 6 months. If such education programs are started at all, it is mainly very young people who (re)enter secondary or tertiary education. Those who are least qualified when they enter the labour market are also the least likely to receive valuable additional training afterward. Instead, the least skilled rely on welfare state-supported training programs, but these are not well recognized in the labour market. In fact, the German analyses show that participation in such welfare state-supported training programs does not improve the labour market situation, especially for men. All in all, these findings suggest that the German adult learning system prolongs and, in some cases, reinforces already existing social inequalities. Adult education in Germany is not able to substantially reduce already existing educational inequalities, as those who would need further education (i.e., individuals without vocational training) hardly receive any valuable further education afterwards.

The most consistent pattern found in the analyses of Blossfeld et al. (2014) is that of a cumulative advantage, in which those who are already better endowed also receive more learning opportunities in adult lives (Matthew effect; see Dannefer, 1987). One reason for this appears to be that the more highly educated are more trainable, meaning that each unit of training produces a larger increase in productivity for highly educated workers than for those with lower levels of education (Blossfeld et al., 2014). Moreover, the occupations in which high-skilled workers work are likely to require more training because they are knowledge-intensive and require knowledge and skills to be constantly updated, while low-skilled jobs may remain more stable in their required tasks but have a greater risk of becoming obsolete in the long run due to technological innovation (Blossfeld et al., 2014). Thus, adult education in general tends to replicate and reinforce the outcomes of initial education, especially in Germany. NEPS data will help to explore these issues further and across time.

1.4 The Structure of the Book

Based on the theoretical priorities of the NEPS, the projects of the SPP 1646 focused on central aspects of education as a lifelong process. The chapters provide an insight and overview of important results and serve as instructive examples of how new substantive insights into education as a lifelong process can be gained. The following structure organizes the 17 chapters into four thematic sections of the book.

The first part 'Competence and Skill Development: Individual Characteristics, Learning Environments, and other Contextual Factors' (six chapters) highlights the importance of differentiated measures of early learning environments, documents how students benefit from varied instructional styles and class composition, indicates that gender differences increase over the educational career with regard to chosen subjects, and shows how competencies develop across the lifespan. It also includes a chapter on a novel methodological approach to study educational achievement by combining longitudinal and local structural equation modeling.

The second part 'Educational Transitions and Pathways: Influencing Factors and Outcomes' (four chapters) shows how educational transitions in secondary school and transitions to and out of higher education depend on social origin. Furthermore, it is analysed and documented how contextual settings (neighbourhoods and regional contexts) are relevant for educational inequalities. Overall, this part confirms and provides insights into the complex relationships between socio-economic contexts and inequalities in education.

The third part 'Vocational Training and Labour Market' (four chapters) demonstrates that the potential of low-achieving school leavers often remains undiscovered and that they, as a result, often do not manage to enter vocational education (even several years after leaving school). Further results highlight that gender-specific employment trajectories are structured mainly by occupational preferences and characteristics. In addition, data on employees' decision to participate in further training is documented and explained by employers' financial support.

The last part, entitled 'Individuals With Migration Background' (three chapters), examines and discusses how educational success of immigrant children depends on their first language. It also suggests that the general motivation of non-institutional social contacts to provide support to students at the transition to vocational/educational training does not differ between natives and migrants. Finally, it indicates that Turkish girls have less gendered aspirations than native females. Addressing a broad range of educational stages and trajectories, the chapters provide insight into education as a lifelong process.

Chapter Overview The second chapter 'Quality of Early Learning Environments: Measures, Validation, and Effects on Child Development' by Sabine Weinert, Manja Attig, Anja Linberg, Franziska Vogel and Hans-Günther Rossbach shows that individual differences and disparities in educationally relevant competencies and skills evolve from the very beginning of a child's life. The chapter focuses on early learning environments as an important basis for the acquisition of competencies and skills that depend and impact on education. Based on the NEPS cohort of newborns

and additional validation studies, the authors address and empirically evaluate different quality measures of parenting behaviour and extra-familial childcare and their effects on early child outcomes. The findings highlight the importance of considering differentiated measures of the early learning environment from the outset, such as indicators of cognitive-verbal stimulation or emotional support from parents, as these are differently related to various domains of early childhood development. In addition, different facets of interaction quality are associated with socio-economic family characteristics (SES), but only moderately related to each other. Furthermore, the authors report on the validity and effects of quality measures of early external childcare in the NEPS cohort of newborns and discuss the emergence of individual differences and SES-related disparities in early childhood development.

The third chapter 'The Emergence of Gender-Specific Competence Patterns and Decision Making During the Course of Educational and Job Careers in Germany' by Loreen Beier, Alessandra Minello, Wilfred Uunk, Magdalena Pratter, Gordey Yastrebov and Hans-Peter Blossfeld shows that there are already gender differences in mathematical competencies at early preschool age, but contrary to the usual expectations in favour of girls. In primary school, the early gender-specific differences are then reinforced: boys perform better in mathematics and girls in German language. However, these relative advantages in the individual domains balance each other out, so that there are no significant differences in overall performance. As far as the transition from secondary school to vocational training or higher education is concerned, the data revealed some indications that young women among school leavers more often opt for vocational training than young men, while men more often than women opt for studies at a university for applied sciences. The authors did not find any gender differences with regard to entry to higher education: women are no less likely to seek access to higher education than boys with comparable grades. Finally, the results show the important role of mothers in shaping the educational attainment of their daughters. In summary, the expected cumulative differences between boys and girls and men and women over the life course seem to be consistent with the so-called Matthew effect hypothesis: The small gender differences at preschool age are getting bigger over the school career, not so much in terms of competence development, but in terms of the choice of school subjects and subjects of study in vocational training and tertiary education.

The fourth chapter 'Patterns and Predictors of Literacy and Numeracy Development During Adulthood: Insights From Two Longitudinal Assessment Surveys' by Clemens M. Lechner shows that literacy (reading competence) and numeracy (mathematical competence) are indispensable prerequisites for lifelong learning and participation in today's knowledge society. However, there is little evidence on the development of these competencies during adulthood. This chapter summarizes the main findings of a project that leveraged the unique potential of two German longitudinal assessment surveys, the NEPS and the 'Programme for the International Assessment of Adult Competencies – Longitudinal' (PIAAC-L), to garner insights into how these competencies develop during adulthood. Both surveys offer repeated measures of adults' competencies at 3–6 year intervals, which allows

the author to provide empirical evidence on two guiding questions: (1) Do literacy and numeracy skills still change in adulthood? If so, are the changes gains or losses, and how are the changes distributed across socio-demographic subgroups? (2) Which individual and contextual factors (e.g., participation in job-related training, engagement in literacy or numeracy practice, or basic cognitive skills) predict change in competence development? The findings suggest that skills develop across the lifespan and may even change over relatively short periods of time. Increases and losses occur in equal measure. Furthermore, the findings suggest that engagement in practice is a crucial factor in changing competencies, while emphasising that engagement in practice itself is dependent on a range of individual and contextual characteristics. The author also discusses methodological insights and avenues for future research that emerged from the project.

The fifth chapter entitled 'The Interplay Between Instructional Pace, Skill Externalities, and Student Achievement: An Empirical Assessment' by David Kiss validates a theoretical model from Kiss (2017) that addresses the transmission channels in which an increase in peer achievement can affect the achievement of other students. In this model, a higher proportion of better students has two effects: First, weaker students benefit from skill externalities generated by their better classmates. Second, the better students induce teachers to instruct at a more demanding pace. Based on these two mechanisms, the author derives three hypotheses and tests them using NEPS data on German secondary school students. The empirical findings are consistent with the predictions of the model: Increases in the proportion of better classmates is (a) always beneficial for good students, (b) can have a detrimental effect on weak students, and (c) increases the performance of weak students when the level of interaction between better and weaker students is high. Taken together, these empirical results suggest that encouraging better and weaker students to interact more may be a Pareto improvement.

The sixth chapter 'Addressing Environmental and Individual Factors in Early Secondary School: The Roles of Instruction Techniques and Self-Perception' by Jeffrey M. DeVries, Carsten Szardenings, Philipp Doebler and Markus Gebhardt examines the risk factors for academic performance, such as lower socio-economic status, migrant status, and the presence of special education needs. Learner self-concept, instructional techniques, and classroom size can mediate these risk factors. As these factors vary widely, a comprehensive approach is needed to examine the role of these factors. This chapter includes two NEPS analyses that examined teaching styles and the moderating role of self-concept and self-esteem as well as different sets of risk factors. Group work related to better outcomes for second-language learners in mathematics and reading, while discussions were associated with poorer outcomes in mathematics for the same group. In addition, self-concept and self-esteem were shown to mediate the effects of gender, special education needs, and nonverbal reasoning on both reading and mathematics literacy.

The seventh chapter 'An Illustration of Local Structural Equation Modeling for Longitudinal Data: Examining Differences in Competence Development in Secondary Schools' by Gabriel Olaru, Alexander Robitzsch, Andrea Hildebrandt and Ulrich Schroeders offers a new approach to study inter-individual differences in educational

development. It describes how a combination of longitudinal and local structural equation modeling (LSEM) can be used to study how students' context influences their growth in educational achievement. LSEM is a nonparametric approach that allows for the moderation of a structural equation model over a continuous variable (e.g., socio-economic status, cultural identity, age). Thus, it does not require the categorization of continuous moderators as applied in multi-group approaches. Unlike regression-based approaches, it does not impose a particular functional form (e.g. linear) on mean differences and can reveal differences in variance-covariance structure. LSEM can be used to detect nonlinear moderation effects, to investigate sources of measurement invariance violations, and to study moderation effects on all parameters in the model. The authors show how LSEM can be implemented with longitudinal NEPS data using the R-package *sirt* written by the authors. The chapter examines the impact of parental education on mathematics and reading literacy in secondary school across three measurement time points and compare LSEM with regression-based approaches and confirmatory multi-group factor analysis. The results provide further evidence of the strong influence of the educational background of the family.

The eighth chapter 'Inequality in Educational Transitions During Secondary School: Results From the German National Educational Panel Study' by Florian Wohlkinger and Hartmut Ditton examines the transitions between different types of secondary schools. This so-called 'openness' of the German education system is supposed to enable a correction of misallocated pupils and thereby support children's delayed improvement in academic performance. Both transition directions are feasible: downward movements from upper to lower secondary school form and upward movements from the lower to upper types of secondary school. The aim of this study is to determine whether transitions in secondary schooling show patterns of social selectivity. Using data from the NEPS, the authors provide an overview of the initial distribution of students across different types of secondary schools. They then distinguish different transitions taking into account the initial secondary school type and compare the various subgroups with regard to various influencing factors known to be associated with educational inequalities. The empirical results show that secondary school transitions are related to students' social background and gender even when controlling for performance.

The ninth chapter 'Alternative Routes to Higher Education Eligibility: Inclusion, Diversion, and Social Inequality on the Way to Higher Education' by Steffen Schindler and Felix Bittmann shows that the expansion of alternative pathways leading to an higher education entry certificate, which dates back to the reforms of the 1960s, has been largely ineffective in reducing social inequality in access to higher education. The authors argue that this is partly due to unintended effects of the expansion of alternative pathways that resulted in diversion processes among students from disadvantaged social origin. These diversion effects channel students from disadvantaged background into non-academic secondary school tracks and expose them to learning environments that differ from those of the academic school track. The chapter provides empirical evidence that these learning environments

influence students' educational aspirations and cognitive development in ways that eventually reduce their chances of attaining higher education.

The tenth chapter 'Dropping Out of Higher Education in Germany: Using Retrospective Life Course Data to Determine Dropout Rates and Destinations of Non-completers' by Nicole Tieben disentangles non-completion and dropout of full-time students in higher education using longitudinal NEPS data. The author discusses the methodological challenges of conventional approaches and shows how the advantages of retrospective life course data can be used for higher education research. She examines the destinations of non-completers and dropouts as well as the labour market returns of dropouts, using sequence data analyses and multinomial logistic regressions. The results show that conventional designs possibly are prone to overestimate dropout rates. Longitudinal analyses of post-dropout destinations show that permeability between vocational training and higher education is bidirectional. Vocational training is a relevant absorber of higher education dropouts, but at the same time, vocational qualifications acquired prior to higher education act as safety net buffering labour market risks of dropouts.

The eleventh chapter 'Studying Influences of Socio-economic Contexts and Spatial Effects on Educational Careers' by Steffen Hillmert, Andreas Hartung and Katarina Weßling focusses on the socio-economic and spatial context effects in education. The authors develop concepts and methodological procedures for analysing spatial contexts. They measure the impact of socio-structural contextual characteristics on aspirations and transition opportunities and collect and prepare relevant contextual data. For certain phases of the educational career, the authors are able to demonstrate that contextual settings (neighbourhoods and regional contexts) are relevant for educational inequalities. The research project also shows that the relationship between socio-economic contexts and inequalities in education is complex, and the researchers develop strategies to deal with temporal, spatial, and interpersonal variation in contextual effects on educational attainment.

The twelfth chapter 'Low-Achieving School-Leavers in Germany – Who Are They and Where Do They Go?' by Anne Christine Holtmann, Laura Menze and Heike Solga analyses school-leavers with a lower secondary school leaving certificate or less who are at risk of being left behind. In a first step, the authors compare the parental resources as well as the cognitive and non-cognitive skills of these school-leavers with those with an intermediate school leaving certificate. In a second step, they then investigate whether these low achievers can improve their educational attainment after general school by either catching up on school-leaving qualifications or starting vocational training. In a third step, the authors analyse transitions from school to vocational education by conducting a sequence analysis. Based on NEPS data, they show that low-achieving school-leavers are on average not as well equipped with agency and social resources as other groups but that they represent a rather heterogeneous group. Many of these school-leavers have similar cognitive and non-cognitive skills as school-leavers with an intermediate school leaving certificate, who usually succeed in entering vocational training. However, this potential often remains undiscovered because a considerable proportion of low-achievers does not improve their school certificates and are unable to enter

vocational training even several years after leaving school. The authors also show that transition patterns vary by school type, with pupils from special needs schools being particularly disadvantaged compared to pupils from regular schools.

The thirteenth chapter 'Occupational Sex Segregation and its Consequences for the (Re-)Production of Gender Inequalities in the German Labour Market' by Corinna Kleinert, Kathrin Leuze, Ann-Christin Bächmann, Dörthe Gatermann, Anna Erika Hägglund and Kai Rompczyk deals with the occupational link between the educational system and the labour market. In theory, this occupational link is gender-neutral, as both women and men are channelled into jobs according to the occupations for which they are trained. In practice, however, this means that patterns of occupational sex segregation in the education system are perpetuated in the labour market. As a result, occupational sex segregation has a significant impact on women's and men's subsequent employment biographies and life courses. In this chapter, the authors examine the relevance of occupational sex segregation for the (re-)production of gender inequalities in the German labour market. More specifically, they examine long-term trends in occupational sex segregation, how occupational sex segregation is linked to other occupational characteristics, how these occupational characteristics translate into gender inequalities regarding non-monetary labour market outcomes, and how these occupational characteristics influence the gender wage gap.

The fourteenth chapter 'Employment-Related Further Training in a Dynamic Labour Market' by Silke Anger, Pascal Heß, Simon Janssen and Ute Leber examines the changing demand for skills and knowledge due to the accelerating technological progress and increasing international trade. As a result, workers have had to continuously invest in training to update their skills, if they wanted to avoid long-term negative consequences for their careers. This project uses data from the NEPS adult cohort to investigate how the participation of workers in continuing education evolves in dynamic labour markets exposed to technological change and increasing international trade. The study analyses the relationship between workplace automation and employment-related training and shows that the training participation of workers whose jobs were highly affected by automation was much lower than the training participation of workers whose jobs were less affected. Moreover, the results suggest that employers' financial support explains most of the training gap. In line with the new training literature, companies are the main driver of training investment.

The fifteenth chapter 'Regional Factors as Determinants of Employees' Training Participation' by Katja Görlitz, Sylvi Rzepka and Marcus Tamm highlights the importance of generally neglected regional factors for training. Regional factors have often been neglected because (both in Germany and abroad) many data sets that contain training information do not include detailed geographical identifiers that would allow a merging of information on the regional level. The regional identifiers of the NEPS adult cohort offer the opportunity to advance research on various regional factors. This chapter summarizes the results of two studies that investigate the relationship between training participation and (a) the local level of competition among firms for workers within specific sectors of the economy and (b) the regional

supply of training measured as the number of firms offering courses or seminars to potential training participants.

The sixteenth chapter 'Is the First Language a Resource, an Obstacle, or Irrelevant for Language Minority Students' Education?' by Aileen Edele, Julian Seuring, Kristin Schotte, Cornelia Kristen and Petra Stanat studies the integration of immigrants and their children in the education system. For this integration, language is generally seen as an important factor. While there is widespread agreement that the language of the country of residence (L2) is crucial for students' educational success, the importance of the language of the country of origin (L1) is disputed. This chapter takes an interdisciplinary perspective and uses NEPS data. It focusses on the role of the L1 in the educational success of immigrants and their children and examines whether the L1 serves as a resource or a barrier, or whether it is largely irrelevant.

The seventeenth chapter 'Ethnic Differences in Social Capital Mobilization at the Transition to Vocational Training in Germany' by Tobias Roth and Markus Weißmann offers an in-depth analysis of the differences between students with and without a migration background in Germany in mobilising social capital during the transition to vocational education and training after lower secondary education. In addition to retrospective information, the authors also analyse (hypothetical) prospective information. They also distinguish between different types of social contacts and support. Using data from the first five waves of NEPS Starting Cohort 4, the authors find that students rely heavily on their social contacts, with parents playing the most important role. In terms of general information and support, they find only small ethnic differences in the mobilization of non-institutional social contacts. In contrast, adolescents with a migration background tend to receive less specific support from relatives outside the nuclear family and significantly less from parents. The results suggest that the general motivation of non-institutional social contacts to support the transition to vocational training does not differ between natives and migrants, but that the ability of these ties to provide more specific, instrumental support depends on their host-country-specific resources and thus on their migration history.

The eighteenth and final chapter 'Gendered Occupational Aspirations: A Comparison of Young Native-Born and Turkish Minority Women' by Manuel Siegert, Tobias Roth and Irena Kogan shows that women with a migration background represent a growing share of the German population, but a disproportionately low share of the total labour force. The authors examine the gender-specific occupational preferences of female adolescents with a Turkish migration background in comparison to adolescents without a migration background and relate these preferences to the young women's interests, family orientations, normative gender role perceptions, and the socio-economic status of the desired occupation. The results indicate that Turkish girls are less likely to aspire female-dominated occupations than majority native-born girls. Instead, they prefer integrated occupations that tend to be more prestigious and better paid. This could be mainly due to their ambitious career aspirations, as the difference between native and Turkish girls decreases significantly when controlling for career aspirations.

References

Attig, M., & Weinert, S. (2020). What impacts early language skills? Effects of social disparities and different process characteristics of the home learning environment in the first two years. *Frontiers in Psychology, 11*, 557751. https://doi.org/10.3389/fpsyg.2020.557751

Baltes, P. B., Reese, H. W., & Lipsitt, L. P. (1980). Life-span developmental psychology. *Annual Review of Psychology, 31*, 65–110.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*, 122–147.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. Freeman.

Barnett, W. S. (1995). Long-term effects of early childhood programmes on cognitive and school outcomes. *The Future of Children, 5*(3), 25–50.

Baumert, J., Blossfeld, H.-P., Cremer, T., Friederici, A. G., Hasselhorn, M., Kempermann, G., Lindenberger, U., Meisel, J., Nöthen, M. M., Röder, B., Rösler, F., Spinath, F., Spieß, C. K., Stern, E., & Trommsdorff, G. (2014). *Socialisation in early childhood. Biological, psychological, linguistic, sociological and economic perspectives*. German Academy of Sciences Leopoldina.

Becker, R., & Schulze, A. (Eds.). (2013). *Bildungskontexte. Strukturelle Voraussetzungen und Ursachen ungleicher Bildungschancen*. VS Verlag für Sozialwissenschaften.

Blossfeld, H.-P. (1992). Is the German dual system a model for a modern vocational training system? A cross-national comparison of how different systems of vocational training deal with the changing occupational structure. *International Journal of Comparative Sociology, 33*(3–4), 168–181.

Blossfeld, P. N. (2018). *Changes in inequality of educational opportunity. The long-term development in Germany*. Springer VS.

Blossfeld, H.-P., & Rossbach, H.-G. (Eds.). (2019). *Education as a lifelong process: The German National Educational Panel Study (NEPS)*. Springer.

Blossfeld, H.-P., Klijzing, E., Mills, M., & Kurz, K. (2005). *Globalization, uncertainty and youth in society*. Routledge.

Blossfeld, H.-P., Kilpi-Jakonen, E., Vono de Vilhena, D., & Buchholz, S. (2014). *Adult learning in modern societies: An international comparison from a life-course perspective* (eduLIFE lifelong learning series) (Vol. 1). Edward Elgar Publishing.

Blossfeld, P. N., Blossfeld, G. J., & Blossfeld, H.-P. (2015a). Educational expansion and inequalities in educational opportunity: Long-term changes for East and West Germany. *European Sociological Review, 31*, 144–160.

Blossfeld, H.-P., Skopek, J., Triventi, M., & Bucholz, S. (2015b). *Gender, education and employment: An international comparison of school-to-work transitions* (eduLIFE lifelong learning series) (Vol. 2). Edward Elgar Publishing.

Blossfeld, P. N., Blossfeld, G. J., & Blossfeld, H.-P. (2016a). Changes in educational inequality in cross-national perspective. In M. Shanahan, J. Mortimer, & M. Kirkpatrick Johnson (Eds.), *Handbook of the life course* (pp. 223–247). Springer. https://doi.org/10.1007/978-3-319-20880-0_10

Blossfeld, H.-P., Buchholz, S., Skopek, J., & Triventi, M. (Eds.). (2016b). *Models of secondary education and social inequality. An international comparison*. Edward Elgar Publishing.

Blossfeld, H.-P., Kulic, N., Skopek, J., & Triventi, M. (Eds.). (2017). *Childcare, early education and social inequality. An international perspective*. Edward Elgar Publishing.

Börsch-Supan, A., Siegrist, J., Blossfeld, H.-P., Breteler, M., Brüderl, J., Doblhammer-Reiter, G., Hoffman, W., Mayer, K. U., Rammstedt, B., & Wagner, G. (2016). *The relevance of population-based longitudinal studies for science and social policies*. Deutsche Akademie der Wissenschaften Leopoldina.

Breen, R., & Müller, W. (2020). *Education and intergenerational social mobility in Europe and the United States*. Stanford University Press.

Coleman, J. S. (1981). *Longitudinal data analysis*. Basic Books.

Dämmrich, J., & Esping-Andersen, G. (2017). Pre-school and reading competencies - A cross national comparison. In H.-P. Blossfeld, N. Kulic, J. Skopec, & M. Triventi (Eds.), *Childcare, early education and social inequality. An international perspective* (pp. 133–151). Edward Elgar Publishing.

Dannefer, D. (1987). Aging as intercohort differentiation: Accentuation, the Matthew effect, and the life course. *Sociological Forum, 2*, 211–236.

Duru-Bellat, M., & Suchaut, B. (2005). Organisation and context, efficiency and equity of educational systems: What PISA tells us. *European Educational Research Journal, 4*, 181–194.

Elder, G. H., Jr. (1974). *Children of the great depression: Social change in life experience*. University of Chicago Press.

Elder, G. H., Jr., Johnson, M. K., & Crosnoe, R. (2004). The emergence and development of life course theory. In J. T. Mortimer & M. J. Shanahan (Eds.), *Handbook of the life course* (pp. 3–19). Springer.

German Federal Statistical Office. (2017). *Kindertagesbetreuung regional 2016: Ein Vergleich aller 402 Kreise in Deutschland*. Federal Statistical Office.

Heckman, J. J. (2006). Skill formation and the economics of investing in disadvantaged children. *Science, 312*(5782), 1900–1902.

Heckman, J. J., & Masterov, D. V. (2007). The productivity argument for investing in young children. *Review of Agricultural Economics, 29*, 446–493.

Horn, D. (2009). Age of selection counts: A cross-country analysis of educational institutions. *Educational Research and Evaluation, 15*, 343–366.

Kamerman, S. B., & Waldfogel, J. (2005). Market and non-market institutions in early childhood education and care. In R. Nelson (Ed.), *Market and non-market institutions* (pp. 185–212). Russell Sage Foundation.

Kerckhoff, A. C., Fogelman, K., Crook, D., & Reeder, D. (1996). *Going comprehensive in England and Wales: A study of uneven change*. Woburn Press.

Kiss, D. (2017). A model about the impact of ability grouping on student achievement. *Journal of Economic Analysis & Policy, 17*(3), 20170036. https://doi.org/10.1515/bejeap-2017-0036

Kreyenfeld, M., & Krapf, S. (2016). Soziale Ungleichheit und Kinderbetreuung—Eine Analyse der sozialen und ökonomischen Determinanten der Nutzung von Kindertageseinrichtungen. In R. Becker & W. Lauterbach (Eds.), *Bildung als Privileg* (pp. 119–144). Springer.

Krupp, H.-J. (2008). Die Anfänge: Zur Entstehungsgeschichte des SOEP. *Vierteljahrshefte zur Wirtschaftsforschung, 77*(3), 15–26. https://doi.org/10.3790/vjh.77.3.15

Linberg, A., Burghardt, L., Freund, J.-D., & Weinert, S. (2020). Differential effect of duration of early childcare under the age of three on socio-emotional outcomes. *Early Child Development and Care, 190*, 2505–2519. https://doi.org/10.1080/03004430.2019.1588891

Marks, G. N. (2005). Cross-national differences and accounting for social class inequalities in education. *International Sociology, 20*, 483–505.

Marsh, H. W., Hau, K.-T., Artelt, C., Baumert, J., & Peschar, J. L. (2006). OECD's brief self-report measure of educational psychology's most useful affective constructs: Cross-cultural, psychometric comparisons across 25 countries. *International Journal of Testing, 6*, 311–360.

Mayer, K. U. (1990). Lebensverläufe und sozialer Wandel. Anmerkungen zu einem Forschungsprogramm. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 31*, 7–21.

Moen, P., & Hernandez, E. (2009). Social convoys: Studying linked lives in time, context, and motion. In G. H. Elder Jr., & J. Z. Giele (Eds.), *The craft of life course research* (pp. 258–279). The Guilford Press.

O'Rand, A. M., & Henretta, J. C. (1999). *Age and inequality: Diverse pathways through later life*. Westview.

OECD. (2006). *Assessing scientific, reading and mathematical literacy: A framework for PISA*. https://doi.org/10.1787/19963777

Olczyk, M., Schneider, T., Washbrook, E., Akabayashi, H., Boinet, C., de la Rie, S., Kameyama, Y., Keizer, R., Nozaki, K., Panico, L., Perinetti Casoni, V., Shikishima, C., Solaz, A.,

Volodina, A., Yamashita, J., Waldfogel, J., & Weinert, S. (2021). *National context and socioeconomic inequalities in educational achievement – An overview of six high-income countries: France, Germany, Japan, The Netherlands, United Kingdom, and United States* (p. 267). Ined, Document de travail.

Shavit, Y., & Blossfeld, H.-P. (1993). *Persisting inequality. Changing educational attainment in thirteen countries*. Westview Press.

Spiess, K. C., Büchel, F., & Wagner, G. G. (2003). Children's school placement in Germany: Does kindergarten attendance matter? *Early Childhood Research Quarterly, 18*(2), 255–270.

Statistisches Bundesamt. (2008). *Datenreport 2008: Ein sozialbericht für die bundesrepublik deutschland*. Wiesbaden.

Statistisches Bundesamt. (2016). *Kindertagesbetreuung regional 2015*. Statistisches Bundesamt.

Van de Werfhorst, H. G., & Mijs, J. B. (2010). Achievement inequality and the institutional structure of educational systems: A comparative perspective. *Annual Review of Sociology, 36*, 407–428.

Vandell, D. L., & Corasaniti, M. A. (1990). Variations in early child care: Do they predict subsequent social, emotional, and cognitive differences? *Early Childhood Research Quarterly, 5*, 555–572.

Volodina, A., Weinert, S., Washbrook, E., Waldfogel, J., Jiyoon Kwon, S., Wang, Y., & Perinetti Casoni, V. (2022). Explaining gaps by parental education in children's early language and social outcomes at age 3–4 years: Evidence from harmonised data from three countries. *Current Psychology*. https://doi.org/10.1007/s12144-022-03754-z

Weinert, S., Linberg, A., Attig, M., Freund, J.-D., & Linberg, T. (2016). Analyzing early child development, influential conditions, and future impacts: Prospects of a German newborn cohort study. *International Journal of Child Care and Education Policy, 10*, 1–20. https://doi.org/10.1186/s40723-016-0022-6

Weinert, S., Attig, M., & Rossbach, H.-G. (2017). The emergence of social disparities – Evidence on early mother–child interaction and infant development from the German National Educational Panel Study (NEPS). In H.-P. Blossfeld, N. Kulic, J. Skopek, & M. Triventi (Eds.), *Childcare, early education, and social inequality: An international perspective* (pp. 89–108). Edward Elgar Publishing.

Zielonka, M. (2017). *Revision und Stabilisierung von Schulwahlentscheidungen in der Sekundarstufe 1*. Logos.

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Part I
Competence and Skill Development: Individual Characteristics, Learning Environments, and Contextual Factors

Chapter 2
Quality of Early Learning Environments: Measures, Validation, and Effects on Child Development



Sabine Weinert, Manja Attig, Anja Linberg, Franziska Vogel, and Hans-Günther Rossbach

Abstract Individual differences and disparities in educationally relevant competencies and skills evolve from the very beginning of a child's life. This chapter focuses on early learning environments as an important basis for acquiring those competencies and skills that depend and impact on education. Drawing on the Newborn Cohort Study of the German National Educational Panel Study (NEPS-SC1) and additional validation studies, we address and empirically evaluate different quality measures of parenting behaviour and extrafamilial childcare along with their effects on early child outcomes. Results highlight the importance of considering differentiated measures of early learning environments such as indicators of cognitive-verbal stimulation or parental responsive emotional support from the very beginning, because these relate differentially to various domains of early child development. Furthermore, although different facets of interaction quality are associated with socio-economic family characteristics (SES), they relate to each other only moderately. In addition, we report on the validity and effects of quality measures of early external childcare in the NEPS-SC1 and discuss the emergence of individual differences and SES-related disparities in early child development.

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2.1 Relevance, Results, and Challenges of Research on Early Childhood Education and Development

Education and the development of educationally relevant competencies start well before formal schooling (Belsky et al., 2007). Both developmental and educational research extensively substantiate the assumption that important individual differences arise from the very beginning and are influenced, from early on, by a wide range of internal and external factors as well as by dynamic interactions between these factors (e.g., Bronfenbrenner & Morris, 2006; Thelen & Smith, 2006). Theoretical models such as the bioecological framework of development (Bronfenbrenner & Morris, 2006) highlight the coaction of children's (developing) characteristics with various processes in proximal learning environments and more distal influencing factors including structural and orientational characteristics of the family and external childcare institutions, their interrelations, and the effects of exo- and macrosystems in societies.

Longitudinal studies tracing the development of children and influencing factors from early on allow us to explore the effects of early childhood education along with the early roots of and mechanisms underlying the emergence and consolidation of individual differences and social disparities in those competencies and skills that depend and impact on education and educational careers (e.g., Weinert et al., 2017; Weinert & Ebert, in press). Yet, when conducting large-scale panel studies on early child development and influencing factors, major challenges have to be met. These are especially pronounced when the very early phases of development are considered (see Weinert et al., 2016). Thus, the present chapter addresses substantive research questions on, for example, the dimensional structure and effects of early educational processes (e.g., parental interaction behaviour), as well as methodological issues such as the validity of quality measures of early learning environments.

2.1.1 Theoretical and Empirical Background and Research Questions

Some Important Results on the Emergence and Stabilization of Individual Differences and Social Disparities From an empirical point of view, developmental disparities related to family background characteristics such as socio-economic status (SES, as indicated by, e.g., parental education, occupation, and/or family income) have been documented in the very early preschool years and even in infancy (Attig & Weinert, 2020; Fernald et al., 2013; Halle et al., 2009; Hart & Risley, 1995; Law et al., 2019). For instance, substantial SES-related disparities were found in the

German BiKS-3-18 study.[1] Amongst others, results of this study documented significant disparities according to family background particularly in children's early language skills and their domain-specific knowledge (factual content knowledge; early mathematical skills) already at the age of 3 years shortly after entering preschool (Dubowy et al., 2008; Kurz et al., 2008). This result holds across many countries and for various competence domains (e.g., Elliott & Bachman, 2018; Hart & Risley, 1995; Hoff, 2006). Furthermore, and despite developmental growth, study results have demonstrated a high level of stability not only in skill differences (Weinert et al., 2010) but also in the observed disparities related to family background characteristics (Weinert & Ebert, 2013, 2017, in press for overviews). In addition, and in line with international findings, significant and long-lasting effects of both the home learning environment (at least partially via child development, see Ebert et al., 2020; Lehrl et al., 2020; Liang et al., 2020) and of preschool quality (e.g., Anders et al., 2013; Sylva et al., 2011) have been documented. Note that these effects may be either additive or compensatory but may also interact (Anders et al., 2012), thus leading to a partial increase in the gap between children from more disadvantaged and more privileged families (see also Weinert & Ebert, 2017).

Domain-Specific Development and Stimulation in Preschool Age One important result from many studies on child development is that developmental trajectories, challenges, and accomplishments are often domain-specific even though there are highly relevant interrelations between different developmental domains such as language, cognition, and socio-emotional development (e.g., Burchinal et al., 2014; Rose et al., 2018; Weinert, 2020, 2022; Weinert & Artelt, 2019; Weinert & Ebert, 2017, in press). The same holds true for many environmental effects in preschool age that often turn out to be domain- or even subdomain-specific. For instance, whereas a structurally complex language input has been shown to be particularly relevant for the acquisition of grammar from 3 to 4 years onwards (Anderka, 2018; Huttenlocher et al., 2010), stimulating interactions in joint book reading situations have proven to be especially supportive for vocabulary acquisition (Lehrl et al., 2012). Furthermore, explicit literacy instruction (e.g., teaching of letter knowledge) seems to be particularly related to early reading development (Lehrl et al., 2012; Sénéchal, 2006; Sénéchal & LeFevre, 2002; Sénéchal et al., 1998; see Weinert & Ebert, 2017, for a brief overview). Interestingly, the very same environmental factors accounted (at least partially) for the observed disparities related to socio-economic family background (see Anderka, 2018).

The Very Early Phases of Development Thus, because many studies have demonstrated important individual differences and SES-related disparities to be rather stable from 3 to 4 years onward, the very early roots and the impact of infant and

[1] The BiKS-3-18 study started in 2005 with a sample of about 550 children at the age of three years tracing their development and relevant contextual factors across 15 years by extensive observations in the children's homes, in preschools, and later in schools, as well as by comprehensive tests, interviews, and questionnaires (see Weinert et al., in press).

very early childhood education, and particularly the factors that account for the emergence of individual differences and SES-related disparities, are key issues in research on early child development and education. However, particularly with respect to the very early phases, there is still a profound need to explore (internal and external) influences and their impact on future life and educational careers. In particular, although various developmental theories and empirical results highlight the importance of early caregiver–child interactions and their quality (e.g., Ainsworth, 1973; Belsky, 1984; Bowlby, 1969; Bruner, 1983; Vygotsky, 1978), the conceptualizations of high-quality interactions or relevant facets of early parent–child interaction differ widely, and their specific (or general) effects still need to be investigated in more depth.

Conceptualizations of Quality of Early Parent–Child Interactions Whereas some theoretical accounts focus on socio-emotional aspects of caregivers' behaviour such as being warm and emotionally supportive (Ainsworth, 1974; De Wolff & van IJzendoorn, 1997), others emphasize the importance of cognitive-verbally stimulating behaviour (Bruner, 1983; Vygotsky, 1978). In addition, whereas many theories stress the impact of caregivers' sensitivity to the child's signals and needs, the exact definition or concept of this sensitivity varies across theories and studies (see Linberg, 2018, for an overview). Drawing on attachment theory (Ainsworth, 1974; Bowlby, 1969), it is, in some cases, the contingent, prompt, and adequate responsivity of the mother (as a primary caregiver) that is seen as most important. Others stress the impact of maternal stimulation in the zone of proximal development (Vygotsky, 1978) and thus stimulations or even instructions that go beyond the child's actual level of action and development, thereby fostering developmental progress. In addition, from an empirical point of view, the exact operationalization of the respective concepts differs across studies. Overall, many studies on the very early phase of child development adhere to a domain- and process-general quality concept that includes the prompt and contingent responsivity of the mother as well as her warm and emotionally supportive behaviour combined with a positive regard of the child (De Wolff & van IJzendoorn, 1997). Other studies focus on a cognitively stimulating maternal interaction behaviour in the zone of proximal development (often referred to as scaffolding behaviour; Bruner, 1983) as well as the mother's instructional behaviour (Attig & Weinert, 2018; NICHD, 2002a, b; Weinert et al., 2017). These studies have demonstrated a significant impact of maternal interaction behaviour on children's socio-emotional as well as cognitive and language development (e.g., Barnett et al., 2012; Baumwell et al., 1997; Nozadi et al., 2013; Tamis-LeMonda et al., 1996). However, partially due to this rather general concept of interaction quality, they mostly did not unravel whether and which facets, aspects, or dimensions of maternal behaviour impact on which domain of early child development (but see Huang et al., 2022).

Research Questions The present chapter aims to shed light on the validity, dimensionality, and effects of quality measures of parental interaction behaviour in the very first years of a child's life, on influencing factors such as family stress and education, and on quality measures and effects of early external childcare as another

learning environment. It reports on analyses that draw on data of the Newborn Cohort Study (SC1) of the German National Educational Panel Study (NEPS; Blossfeld & Rossbach, 2019) and two additional validation studies, thereby focusing on the following research questions:

1. Validity of quality measures of parental interaction behaviour
   - Are the measures of early mother–child interaction assessed in the Newborn Cohort Study of the NEPS (NEPS-SC1) valid in the sense that they indicate relevant differences in maternal interaction behaviour and, thus, in children's early home learning environment? Are they reasonably stable across situations, time points, and coding systems?
   - Can a more fine-grained micro-analytical coding system validate the scales of the macro-analytical rating system of early mother–child interaction used in NEPS-SC1? This question is related to the next question addressing the dimensionality and effects of parental interaction behaviour.
2. Dimensions of parental interaction behaviour and effects on child development
   - Is positive parenting behaviour (e.g., maternal sensitivity) in early mother–child interactions a unitary construct, or should it be differentiated into distinct dimensions such as socio-emotionally supportive and cognitive-verbally stimulating behaviour from early on? In other words, in the very first years of a child's life, are mothers comparatively supportive (or less supportive) across different facets of parenting behaviour and different domains of child development? The issue whether early parenting behaviour already differs along various dimensions of support is not only theoretically but also practically relevant, because it suggests that mothers may support their children in one area though not to the same extent in another area of development—with important implications for intervention.
   - Do different dimensions of maternal behaviour in early mother–child interactions differentially impact the different areas of child development such as socio-emotional and cognitive-verbal development?
3. Association of parental interaction behaviour with social background variables
   - Are the observed differences in maternal interaction behaviour related to family SES (SES-related disparities) from early on as suggested by international studies (e.g., Bradley et al., 2001a, b; Gudmundson, 2012) even when also considering children's interaction behaviour and characteristics? How do cumulative risk factors affect the quality of mother–child interaction?
   - If quality aspects of maternal interaction behaviour are associated with SES and, in addition, contribute to specific areas of child development, do they account for or even mediate the association between SES and child development?

4. Quality of external childcare and effects
   - Because the use of early external childcare in the first years is increasing, the present chapter also reports whether questionnaire measures on quality of external childcare institutions (as used in the NEPS-SC1) can be validated by direct observations.
   - Is the use of early external childcare below age 3 associated with children's socio-emotional outcomes in Germany?

To address these issues, we draw on research and data of the Newborn Cohort Study of the NEPS as well as two additional validation studies. The NEPS-SC1 is a longitudinal large-scale study that includes a wide range of individual, familial, and institutional characteristics that are highly relevant when it comes to unravelling the dynamics of child development and the effects of early childhood education. The validation studies, set up—amongst others—to compare the NEPS play situation and ratings across different mother–child interaction situations, i.e., to test the generalizability of the measures and the stability of maternal behaviour across situations (see below) and to validate the report measures on the quality of external childcare, as well as most of the research questions were part of the project 'ViVA'[2] and related dissertation projects. ViVA aimed to enhance the data of the NEPS-SC1 by focusing on methodological questions and issues as well as on substantive empirical research.

2.1.2 The Newborn Cohort Study of the German National Educational Panel Study (NEPS-SC1)

The Newborn Cohort Study of the NEPS (NEPS Starting Cohort 1: NEPS-SC1) is the first longitudinal large-scale study in Germany designed to trace the development of a representatively drawn sample of about 3500 infants and their context persons from the age of 7 months onwards (Weinert et al., 2016; Würbach et al., 2016). Assessments started in 2012 with videotaped observations and computer-assisted personal parent interviews (CAPI) in the family homes. The second wave was conducted when children were 14 months (computer-assisted parent telephone interview, CATI) and 17 months old (videotaped observations in the child's home in one half of the sample); and the third wave, when children were on average 26 months old (assessments in the family home). Thereafter, assessment waves are being conducted every year (assessments in the family home). Overall, within the NEPS-SC1 study, children's development is traced through semi-standardized

[2] ViVA I/II: **Vi**deo-Based **V**alidity **A**nalyses of Measures of Early Childhood Competencies and Home Learning Environment; ViVAplus: Impact of early childcare arrangements and the home-learning environment on child development; funded by the German Research Foundation within Priority Programme 1646 (grant to S. Weinert and H.-G. Rossbach; WE 1478/7-1, 7-2, RO 820/14-1, 14-2).

videotaped observations; standardized direct measures and tests of children's basic cognitive abilities as well as their domain-specific skills and competencies; and by caretaker reports taking a multi-informant perspective from parents and preschool teachers when possible. The home learning environment is indicated by various assessments including videotaped observations of mainly early mother–child interactions (first three waves), reports on joint activities (e.g., frequency of joint picture book reading), as well as data on—amongst others—attitudes, co-parenting, extrafamilial childcare arrangements, and socio-demographic characteristics of the families (Hachul et al., 2019; Schlesiger et al., 2011; Weinert et al., 2016). Furthermore, characteristics and quality of extrafamilial childcare were assessed by a drop-off questionnaire to the childcare institutions and childminders (across the first seven waves, at least one questionnaire available from childminders, educators, or head of institution: $n = 1563$).

Some Important Validation Issues Although there are longitudinal newborn cohort studies being carried out around the world (see Hachul et al., 2019, for a brief overview), major challenges have to be met especially when considering the very early phases of development and the assessment of early precursors and child characteristics as well as relevant facets of the learning environments from the very beginning of a child's life (see Weinert et al., 2016, for a more in-depth discussion and the solutions chosen in the Newborn Cohort Study of the NEPS). In particular, measures have to be validated thoroughly, because instruments often have to be rather short (due to restricted assessment time) or must be conducted within varying non-standardized settings (e.g., in the children's homes) by trained though still non-professional test administrators or interviewers. To address these validation aspects, the following aims were pursued within the ViVA project:

1. To validate short scales on child characteristics administered in the NEPS-SC1. These short measures were compared to more comprehensive scales and/or (elicited) child behaviour, with overall satisfactory results, for example, regarding the validity of parent-report measures on early child temperament (see Bayer et al., 2015; Freund, 2018a, b; Vogel, 2020)[3] and the standardized observation of infants' sensorimotor development (adapted from items of the Bayley Scales of Infant Development; Bayley, 2006; see Attig et al., 2015, 2016).
2. To extend and add to the coding of videotaped, standardized observations of children's visual attention in various computer-assisted habituation–dishabituation tasks (taken from baby lab studies and transferred to the children's homes; Weinert et al., 2016). These tasks were conducted to measure domain-general as well as domain-specific early cognitive child characteristics and skills that have been shown to predict later cognitive development (see Bornstein & Sigman, 1986; Fagan & Singer, 1983; Kavšek, 2004).[4]

[3] These analyses also show differences and similarities between report and observational measures of child characteristics (Freund, 2018b; Vogel, 2020; see also Sect. 2.2.1).

[4] These additional measures will be integrated into the NEPS scientific use files later on (see, e.g., Seitz & Weinert, 2022 for first results on these measures).

3. To validate, extend, and differentiate the assessment of qualitative aspects of the observed home learning environment (semi-standardized mother-child interaction situation – play situation; see below).
4. To validate the report measures on the quality of external childcare institutions by direct observations.
5. To conduct substantive analyses.

The present chapter focuses particularly on early mother–child interaction as an important basis of early child development. In particular, our emphasis will be on quality measures of the early home learning environment of young children and their impact on early child development (Sect. 2.2) as well as on factors influencing early interaction quality (Sect. 2.3). Further, we shall briefly report on the validity of the NEPS-SC1 report measures on the quality of early external childcare and on effects of early extrafamilial childcare attendance on children's early socio-emotional outcomes (Sect. 2.4).

2.2 Early Mother–Child Interaction: Stability of Quality Measures, Distinguishable Dimensions, and Effects on Early Child Development

Within the first years of a child's life, research has suggested that the family is the most important environment that impacts significantly on that child's development (Bornstein, 2002; Walper, 2012). In many societies, the mother is still the predominant caregiver particularly in the very early phases of a child's life. Hence, in the following section, we shall focus on mother–child interactions.

2.2.1 Quality Measures of Mother–Child Interaction as an Important Basis of Early Child Development

Assessment and Indicators of Quality of Mother–Child Interactions in the NEPS-SC1 Because parent reports may be biased and interactional quality indicators may not be explicitly accessible by the acting person her- or himself, the NEPS-SC1 implemented a semi-standardized mother–child interaction situation in the first three assessment waves when children were 7, 17, and 26 months old.[5] In the family homes, mothers were presented with a standardized set of toys and asked to

[5] In fact, the NEPS also included a few father–child interactions. Because the NEPS in the first wave includes questions concerning pregnancy, birth, maternal depression, and breastfeeding, it intends to have the mother as respondent. As a consequence, it was mostly the mother who took part in the interaction situation.

play with their child as they would normally do for 5 (wave 1) to 10 min (waves 2 and 3). Interactions were videotaped and later coded by extensively trained coders (see Table 2.1; Linberg et al., 2019a, c).

Table 2.1 Items rated by the NEPS macro-analytic coding system

Items	Description
Parental interaction behaviour	
Sensitivity to distress[a]	Captures how promptly and appropriately parent reacts to signals of emotional stress in child.
Sensitivity to non-distress	Captures whether parent perceives and reacts in a prompt and appropriate manner to social gestures and expressions of child that signal emotional relaxation.
Intrusiveness	Captures to what extent parent actively limits child's actions – her/his autonomy – by being adult-centred and imposing parental agenda on child regardless of child's signals.
Detachment	Captures to what extent parent seems to be uninvolved or misses child's signals.
Stimulation	Assesses degree to which parent attempts to foster child's development by teaching or stimulating cognitive development and enriching the play situation.
Language stimulation (wave 3 only)	Assesses amount and quality of verbal enrichment of play situation, including prompting and expanding child's verbalizations, asking open-ended questions, using de-contextualized language, and verbal distancing from the here and now.
Numeracy stimulation (wave 3 only)	Captures the reference to mathematical concepts in the play situation at a very basic level (e.g., counting, comparing, sorting, distinguishing patterns, or referring to amount and variation).
Positive regard	Assesses extent of positive emotions parent expresses in the observed interaction through body language, mimicry, and language.
Negative regard	Captures any signs of a critical and antagonistic maternal attitude towards child (e.g., unfriendly behaviour, negative voice, being harsh or tense).
Emotionality	Captures dynamics of maternal emotions (are emotions and their changes appropriate to the situation and within usual range?).
Child's interaction behaviour	
Positive mood of child	Captures extent to which child seems to be satisfied with the situation.
Negative mood of child	Captures extent to which child seems to be dissatisfied with the situation.
Activity level of child	Assesses level of gross motor activity of child during the observation.
Non-social sustained attention of child	Assesses whether child focuses on objects or other non-social activities based on the relative time spent on focused play and how easily child is distracted.
Positive engagement with parent	Captures extent to which child actively participates or actively initiates an interaction with parent.

Note. [a]Because child distress was hardly ever observed, there were many cases in which this item could not be applied

The procedures as well as the coding system were adapted from the NICHD study (1991, 1992a, b; see Sommer et al., 2016, for a detailed rationale) to also allow for international comparisons. In particular, eight dimensions of maternal interaction behaviour (in wave 3: two additional items on domain-specific language and math stimulation) and five aspects of the children's behaviour were rated on qualitatively defined 5-point scales ranging from 1 (*not at all characteristic*) to 5 (*highly characteristic*) (see Table 2.1; Linberg et al., 2019a, c for an elaborate description). Interrater reliability was high (see Linberg et al., 2019a, c, p. 16). Note that due to a slight adaptation of the coding system to the age and development of the children, the scales are not directly comparable across waves.

Additional Micro-Analytic Coding To extend and validate the macro-analytic coding system for interaction quality and to assess different dimensions of maternal interaction behaviour more precisely, a more fine-grained micro-analytic coding system was developed to additionally analyse the mother–child interaction situations videotaped in the first three waves of the NEPS-SC1 (see Linberg, 2018, for the system developed for the first two waves).[6] With respect to the first two waves, this instrument follows two theoretical assumptions: (a) that the construct of the quality of parental interaction behaviour can be subdivided into different dimensions (similar to existing approaches for older children; Hamre et al., 2013; Klieme & Rakoczy, 2008), and (b) that interactions are a dyadic process between two active partners with each partner contributing to the interactional exchange (Bornstein et al., 2008; Linberg, 2018). Methodologically, the instrument was constructed as a combined event- and time-sampling procedure that draws on existing micro-analytic coding systems (Bornstein et al., 2008; Kärtner et al., 2010; Olson & Masur, 2015; Seifer et al., 1996). It captures the event of a three-turn reciprocal interaction sequence in its different dimensions within a certain time frame (10-s interval in wave 1; 15-s interval in wave 2). The three-turn reciprocal interaction sequence covers the child's interaction behaviour (needs, signals, and interests such as vocalizations and the level of action), the subsequent behaviour of the mother (responsivity, language, emotional support, cognitive stimulation), and the subsequent interaction behaviour of the child. Thereby, the instrument accounts for the dyadic nature of interactions as well as the temporal reference between child's and mother's interaction behaviour.

In particular, it allows us to assess and possibly to differentiate maternal emotional support and cognitive-verbal stimulation behaviour amongst others and to analyse their effects on subsequent child behaviour. As already mentioned, the dimension 'emotional support' has its roots in attachment theory (Ainsworth et al., 1974) and parenting styles (Baumrind, 1989), in which the parent reacts in a prompt, warm, and appropriate manner to the child's signals. Cognitive-verbal 'stimulation'

[6]The coding system for waves 1 and 2 was developed in the educational subproject of the ViVA project (see Linberg, 2018). The micro-coding for wave 3 differs and will not be included in this chapter.

in contrast is based on the concept of scaffolding in which a parent scaffolds a child's behaviour or problem-solving by attuning her or his stimulating reaction to the child's signals, needs, and interests (Berk & Winsler, 1995; see Linberg, 2018, for a more detailed description).

Thus, both the child's signal and (re-)action as well as maternal responsive emotional support and cognitive-verbally stimulating behaviour were captured within the interval and then aggregated across all intervals (see Linberg, 2018, for a more detailed description).

In the following, we shall first report on the stability of the macro-analytic coding across situations and time points and then on its dimensionality and validation based on the micro-analytic coding system.

2.2.2 *Stability of Quality Measures of Mother–Child Interaction Across Situations and Time Points*

An important question concerning the validity and meaningfulness of (quality) indicators of parents' and children's interaction behaviour is its dependence on and stability across different interaction situations. Indeed, Maas et al. (2013) questioned how generalizable observed interaction behaviour in a joyful play situation is to the extensive other more goal-oriented interactional situations in the daily life of a parent–child dyad. Their observation of 292 mother–infant dyads showed substantial effects of the interaction situation on maternal behaviour (mean levels assessed with the global NICHD rating scales) towards their 6-month-old toddlers during free and face-to-face play compared to diaper changing. Mothers showed higher positive regard, less flatness and detachment, and more stimulation behaviour during the play situations compared to the caregiving situation. Infants were, for example, more sociable and displayed more positive affect in the face-to-face play episode than in free play and during diaper change (Maas et al., 2013, p. 46). Despite the observed situational effects, most maternal and infant behaviour scales showed moderate stability of interindividual differences across the different play situations with ICCs ranging from .39 to .71 ($p < .001$), but less consistency between playing and diaper change. This might be explained by the different situational characteristics with respect to structure and goal orientation.

To investigate whether these results also hold for the NEPS-SC1 measures, a small community-based validation study including a sample of 50 mothers and their 7-month-old children (comparable to the age of the children in the first wave of the NEPS-SC1) was conducted (see Appendix Table 2.A1 for sample characteristics).[7]

[7]This study was conducted by Jan-David Freund and Anja Linberg within the ViVA project (developmental subproject; grant to S. Weinert) and by Franziska Vogel within her dissertation project.

This study aimed, among other things, to test for the mean-level stability of the observed indicators and for the stability of individual differences in interaction behaviour (of both mothers and their children) by using the same toys (in the play situation) and the same assessment and coding procedures as in the NEPS-SC1 across different interaction situations. In particular, maternal and child behaviour in mother–child interactions was observed across three different interaction situations: namely, playing, feeding, and diaper change (see Vogel, 2020, for an in-depth description of the assessments). These two additional situations were chosen because they might cover quite different requirements compared to the less goal-oriented and probably less demanding play situation.

Situation-Specific Quality Levels The comparison of the mean quality levels of the various maternal interaction variables showed a comparatively higher level of maternal stimulation behaviour in the play compared to the feeding and diaper-changing situation, thus replicating the results of the study by Maas et al. (2013). Further, mothers tended to be less sensitive and more intrusive, but also more detached during play compared to the more goal-oriented interaction situations (Vogel, 2020, pp. 117–121). Interestingly and despite high interrelations between maternal and child behaviour within mother–child interactions (see below), the children did not show significantly different mean levels on the various behavioural indicators across the diverse interaction contexts (Vogel, 2020, pp. 122–124).

Stability of Individual Differences in Interaction Behaviour in Early Parent–Child Interactions Whereas the observed differences in the level of maternal interaction behaviour between situations hint to an adaptation of maternal behaviour to the specific affordances of the interaction situation, an additional major question is whether the assessed behavioural differences between individuals (either mother or child) are relatively stable across situations. This would imply that the individual differences observed in one interaction situation are more or less representative for differences in the interactional learning environment provided by mothers and/or for interactional characteristics of children in mother–child interactions in the early years.

Low Stability of Individual Differences in Children's Interaction Behaviour Although the mean levels of the children's behaviour observed during mother–child interaction were rather stable (i.e., they did not differ significantly) across the various interaction situations, the stability of individual differences turned out to be low and mostly nonsignificant (Vogel, 2020, pp. 132–134). Thus, individual differences in the children's behaviour seem to be rather situation-specific in these assessments. In the same vein, Linberg (2018), using NEPS-SC1 data, found that the children's positive mood between waves 1 and 2 was not stable. These findings converge with the result that the observed behaviour of the children during a stressless play situation (Freund, 2018a, b; based on NEPS-SC1 data) and even in the probably more stress-inducing caretaking situations realized in the ViVA validation study (Freund,

2018a, b; Vogel, 2020, pp. 137–139) did not relate to parent-report measures of their temperament. This hints to the assumption that children's behaviour observed in short mother–child interactions and parent-report measures on child temperament capture different child characteristics—at least in rather stressless interaction situations that seem to reflect a high variability in child behaviour. Note that, in accordance with this interpretation, the parent-reported child temperament could be validated in an experimentally induced stress situation (still face paradigm in which the mother is instructed to not react to the child within a few minutes; see Freund, 2018a, b).

Stability of Quality Differences in Maternal Interaction Behaviour In contrast to the low stability of the children's interaction behaviour, study results showed a rather high stability for individual differences in maternal behaviour across situations (Vogel, 2020). Using the data from the ViVA validation study, at least moderate correlations were found for sensitive, for stimulating, and for warm maternal behaviour; whereas maternal intrusiveness and detachment seemed to depend more on situational effects (see Table 2.2; Vogel, 2020, for a more detailed description).

This converges with the notion that negative interaction behaviour such as detachment and intrusiveness are not the lower end of positive interaction behaviour. Note, however, that the sample in this study was rather small and homogeneous with respect to the socio-economic and educational status of families. Nonetheless, this might even lead to an underestimation of the stabilities of individual differences in maternal interaction behaviour across interaction situations. Overall, results suggest that at least (more or less) positive maternal interaction behaviour assessed in a short semi-standardized play situation might be used as a meaningful indicator for the quality of maternal interaction behaviour.

In line with this assumption, various analyses of NEPS-SC1 data document rather high stabilities of global measures of maternal interaction quality across the first three measurement waves and thus the first 2 years of the children's lives (Freund et al., 2019). For instance, Freund et al. (2019) aggregated four items measuring the quality of maternal interaction behaviour—namely, sensitivity to child's non-distress, stimulation, positive regard, and emotionality. When analysing the cross-lagged effects between this global measure of the quality of maternal interaction behaviour and the parent-reported negative affectivity of the child, the stability of maternal behaviour turned out to be rather high (.55 between wave 1 and 2 and wave 2 and 3 respectively; see Freund et al., 2019, p. 128).

However, when considering various single scales (compared to an aggregated global indicator) for assessing the quality of maternal interaction behaviour, the stability across waves in the NEPS is considerably lower (Attig & Weinert, 2020; see Table 2.3).

This may be due not only to the fact that single scales are less reliable than aggregated measures, but also to the possibility that mothers adapt their behaviour to their child's development differently across waves (see also next section).

Table 2.2 Stabilities of maternal interaction behaviour across situations (correlations between a dyadic play situation and a feeding or diaper-changing situation)

		1	2	3	4	5	6	7
Playing and								
(a) Feeding ($n = 31$)								
(b) Diaper changing ($n = 33$)								
1. Sensitivity to non-distress	Feeding	.29	.02	−.20	.39*	.30	−.24	.17
	Diaper changing	.36*	−.16	−.20	.25	.38*	−.21	.25
2. Intrusiveness	Feeding	−.06	−.13	.32	−.01	.00	−.11	.01
	Diaper changing	−.05	.10	.11	.20	−.04	−.20	.06
3. Detachment	Feeding	−.06	.03	.12	−.35	−.30	.23	−.24
	Diaper changing	−.50**	.20	.13	−.36*	−.47**	.36*	−.43*
4. Stimulation	Feeding	.30	−.14	−.33	.51**	.42*	−.30	.31
	Diaper changing	.40*	−.36*	−.02	.42*	.41*	−.32	.46**
5. Positive regard	Feeding	.44*	−.27	−.24	.31	.57**	−.07	.33
	Diaper changing	.36*	−.31	−.01	.39*	.68**	−.29	.51**
6. Negative regard	Feeding	−.01	−.16	.17	−.03	−.10	−.01	−.16
	Diaper changing	−.37*	.09	−.08	−.24	−.40*	.33	−.24
7. Emotionality	Feeding	.37*	−.20	−.21	.51**	.56**	−.32	.46**
	Diaper changing	.37*	−.32	−.12	.34	.60**	−.27	.63**

Correlations adopted from Vogel (2020)

Note: Insufficient cases for calculating sensitivity to distress. * $p < .05$, ** $p < .01$. Corresponding items are coloured grey

Table 2.3 Stability of individual differences in maternal interaction behaviour across assessment waves

	1	2	3	4	5	6
1. Sensitivity w1	1					
2. Sensitivity w2	.16***	1				
3. Sensitivity w3	.15***	.25***	1			
4. Stimulation w1	.27***	.14***	.06**	1		
5. Stimulation w2	.18***	.34***	.14***	.34***	1	
6. Stimulation w3	.21***	.16***	.25***	.22***	.30***	1

Correlations adopted from Attig and Weinert (2020)
Note. Maternal sensitivity, maternal stimulation in mother–child interaction in waves 1 to 3 (i.e., at the age of 7, 17, and 26 months). $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

2.2.3 *Micro-analytic Validation of the Macro-analytic Rating System of the NEPS and Differentiating Dimensions of Interaction Behaviour*

Interrelation Between Micro- and Macro-analytically Assessed Measures of Interaction Quality Results indicate that the micro- and macro-analytic coding systems (i.e., the assessment) of the various constructs cover slightly different, though associated facets of maternal behaviour, because the associations on the bivariate level were low to moderate (e.g., micro-analytically assessed 'emotional support' is slightly associated with macro-analytically assessed 'sensitivity to non-distress' [wave 1: $r = .28$, $p < .001$; wave 2: $r = .30$, $p < .001$]; and micro-analytically assessed 'stimulation' is moderately associated with macro-analytically assessed 'cognitive-verbal stimulation' [wave 1: $r = .46$, $p < .001$; wave 2: $r = .43$, $p < .001$]). However, when considering a global concept of positive parenting behaviour by aggregating the respective items of the micro-analytic instrument (i.e., emotional support, [verbal] stimulation) and the respective items of the macro-analytic instrument (i.e., sensitivity to non-distress, positive regard, stimulation, emotionality) separately into a composite measure indicating global quality of maternal interaction behaviour, associations between micro- and macro-analytically coded quality measures are clearly higher (wave 1: $r = .64$, $p < .001$; wave 2: $r = .60$, $p < .001$; see Linberg et al., in press).

Dimensions of Maternal Supportive Behaviour: Distinguishable Though Related in Early Mother–Child Interaction The question whether the theoretically derived dimensions of maternal supportive behaviour can be separated empirically can be answered on two levels: (a) on the level of individual time intervals – that is, whether emotionally supportive mothers also interact in a cognitively stimulating way in each action sequence and (b) on the level of each

mother–child dyad. On the interval level, it is notable that in nearly 75% of the captured interaction sequences, both stimulation and emotionally supportive behaviour are demonstrated. This means that most actions of the mothers are both emotionally supporting and, at the same time, cognitive-verbally stimulating. Yet, in the first year of life, emotional support occurs far more frequently without stimulation than the other way around (Linberg, 2018). However, when aggregating the observations on each sensitivity dimension for each mother–child dyad across the whole observation period, only a moderate association is found ($r = .32$, $p < .001$). Even when additionally taking into account the macro-analytically acquired information on mother–child interaction, it can be seen that the two dimensions are separable, with a two-factor solution leading to a better model fit compared to a single-factor solution (two-factor model: $\chi^2 = 91.65$, $p < .001$, CFI = 0.95, SRMR = 0.03, RMSEA = 0.10; one-factor-model: $\chi^2 = 190.78$, $p < .001$, CFI = 0.90, SRMR = 0.04, RMSEA = 0.14; see Linberg, 2018).

Using a different analytical approach, Huang et al.'s (2022) results also point to the usefulness of separating different dimensions of early parenting behaviour into socio-emotionally supportive (sensitivity to non-distress, positive regard, emotionality) and cognitive-verbally stimulating (general and language stimulation). Using NEPS-SC1 data (i.e., the macro-analytic coding), this analysis also showed a significantly better fit for a model differentiating these dimensions within a two-factor model compared to a one-factor global quality model. Thus, despite some overlap, mothers seem to differ in their socio-emotionally supportive versus their cognitive-verbally stimulating interaction behaviour, and these differentiable dimensions of parental interaction behaviour may impact differentially on different domains of child development (see Sect. 2.2.4).

In addition to this still rather global differentiation between emotionally supportive and cognitive-verbally stimulating behaviour, a wide range of different facets or dimensions of positive parenting behaviour have been suggested (at least from the age of 2 years onwards) that may differ in their impact on child development. For example, one might differentiate between parental responsivity, scaffolding behaviour as defined above, instructional behaviour including explanations that direct the child's attention and offer new perspectives, open-ended questions, and the complexity of language input. It has yet to be resolved empirically whether parental interaction behaviour is to be described by rather general qualitative measures or whether these differentiated concepts are an indication for separable dimensions of interaction behaviour with potentially different impacts across child development and developmental domains that have important implications for intervention (see, e.g., Möwisch et al., 2022).[8]

[8] In the near future, the ViVA project will be offering additional measures covering different concepts of maternal interaction behavior in mother–child interaction at the age of 26 months (wave 3).

2.2.4 *Impact of Quality of Mother–Child Interaction on Child Development*

Obviously, when considering differences in the global quality of maternal interaction behaviour (or differences in specific aspects or dimensions of parental interaction behaviour), it is of major interest whether these differences impact on child development. In particular and as already mentioned, dyadic interaction situations are always shaped by both interaction partners from early on (e.g., Bornstein et al., 2008; Linberg, 2018). As a result, profound associations between maternal and child behaviour in mother–child interaction situations have been documented (Attig & Weinert, 2018; Weinert et al., 2017). In line with such findings, more fine-grained analyses of the NEPS-SC1 data by Linberg (2018) using logistic regression analyses showed that children's positive mood, compared to a less positive mood, led to a 1.39 higher chance of an emotionally supportive response by the mother within the actual interaction situation. Yet, cross-lagged panel analyses across two assessment waves of NEPS-SC1 demonstrated that the children's positive mood at 7 months of age did not relate significantly to later emotional support of the mother at 17 months of age. Instead, maternal emotional support at the age of 7 months seems to slightly affect children's positive mood at the age of 17 months ($\beta = .10$, $p < .01$; Linberg, 2018; for further cross-lagged effects between the quality of maternal interaction behaviour and children's temperament and the moderating role of cumulative risk factors, see Freund et al., 2019).

Because many studies have shown significant effects of the quality of maternal interaction behaviour on various facets of child development, in the following, we shall focus on three important results that add to and differentiate this overall picture: (a) whether there is a distinctive impact of specific dimensions of maternal interaction behaviour on different domains of child development already in the early phases of child development; (b) whether the impact of specific quality dimensions of maternal interaction behaviour changes across the early years of child development. Finally, we shall also consider; and (c) whether the quality of early mother–child interaction mediates the effect of socioeconomic background on child development.

Differential Effects of Separable Dimensions of Maternal Interaction Behaviour As already described, Linberg (2018) as well as Huang et al. (2022) have shown maternal interaction behaviour to be more differentiated than global quality measures presume. In fact (see Sect. 2.2.3), models that separate, for example, socio-emotionally supportive and cognitive-verbally stimulating behaviour of mothers in mother–child interaction fit the interaction data better than one global construct of positive interactional parenting behaviour. Importantly, these dimensions of maternal interaction behaviour also impact differentially on both child behaviour and child development. For instance, Linberg (2018) found that, within a mother–child interaction situation, maternal scaffolding behaviour seems to influence the child's action level (but not the child's emotional well-being), whereas her emotionally supportive behaviour seems to influence the child's emotional well-

being (but not to the same extent the child's level of action). These differential effects are particularly evident for maternal scaffolding behaviour. Logistic multilevel analyses have demonstrated that maternal scaffolding behaviour is related to a 10.71 higher chance of the child playing on a higher (i.e., more elaborate) level of action thereafter (OR = 10.71, $p < .001$), whereas no higher chance of emotional well-being was observed after the mother has displayed scaffolding behaviour (OR = 1.03, *ns*; NEPS-SC1-data; Linberg, 2018).

Of course, these effects on actual child behaviour in parent–child interactions may suggest, but do not document, differential effects on child development. Nonetheless, other analyses do substantiate this conclusion. For instance, using structural equation modelling with the NEPS-SC1 data, Huang et al. (2022) showed that the cognitive-verbally stimulating behaviour of mothers predicted the language skills of their children at the age of 2, whereas the socio-emotionally supportive behaviour of the mothers predicted the children's prosocial behaviour as well as their peer relationships at the age of 3.

Furthermore, as already mentioned, Linberg (2018) demonstrated that early maternal emotional support is slightly associated with children's positive mood in the subsequent wave (even after controlling for autoregressive effects). Additional analyses showed that this is not the case for maternal stimulation behaviour. In particular, children's later positive mood was not predicted by maternal stimulation, but by maternal emotional support. However, the level of action—meaning elaborated play during the interaction—was related to neither maternal emotional support nor to maternal stimulation from the previous assessment wave. This suggests that it is meaningful to differentiate between facets of maternal interaction behaviour from early on. Nevertheless, simple relations may not be expected, because mothers may adapt to a child's level of competence or temperament (see also Freund et al., 2019).

Changing Effects of Different Facets of Maternal Interaction Behaviour on Child Development Whereas most studies average across many facets of maternal interaction behaviour (i.e., use a global quality measure; NICHD, 2002a, b) or do not consider different measurement points, Attig and Weinert (2020) analysed the effects of separate process characteristics of the home learning environment—assessed longitudinally at three different time points—on children's early language outcomes. Process characteristics were derived from different theoretical accounts such as attachment theory (maternal responsive sensitivity[9]; Ainsworth, 1973; Bowlby, 1969) and socio-cultural theories (scaffolding and cognitive-verbally stimulating behaviour; Bruner, 1983; Vygotsky, 1978) with respect to mother–child interactions, as well as from literacy research (frequency of joint picture book reading). Using NEPS-SC1 data and structural equation

[9]Note that responsive sensitivity is not identical to socio-emotional support, because the latter is usually indicated by a compound measure also including, for example, positive regard and emotionality.

modelling (SEM), findings showed that, across three measurement points within the first 2 years of life, nearly all included process characteristics predicted children's vocabulary as well as their grammatical skills at the age of 2 years. Whereas maternal responsive sensitivity predicted children's language skills already from the very first measurement point at the age of 7 months, the effect of stimulating behaviour of the mothers in early mother–child interactions increased across waves as well as compared to the effect of maternal responsive sensitivity (see also Valloton et al., 2017, for converging results on the increasing impact of maternal stimulation behaviour). In addition, early joint picture book reading impacted on children's language outcomes from early on. Note that effects of earlier waves were not just mediated by differences in the quantity or quality of interactional behaviour in later waves, but, in many cases, also exerted an additional direct effect on children's early language outcomes (Attig & Weinert, 2020).

Overall, we find differentiated and partially changing effects of various facets of parenting behaviour on early child outcomes. In particular, various theoretically derived and empirically validated facets of mothers' interactional behaviour seem to affect different domains of child development, and they do not prove to be highly interrelated.

2.3 Effects of Social Inequality and Cumulative Risk Factors on Maternal Interaction Quality

Obviously, parent–child interactions could be influenced by many factors such as child behaviour, child temperament, and/or the child's developmental status (Attig & Weinert, 2018; Bornstein et al., 2007; Kochanska & Aksan, 2004; Linberg, 2018; Masur et al., 2013; Weinert et al., 2017), as well as by characteristics of the mother herself (e.g., personality; Vogel, 2020) and structural aspects of the family such as living in a partnership, number of siblings, and/or the socio-economic status and/or migration background of the family (Bradley et al., 2001a, b; Gudmundson, 2012; Weinert et al., 2017).

Following family stress and family investment models (Conger & Donnellan, 2007; Haveman & Wolfe, 1994), parental behaviour in parent–child interactions is supposed to be influenced by various stress-related and socio-economic factors such as parental education, family income, and/or parental occupation. In more detail, these models state that a comparatively higher socio-economic status (SES; e.g., higher education, lower economic hardship) impacts—among others—on family processes, and that families with higher SES may be more able to provide their children with a high-quality home learning environment compared to families with a lower SES. Indeed, research has shown that family SES is associated with quality measures of parent–child interaction (Attig & Weinert, 2018, 2020; Bradley et al., 2001a, b; Gudmundson, 2012; Linberg, 2018; Weinert et al., 2017).

Using NEPS-SC1 data, Weinert et al. (2017) documented that the educational level of the mother may affect the quality of her interaction behaviour already in the very first year of a child's life. Not surprisingly, the same holds true in the second year of life: again, higher educated mothers showed a higher global quality of interaction behaviour in dyadic interactions with their child compared to lower educated mothers (Attig & Weinert, 2018). Note, however, that in both studies, the explained variation is rather small (Attig & Weinert, 2018; Weinert et al., 2017). Nonetheless, both analyses showed that the effect of maternal education remained significant even when considering other influential factors in the models such as maternal psychological stress, maternal age at birth, children's positive and negative mood in mother–child interaction, children's social interest, activity level, sustained attention to objects during parent–child interaction, their temperament (negative affectivity, orienting/regulatory capacity), status of sensorimotor development, child age, and sex. Whereas interactional child behaviour was substantially associated with the quality of maternal interaction behaviour, it hardly reduced the effect of maternal education on the quality of her interaction behaviour particularly in the first year of children's lives (Attig & Weinert, 2018; Weinert et al., 2017).

In a similar vein, again using NEPS-SC1 data, Attig and Weinert (2020) analysed the potentially changing associations between family SES (including maternal education, parental occupational status, and equivalized family income) and mothers' interaction behaviour across the first 2 years of the children's lives. Mixed-effect regression models showed a significant main effect of SES on the mothers' responsive sensitivity as well as on their cognitive-verbal stimulation behaviour (.25 and .12 respectively). Further, the analysis indicated changes in the association between SES and maternal stimulation behaviour across the first 2 years, suggesting an increasing impact of SES on maternal stimulation behaviour as children grow older. In contrast, the statistical interaction between SES and maternal responsive sensitivity assessed across three measurement points was non-significant, indicating no substantial change in the association of SES and maternal responsive sensitivity in mother–child interaction over time. Thus, SES effects changed differentially across age and different facets of maternal behaviour. Because SES as well as maternal interaction behaviour—among other factors—influence child development (e.g., Attig & Weinert, 2020; Fernald et al., 2013; Hart & Risley, 1995, Law et al., 2019; Weinert & Ebert, 2013; Weinert et al., 2017; see also Sect. 2.2.4 of this chapter), such results help to better understand differences in the early learning environments of children, and how, for example, disadvantaged families can be supported in promoting the early development of their children.

Effects of Cumulative Risk Factors on the Quality of Maternal Interaction Behaviour in Early Mother–Child Interactions As already mentioned, theoretical assumptions on how child and context characteristics (such as low parental education, low family income, or a difficult temperament of the child) affect the quality of maternal behaviour in mother–child interactions (maternal sensitivity) usually assume that unfavourable expressions of these characteristics reduce maternal resources and thus lead to stress. This, in turn, impacts negatively on maternal

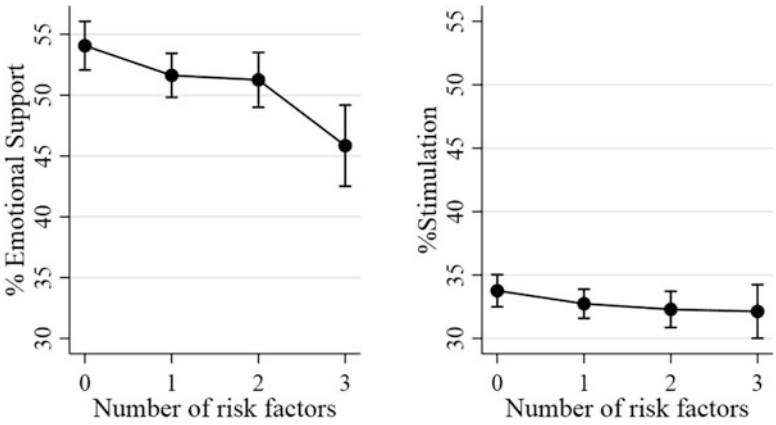


Fig. 2.1 Linear prediction of percentage of emotional support and stimulation at 7 months (wave 1). (Adopted from Linberg, 2018, p. 114)

interaction behaviour (Conger & Donnellan, 2007). Although every single unfavourable characteristic might lead to a reduction of parents' positive interaction behaviour, study results hint to the assumption that only a certain threshold of stress, indicated by the accumulation of unfavourable characteristics or conditions, reduces positive parenting behaviour (Jenkins et al., 2003; Whittaker et al., 2011). Using wave 1 of the NEPS-SC1 study, Linberg (2018) demonstrated that, by combining risk factors such as unfavourable characteristics of the child, the mother, and the context (e.g., difficult temperament of the child, low maternal education, low household income) into a risk index. One or two risk factors predicted only a slightly reduced maternal emotional support (one risk factor: $\beta = -.0.5$, $p < .05$; two risk factors: $\beta = -.05$, $p > .10$). Yet, three or more risk factors were associated significantly with reduced emotional support ($\beta = -.11$, $p < .001$). However, the same effect is not observed for maternal stimulation behaviour in mother–child interaction. Here, the presence of none, one, or even more risk factors seems to make only a very small and non-significant difference (Fig. 2.1).

These findings are especially interesting in light of the previously mentioned results indicating that SES impacts increasingly on maternal stimulation behaviour across waves (but remains stable with respect to her responsive sensitivity, Attig & Weinert, 2020). Whether the pattern could be replicated in risk samples or when taking additional factors into account deserves further investigations.

In a similar vein, also drawing on NEPS-SC1 data, Freund et al. (2017) showed cumulating and, additionally, non-additive effects of different risk factors. Using a global concept of maternal interaction quality (including maternal sensitivity to non-distress, her stimulation behaviour, positive regard, and emotionality in mother–child interaction), the analysis showed that a difficult temperament in the child (namely high negative affectivity) did not affect the quality of maternal interaction behaviour if the number of other risk factors (e.g., low education, low income, low

maternal age at the birth of the child, low weight of the child at birth, etc.) was low (0–2). Yet if three or more risk factors accumulated, the impact of a difficult child temperament on the quality of maternal interaction behaviour was substantial. In particular, study results showed that the global quality of maternal interaction behaviour decreased as the number of risk factors increased ($\eta^2 = 0.021$, $p < .001$); yet, with three or more cumulative risk factors, it dropped substantially when interacting with a child with a difficult temperament compared to a child with low negative affectivity (Cohen's $d = 0.60$, $p < .001$; see Freund et al., 2017, p. 203–204). This suggests the conclusion that even if a child shows relatively high negative affectivity, mothers manage to show a quality of interaction behaviour comparable to that when the child's temperament is less demanding—as long as the number of other risk factors is not too high. However, as risk factors accumulate, a difficult child temperament impacts strongly on the quality of maternal interaction behaviour.

SES Effects on Child Development: Mediated Only Partially by the Quality of Mother–Child Interaction As many studies have shown, both proximal process characteristics of the home learning environment as well as more distal structural variables such as SES impact on child development (Bornstein, 2002; Hart & Risley, 1995; Melhuish et al., 2008; Weinert et al., 2010). For instance, the above-mentioned analyses by Attig and Weinert (2020) considered the predictive effect of both structural and process characteristics on children's early vocabulary and grammar skills at the age of 2 years. Results showed that even when including all the described process characteristics (maternal responsivity, her cognitive-verbally stimulating behaviour, as well as the frequency of early joint picture book reading), family SES still predicted both language facets directly—despite the association of the process characteristics with SES as well as with early language outcomes. This hints to the assumption that the assessed process characteristics did not (or only partially) mediated the effect of SES. An explicit investigation of the mediating effect of maternal language-stimulating interaction behaviour at the age of 17 months (i.e., verbal stimulation during episodes of joint attention) on the children's expressive vocabulary at 26 months of age with the same dataset (NEPS-SC1) by Linberg et al. (2020) also showed that the assessed language-stimulating interaction behaviour did not mediate the effect of maternal education on vocabulary development, because it accounted for only 9% of the effect. Because, for example, the educational framework of the home learning environment (Kluczniok et al., 2013) assumes that structural characteristics affect educational processes, and educational processes impact, in turn, on child development, it is up to future research to investigate which mechanisms could explain the effect of SES on early child language.

At this point, it is important to note that the interrelations between various influential factors in the very early phases of child development are not particularly high. This hints at a differentiated picture of environmental effects from early on that needs much more research (e.g., Attig & Weinert, 2019, 2020; see also Table 2.3).

2.4 Quality and Effects of External Early Childcare: Validation of the NEPS-SC1 Report Measure and Effects on Early Socio-emotional Child Development

In early childhood, not only the home learning environment but also early childhood educational settings (ECEC) play an important role in child development. In 2020, up to 35% of all children under the age of 3 attended ECEC (i.e., centre- or family-based external childcare) in Germany (German Federal Statistical Office, 2020). Various studies have demonstrated that the quality of these settings is associated with children's cognitive and socio-emotional skills (see Anders, 2013; Gorey, 2001, for overviews); and it has been suggested that extrafamilial childcare might compensate for quality restrictions in the home learning environment.

Therefore, the quality of early external childcare is a crucial variable in early childhood studies. Yet, its measurement is challenging, because reports by the key actors might be inaccurate or biased. A report by educators implies that they evaluate their own work, parents are not present during daily routines in ECEC (and thus not able to report on the actual quality), and the children are mostly too young to provide valid information. Hence, external observations are often considered as the 'gold standard' in measuring ECEC quality (Bäumer & Rossbach, 2016; Spieß & Tietze, 2002). Nevertheless, as such measures are costly and time-consuming, large-scale studies such as NEPS often have to rely on (short) questionnaires from educators that assess selected aspects as proxies for or indicators of ECEC quality.

Validation of the Report Measure To evaluate the accuracy of these educator-reported indicators of ECEC quality (particularly those used in the NEPS-SC1), Linberg et al. (2019b) used both questionnaire and standardized established instruments for observing external childcare quality (environment rating scales: ITERS and FCCERS) in a small sample of centre- ($n = 65$) and family-based ($n = 47$) childcare facilities (see Appendix, Table 2.A2 for sample description).[10] Results indicated that up to 43% of the observed variance in toddler childcare quality could be explained by staff-reported quality measures assessed via questionnaires. When the staff-reported indicators served as a rough classification of ECEC quality (e.g., in the categories poor, mediocre, good quality), most ECEC settings (75% of the centre-based and 83% of the family-based settings) were classified correctly by staff-reported indicators.

Effect of Early Extra-Familial Childcare on Early Socio-emotional Outcomes Yet, when considering the effects of early external childcare on child development, international study results point to potentially negative associations between time spent in those ECEC settings in the first 3 years of a child's life and

[10]This validation study was conducted within the project ViVA (educational subproject; grant to H.-G. Rossbach) by Anja Linberg and Jan-David Freund.

children's socio-emotional outcomes (indicated by problem behaviour with peers and prosocial behaviour). Nonetheless, because international study results are controversial and inconsistent across countries (e.g., Loeb et al., 2004; Votruba-Drzal et al., 2010), it remains unclear whether or to what extent these international results transfer to the German ECEC system. To empirically evaluate this issue as well as the role of the home learning environment and child characteristics in these effects, Linberg, Burghardt, et al. (2019a) used NEPS-SC1 data and demonstrated that irrespective of global parental sensitivity, more years spent in centre-based ECEC under the age of 3 related significantly to comparatively lower rates of problem behaviour with peers. With respect to child characteristics, particularly children with a moderately difficult temperament seemed to profit from attending more years in centre-based ECEC in terms of their prosocial behaviour. Note however, that in Germany, the intensity (i.e., hours per day) of the use of external childcare is only moderate compared to other countries, and this may explain some of the controversial results. In addition, although controlled in the models, there is an association between early use of external childcare and family background (SES, migration status) in Germany that calls for further investigation.

2.5 Some Concluding Remarks

To sum up, the different analyses and studies presented in this chapter underpin the importance for child development of the quality of early learning environments. Results support and extend previous findings on the interrelation between families' educational and socio-economic resources and the quality of the early home learning environment, as well as on the effects of both structural and process variables on child development. Yet the mechanisms that may explain SES effects in infancy and toddlerhood still have to be unravelled. Most notably, the results suggest that—from early on—positive parenting behaviour should be differentiated into distinct facets with potentially differential effects on the various domains of child development. This has important practical implications, because these facets are only moderately interrelated. Further, the presented results confirm how important longitudinally assessed measures are for analysing early child development and education. It is up to future research to show whether and which facets of parenting behaviour change dynamically, which remain rather stable across measurement points, and what role they play in fostering (or restricting) developmental progress in the various domains of child development in interaction with the extrafamilial learning environments in cribs, preschools, and schools. Because the NEPS-SC1 is being followed up longitudinally, some of these questions could be addressed with this study. And as a last point, it should be mentioned that most of the results presented here focused on the quality of mother–child interactions. It will be up to further studies to investigate whether the same patterns also hold true for father–child interactions.

Appendix

Table 2.A1 Sample characteristics of the ViVA validation study on mother–child interactions across different situations (Vogel, 2020) and on the validity of short scales used in the NEPS-SC1 (see also Freund, 2018a, b)

$n = 50$ Variable	Frequency (%)
Sex child	52.9% male, 47.1% female
Siblings	47.1%
Relationship status parents	92.2% in a relationship, 3.9% single parent
Education mother	2.0% no graduation, 5.9% *Hauptschulabschluss,* 9.8% secondary school level 1, 21.5% higher education level, 58.8% university education
Migration status mother	88.2% born in Germany
External care at 7 months	15.4%
Household income	9.8% < 2000€, 56.9% 2000€–4000€, 31.4% > 4000€
	Mean (standard deviation)
Age child	7.4 (0.7) months
Age mother	32.3 (5.6) years
Birthweight	3326.0 (672.1) gram
Years of education mother	11.9 (1.7)
HISEI	57.3 (15.4)

Table 2.A2 Sample characteristics of the ViVA validation study of ECEC quality measures from the NEPS-SC1

Variable	Frequency (%)	
	Centre-based ECEC ($n = 65$)	Family-based ECEC ($n = 47$)
Children with disabilities	0.46%	1.42%
Children with migration background (country of birth of the child or at least one parent)	14.4%	14.3%
	Mean (standard deviation)	
Group size	12.9 (3.55)	5.64 (2.47)
Age range (Δ oldest and youngest child in the group)	1.84 (0.419)	2.56 (3.13)
Professional training (0: No professional training in the childcare sector, 1: Childcare workers [lower secondary school leaving certification with 2-year training], 2; educators [lower secondary school leaving certification with 5-year training] 3: Training on university level)	1.98 (0.28)	0.68 (0.96)

References

Ainsworth, M. D. S. (1973). The development of infant–mother attachment. In B. M. Caldwell & H. N. Ricciuti (Eds.), *Review of child development research* (pp. 1–94). University of Chicago Press.

Ainsworth, M. D. S. (1974). *The development of infant-mother-attachment. A final report of the office of child development*. Office of Child Development (DHEW).

Ainsworth, M. D. S., Bell, S. M., & Stayton, D. F. (1974). Infant–mother attachment and social development: Socialization as a product of reciprocal responsiveness to signals. In M. P. M. Richards (Ed.), *The integration of a child into a social world* (pp. 99–135). Cambridge University Press.

Anderka, A. (2018). *Elterliches Sprachangebot und vorschulischer Spracherwerb - eine empirische Analyse zu Zusammenhängen und sozialen Disparitäten*. Waxmann.

Anders, Y. (2013). Stichwort: Auswirkungen frühkindlicher, institutioneller Bildung und Betreuung. *Zeitschrift für Erziehungswissenschaft, 16*, 237–275. https://doi.org/10.1007/s11618-013-0357-5

Anders, Y., Rossbach, H.-G., Weinert, S., Ebert, S., Kuger, S., Lehrl, S., & von Maurice, J. (2012). Home and preschool learning environments and their relations to the development of early numeracy skills. *Early Childhood Research Quarterly, 27*, 231–244. https://doi.org/10.1016/j.ecresq.2011.08.003

Anders, Y., Große, C., Rossbach, H.-G., Ebert, S., & Weinert, S. (2013). Preschool and primary school influences on the development of children's early numeracy skills between the ages of 3 and 7 years in Germany. *School Effectiveness and School Improvement: An International Journal of Research, Policy and Practice, 24*, 195–211. https://doi.org/10.1080/09243453.2012.749794

Attig, M., & Weinert, S. (2018). Soziale Disparitäten im Kontext von Eltern-Kind-Interaktionen und frühen Entwicklungsmaßen von Kindern. *Frühe Bildung, 7*, 1–10.

Attig, M., & Weinert, S. (2019). Häusliche Lernumwelt und Spracherwerb in den ersten Lebensjahren. *Sprache-Stimme-Gehör, 43*, 86–92.

Attig, M., & Weinert, S. (2020). What impacts early language skills? Effects of social disparities and different process characteristics of the home learning environment in the first two years. *Frontiers in Psychology, 11*, 557751. https://doi.org/10.3389/fpsyg.2020.557751

Attig, M., Freund, J.-D., & Weinert, S. (2015). *Ein Vergleich der sensomotorischen Skala des Nationalen Bildungspanels mit den Bayley Scales bei 7 bzw. 8 Monate alten Kindern*. Paper presented at the 22nd Fachgruppentagung Entwicklungspsychologie (EPSY) of the German Psychological Society (DGPs).

Attig, M., Freund, J.-D., & Weinert, S. (2016). *The cognitive-sensorimotor scale of the NEPS: A validation study of a very short assessment instrument at the age of 7 to 9 months*. Poster presented at the International Conference on Infant Studies (ICIS).

Barnett, K., Mercer, S. W., Norbury, M., Watt, G., Wyke, S., & Guthrie, B. (2012). Epidemiology of multimorbidity and implications for health care, research, and medical education: A cross-sectional study. *The Lancet, 380*, 37–43.

Bäumer, T., & Rossbach, H.-G. (2016). Measurement of preschool quality within the National Educational Panel Study – Results of a methodological study. In H.-P. Blossfeld, J. von Maurice, M. Bayer, & J. Skopek (Eds.), *Methodological issues of longitudinal surveys: The example of the National Educational Panel Study* (pp. 543–560). Springer.

Baumrind, D. (1989). Rearing competent children. In W. Damon (Ed.), *The Jossey-bass social and behavioral science series. Child development today and tomorrow* (pp. 349–378). Jossey-Bass.

Baumwell, L., Tamis-LeMonda, C. S., & Bornstein, M. H. (1997). Maternal verbal sensitivity and child language comprehension. *Infant Behavioral Development, 20*, 247–258.

Bayer, M., Wohlkinger, F., Freund, J.-D., Ditton, H., & Weinert, S. (2015). *Temperament bei Kleinkindern – Theoretischer Hintergrund, Operationalisierung im Nationalen Bildungspanel (NEPS) und empirische Befunde aus dem Forschungsprojekt ViVA* (NEPS Working Paper

No. 59). Leibniz Institute for Educational Trajectories, National Educational Panel Study. https://www.neps-data.de/Portals/0/Working%20Papers/WP_LVIII.pdf

Bayley, N. (2006). *Bayley scales of infant and toddler development* (3rd ed.). Psychological Corporation.

Belsky, J. (1984). The determinants of parenting. A process model. *Child Development, 55*, 83–96.

Belsky, J., Vandell, D. L., Burchinal, M., Clarke-Stewart, K. A., McCartney, K., & Owen, M. (2007). Are there long-term effects of early child care? *Child Development, 78*, 681–701. https://doi.org/10.1111/j.1467-8624.2007.01021.x

Berk, L., & Winsler, A. (1995). *Scaffolding children's learning: Vygotsky and early childhood education*. NAEYC.

Blossfeld, H.-P., & Rossbach, H.-G. (2019). *Education as a lifelong process: The German National Educational Panel Study (NEPS), edition ZfE* (2nd ed.). Springer. https://doi.org/10.1007/978-3-658-23162-0

Bornstein, M. H. (Ed.). (2002). *Handbook of parenting: Children and parenting* (2nd ed.). Lawrence Erlbaum.

Bornstein, M. H., & Sigman, M. (1986). Continuity in mental development from infancy. *Child Development, 57*, 251–274. https://doi.org/10.2307/1130581

Bornstein, M. H., Hendricks, C., Haynes, O. M., & Painter, K. M. (2007). Maternal sensitivity and child responsiveness: Associations with social context, maternal characteristics, and child characteristics in a multivariate analysis. *Infancy, 12*, 189–223.

Bornstein, M. H., Tamis-LeMonda, C. S., Hahn, C. S., & Haynes, O. M. (2008). Maternal responsiveness to young children at three ages: Longitudinal analysis of a multidimensional, modular, and specific parenting construct. *Developmental Psychology, 44*, 867–874. https://doi.org/10.1037/0012-1649.44.3.867

Bowlby, J. (1969). *Attachment and loss* (Vol. 1). Basic Books.

Bradley, M. M., Codispoti, M., Cuthbert, B. N., & Lang, P. J. (2001a). Emotion and motivation I: Defensive and appetitive reactions in picture processing. *Emotion, 1*, 276–298.

Bradley, R. H., Corwyn, R., McAdoo, H., & Coll, C. G. (2001b). The home environments of children in the United States. Part I: Variations by age, ethnicity, and poverty status. *Child Development, 72*, 1844–1867. https://doi.org/10.1111/1467-8624.t01-1-00382

Bronfenbrenner, U., & Morris, P. A. (2006). The bioecological model of human development. In W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology, Vol 1: Theoretical models of human development* (6th ed., pp. 793–828). John Wiley.

Bruner, J. S. (1983). *Child's talk*. Oxford University Press.

Burchinal, M., Harris, T., Pickett, C., Serpell, Z., & Sideris, J. (2014). Domain-specific cognitive stimulation and maternal sensitivity as predictors of early academic outcomes among low-income African American preschoolers. *The Journal of Negro Education, 83*, 15–28.

Conger, R. D., & Donnellan, M. B. (2007). An interactionist perspective on the socioeconomic context of human development. *Annual Review of Psychology, 58*, 175–199. https://doi.org/10.1146/annurev.psych.58.110405.085551

De Wolff, M. S., & van IJzendoorn, M. H. (1997). Sensitivity and attachment: A meta-analysis on parental antecedents of infant attachment. *Child Development, 68*, 571–591.

Dubowy, M., Ebert, S., von Maurice, J., & Weinert, S. (2008). Sprachlich-kognitive Kompetenzen beim Eintritt in den Kindergarten. Ein Vergleich von Kindern mit und ohne Migrationshintergrund. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie, 40*, 124–134. https://doi.org/10.1026/0049-8637.40.3.124

Ebert, S., Lehrl, S., & Weinert, S. (2020). Differential effects of the home language and literacy environment on child language and theory of mind and their relation to socioeconomic background. *Frontiers in Psychology, 11*, 555654. https://doi.org/10.3389/fpsyg.2020.555654

Elliott, L., & Bachman, H. J. (2018). SES disparities in early math abilities: The contributions of parents' math cognitions, practices to support math, and math talk. *Developmental Review, 49*, 1–15. https://doi.org/10.1016/j.dr.2018.08.001

Fagan, J. F., & Singer, L. T. (1983). Infant recognition memory as a measure of intelligence. *Advances in Infancy Research, 2*, 31–78.

Fernald, A., Marchman, V. A., & Weisleder, A. (2013). SES differences in language processing skill and vocabulary are evident at 18 months. *Developmental Science, 16*, 234–248.

Freund, J.-D. (2018a). Early temperament in parental report and scientific observation. *Early Child Development and Care, 189*, 2318–2333. https://doi.org/10.1080/03004430.2018.1450252

Freund, J.-D. (2018b). *Temperament und Interaktionsqualität in den ersten Lebensjahren – Das längsschnittliche Wechselspiel frühkindlichen Temperaments und mütterlicher Interaktionsqualität vor dem Hintergrund ungleicher psychosozialer Ressourcen*. Dissertation. OPUS. https://doi.org/10.20378/irbo-53583

Freund, J.-D., Linberg, A., & Weinert, S. (2017). Einfluss eines schwierigen frühkindlichen Temperaments auf die Qualität der Mutter-Kind-Interaktion unter psychosozialen Risikolagen. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie, 49*, 197–209.

Freund, J.-D., Linberg, A., & Weinert, S. (2019). Longitudinal interplay of young children's negative affectivity and maternal interaction quality in the context of unequal psychosocial resources. *Infant Behavior and Development, 55*, 123–132. https://doi.org/10.1016/j.infbeh.2019.01.003

German Federal Statistical Office (Statistisches Bundesamt). (2020). *Betreuungsquote der unter 3-jährigen Kinder auf 35.0% gestiegen*. Statistisches Bundesamt.

Gorey, K. M. (2001). Early childhood education: A meta-analytic affirmation of the short- and long-term benefits of educational opportunity. *School Psychology Quarterly, 16*, 9–30. https://doi.org/10.1521/scpq.16.1.9.19163

Gudmundson, J. A. (2012). *Links between maternal education and parenting quality during children's first three years: The moderating role of income and partner status*. Dissertation. University of North Carolina, Chapel Hill.

Hachul, C., Attig, M., Lorenz, J., Weinert, S., Schneider, T., & Rossbach, H.-G. (2019). From birth to early child care: The Newborn Cohort Study of the National Educational Panel Study. In H.-P. Blossfeld & H.-G. Rossbach (Eds.), *Education as a lifelong process: The German National Educational Panel Study (NEPS), edition ZfE* (2nd ed., pp. 195–214). Springer. https://doi.org/10.1007/978-3-658-23162-0_11

Halle, T., Forry, N., Hair, E., Perper, K., Wandner, L., Wessel, J., & Vick, J. (2009). *Disparities in early learning and development: Lessons from the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B)*. Child Trends.

Hamre, B. K., Pianta, R. C., Downer, J. T., DeCoster, J., Mashburn, A. J., Jones, S. M., Brown, J. L., Cappella, E., Atkins, M., Rivers, S. E., Brackett, M. A., & Hamagami, A. (2013). Teaching through interactions: Testing a developmental framework of teacher effectiveness in over 4,000 classrooms. *The Elementary School Journal, 113*, 461–487.

Hart, B., & Risley, T. R. (1995). *Meaningful differences in the everyday experience of young American children*. Paul H.

Haveman, R. H., & Wolfe, B. S. (1994). *Succeeding generations: On the effects of investments in children*. Russell Sage Foundation.

Hoff, E. (2006). How social contexts support and shape language development. *Developmental Review, 26*, 55–88.

Huang, W., Weinert, S., von Maurice, J., & Attig, M. (2022). Specific parenting behaviors link maternal education to toddlers' language and social competence. *Journal of Family Psychology, 36*, 998–1009. https://doi.org/10.1037/fam0000950

Huttenlocher, J., Waterfall, H., Vasilyeva, M., Vevea, J., & Hedges, L. V. (2010). Sources of variability in children's language growth. *Cognitive Psychology, 61*, 343–365. https://doi.org/10.1016/j.cogpsych.2010.08.002

Jenkins, J. M., Rasbash, J., & O'Connor, T. G. (2003). The role of the shared family context in differential parenting. *Developmental Psychology, 39*, 99–113.

Kärtner, J., Keller, H., & Yovsi, R. D. (2010). Mother–infant interaction during the first 3 months: The emergence of culture-specific contingency patterns. *Child Development, 81*, 540–554. https://doi.org/10.1111/j.1467-8624.2009.01414.x

Kavšek, M. (2004). Predicting later IQ from infant visual habituation and dishabituation: A meta-analysis. *Journal of Applied Developmental Psychology, 25*, 369–393. https://doi.org/10.1016/j.appdev.2004.04.006

Klieme, E., & Rakoczy, K. (2008). Empirische Unterrichtsforschung und Fachdidaktik. Outcome-orientierte Messung und Prozessqualität des Unterrichts. *Zeitschrift für Pädagogik, 54*, 222–237.

Kluczniok, K., Lehrl, S., Kuger, S., & Rossbach, H.-G. (2013). Quality of the home learning environment during preschool age – Domains and contextual conditions. *European Early Childhood Education Research Journal, 21*, 420–438.

Kochanska, G., & Aksan, N. (2004). Development of mutual responsiveness between parents and their young children. *Child Development, 75*, 1657–1676.

Kurz, K., von Maurice, J., Dubowy, M., Ebert, S., & Weinert, S. (2008). Kompetenzentwicklung und Bildungsentscheidungen im Vor- und Grundschulalter. In K.-S. Rehberg (Ed.), *Die Natur der Gesellschaft. Verhandlungen des 33. Kongresses der Deutschen Gesellschaft für Soziologie in Kassel 2006* (pp. 310–322). Campus.

Law, J., Clegg, J., Rush, R., Roulstone, S., & Peters, T. J. (2019). Association of proximal elements of social disadvantage with children's language development at 2 years: An analysis of data from the Children in Focus (CiF) sample from the ALSPAC birth cohort. *International Journal of Language and Communication Disorders, 54*, 362–376. https://doi.org/10.1111/1460-6984.12442

Lehrl, S., Ebert, S., Rossbach, H.-G., & Weinert, S. (2012). Die Bedeutung der familiären Lernumwelt für Vorläufer schriftsprachlicher Kompetenzen im Vorschulalter. *Zeitschrift für Familienforschung, 24*, 115–133.

Lehrl, S., Ebert, S., Blaurock, S., Rossbach, H.-G., & Weinert, S. (2020). Long-term and domain-specific relations between the early years home learning environment and students' academic outcomes in secondary school. *School Effectiveness and School Improvement, 31*, 102–124.

Liang, Y., Cao, H., Zhou, N., Li, J., & Zhang, L. (2020). Early home learning environment predicts early adolescents' adjustment through cognitive abilities in middle childhood. *Journal of Family Psychology, 34*, 905–917. https://doi.org/10.1037/fam0000675

Linberg, A. (2018). *Interaktion zwischen Mutter und Kind. Dimensionen, Bedingungen und Effekte*. Waxmann.

Linberg, A., Burghardt, L., Freund, J.-D., & Weinert, S. (2019a). Differential effect of duration of early childcare under the age of three on socio-emotional outcomes. *Early Child Development and Care., 190*, 2505–2519. https://doi.org/10.1080/03004430.2019.1588891

Linberg, A., Kluczniok, K., Burghardt, L., & Freund, J.-D. (2019b). Quality of toddler childcare – Can it be assessed with questionnaires? *Early Child Development and Care, 189*, 1369–1383. https://doi.org/10.1080/03004430.2017.1380636

Linberg, A., Mann, D., Attig, M., Vogel, F., Weinert, S., & Rossbach, H.-G. (2019c). *Assessment of interactions with the macro-analytic rating system of parent-child-interactions in the NEPS at the child's age of 7, 17, and 26 months*. (NEPS Survey Paper No. 51). Leibniz Institute for Educational Trajectories, National Educational Panel Study. https://www.neps-data.de/Portals/0/Survey%20Papers/SP_LI.pdf

Linberg, A., Attig, M., & Weinert, S. (2020). Social disparities in the vocabulary of 2-year-old children and the mediating effect of language-stimulating interaction behavior. *Journal for Educational Research Online, 12*, 12–35.

Linberg, A., Freund, J.-D., Weinert, S., Rossbach, H.-G. (in press). *Domain-specific interaction behavior in parent-child-interactions. A new micro-analytic coding system and its validity* (NEPS Working Paper). Leibniz Institute for Educational Trajectories, National Educational Panel Study.

Loeb, S., Fuller, B., Kagan, S. L., & Carrol, B. (2004). A longitudinal analysis of the effects of child care type, quality, and stability on the social and cognitive development of preschool children of low-income single mothers. *Child Development, 75*, 47–65.

Maas, A. J. B. M., Vreeswijk, C. M. J. M., & van Bakel, H. J. A. (2013). Effect of situation on mother–infant interaction. *Infant Behavior and Development, 36*, 42–49.

Masur, E., Flynn, V., & Lloyd, C. A. (2013). Infants' behaviors as antecedents and consequents of mothers' responsive and directive utterances. *First Language, 33*, 354–371.

Melhuish, E., Sylva, K., Sammons, P., Siraj-Blatchford, I., Taggart, B., & Phan, M. (2008). Effects of home learning environment and preschool center experience upon literacy and numeracy in early primary school. *Journal of Social Issues, 64*, 95–114. https://doi.org/10.1111/j.1540-4560.2008.00550.x

Möwisch, D., Konrad-Ristau, K., & Weinert, S. (2022). Cognitively stimulating maternal language as predictor for vocabulary growth. *Zeitschrift für Erziehungswissenschaft*, Online first. https://doi.org/10.1007/s11618-022-01114-y

NICHD Early Child Care Research Network. (1991). *Procedures for videotaping mother-child-interaction at 6 months*. Unpublished document, NICHD Study of Early Child Care.

NICHD Early Child Care Research Network. (1992a). *Procedures for videotaping mother-child-interaction at 15 months*. Unpublished document, NICHD Study of Early Child Care.

NICHD Early Child Care Research Network. (1992b). *Procedures for videotaping mother-child-interaction at 24 months in the 3-boxes paradigm*. Unpublished document, NICHD Study of Early Child Care.

NICHD Early Child Care Research Network. (2002a). Child-care structure→ process→ outcome: Direct and indirect effects of child-care quality on young children's development. *Psychological Science, 13*, 199–206. https://doi.org/10.1111/1467-9280.00438

NICHD Early Child Care Research Network. (2002b). Early child care and children's development prior to school entry: Results from the NICHD Study of Early Child Care. *American Educational Research Journal, 39*, 133–164. https://doi.org/10.3102/00028312039001133

Nozadi, S. S., Spinrad, T., & Eisenberg, N. (2013). Prediction of toddlers' expressive language from maternal sensitivity and toddlers' anger expressions: A developmental perspective. *Infant Behavior & Development, 36*, 650–661.

Olson, J., & Masur, E. F. (2015). Mothers' labeling responses to infants' gestures predict vocabulary outcomes. *Journal of Child Language, 42*, 1289–1311. https://doi.org/10.1017/S0305000914000828

Rose, E., Lehrl, S., Ebert, S., & Weinert, S. (2018). Long-term relations between children's language, the home literacy environment, and socioemotional development from ages 3 to 8. *Early Education and Development, 29*, 342–356. https://doi.org/10.1080/10409289.2017.1409096

Schlesiger, C., Lorenz, J., Weinert, S., Schneider, T., & Rossbach, H.-G. (2011). From birth to early child care. In H.-P. Blossfeld, H.-G. Rossbach, & J. von Maurice (Eds.), *Education as a lifelong process: The German National Educational Panel Study (NEPS), edition ZfE* (pp. 187–202). Springer. https://doi.org/10.1007/s11618-011-0186-3

Seifer, R., Schiller, M., Sameroff, A. J., Resnick, S., & Riordan, K. (1996). Attachment, maternal sensitivity, and infant temperament during the first year of life. *Developmental Psychology, 32*, 12–25. https://doi.org/10.1037/0012-1649.32.1.12

Seitz, M., & Weinert, S. (2022). Numeracy skills in young children as predictors of mathematical competence. *British Journal of Developmental Psychology, 40*(2), 224–241.

Sénéchal, M. (2006). Testing the home literacy model: Parent involvement in kindergarten is differentially related to grade 4 reading comprehension, fluency, spelling, and reading for pleasure. *Journal for the Scientific Study of Reading, 10*(1), 59–87.

Sénéchal, M., & LeFevre, J.-A. (2002). Parental involvement in the development of children's reading skill: A 5-year longitudinal study. *Child Development, 73*(2), 445–460.

Sénéchal, M., LeFevre, J.-A., Thomas, E., & Daley, K. (1998). Differential effects of home literacy experiences on the development of oral and written language. *Reading Research Quarterly, 33*(1), 96–116.

Sommer, A., Hachul, C., & Rossbach, H.-G. (2016). Video-based assessment and rating of parent-child interaction within the National Educational Panel Study. In H.-P. Blossfeld, J. von Maurice, M. Bayer, & J. Skopek (Eds.), *Methodological issues of longitudinal surveys. The example of the National Educational Panel Study* (pp. 151–167). Springer VS.

Spieß, C. K., & Tietze, W. (2002). Qualitätssicherung in Kindertageseinrichtungen – Gründe, Anforderungen und Umsetzungsüberlegungen für ein Gütesiegel. *Zeitschrift für Erziehungswissenschaft, 5*, 139–162.

Sylva, K., Melhuish, E., Sammons, P., Siraj-Blatchford, I., & Taggart, B. (2011). Preschool quality and educational outcomes at age 11: Low quality has little benefit. *Journal of Early Childhood Research, 9*, 109–124.

Tamis-LeMonda, C. S., Bornstein, M. H., Baumwell, L., & Damast, A. M. (1996). Responsive parenting in the second year: Specific influences on children's language and play. *Early Development & Parenting, 5*, 173–183.

Thelen, E., & Smith, L. B. (2006). Dynamic systems theories. In W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology, Vol. 1: Theoretical models of human development* (6th ed., pp. 258–312). Wiley.

Vallotton, C. D., Mastergeorge, A., Foster, T., Decker, K. B., & Ayoub, C. (2017). Parenting supports for early vocabulary development: Specific effects of sensitivity and stimulation through infancy. *Infancy, 22*, 78–107. https://doi.org/10.1111/infa.12147

Vogel, F. (2020). *Elterliche und kindliche Einflussfaktoren auf Interaktionsverhalten und Bindungssicherheit – Auswirkungen von Temperament und Persönlichkeit auf das dyadische Interaktionsverhalten und die kindliche Bindungssicherheit in Belskys transaktionalem Prozessmodel des Erziehungsverhaltens.* Dissertation. Bamberg: University of Bamberg. https://doi.org/10.20378/irb-47607.

Votruba-Drzal, E., Coley, R. L., Maldonado-Carreño, C., Li-Grining, C. P., & Chase-Lansdale, P. L. (2010). Child care and the development of behavior problems among economically disadvantaged children in middle childhood. *Child Development, 81*, 1460–1474.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Walper, S. (2012). Vom Einfluss der Eltern. Wie Kinder in der Familie aufwachsen, ist entscheidend für ihre Bildungsmöglichkeiten. *DJI-Impulse, 100*, 10–13.

Weinert, S. (2020). Sprachentwicklung im Kontext anderer Entwicklungsbereiche. In S. Sachse, A.-K. Bockmann, & A. Buschmann (Eds.), *Sprachentwicklung: Entwicklung – Diagnostik – Förderung im Kleinkind- und Vorschulalter* (pp. 131–162). Springer.

Weinert, S. (2022). Language and cognition. In J. Law, S. Reilly, & C. McKean (Eds.), *Language development: Individual differences in a social context* (pp. 122–143). Cambridge University Press.

Weinert, S., & Artelt, C. (2019). Measurement of skills and achievement: A critical assessment of theoretical and methodological concepts. In R. Becker (Ed.), *Research handbook on the sociology of education* (pp. 106–131). Edward Elgar Publishing.

Weinert, S., & Ebert, S. (2013). Spracherwerb im Vorschulalter: Soziale Disparitäten und Einflussvariablen auf den Grammatikerwerb. *Zeitschrift für Erziehungswissenschaft, 16*, 303–332. https://doi.org/10.1007/s11618-013-0354-8

Weinert, S., & Ebert, S. (2017). Verlaufsmerkmale und Wirkfaktoren der frühen kognitiv-sprachlichen Entwicklung – Ergebnisse aus der BiKS-3-10 Studie. In V. Mall, F. Voigt, & N. H. Jung (Eds.), *Entwicklungsstörungen und chronische Erkrankungen: Diagnose, Behandlungsplanung und Familienbegleitung* (pp. 13–33). Schmid-Römhild Verlag.

Weinert, S., & Ebert, S. (in press). Developmental dynamics and social disparities in early education-related child development: Results from the BiKS-3-18 study. In S. Weinert, H.-G. Rossbach, J. von Maurice, H.-P. Blossfeld, & C. Artelt (Eds.), *Educational processes, decisions, and the development of competencies from early preschool age to adolescence: Findings from the BiKS cohort panel studies*. Springer.

Weinert, S., Ebert, S., & Dubowy, M. (2010). Kompetenzen und soziale Disparitäten im Vorschulalter. *Zeitschrift für Grundschulforschung, 1*, 32–45.

Weinert, S., Linberg, A., Attig, M., Freund, J.-D., & Linberg, T. (2016). Analyzing early child development, influential conditions, and future impacts: Prospects of a German newborn cohort study. *International Journal of Child Care and Education Policy, 10*, 1–20. https://doi.org/10.1186/s40723-016-0022-6

Weinert, S., Attig, M., & Rossbach, H.-G. (2017). The emergence of social disparities – Evidence on early mother-child interaction and infant development from the German National Educational Panel Study (NEPS). In H.-P. Blossfeld, N. Kulic, J. Skopek, & M. Triventi (Eds.), *Childcare, early education, and social inequality: An international perspective* (pp. 89–108). Edward Elgar Publishing.

Weinert, S., Rossbach, H.-G., von Maurice, J., Blossfeld, H.-P., & Artelt, S. (Eds.). (in press). *Educational processes, decisions, and the development of competencies from early preschool age to adolescence: Findings from the BiKS cohort panel studies*. Springer.

Whittaker, J. E. V., Harden, B. J., See, H. M., Meisch, A. D., & Westbrook, T. R. (2011). Family risks and protective factors: Pathways to early head start toddlers' social-emotional functioning. *Early Childhood Research Quarterly, 26*, 74–86.

Würbach, A., Zinn, S., & Aßmann, C. (2016). *Samples, weights, and nonresponse: The Early Childhood Cohort of the National Educational Panel Study (Wave 1 to 3)*. (NEPS Survey Paper No. 8). Bamberg: Leibniz Institute for Educational Trajectories, National Educational Panel Study. https://www.neps-data.de/Portals/0/Survey%20Papers/SP_VIII.pdf

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Chapter 3
The Emergence of Gender-Specific Competence Patterns and Decision Making During the Course of Educational and Job Careers in Germany

Loreen Beier, Alessandra Minello, Wilfred Uunk, Magdalena Pratter, Gordey Yastrebov, and Hans-Peter Blossfeld

Abstract Starting at the earliest phase in the educational career, our analyses show that there are already gender differences in mathematical competencies at early preschool age, but against the usual expectations, in favour of girls. In primary school, the early gender-specific differences are then reinforced: Boys perform better in mathematics and girls in German language. Nevertheless, these relative advantages in each domain compensate for each other, so there are no significant differences in the overall performance. Concerning the transition from secondary school to vocational training or higher education there was some evidence from the data that among graduates, young women tend to opt more often for vocational training than young men, whereas the men more often choose to study at universities for applied science than women. We did not find gender differences regarding university entry: Women do not aim lower with respect to university entry at similar grades than boys.

Finally, our results show the important role of mothers in shaping the level of education of their daughters. In summary, based on our analyses the expected

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cumulative differences among boys and girls and men and women over the life course appear to be in accordance with the so-called Matthew effect hypothesis: Small gender differences at preschool age are getting bigger over the school career, not so much with regard to competence trajectories but with regard to the chosen subjects in schools and fields of study at vocational training and tertiary education.

3.1 Introduction

It is not just the case that gender-specific competence patterns and educational decision making frequently differ between girls and boys as well as between women and men. They also seem to become increasingly divergent over the life course. Even at the age when girls and boys start their preschool education and go on to compulsory schooling, gender-specific educational achievements, interests, choices, and motivations seem to already exist. These small differences in early educational trajectories then seem to become more pronounced during secondary school and grow even further in vocational training and tertiary education. Gender patterns are then most evident in terms of occupational segregation when women and men opt for different jobs and pursue different careers in various sectors of the economy.

Life course research has hypothesized that events and states during earlier educational stages often have important consequences for later educational trajectories and their outcomes in the labor market (Mayer & Tuma, 1990). Dannefer (1987) introduced the so-called *Matthew* effect hypothesis into the life course literature and used it to describe this phenomenon. In the context of our research project conducted within the DFG Priority Programme 1646 "Education as a Lifelong Process. Analyzing Data of the National Educational Study (NEPS)," we studied whether or not small initial gender differences and competence inequalities between girls and boys at preschool age actually do gradually increase over the school career and the later job trajectory. Thus, the aim of our empirical analyses in this DFG project was to investigate (with longitudinal data and the cohort sequence design of the National Educational Panel Study [NEPS]) the emergence of gender differences in early stages of education and to trace how these differences evolve over the later educational career and job trajectories.

This chapter summarizes the main findings of our project. Our research focused on competence development and educational decision making at the most crucial phases in educational careers. We studied the development and dynamic interaction of gender-specific competencies, self-concepts, and learning efforts, as well as the educational and job decision making that not only families engage in for their daughters and sons but also women and men engage in for themselves. The cohort sequential design of NEPS data allowed us to follow up a stepwise life course perspective. We stringed together different starting cohorts with clear connections between successive phases of the educational career. We started by analyzing the early gender patterns and disparities using *NEPS Starting Cohort Newborns* and

NEPS Starting Cohort Kindergarten. This allowed us to study gender-specific performance up to school entrance. We then analyzed gender-specific performance in elementary school and the transition from elementary to secondary school with the help of *NEPS Starting Cohort Grade 5*. Then we drew on NEPS *Starting Cohort Grade 9* and *NEPS Starting Cohort of First-Year Students* to focus on the different educational choices of female and male students entering different institutions of tertiary education such as professional college versus university, on gender differences in fields of study, and on dropout intentions. Finally, using *NEPS Starting Cohort Adults*, we traced changes in gender-specific educational trajectories along with the job entry and careers of women and men over successive birth cohorts.

3.2 The Development of Gender-Specific Mathematical Competencies in Preschool Children and the Influences of the Family

Preschool age is a formative phase for both girls and boys that lays the foundations for further development and differentiation between the genders. Some studies indicate that there are already appreciable gender differences in the competencies of preschool children: Boys are better in mathematics than girls (Artelt et al., 2001; Blossfeld et al., 2009; Bonsen et al., 2008; Dornheim, 2008; Frey et al., 2010; Jordan et al., 2006; Lonnemann et al., 2013; Niklas & Schneider, 2012) and girls have higher literacy skills than boys (Phillips et al., 2002; Ready et al., 2005; Stanat & Bergmann, 2009).

However, there has been little research on how these gender differences emerge in preschool age. We expect that early socialization experiences in the family establish the foundation for the emergence of subsequent gender-specific structures in the life course. In the literature, the explanations given for the emergence of gender-specific interests and competencies range from biological differences, across varying psychosocial conditions, to the role of the family of origin and differences in the home learning environment (Stanat & Bergmann, 2009). Empirical results indicate that parents have a kind of gender-specific bias toward gender stereotypes (Blossfeld et al., 2009). Moreover, several sociological articles have also stressed the role of family characteristics (especially social class; see, e.g., Connolly, 2004, 2006).

When analyzing how gender differences in mathematical competencies emerge at preschool age, we took the following three different approaches: (1) we applied the framework of the home learning environment that assigns central importance to the domain-specific stimulation that fosters domain-specific competencies such as mathematics (Kluczniok et al., 2013). We assumed that the emergence of gender differences in mathematical competencies would relate to early gender differences in numeracy and literacy stimulation. Therefore, possible gender differences could be explained partly by differences in domain-specific stimulation during mother–child

interaction[1] (Hypothesis H1), because a higher input in terms of stimulation should lead to a better outcome in terms of competencies.[2] (2) We focused on the hypothesis that differences in social origin would have different implications for boys' and girls' competencies (Connolly, 2004, 2006). In particular, we expected that families from various social origins would reveal large differences in the way they treat daughters versus sons. Therefore, according to the sociological egalitarian values hypothesis (Farkas, 1976; van Berkel & de Graaf, 1999), we assumed that both girls and boys would be treated more equally by parents with an advantaged social background, whereas more traditional gender attitudes should play a stronger role in less advantaged families with girls and boys consequently not being supported in the same way. We expected that the size of the potential gender gap would be associated at least partly with differences in socioeconomic status (SES) (Hypothesis H2). (3) According to the literature on school-age children (e.g., Eccles et al., 1990; Eccles Parsons et al., 1983), a positive relationship between parental gender expectations, higher mathematical self-concept, and mathematical competencies is assumed to favor boys. We wanted to know whether these relations are also true for preschool age. However, there is only little research on such relations at this age, although the literature does show that even younger children have a domain-specific self-concept that relates to achievement (Arens et al., 2016; Marsh et al., 2002). Based on previous research (e.g., Marsh & Craven, 2006), we expected that boys at age 6 would have both a higher mathematical self-concept and higher mathematical competencies (Hypothesis H3), and that there would be a positive relationship between both concepts (Hypothesis H4). In addition, according to the model of parental influences on children (Eccles et al., 1990), the higher mathematical self-concept favoring boys found at school age is associated with parental beliefs about their children's abilities. Therefore, we also focused on these relationships for children at age 6. We assumed that parental assessments of their children's abilities would relate positively to their children's self-concept (Hypothesis H5), and that parents would assess their sons' mathematical abilities as being higher than those of their daughters (Hypothesis H6).

Following these theoretical expectations, we empirically assessed the development of early gender differences in mathematical competencies at ages 4 and 6. For the earlier preschool age, the focus was on the influence of social origin and domain-specific stimulation; whereas for children who are about to enter school at age 6, we concentrated on the association between mathematical competencies, mathematical self-concept, and parental assessment of their children's mathematical abilities.

[1] Our sample included only mothers. Fathers were set as missing, because measurements of parent–child interactions are generally gathered only from mothers in NEPS.

[2] We considered both numeracy and literacy stimulation in our models, because research shows a general association between linguistic skills and mathematical competencies, and linguistic skills can be seen as a necessary requirement for understanding and responding to mathematical items (Halpern et al., 2007; Jordan et al., 2002; Kleemans et al., 2012; Koponen et al., 2007; Krajewski & Schneider, 2009).

3.2.1 *Results of the Analyses at Age 4: Are There Already Pronounced Gender Differences in Mathematical Competencies at This Age, and, if So, Do These Relate to Early Domain-Specific Stimulation of Boys and Girls?*

Using *NEPS Starting Cohort Newborns*, we already observed small gender differences in mathematical competencies at age 4. In contrast to studies on elementary school age, our study showed that mathematical competencies favor girls (see Model 1 in Table 3.1). Girls have a 0.11 higher mathematical competence test score than boys. Yet, this difference is only small.[3] The interaction term of child's sex with mother's SES is not statistically significant (Model 3), implying that in all SES milieus, the observed gender differences (small gaps in favor of girls) are about the same. Therefore, we rejected Hypothesis H2. The observed small gender gap in mathematical competencies cannot be attributed to the numeracy stimulation children experienced in interaction with their mothers at age 2, because the gender gap does not decrease, but even slightly increases (Model 4). Thus, it seems that boys

Table 3.1 OLS models predicting mathematical competence ($N = 1956$ children)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Female	0.113*	0.115*	0.114*	0.117*	0.117*	0.108*	0.109*
	(0.0507)	(0.0505)	(0.0505)	(0.0504)	(0.0504)	(0.0506)	(0.0506)
SES mother		0.117***	0.0762+	0.118***	0.118***	0.116***	0.116***
		(0.0289)	(0.0392)	(0.0289)	(0.0290)	(0.0291)	(0.0291)
Female × SES mother			0.0816				
			(0.0548)				
Numeracy stimulation				0.0479+	0.0435		
				(0.0289)	(0.0403)		
Female × numeracy stimulation					0.00954		
					(0.0564)		
Literacy stimulation						0.100*	0.0805
						(0.0458)	(0.0522)
Female × literacy stimulation							0.0428
							(0.0566)
Constant	−8.846***	−8.544***	−8.597***	−8.593***	−8.594***	−8.298***	−8.315***
	(0.804)	(0.802)	(0.806)	(0.802)	(0.800)	(0.806)	(0.806)

Source: NEPS, Starting Cohort Newborn; own computations

Notes: All models control for birth cohort of mother, employment of mother, age of child, temperament of child, marital status, number of children in household, educational aspirations of mother, sensitivity of mother, global stimulation by mother, emotionality of mother, and vocabulary of child. m = 50 imputations. Standard errors in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[3] The mathematical test score ranges from −3.461 to 3.187.

receive a slightly higher numeracy stimulation within mother–child interaction. Including literacy stimulation (see Model 6) leads to a small decrease in the gender gap, indicating that it contributes to the observed gender gap. Nonetheless, the part it explains is not large (6%) and a significant gender gap remains. Therefore, we also rejected Hypothesis H1. The nonsignificant interaction effects between the sex of the child and numeracy/literacy stimulation (see Models 5 and 7) means that girls' mathematical competencies do not benefit more from higher stimulation in each domain than those of boys.

Thus, based on NEPS data, we conclude that at the early age of 4, there is already a gender gap in mathematical competencies that is surprisingly in favor of girls. However, this gap is not large. Furthermore, we cannot explain it well through literacy and numeracy stimulation within the home environment, although the former seems to be surprisingly more important here than the latter. The underlying reasons are small gender differences in stimulation (girls are stimulated more in literacy; boys, more in numeracy), and the comparatively small effects of stimulation on mathematical competencies. Because all models controlled for structural characteristics of the family as well as the child's characteristics, we conclude that at this early age, girls seem to have a small developmental advantage with regard to mathematical competencies. This development seems to hold in each social origin milieu and at this early age. Therefore, (potential) differences between origin milieus in the socialization of girls and boys do not seem to be very important.

3.2.2 *Results of Analyses at Age 6: Do Gender Differences in Mathematical Competencies Change Between Ages 4 and 6? What Is the Role of the Early Mathematical Self-Concept?*

Although at an early age, girls may start out with a small advantage in mathematical competencies, previous studies have demonstrated that at a somewhat later age—at the end of preschool—this gender gap reverses in favor of boys. Is this also true for Germany on the basis of NEPS data, and what is the role of the mathematical self-concept in explaining this gap? To answer these questions, we first analyzed whether the gender gap favoring girls at age 4 does indeed reverse; and, second, whether there is a relationship between gender, mathematical self-concept, and parental beliefs relating to the gender of children at the age shortly before school entry.

Using *NEPS Starting Cohort Kindergarten*, our results (not reported in the tables) indicate that boys at age 6 indeed have both a significantly higher mathematical self-concept and higher mathematical competencies than girls, although the relationship is not very strong statistically, $t(1942) = 2.95$, $p < 0.01$, $d = 0.13$ for mathematical competencies; $r = 0.06$, $Z(1942) = 2.7$, $p < 0.01$ for mathematical self-concept.

Therefore, the gender gap favoring girls at age 4 reverses at the end of preschool age and confirms Hypothesis H3. Furthermore, and surprisingly, there is a negative relationship between the two concepts, $t(1942) = 3.4$, $p < 0.001$, $d = -0.17$. Previous studies interpret this relationship in light of the very optimistic self-concept children have at this young age (Helmke, 1999). Therefore, at age 6, a very high self-concept is not yet associated with high competencies, so we rejected Hypothesis H4. Concerning parental assessment of children's mathematical abilities, we found no significant relationship with regard to the mathematical self-concept, $Z(1942) = -0.28$, $p = 0.8$. Therefore, we rejected Hypothesis H5. However, there is a small relationship with regard to the sex of the child, $r = 0.06$, $Z(1942) = 2.6$, $p < 0.01$. Thus, based on NEPS data, parents assess boys' mathematical abilities slightly higher than those of girls, confirming Hypothesis H6.

Hence, we found an association between gender, mathematical self-assessment, and mathematical competencies at preschool age that is in line with other findings at school age. Therefore, we concluded that the gender differences we found for the mathematical self-concept and mathematical competencies are related. Second, the parental assessment of children's mathematical abilities is not related to their mathematical self-concept, although parents assess their children's abilities differently depending on their sex. Therefore, we conclude that at age 6, there is no relationship between a higher mathematical self-concept favoring boys and parental assessment.

3.3 Gender-Specific Differences in Elementary School Performance and in the Transition to Secondary Education: Primary and Secondary Effects of Gender and Social Background in the German Secondary School System

Germany is still dominated by the hierarchically ordered secondary school types of *Hauptschule*, *Realschule*, and *Gymnasium*, each offering a particular qualification (along with a small proportion of *Gesamtschulen*, i.e., comprehensive schools). Whereas girls tend to be more present in the academic tracks of secondary school and *Realschule*, boys tend to opt more for *Hauptschule*. Thus, in Germany, the later field and the position reached in the labor market seem to be based on early educational choices such as the choice of secondary school type and vocational training. Types of vocational training differ clearly in terms of reputation and labor market outcomes such as income (Ammermüller & Weber, 2005), unemployment, and occupational status (Reimer & Steinmetz, 2009).

Our project addressed the interplay between social and gender inequalities in shaping families' educational decisions on the transitions from elementary to

secondary education. Specifically, we examined (1) whether social background moderates the gender gap in academic performance in German elementary schools, and (2) whether it further moderates the gender gap in the allocation of students to different secondary school types after fourth grade (net of differences in academic performance). In other words, using a well-established distinction in the educational transition literature (Boudon, 1974), we were interested in whether primary and secondary effects of social background play out differently for children of different genders.

To date, available evidence suggests almost unequivocally that girls generally outperform boys in school, at least when educational achievement is measured in grades (Buchmann et al., 2008). For instance, DiPrete and Buchmann (2013) argue that the major part of girls' advantage in schools comes from their being more predisposed to the types of behavior that are rewarded in school contexts, such as demonstrating diligence, good conduct, and obedience. Furthermore, similar types of behavior are more likely to be discouraged among boys due to their partial incompatibility with particular concepts of masculinity dominant among youth. In sum, we generally expected that girls would outperform boys in terms of their school grades (Hypothesis H7).

Furthermore, and according to the gender ideology perspective, girls and boys would choose secondary school tracks that enable stereotypically appropriate gender roles (Ridgeway, 2011; Vleuten et al., 2016). Thus, in line with previous findings (e.g., Jürges & Schneider, 2011) we expected that after accounting for their disadvantage in academic performance, boys would be more likely to opt for higher grade educational tracks (Hypothesis H8). Furthermore, and regarding the impacts of social origin, we expected that boys and girls from advantaged backgrounds would benefit equally from their parents, thanks to the more gender-egalitarian norms and values typically held among higher educated parents (Alwin et al., 1992; Dryler, 1998; Guiso et al., 2008). Similarly, boys from more advantaged backgrounds might be more immune to the concepts of masculinity/femininity that stigmatize academic excellence in school, because they have internalized the more successful role models embodied in the success of their own parents (DiPrete & Buchmann, 2013; Francis, 1999). Finally, a complementary argument to predict lower contingency of gender differences on the socioeconomic standing of families can be derived from the theory of compensatory advantage of social background (Bernardi, 2014). This perspective postulates merely that advantaged families are generally better equipped to confront unfavorable events or circumstances. Accordingly, given that boys are generally more sensitive to negative influences from surrounding environments (Buchmann et al., 2008; DiPrete & Buchmann, 2013), more advantaged families should mitigate (or compensate for) the impact of these influences more effectively. In line with these arguments, we therefore expect that gender differences in educational achievement should be less pronounced among children from more advantaged backgrounds than among children from less advantaged backgrounds (Hypothesis H9).

Table 3.2 OLS models predicting elementary school grades in math, German, and their average

	Math		German		GPA	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Female	−0.243***	−0.316***	0.165***	0.136**	−0.038	−0.089*
	(0.028)	(0.045)	(0.026)	(0.042)	(0.024)	(0.038)
Parental education	0.442***	0.385***	0.444***	0.421***	0.444***	0.405***
	(0.032)	(0.041)	(0.028)	(0.038)	(0.025)	(0.034)
Female × parental education		0.120*		0.048		0.083*
		(0.057)		(0.054)		(0.048)
R^2	0.112	0.113	0.147	0.147	0.148	0.149
F	96.11***	80.89***	130.9***	109.2***	131.9***	110.5***
Df	5	6	5	6	5	6
N	3806	3806	3803	3803	3801	3801

Source: NEPS Starting Cohort Grade 5; own computations

Notes: All models control for age, migrant status, and East German origin of children. Parental education = binary indicating whether the highest education of parents is ISCED 6 or above. Grades = self-reported grades as of Grade 5 (1 = lowest; 6 = highest) complemented by parents' reports were missing. GPA = the average of the grades in math and German. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We tested our hypotheses with *NEPS Starting Cohort Grade 5*.[4] First of all, our analyses corroborate the widely held belief that girls tend to excel in literacy and boys tend to excel in math (Buchmann et al., 2008; OECD, 2015). Table 3.2 shows that, as of Grade 4, boys' grades are, on average, 0.24 points higher in math (Model 1), but 0.17 points lower in German (Model 3). In turn, however, the two relative advantages for boys or for girls in these two different domains seem to compensate for each other, and this results in no statistically significant gender difference in terms of GPA (i.e., the average of the two grades, Model 5). Taken as a whole, this does not corroborate our Hypothesis H7 predicting that girls would exhibit higher academic performance than boys. Instead, it reveals that gender differences manifest themselves rather differently in two different domains.

Do these differences manifest themselves differently when we look at children's social backgrounds? As far as performance in math is concerned (Model 2), we do find that girls with higher educated parents enjoy a substantially smaller (albeit still statistically significant) difference in grades compared to boys, with the gap favoring

[4]Following the recommendation of NEPS data providers (Skopek et al., 2012), we omitted the *Sonderschule* (special schools) subsample due to its highly specific nature. Moreover, although we employed various strategies to reduce the amount of missing cases in the data, the final analytical sample constitutes only 73–74% of the total number of available observations ($N = 5153$) in Wave 1 (Grade 5). The analytical and full samples do not differ substantially, although the former seems to slightly overrepresent higher achieving children from more advantaged backgrounds, who are, in turn, more likely to end up in more challenging educational tracks. In order to rule out the possibility that selective nonresponse potentially affects our findings, we applied multiple imputation techniques to reconstruct the missing part of the analytical sample. These analyses do not reveal any substantial departures from the main findings.

boys constituting only 0.19 points (instead of 0.32 for children of lower educated parents). However, we do not find any statistically significant moderating effect of social background with regard to the gender gap in grades in German (Model 4)—if anything, the model suggests that the gap in favor of girls tends to widen slightly among the children of higher educated parents. In terms of GPA (Model 6), the overall pattern replicates the pattern of declining disadvantage for girls in families with higher educated parents, although this is somewhat less pronounced due to the offsetting effects of girls' persistent advantage in German. In sum, the evidence presented in Table 3.2 provides modest support for H9, according to which we expected the gender gaps in academic performance to narrow for children coming from more advantaged backgrounds.

We now turn to the study of secondary effects of gender and social background—that is, the effects that concern the secondary school track choice over and above elementary school academic performance. Table 3.3 contains the predicted probabilities (and the average marginal difference of these probabilities for boys and girls) of being in each of the respective four states (i.e., *Gymnasium*, *Realschule*, and *Hauptschule* tracks or *Gesamtschule*) as of Grade 5 (the underlying multinomial regression model is described in the table footer). Statistically significant but small differences emerge only for the choice of the *Hauptschule* track: Boys are slightly more likely to be drawn into this track in the case of both higher and lower educated parents. Largely, however, the pattern of educational outcomes between boys and girls is quite similar, and it does not appear to be modified whatsoever by the children's social background. We therefore evaluate this evidence as not supporting our Hypotheses H8 and H9. It also seems to contradict previous findings for Germany, according to which girls are found to be more likely to end up in the academic track even after controlling for academic performance (Jürges & Schneider, 2011).

Table 3.3 Predicted probabilities of track choice by education of parents and gender ($N = 3801$)

	Gymnasium	Gesamtschule	Realschule	Hauptschule
Higher educated parents				
Male	61.1***	7.5***	20.4***	5.5***
Female	63.2***	8.3***	17.7***	3.0***
AM difference[1]	−0.3	1.2	−0.7	−1.8**
Lower educated parents				
Male	30.3***	12.7***	29.2***	21.7***
Female	30.2***	13.9***	32.0***	18.6***
AM difference[1]	0.4	1.5	2.1	−4.1**

Source: NEPS, Starting Cohort Grade 5; own computations

Notes: Results from multinomial regression models regressing the outcome on children's gender, parental education (refer to the previous table for precise definition), their interaction, and controls for grades in math and German, age, migrant status, and East German origin of children. Main figures expressed in percentage points. [1] Average marginal effect of being female rather than male. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

3.4 Gender-Specific Choices in Transitions to and Within Tertiary Education: Do Gender Differences Persist?

Do the gender differences in educational outcomes reported above persist in higher, tertiary education? Do women enter higher education institutions as much as or less than men after *Gymnasium* graduation, and how (and, if so, why) do study field choices differ between the two genders? Regarding the entry into higher education, one might first think that gender no longer plays any role. The proportions of German women and men who obtain higher tertiary education degrees have become more equal in recent decades (Mayer, 2008), and for several years now, more women than men are entering higher education institutions (Statistisches Bundesamt, 2019). Nevertheless, this does not mean that women aim as high or even higher than men in their educational choices. The growing share of women in higher education may simply be due to the (growing) overrepresentation of women at *Gymnasium* and their higher exam grades compared to men. Net of these factors (e.g., with similar exam grades), women may still opt more often than men for the lower tertiary education levels. Women may, for example, "more often shy away from university education than men, because the vocational training system provides many attractive opportunities for women to enter qualified service occupations such as nursery or kindergarten teacher" (Blossfeld, 2017, p. 143). Another form of gender segregation in tertiary education is the choice of field of study. If girls opt for the highest tertiary educational level, they less often choose STEM majors (science, technology, engineering, and mathematics) than boys (Charles & Bradley, 2009; for Germany, see Lörz et al., 2011; Uunk et al., 2019)—majors that are assumed to deliver better career and earning prospects than non-STEM majors (Blossfeld et al., 2015).

In our project, we tested two competing theoretical perspectives on (tertiary) education choices of young men and women: the culturalist perspective and the rational choice perspective. The culturalist perspective suggests that female educational choices should be analyzed in light of a preference for "fields characterized by functional or symbolic proximity to the traditional female domestic role" (Charles & Bradley, 2002, p. 581). Males are assumed to be more attracted to fields delivering higher status occupations, and their ambitions will be directed toward majors that lead into higher paid "masculine" and "breadwinner" jobs. The rational choice model dedicates less attention to the role of gender norms and sex stereotypes and explains gender differences in educational choices as being a consequence of gender-specific achievement in different subjects that are indicative of the study success in a particular subject (Jonsson, 1999; van de Werfhorst et al., 2003). On the basis of these arguments and additional assumptions on gender differences in relevant determinants, we hypothesized that we would find only a weak gender difference in the probability of entering general university among *Gymnasium* graduates (Hypothesis H10): Girls' relatively higher achievement in German over math (in contrast to boys) can make them opt more often for socially and culturally oriented majors at a lower tertiary level (vocational training and applied university). Yet, the, on average, higher exam grades of girls than those of boys may offset this

and lead them more often to general university. We did not assume that boys' and girls' orientations toward a job career would affect this decision much, because this life goal appears not to differ strongly by gender (see in Table 3.5 the item "to earn a lot"; cf. Mann & DiPrete, 2013). Moreover, the value of university education can be assumed to be broader. However, we hypothesized that we would find a large gender difference in the choice of the field of study, with women being underrepresented in STEM fields of study and overrepresented in non-STEM fields (Hypothesis H11). This could be expected on the basis of the relative strengths of boys and girls at Gymnasium, with boys showing better math than German performance; and girls, vice versa (see Sect. 3).[5] Again, we expected that the alternative culturalist model via life goals would be a less powerful explanation for the gender gap in the field of study, because gender differences in these life goals are at most modest (see Table 3.5).

Our analyses on the longitudinally followed *NEPS Starting Cohort Grade 9* improve on prior studies on Germany (as well as on other countries) in several ways: First, we improved on the comprehensive work of Lörz et al. (2011) on gender and entry into higher education by investigating realized study choices instead of study intentions. Study intentions may give a distorted picture of gender differences in educational choices if one of the genders abandons its intentions more often (and that appears to be the case in women, as Lörz et al., 2011, themselves suggest). Second, we studied whether relative strength in math compared to German at secondary school can explain the gender gap in the field of study choice (cf. Jonsson, 1999).[6] The study by Lörz et al. (2011) underestimated the role of relative strength in math (and other explanatory factors) when accounting for the gender gap in study field choice, because it controlled for the choice of taking an advanced math course at secondary school (choosing an advanced math course might actually be another expression of a STEM choice).

Our analyses do not display a gender difference in the probability of entering general university after *Gymnasium* graduation (as in Hypothesis H10).[7] An equal share of both genders (55% men, 56% women) enters general university as a first further education (see Table 3.4, Panel A). Female *Gymnasium* graduates opt somewhat less often for the applied university level (*Fachhochschule*) than male *Gymnasium* graduates and more often commence vocational training (vocational training, or *Lehre*, is an increasingly significant pathway for *Gymnasium* students in

[5] Grades should be a more powerful predictor of the study field choice than test competencies, because grades are more visible and important on the labor market.

[6] The analyses on study field choice presented here build on our earlier work on NEPS Starting Cohort First-Year Students (Uunk et al., 2019). It extends this by taking a more comprehensive approach that accounts for such factors as grades, test competencies, and life-goal and gender-role indicators measured in secondary school. Substantively, however, the findings are the same.

[7] Our sample consists of students who were attending *Gymnasium* during the panel period, graduated from it, and provided valid information on study choices and relevant background characteristics. The analyses refer to the first educational training after graduation and the choice for the first major at general university.

Table 3.4 Study choice of male and female *Gymnasium* students after graduation: Level of (first) further/tertiary education and (first) field of study at general university

	Men	Women	Difference women–men (%-point)
A. Level of tertiary education			
Vocational training/other[a]	20.1%	22.1%	2.0%
Applied university	24.8%	22.1%	−2.8%
General university	55.1%	55.9%	0.9%
N cases	906	1179	
B. Field of study at general university[b]			
STEM	51.2%	23.1%	−28.1%**
Science, math, computing	30.0%	17.0%	−13.0%**
Engineering, manufacturing	21.2%	6.1%	−15.1%**
Non-STEM	48.9%	76.9%	28.1%**
Pedagogics	4.2%	12.4%	8.2%**
Humanities and arts	6.9%	18.2%	11.2%**
Social sciences, business, law	31.0%	33.2%	2.2%
Health and welfare	4.2%	8.8%	4.6%**
Other non-STEM[c]	2.5%	4.3%	1.7%
N	477	611	

Source: NEPS, Starting Cohort Grade 9; unweighted data, own computations
Notes: [a] "Vocational training/Other" includes apprenticeship, education at a school in the health sector, school-based vocational training, training at another college, master craftsman, course at an association/chamber, or course to obtain a license. "Applied university" includes study at a university of applied sciences, study at an administration and business academy, study at a university of cooperative education, cooperative state university, and study at a college of public administration. [b] First major at general university, ISCED-97 (1-digit) classification. [c] "Other non-STEM" includes agriculture, veterinary, and services studies. * $p < 0.05$; ** $p < 0.01$

Germany; see also Blossfeld, 2017). Yet, these gender differences are not statistically significant.[8] Furthermore, the gender difference in the probability of entering general university is not larger for children from lower educated parents than for children from higher educated parents, although this might have been expected on the basis of distinct gender socialization patterns within these origin milieus (see Sect. 3 of this chapter). Explanatory analyses revealed that the exam grade received at *Gymnasium* is the most powerful of the explanatory factors studied for the choice of a general university education and it has a positive effect (better grades, higher probability), whereas the relative math grade does not have a significant effect (findings not reported in the table, yet using the same variables as in Table 3.5). Given equal exam grades, girls appear to have a somewhat lower probability of entering general university than boys, but the difference is not statistically significant. Thus, we concluded that in Germany, girls from *Gymnasium* "aim as high" as boys in their choice of level of tertiary education.

[8] Women do not differ from men in their probability to enter higher tertiary education (applied or general university).

Table 3.5 Factors explaining the gender gap in STEM fields of study at general university ($N = 1088$ students)

Variables[a]	Measured at school grade level	Mean men	Mean women	Difference W–M[a]	Relative effect on STEM choice[b]	% explained gender gap[c]
Control variables						0.6%
Age (17–22)	Uni-1	18.62	18.48	−0.14**	0.029	1.0%
Migrant child (0–1)	9	0.13	0.14	0.01	0.000	0.0%
Sample school former East Germany (0–1)	9	0.12	0.12	0.00	0.077**	−0.1%
Parents at least high school (0–1)	9	0.65	0.62	−0.03	−0.031	−0.3%
Academic performance						38.3%
Exam grade (1 low–6 high)	12	4.75	4.89	0.14**	−0.084*	3.1%
Grade math (1 low–6 high)	10	4.55	4.39	−0.16*	−0.023	−0.6%
Grade German (1 low–6 high)	10	4.28	4.83	0.55**	d	d
Difference math–German grade (−3 − +3)	10	0.27	−0.44	−0.71**	0.230**	24.2%
Test competencies math (−3.3 − +4.6)	9	1.66	0.94	−0.72**	0.040	4.1%
Test competencies German (−2.8 − +3.3)	9	0.93	1.20	0.27**	d	d
Difference math–German test (−4.1 − +4.8)	9	0.74	−0.25	−0.99**	0.059	7.5%
Academic self-assessment						16.5%
Self-assessment math (1–4)	9	3.08	2.46	−0.62**	0.081	8.2%
Self-assessment German (1–4)	9	2.89	3.12	0.23**	d	d
Difference math–German self-assess (−3 − +3)	9	0.19	−0.67	−0.86**	0.073	8.3%
Life goals						5.9%
Job goal “to earn a lot” (1–6)	10	5.16	5.00	−0.16**	−0.003	0.0%
Job goal “to help others” (1–6)	10	4.19	4.75	0.56**	−0.080**	6.4%
Family goal “to have children” (1–5)	9	3.91	4.07	0.16**	0.020	−0.5%

(continued)

Table 3.5 (continued)

Variables[a]	Measured at school grade level	Mean men	Mean women	Difference W–M[a]	Relative effect on STEM choice[b]	% explained gender gap[c]
Gender roles						−3.9%
"Men should earn, women care" (1–4)	10	1.97	1.41	−0.56**	−0.034	−3.9%
Mother works full-time (0–1)	9	0.32	0.32	0.00	−0.012	0.0%
Total explained gap						57.4%
Total unexplained gap						42.6%

Source: NEPS, Starting Cohort Grade 9; unweighted data, own computations
Notes: [a] Test on statistical difference in mean between men and women (university students). [b] Standardized (beta) coefficients from OLS regression of the probability of a STEM choice (including main effect of gender). [c] Blinder–Oaxaca decomposition (pooled estimates). [d] Omitted in explanatory analyses because redundant. * $p < 0.05$; ** $p < 0.01$

In line with other studies for Germany (Lörz et al., 2011; Uunk et al., 2019) and with our own expectations (Hypothesis H11), our analyses do reveal a large gender gap in the field of study (see Table 3.4, Panel B). Girls much less often choose a STEM major at general university than boys: nearly one-quarter of girls (23%) compared to more than one-half of boys (51%)—a difference of 28 percentage points.[9] A similarly sized gender difference in the field of study has been noted for other industrial countries (see Charles & Bradley, 2009), though the general share of students choosing STEM is larger in Germany (OECD, 2017). The explanatory analyses in Table 3.5 report that the largest part of this gender gap in STEM study choice can be attributed to relative math performance, in particular with regard to grades (it also has the strongest relative effect on the choice of a STEM major). Almost one-quarter of the gender gap (24%) can be attributed to this factor, which outperforms the contribution of other potential explanations of the gender gap, including academic self-assessment, students' life goals, and gender-role attitudes (contribution of each of these factors is at most 8%). This implies that the rational choice explanation of the gender gap in STEM fields of study prevails over the culturalist explanation, and that girls partly choose STEM majors at general university less often than boys due to their relative strength in German compared to math (cf. Jonsson, 1999). Notwithstanding, this "relative strength" explanation does not suffice, as is shown by the substantial unexplained gender gap (43%): In other words, even if girls show the same relative strength in math as boys (or vice versa:

[9] Again, we find that the gender gap in this educational outcome is the same for children from lower and higher educated parents.

boys in German), girls less often opt for a STEM major. Therefore, future research needs to further disentangle this important form of gender inequality within tertiary education.

Because about 20% of students leave the higher educational system without a certificate (Heublein & Schmelzer, 2018), we also tested how far the intention to drop out from the chosen field of study differs between women and men in terms of the opinion of significant others, especially for those enrolled in a gender-atypical major. We know that young women face a lower dropout rate than men in general and with regard to all subjects (ibid.). However, research on gender-specific differences in dropout within gender-atypical fields of study is scant and focuses mostly on women in STEM subjects. A common explanation of the larger dropout in STEM than non-STEM is that women show a lower identification with that field of study (e.g., Wolffram et al., 2009). Referring to Tinto's (1987, p. 93) model and the work of Nora (2001), we know that for students, significant others play a crucial role not only in the phase of integration in the academic system but also in their separation from the well-known home environment. Therefore, the support of parents and peers is important when students think about staying or leaving the system or field of study. We thus expected that the more that significant others support the chosen field of study, the more likely it would be for students to stay in the system and the more the probability of dropping out would decrease (Hypothesis H12). Based on former results (Choy et al., 2000; Wells et al., 2013), we expected the following differences between female and male students: Positive parental and peer influences should show a stronger effect on women than men (Hypothesis H13). Moreover, in gender-atypical fields of study, the opinion of significant others should have a stronger influence on decision-making processes with regard to "doing gender" (West & Zimmerman, 1987) than in gender-typical fields (Hypothesis H14).

Using *NEPS Starting Cohort First-Year Students*, we first looked at the influence of significant others (parents and peers) on women's and men's intention to drop out; and, second, we estimated the influence of significant others by field of study (FEM vs. STEM[10]). The structure of our analyses was based on previous findings (results are not reported here in detail) and indicate that male and female students face different dropout intentions. Therefore, the probability is lower for women in general as well as within FEM and STEM fields.

Table 3.6 shows the influence of significant others on the dropout intention of women and men. Here we find influences of both the parents' as well as the peers' attitudes toward the students' fields of study for both sexes. The more that significant others support the choice concerning the field of study, the lower the probability of dropout intention. This is in line with Hypothesis H12. We further see in Table 3.6 that parental influences are slightly higher than those of peers. Furthermore, the influence of parents' and peers' opinion is stronger for men than for women.

[10]We differentiated between STEM (math, science, and engineering) and FEM (traditional more women-dominated subjects: linguistic and cultural studies, human medicine and health science, as well as veterinary medicine) (Statistisches Bundesamt, 2018).

Table 3.6 Average marginal effects of influence of significant others on dropout intention

	Model 1: Male	Model 2: Male	Model 3: Female	Model 4: Female	Model 5: Male	Model 6: Female
Support of parents (ref.: Lowest)	−0.092*		−0.049*		−0.072*	−0.034
Support of peers (ref.: Lowest)		−0.060*		−0.044*	−0.024	−0.026
N	6716	6716	10535	10535	6716	10535

Source: NEPS, Starting Cohort First-Year Students; own computations
Notes: All models control for academic performance and migration background. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.7 Average marginal effects of influence of significant others on dropout intention within STEM fields

	Model 1: Male	Model 2: Male	Model 3: Female	Model 4: Female	Model 5: Male	Model 6: Female
Support of parents (ref.: Lowest)	−0.093*		−0.050*		−0.073*	−0.035
Support of peers (ref.: Lowest)		−0.060*		−0.044*	−0.023	−0.026
N	6716	6716	10535	10535	6716	10535

Source: NEPS, Starting Cohort First-Year Students; own computations
Notes: All models control for academic performance and migration background. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Contrary to our expectations, the probability of dropout decreases by about 9 percentage points for male students but by only 5 percentage points for female students when the choice of the field of study is supported by parents, compared to students whose parents do not support their field of study at all. We could identify a similar effect for peers: Here the dropout intentions decrease by about 5 percentage points for men and women. Therefore, we could reject Hypothesis H13.

In a last step, we looked at the influence of parents and peers simultaneously. It appears that it is only the parent's opinion that has a significant effect for male students, whereas we find no statistically significant differences for female students.

We also wanted to know whether there are differences between fields of study. Tables 3.7 and 3.8 show the influence of significant others on the probabilities of the dropout intention for STEM and FEM fields of study split for women and men. When we look at the influence of parents' opinion on their children's study subject, we find significant effects for female and male students that do not differ significantly between STEM and FEM fields of study. For men, the probability of dropping out decreases 9 percentage points when the choice is supported by parents. For women the effect is lower: Here, the probability decreases 5 percentage points compared to students whose parents do not at all support the decision for the chosen field of study.

Table 3.8 Average marginal effects of influence of significant others on dropout intention within FEM fields

	Model 1: Male	Model 2: Male	Model 3: Female	Model 4: Female	Model 5: Male	Model 6: Female
Support of parents (ref.: Lowest)	−0.091*		−0.049*		−0.071	−0.034
Support of peers (ref.: Lowest)		−0.060*		−0.043*	−0.024	−0.026
N	6716	6716	10535	10535	6726	10535

Source: NEPS, Starting Cohort First-Year Students; own computations
Notes: All models control for academic performance and migration background. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Considering the effects of peers' opinions about field of study, we find similar results: Again, the effect is (nearly) identical between STEM and FEM fields, but it is stronger for male students (6 percentage points for men and only 4 percentage points for women).

For FEM fields, we find no significant effects of peers' or parents' opinions on dropout intentions. These findings support the effects found in our first analyses (see Table 3.6).

Overall, contrary to our theoretical expectations, effects are stronger for male students when we look at the support of significant others. However, for female and male students, the impact of parental opinions is stronger than the impact of peers' opinions on the intention to drop out. So far, we could not identify systematic differences between male and female (STEM or FEM) fields of study. Therefore, we evaluate this evidence as not supporting our Hypothesis H14.

3.5 The Role of Mothers in Their Daughters' Educational and Occupational Career over Cohorts

The role of the family of origin is crucial on two opposite sides: On the one side, performances, aspirations, and choices depend on social origins (Dustmann, 2004). There is a link between overall educational achievements and parental background. On the other side, parents influence children via stereotypes and the cultural norms surrounding gender and gender-specific parenting (e.g., Eccles, 1987) (Hypothesis H15). The literature demonstrates that whereas sons are more oriented toward taking fathers as examples for themselves, daughters tend to refer to their mothers (Huttunen, 1992; Updegraff et al., 1996). The theoretical explanation for this connection is based on the theory of sex-role socialization. It suggests that parents tend to act as models and provide more valuable information if they have the same sex as their child (Boyd, 1989) because they are perceived as having more relevant information and expertise (Acock & Yang, 1984; Boyd, 1989).

The proportions of German women and men who obtain tertiary degrees have recently become more equal (Mayer, 2008). This change in modern families has led to a modification across cohorts in the relative positions of mothers in terms of education and with respect to fathers (Blossfeld & Drobnič, 2001): Mothers are more and more educated, and the education gap between mothers and fathers has been reduced drastically. The occupational level of mothers is particularly important for the job status that daughters achieve (Hypothesis H16): The background characteristics of mothers prove to be more important for daughters than those of their fathers (Khazzoom, 1997).

Following our life course perspective, we wanted to know which consequences these structural changes on the side of parents are having for the development of gender-specific educational trajectories in general as well as for job entry and careers of men and women in Germany across cohorts. Therefore, this section focuses on the intergenerational transmission of education and occupation with special regard to the mothers' role. It aims, first, to compare the long-term gender-specific changes in educational opportunities and early job careers across birth cohorts; and, second, to analyze the effects of educational expansion on gender-specific structures of occupational segregation at job entry and early careers.

Starting from the theoretical perspective of sex-role socialization (Acock & Yang, 1984; Boyd, 1989; Khazzoom, 1997), we analyzed the separate role of mothers and fathers in determining the educational achievements of daughters and looked at the maternal-line job mobility of daughters by comparing successive cohorts of German students. First, we calculated the predicted probabilities of reaching low, medium, or high educational attainment on the basis of the level of education of the mothers and the fathers in order to study whether the same-sex parent has a diverse role in influencing the same-sex child's highest level of education (Minello & Blossfeld, 2016). Second, we focused on the maternal-line relation, demonstrating that the association between mothers' and daughters' occupational career has changed over time, and that education plays a fundamental role for daughters' job mobility (Minello & Blossfeld, 2014).

Our first aim was to understand the separate role of mothers and fathers over time and across different levels of education in influencing the educational attainment of their daughters. Using *NEPS Starting Cohort Adults*, we first analyzed the educational attainment of daughters on the basis of the level of education reached by their parents. We entered the level of education of the mother, then that of the father into the models. First, we investigated the children of parents with low education (at least a lower secondary education or intermediate level with no vocational training); then, those whose parents have medium education (at least an intermediate level or having completed secondary education); and last, we compared the educational attainment of children with highly educated parents (tertiary degree). We compared children born in 1945–1954, 1955–1964, 1965–1974, and 1975–1980.

For daughters of low educated parents, the investment in secondary education and the reduction in low education numbers are already large in the 1955–1964 cohort. We observe an increase in girls obtaining high education, especially among the younger cohorts. The dissimilarities between considering fathers and mothers are

accentuated, but only if we consider the youngest birth cohort. We find a strong reduction in numbers of poorly educated daughters over cohorts, accompanied by a strong rise in daughters with medium education and increasing investment in tertiary education, especially when the youngest cohort of mothers is considered.

When their mother or father has a medium education, daughters have a high and increasing probability of attaining a medium education across cohorts. In the past, fathers rather than mothers with medium education had a higher probability of having daughters with low education. However, this tendency has reversed in the young generations. Nonetheless, the differences are very small, and the pattern does not change much when we compare children with either their mothers or their fathers.

Finally, investment in higher education for daughters is different for mothers and fathers, especially when the younger generations are considered. This speaks in favor of Hypotheses H15 and H16. If the mother has a high education, the recent cohorts of daughters have a higher probability of acquiring a high level of education than the daughters of mothers with only medium education. If the father is considered, the gap between the probabilities of receiving medium or high education is narrower. The probability of being poorly educated is close to zero in both cases.

Our second research aim was to test how far daughters experience upward or downward mobility in relation to their mothers when entering the labor market, thereby testing the role of education in affecting daughters' maternal-line social mobility. We compared the prevalent ISEI position (International Socio-Economic Index of occupational status by Ganzeboom et al., 1992) of the mother and the ISEI position of the daughter at entry in the labor market with respect to the daughters' level of education and by cohort. The level of education is defined here as it was done before, and the following cohorts are distinguished: 1944–1956, 1957–1973, and 1974–1984.

Figure 3.1 upper panel shows the predicted probability of experiencing maternal-line upward mobility by educational attainment for different cohorts of daughters. It was much easier for the older birth cohorts to experience upward mobility, despite their lower level of education. Daughters born before 1957, with the exception of those without any educational level, have a higher probability of entering the job market with a higher job position than that of their mothers. Daughters born after 1973 can have a high probability of experiencing an upward move relative to their mothers only if they have a high education, hence a tertiary degree (Minello & Blossfeld, 2016).

Figure 3.1 lower panel reports the predicted probability of experiencing maternal-line downward mobility by educational attainment for different birth cohorts. For the younger birth cohorts of daughters, it is much easier to experience downward intergenerational mobility relative to their mothers. For the oldest birth cohorts, it is least likely, with the exception of women without any educational degree (within the low educated). In every birth cohort, highly educated daughters have a much lower probability of experiencing downward mobility than lower educated women.

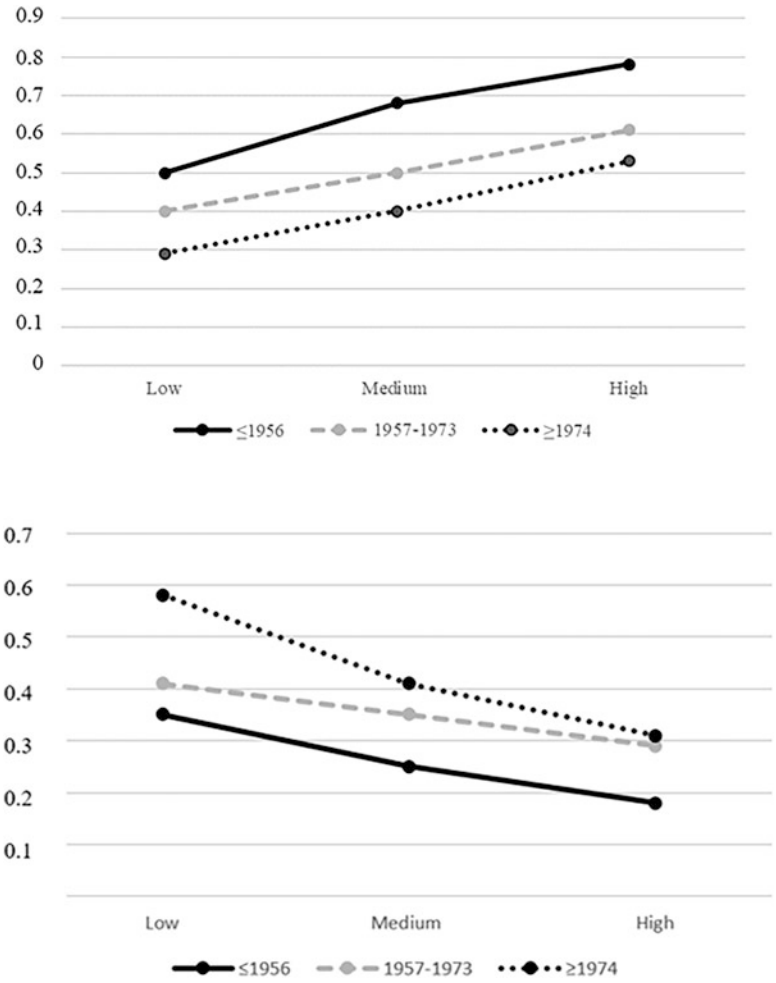


Fig. 3.1 Predicted probability of experiencing maternal-line female upward/downward mobility by educational level and birth cohorts (to analyze maternal-line educational and job mobility, we identified upward intergenerational occupational mobility as an increase of at least 5 points on the ISEI scale for the daughters' first job compared to the ISEI of the mother's job position. We defined downward mobility as a decrease in the occupational status of the daughter compared with that of the mother. We consider the first job position of daughters and the prevalent job position of the mother (intended as the job that the mother has had for most of her life when the daughter was 15 years old). We defined three levels: at least a lower secondary education or intermediate level with no vocational training (corresponding to the German *kein Abschluss*, *Hauptschulabschluss ohne beruflicher Ausbildung*, *Hauptschulabschluss mit beruflicher Ausbildung*, or *Mittlere Reife ohne beruflicher Ausbildung*); at least an intermediate level or having completed secondary education (*Mittlere Reife mit beruflicher Ausbildung*, *Hochschulreife ohne beruflicher Ausbildung*, or *Hochschulreife mit beruflicher Ausbildung*); and a tertiary degree (*Fachhochschulabschluss* or *Universitätsabschluss*). The three levels of educational attainment are renamed "low," "medium," and "high" education). (Source: NEPS, Starting Cohort Adults; own computations; $N = 3645$)

3.6 Conclusions and Discussion

Our project aimed to trace the emergence and stepwise development of gender-specific differences in competence development as well as decision making at the four most important phases/transitions in educational and occupational careers in Germany: (1) experiences at preschool age, (2) achievement during elementary school and the transition to secondary school, (3) transition from secondary school to vocational training or higher education, and (4) occupational careers. Unfortunately, NEPS data do not allow us to observe the educational careers of men and women as a whole over the life course, but we can follow up the development of changes in transitions across the life course for different cohorts thanks to the NEPS cohort-sequence design. Hence, because the different NEPS Starting Cohorts follow different phases of the educational career, it is possible to string them together.

Starting at the earliest phase in the educational career, our analyses show that there are already gender differences in mathematical competencies at early *preschool age*, but contrary to the usual expectations, they favor girls. This gender gap cannot be explained by previous maternal, domain-specific stimulation in terms of numeracy and literacy, although there is some evidence that girls gain higher literacy stimulation and boys higher numeracy stimulation. We conclude that at age 4, girls tend to make more rapid advances in development, because the female advantage at this age is persistent even after controlling for theoretically important covariates. Going one step further in life, our analysis of the age of 6, which is shortly before school entry, shows that this gender gap reverses to a traditional gender pattern with mathematical competencies in favor of boys. There is some evidence that compared to girls, this might be due to the higher mathematical self-concepts of boys at this age. Furthermore, it is interesting that this higher mathematical self-concept is not related to the fact that parents make slightly different assessments of their children's mathematical abilities in favor of boys.

In *elementary school,* these early gender-specific differences are reinforced: Boys perform better in mathematics and girls perform better in German. Nevertheless, because these relative advantages in each domain compensate for each other, there are no differences in overall performance. This finding emphasizes the salience of educational specialization within the school curriculum, and hence potentially suggests that gender inequalities in educational outcomes in the German educational system should manifest particularly in the horizontal stratification dimension (such as, e.g., STEM vs. FEM orientation). With regard to the *transition to secondary school*, in contrast to previous findings from research, we do not find that girls are more likely to end up in academic tracks. The only difference we find is that boys have a higher probability of transitioning to *Hauptschule*. Furthermore, our analysis provides evidence that there is a wider gender gap in educational outcomes among students from less advantaged backgrounds. However, this finding is limited exclusively to students' performance in math, whereas we do not find any declining effect of gender by social background with regard to students' performance in German, or any similar compensatory effects with regard to the choice of educational tracks.

Concerning the next phase of the educational career—the *transition from secondary school to vocational training or higher education*—there is some evidence from the data that among graduates, young women tend to opt more often for vocational training than young men, whereas the latter more often choose to study at universities of applied sciences than women. We do not find gender differences regarding university entry, nor do women aim lower with respect to university entry when they have similar grades to boys. However, a clear gender-specific differentiation appears with regard to the field of study at university: Men more often choose a STEM major than women. Our analyses show that to a large extent, this gender gap can be explained by the girls' higher relative school achievement in languages than in math. But what about those who enroll in gender-atypical fields of study? Do they have a higher dropout intention than those who enroll in gender-typical fields of study? And what role does the opinion of significant others play? So far, we have not been able to identify a systematic pattern of dropout intentions for students within different fields. This might be due to the fact that students in atypical fields are a highly selective group. Furthermore, our analyses show that significant others are important when looking at dropout intentions. The parents' opinions seem to be particularly important for students, although it turns out that the peers' opinions do matter as well for the intentions of students to drop out. The more that significant others support the chosen subject, the more the intentions to drop out decrease. However, the effects we find are not as strong as expected, and the differences between males and females remain on a low level. Nevertheless, we find differences between male and female students: Contrary to theoretical expectations, the influences of significant others are generally stronger for male students than for females. This stronger effect for men shows up in STEM and in those fields related more to women (FEM). When considering the opinion of peers and parents simultaneously, we can identify a significant influence only for parents' opinion on the dropout intention of male students.

Finally, our results show the important role of mothers in shaping the level of education of their daughters. This plays a fundamental role in guaranteeing the chances of maternal-line mobility of daughters, especially among the young generations. We see an increased investment in middle and secondary education for daughters across cohorts. This change is evident when we regard daughters whose parents have low or medium education. When considering highly educated parents, our results demonstrate that when the mother has tertiary education, the daughter has a very high probability of getting a higher education as well, especially when looking at the younger birth cohort (1975–1980). Because this is not the case when we take only fathers with tertiary education into consideration, we conclude that mothers with tertiary education tend to invest more in their daughters than fathers do. Moreover, younger and more educated daughters have greater chances than older and low educated ones of experiencing upward maternal-line intergenerational mobility and avoiding downward mobility. University degrees are, in fact, more and more important for young women living in Germany, because they are the main way to commence a decent job career in a position higher than that of their mothers.

In summary, based on our analyses, the expected cumulative differences among boys and girls and men and women over the life course emerge in line with the so-called Matthew effect hypothesis: Small gender differences at preschool age get bigger over the school career, not so much with regard to competence trajectories, but with regard to the chosen subjects in schools and fields of study in vocational training and tertiary education. Small gender-specific differences in mathematical competencies at the end of preschool seem to be reinforced in elementary and secondary school and lead to gender-specific choices of fields of study in vocational training and tertiary education as well as to gender-specific differences in job careers. Even though our research is limited and only partially longitudinal, we can shed some light on the gender-specific processes over the life course by comparing short-term processes for different NEPS starting cohorts. It is clear that we are only beginning to understand the gender-specific causal mechanisms, and that we need longer individual histories from the data. However, with each additional panel wave of NEPS, researchers will have longer observation windows and a better opportunity to use real longitudinal data to study the educational and job trajectories of women and men from the various NEPS starting cohorts.

References

Acock, A. C., & Yang, W. S. (1984). Parental power and adolescents' parental identification. *Journal of Marriage and Family, 46*, 487–495.

Alwin, D. F., Braun, M., & Scott, J. (1992). The separation of work and the family: Attitudes towards women's labour-force participation in Germany, Great Britain, and the United States. *European Sociological Review, 8*(1), 13–37.

Ammermüller, A., & Weber, A. M. (2005). Educational attainment and returns to education in Germany: An analysis by subject of degree, gender and region. In *ZEW Discussion Papers 05–17*. ZEW – Zentrum für Europäische Wirtschaftsforschung/Center for European Economic Research.

Arens, A. K., Marsh, H. W., Craven, R. G., Yeung, A. S., Randhawa, E., & Hasselhorn, M. (2016). Math self-concept in preschool children: Structure, achievement relations, and generalizability across gender. *Early Childhood Research Quarterly, 36*, 391–403.

Artelt, C., Baumert, J., Klieme, E., Neubrand, M., Prenzel, M., Schiefele, U., Schneider, W., Schümer, G., Stanat, P., Tillmann, K.-J., & Weiß, M. (Eds.). (2001). *PISA 2000. Zusammenfassung zentraler Befunde*. Max-Planck-Institut für Bildungsforschung.

Bernardi, F. (2014). Compensatory advantage as a mechanism of educational inequality. A regression discontinuity based on month of birth. *Sociology of Education, 87*(2), 74–88.

Blossfeld, P. N. (2017). *Changes in inequality of educational opportunity. The long-term development in Germany*. Springer VS.

Blossfeld, H.-P., & Drobnic, S. (2001). *Careers of couples in contemporary societies: A cross-national comparison of the transition from male breadwinner to dual-earner families*. Oxford University Press.

Blossfeld, H.-P., Bos, W., Hannover, B., Lenzen, D., Müller-Böling, D., Prenzel, M., & Wößmann, L. (2009). Geschlechterdifferenzen im Bildungssystem, Jahresgutachten 2009, Vereinigung der Bayerischen Wirtschaft e. V. (Ed.), *Geschlechterdifferenzen im Bildungssystem*. VS Verlag für Sozialwissenschaften.

Blossfeld, H.-P., Skopek, J., Triventi, M., & Buchholz, S. (Eds.). (2015). *Gender, education and employment. An international comparison of school-to-work transitions*. Edward Elgar Publishing.

Bonsen, M., Lintorf, K., & Bos, W. (2008). Kompetenzen von Jungen und Mädchen. In W. Bos (Ed.), *TIMSS 2007. Mathematische und naturwissenschaftliche Kompetenzen von Grundschulkindern in Deutschland im internationalen Vergleich* (pp. 125–140). Waxmann.

Boudon, R. (1974). *Education, opportunity, and social inequality: Changing prospects in western society*. Wiley.

Boyd, C. J. (1989). Mothers and daughters: A discussion of theory and research. *Journal of Marriage and Family, 51*, 291–301.

Buchmann, C., DiPrete, T. A., & McDaniel, A. (2008). Gender inequalities in education. *Annual Review of Sociology, 34*, 319–337.

Charles, M., & Bradley, K. (2002). Equal but separate? A cross-national study of sex segregation in higher education. *American Sociological Review, 67*, 573–599.

Charles, M., & Bradley, K. (2009). Indulging our gendered selves? Sex segregation by field of study in 44 countries. *American Journal of Sociology, 114*, 924–976.

Choy, S. P., Horn, L. J., Nunez, A. M., & Chen, X. (2000). Transition to college: What helps at-risk students and students whose parents did not attend college. *New Directions for Institutional Research, 107*, 45–63.

Connolly, P. (2004). *Boys and schooling in the early years*. Routledge Falmer.

Connolly, P. (2006). The effects of social class and ethnicity on gender differences in GCSE attainment: A secondary analysis of the youth cohort study of England and Wales 1997–2001. *British Educational Research Journal, 32*(1), 3–21.

Dannefer, D. (1987). Aging as an inter-cohort differentiation. Accentuation, the Matthew effect and the life course. *Sociological Forum, 2*, 211–236.

DiPrete, T. A., & Buchmann, C. (2013). *The rise of women: The growing gender gap in education and what it means for American schools*. Russell Sage Foundation.

Dornheim, D. (Ed.). (2008). *Prädiktion von Rechenleistung und Rechenschwache: Der Beitrag von Zahlen-Vorwissen und allgemein-kognitiven Fähigkeiten*. Logos.

Dryler, H. (1998). Parental role models, gender and educational choice. *The British Journal of Sociology, 49*(3), 375–398.

Dustmann, C. (2004). Parental background, secondary track choice, and wages. *Oxford Economic Papers, 56*, 209–230.

Eccles, J. S. (1987). Gender roles and women's achievement-related decisions. *Psychology of Women Quarterly, 11*, 135–172.

Eccles Parsons, J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives* (pp. 75–146). W. H. Freeman.

Eccles, J. S., Jacobs, J. E., & Harold, R. D. (1990). Gender role stereotypes, expectancy effects, and parents' socialization of gender differences. *Journal of Social Issues, 46*(2), 183–201.

Farkas, G. (1976). Education, wage rates, and the division of labor between husband and wife. *Journal of Marriage and Family, 38*(3), 473–483.

Francis, B. (1999). Lads, lasses and (new) labour: 14-16-year-old students' responses to the "laddish behaviour and boys' underachievement" debate. *British Journal of Sociology of Education, 20*(3), 355–371.

Frey, A., Heinze, A., Milder, D., Hochweber, J., & Asseburg, R. (2010). Mathematische Kompetenz von PISA 2003 bis PISA 2009. In E. Klieme, C. Artelt, J. Hartig, N. Jude, O. Köller, M. Prenzel, W. Schneider, & P. Stanat (Eds.), *PISA 2009. Bilanz nach einem Jahrzehnt* (pp. 153–176). Waxmann.

Ganzeboom, H. B. G., De Graaf, P. M., & Treiman, D. J. (1992). A standard international socio-economic index of occupational status. *Social Science Research, 21*, 1–56.

Guiso, L., Monte, F., Sapienza, P., & Zingales, L. (2008). Culture, gender, and math. *Science, 320*(5880), 1164–1165.

Halpern, D. F., Benbow, C. P., Geary, D. C., Gur, R. C., Hyde, J. S., & Gernsbacher, M. A. (2007). The science of sex differences in science and mathematics. *Psychological Science in the Public Interest, 8*(1), 1–51.

Helmke, A. (1999). From optimism to realism? Development of children's academic self-concept from kindergarten to grade 6. In W. Schneider & F. E. Weinert (Eds.), *Individual development from 3 to 12. Findings from the Munich longitudinal study* (pp. 198–221). Cambridge University Press.

Werfhorst, van de, Herman, G., Sullivan, A., & Cheung, S. Y. (2003). Social class, ability and choice of subject in secondary and tertiary education in Britain. *British Educational Research Journal, 29*(1), 41–62.

Heublein, U., & Schmelzer, R. (2018). *Die Entwicklung der Studienabbruchquoten an den deutschen Hochschulen*. DZHW Projektbericht.

Huttunen, J. (1992). Father's impact on son's gender role identity. *Scandinavian Journal of Educational Research, 36*, 251–260.

Jonsson, J. O. (1999). Explaining sex differences in educational choice: An empirical assessment of a rational choice model. *European Sociological Review, 15*, 391–404.

Jordan, N. C., Kaplan, D., & Hanich, L. B. (2002). Achievement growth in children with learning difficulties in mathematics. Findings of a two-year longitudinal study. *Journal of Educational Psychology, 94*(3), 586–597.

Jordan, N. C., Kaplan, D., Nabors Oláh, L., & Locuniak, M. N. (2006). Number sense growth in kindergarten: A longitudinal investigation of children at risk for mathematics difficulties. *Child Development, 77*(1), 153–175.

Jürges, H., & Schneider, K. (2011). Why young boys stumble: Early tracking, age and gender bias in the German school system. *German Economic Review, 12*(4), 371–394.

Khazzoom, A. (1997). The impact of mothers' occupations on children's occupational destinations. *Research in Social Stratification and Mobility, 15*, 57–90.

Kleemans, T., Peeters, M., Segers, E., & Verhoeven, L. (2012). Child and home predictors of early numeracy skills in kindergarten. *Early Childhood Research Quarterly, 27*(3), 471–477.

Kluczniok, K., Lehrl, S., Kuger, S., & Rossbach, H.-G. (2013). Quality of the home learning environment during preschool age – Domains and contextual conditions. *European Early Childhood Education Research Journal, 21*(3), 420–438.

Koponen, T., Aunola, K., Ahonen, T., & Nurmi, J.-E. (2007). Cognitive predictors of single-digit and procedural calculation skills and their covariation with reading skill. *Journal of Experimental Child Psychology, 97*(3), 220–241.

Krajewski, K., & Schneider, W. (2009). Exploring the impact of phonological awareness, visual-spatial working memory, and preschool quantity-number competencies on mathematics achievement in elementary school. Findings from a 3-year longitudinal study. *Journal of Experimental Child Psychology, 103*(4), 516–531.

Lonnemann, J., Linkersdörfer, J., Hasselhorn, M., & Lindberg, S. (2013). Gender differences in both tails of the distribution of numerical competencies in preschool children. *Educational Studies in Mathematics, 84*(2), 201–208.

Lörz, M., Schindler, S., & Walter, J. G. (2011). Gender inequalities in higher education: Extent, development and mechanisms of gender differences in enrollment and field of study choice. *Irish Educational Studies, 30*, 179–198.

Mann, A., & DiPrete, T. (2013). Trends in gender segregation in the choice of science and engineering majors. *Social Science Research, 42*, 1519–1541.

Marsh, H., & Craven, R. (2006). Reciprocal effects of self-concept and performance from a multidimensional perspective. *Perspectives on Psychological Science, 1*(2), 133–163.

Marsh, H. W., Ellis, L. A., & Craven, R. G. (2002). How do preschool children feel about themselves? Unraveling measurement and multidimensional self-concept structure. *Developmental Psychology, 38*(3), 376–393.

Mayer, K. U. (2008). Das Hochschulwesen. In K. S. Cortina, J. Baumert, A. Leschinsky, K. U. Mayer, & L. Trommer (Eds.), *Das Bildungswesen in der Bundesrepublik Deutschland* (2nd ed., pp. 599–645). Rowohlt Verlag.

Mayer, K. U., & Tuma, N. B. (1990). *Event history analysis in life course research*. University of Wisconsin Press.

Minello, A., & Blossfeld, H.-P. (2014). From mother to daughter: Changes in intergenerational educational and occupational mobility in Germany. *International Studies in Sociology of Education, 24*(1), 65–84.

Minello, A., & Blossfeld, H.-P. (2016). From parents to children: The impact of mothers' and fathers' educational attainments on those of their sons and daughters in West Germany. *British Journal of Sociology of Education, 38*, 686–704.

Niklas, F., & Schneider, W. (2012). Die Anfänge geschlechtsspezifischer Leistungsunterschiede in mathematischen und schriftsprachlichen Kompetenzen. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie, 44*(3), 123–138.

Nora, A. (2001). The depiction of significant others in Tinto's "rites of passage": A reconceptualization of the influence of family and community in the persistence process. *Journal of College Student Retention Research Theory and Practice, 3*(1), 41–56.

OECD. (2015). *The ABC of gender equality in education: Aptitude, behaviour, confidence*. OECD Publishing.

OECD. (2017). *Education at a glance 2017: OECD indicators*. OECD Publishing.

Phillips, L. M., Norris, S. P., Osmond, W. C., & Maynard, A. M. (2002). Relative reading achievement: A longitudinal study of 187 children from first through sixth grades. *Journal of Educational Psychology, 94*(1), 3–13.

Ready, D., LoGerfo, L., Burkam, D., & Lee, V. (2005). Explaining girls' advantage in kindergarten literacy learning: Do classroom behaviors make a difference? *The Elementary School Journal, 106*, 21–38.

Reimer, D., & Steinmetz, S. (2009). Highly educated, but in the wrong field? Educational specialization and labour market risks of men and women in Spain and Germany. *European Societies, 11*(5), 723–746.

Ridgeway, C. L. (2011). *Framed by gender: How gender inequality persists in the modern world*. Oxford University Press.

Skopek, J., Pink, S., & Bela, D. (2012). *Starting cohort 3: 5th grade (SC3) data manual*. National Educational Panel Study.

Stanat, P., & Bergmann, S. (2009). Geschlechtsbezogene Disparitäten in der Bildung. In R. Tippelt & B. Schmidt (Eds.), *Handbuch Bildungsforschung* (pp. 513–528). VS-Verlag für Sozialwissenschaften.

Statistisches Bundesamt. (2018). *Hochschulen auf einen Blick*. Ausgabe 2018.

Statistisches Bundesamt. (2019). *Studienanfänger: Deutschland, Semester, Nationalität, Geschlecht*. Retrieved from https://www-genesis.destatis.de/genesis/online/logon?sequenz=tabelleErgebnis&selectionname=21311-0010

Tinto, V. (1987). *Leaving college: Rethinking the causes and cures of student attrition*. University of Chicago Press.

Updegraff, K. A., McHale, S. M., & Crouter, A. C. (1996). Gender roles in marriage: What do they mean for girls' and boys' school achievement? *Journal of Youth and Adolescence, 25*, 73–88.

Uunk, W. J. G., Beier, L., Minello, A., & Blossfeld, H.-P. (2019). Studienfachwahl MINT durch Frauen–Einfluss von Leistung in Mathematik, Lebenszielen und familialem Hintergrund. In E. Schlemmer & M. Binder (Eds.), *MINT oder Care? Eckpunkte einer gendersensiblen Berufsorientierung*. Beltz/Juventa.

van Berkel, M., & de Graaf, N. D. (1999). By virtue of pleasantness? Housework and the effects of education revisited. *Sociology, 33*(4), 785–808.

Vleuten, M. V. D., Jaspers, E., Maas, I., & Lippe, T. V. D. (2016). Boys' and girls' educational choices in secondary education: The role of gender ideology. *Educational Studies, 42*(2), 181–200.

Wells, R. S., Seifert, T. A., & Saunders, D. B. (2013). Gender and realized educational expectations: The roles of social origins and significant others. *Research in Higher Education, 54*(6), 599–626.

West, C., & Zimmerman, D. H. (1987). Doing gender. *Gender & Society, 1*(2), 125–151.

Wolffram, A., Derboven, W., & Winker, G. (2009). Konflikte und Bildungserlebnisse von Studienabbrecherinnen in den Ingenieurswissenschaften. In A. Thaler & C. Wächter (Eds.), *Geschlechtergerechtigkeit in Technischen Hochschulen* (pp. 139–148). Profil Verlag.

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Chapter 4
Patterns and Predictors of Literacy and Numeracy Development During Adulthood: Insights from Two Longitudinal Assessment Surveys



Clemens M. Lechner

Abstract Literacy (reading competence) and numeracy (mathematical competence) are indispensable prerequisites for lifelong learning and participation in today's knowledge-based societies. However, evidence on the development of these competencies during adulthood is limited. This chapter summarizes the main findings of a research project that leveraged the unique potential of two German longitudinal assessment surveys, NEPS and PIAAC-L, to garner insights into how these competencies develop during adulthood. Both surveys offer repeated measures of adults' competencies spaced 3–6 years apart, allowing light to be cast on two guiding questions: (1) *Patterns of change*: Can literacy and numeracy still change in adulthood? If so, does change involve gains or losses, and how is change distributed across sociodemographic subgroups? (2) *Predictors of change*: Which individual and contextual factors (e.g., participation in job-related training, engagement in literacy or numeracy practice, or basic cognitive skills) predict change in competence development? Findings suggest that competencies continue to develop across the lifespan and can change even over relatively short time periods. Gains and losses occur in equal measure. Moreover, findings pinpoint practice engagement as a crucial driver of change in competencies, while highlighting that practice engagement is itself dependent on a range of individual and contextual characteristics. Methodological insights and avenues for future research that emerged from our project are also discussed.

Abbreviations

Gc	Crystallized Intelligence
Gf	Fluid intelligence
LDV	Lagged dependent variable model

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NEPS	German National Educational Panel Study
PET	Practice engagement theory
PIAAC	Programme for the International Assessment of Adult Competencies
PIAAC-L	German PIAAC-Longitudinal Study
PV	Plausible value
SC3	Starting Cohort 3 (5th graders) of NEPS
SC6	Starting Cohort 6 (adults) of NEPS

4.1 Introduction

Among the most distinctive features of social and economic change in today's societies are rapid technological progress ('digitization'), demographic ageing, and a generally increased pace and scope of societal change (e.g., Mills & Blossfeld, 2013; Rosa, 2013; Silbereisen & Chen, 2010). One of the obvious implications of these macrolevel trends is that an ageing population will have to navigate an increasingly complex, knowledge-based, and technology-rich world in which skills that were once needed and useful may quickly become obsolete. In such a world, lifelong education and lifelong learning become the norm (Billett, 2018; Blossfeld et al., 2020; Kilpi-Jakonen et al., 2015).

Are today's cohorts of adults prepared for this world? Because it is hard to foresee which specific skills will be needed in the future, it is sensible to ask instead whether adults possess the *prerequisites* to learn and update their skills across the entire lifespan. Two such prerequisites are undoubtedly literacy (or reading competence, i.e., the ability to understand, use, and interpret written text) and numeracy (or mathematical competence, i.e., the ability to access, use, and interpret mathematical information) (OECD, 2012; PIAAC Literacy Expert Group, 2009). Without sufficient levels of these basic competencies, acquiring the types of specific skills and qualifications needed to navigate one's life in a technology-rich knowledge society is all but impossible. To illustrate, learning a foreign language through a smartphone app, understanding how to operate a CNC milling machine, reading up on the latest regulatory changes in a commodities market, or learning how to use spreadsheet tools for sales forecasting are all skills whose acquisition and execution require dealing with what is often complex symbolic (verbal and numeric) material—that is, they require literacy and numeracy skills. Apart from being prerequisites for lifelong learning, literacy and numeracy are indispensable for labour market participation, social and political participation, or managing one's health and finances. The robust links these basic competencies have to individual-level outcomes such as income, health, and social participation as well as to macrolevel outcomes such as economic growth testify to their importance (e.g., Hanushek et al., 2015; Lunze & Paasche-Orlow, 2014; OECD, 2016; Pullman et al., 2021).

The high and perhaps growing relevance of literacy and numeracy skills directs attention to how these competencies develop over the lifespan. People acquire

literacy and numeracy primarily through schooling. That much is clear. But what happens after people leave education is far less clear. How come, for example, that there is a substantial number of adults even in economically developed countries—between 12.1% and 17.5% of the working-age adults in Germany according to various estimates—who possess only low literacy levels that allow them to read simple words and sentences, but not longer or more complex texts (Durda et al., 2020; Grotlüschen et al., 2020)? Did these adults never acquire sufficient levels of literacy in the first place, or did they lose them at some stage? What are the normative trajectories of literacy and numeracy development over the lifespan? If competencies continue to change in adulthood, does change involve only losses or also gains, and how are gains and losses distributed across different segments of the population? Moreover, what individual and contextual factors drive potential gains and losses in literacy and numeracy—can we pinpoint risk and protective factors? Such questions are interesting research topics in their own right, but they are also relevant for policymakers and practitioners who are interested in promoting literacy and numeracy as well as lifelong learning more broadly (e.g., Wolf & Jenkins, 2014).

This chapter summarizes the key insights from a research project, led by the author of this chapter, that aimed to unravel these questions. This interdisciplinary project brought together psychologists, sociologists, and economists. It leveraged the unique potential to study change over time in adults' competencies offered by two German large-scale assessment surveys: the German National Educational Panel Study (NEPS; Blossfeld et al., 2011) and the German PIAAC Longitudinal Study (PIAAC-L; GESIS et al., 2017). These surveys' combination of large samples with a repeated-measures design has so far been a rarity in research on competence development during adulthood.

I shall proceed as follows. First, I shall briefly review the theoretical perspectives that guided the research project. Next, I shall outline the opportunities for studying adults' competence development offered by the repeated-measures data in NEPS and PIAAC-L while also highlighting methodological challenges and how our project addressed them. I shall then summarize the key findings on the patterns and predictors of literacy and numeracy development from the research project. I shall conclude by discussing open questions and avenues for future research on competence development. Table 4.1 lists the project's key publications, on which this chapter will dwell.

4.2 Theoretical Perspectives on Competence Development in Adulthood

The literature on competence development during adulthood is highly diverse (e.g., Desjardins & Warnke, 2012). It has approached competence development from various disciplinary perspectives including psychology, economics, sociology, and adult education. As a result, there is not even consensus on terminology, with

Table 4.1 Overview of the key publications from the DFG research project 'Stability and Change in Adult Competencies: Patterns and Predictors of Literacy and Numeracy Development'

Subject area	Publication	Key insights
 Methods of competence research	Martin et al. (2020)	Literacy skills predict refusal to participate in follow-up panel waves in ALWA/NEPS SC6 and PIAAC/PIAAC-L (selectivity).
	Lechner et al. (2021a)	Plausible values methodology (PV) and structural equation modelling (SEM) are needed to deal with measurement error in large-scale competence assessments.
 Patterns of change in competencies	Lechner et al. (2021b)	Adults' literacy and numeracy proficiency can change even across relatively short periods of 3–6 years in PIAAC-L and NEPS SC6. Gains and losses occur in equal measure. Individual differences in change, not mean-level trends or systematic subgroup differences, dominate the picture.
 Predictors of change in competencies	Gauly and Lechner (2019)	Participation in job-related training in PIAAC-L has no causal effect on changes in literacy. Instead, the often-observed cross-sectional link between training participation and competencies reflects selection into job-related training of those who are more competent.
	Gauly et al. (2020)	Participation in job-related training in PIAAC-L has no causal effect on changes in numeracy. This holds even when differentiating by training type or intensity. Instead, the often-observed cross-sectional link between training participation and competencies reflects selection into training of those who are more competent.
	Wicht et al. (2020)	Three main groups of predictors explain changes in literacy over 6 years in NEPS SC6: sociodemographic factors (e.g., education, age, mother tongue, indicating 'Matthew effects'), basic cognitive skills (in line with the 'general slowing' hypothesis), and practices in everyday life (in line with PET and the 'use it or lose it' principle).
	Reder et al. (2020)	Engagement in literacy-related and numeracy-related practices ranks among the strongest predictors of change in literacy and numeracy in PIAAC-L, supporting the central tenet of PET.
	Lechner et al. (2019b)	Basic cognitive skills and motivation coalesce in shaping the acquisition of literacy and numeracy in adolescence (NEPS SC3).

different research traditions referring to competencies as 'skills' (predominantly in economics), 'proficiencies', or '(crystallized) intelligence' (predominantly in psychology). The various disciplines that have studied competencies offer several theoretical perspectives that guided our project.

In psychology, a classic theory is Raymund B. Cattell's (1971) investment theory, initially proposed in the early 1940s and thus decades before data allowing for

stringent tests of its central claims were available. In his theory, Cattell (1971) proposed that 'intelligence' is comprised of two distinct aspects: 'fluid intelligence' (Gf), the ability to process novel information and stimuli, and 'crystallized intelligence' (Gc), the totality of acquired knowledge and skills.[1] Crucially, Cattell posited that Gf and Gc are subject to different influences and follow different age trajectories: he envisioned Gf to be largely innate (i.e., heritable) and dependent on biological, neural functioning. For this reason, Gf would peak early in life and then slowly decline. Contrariwise, he conceived of Gc as resulting from the investment (hence 'investment theory') of Gf in different subject areas and being influenced by education, experience, and culture. Accordingly, he posited that Gc would continue to increase across adulthood and decline only in old age when biological ageing negatively affects overall functioning. Cattell's theory is an early example of a theory of lifespan development, and it strongly influenced subsequent work (Brown, 2016; Nisbett et al., 2012). For example, it inspired Phil Ackerman's (1996) distinction between *intelligence-as-process* and *intelligence-as-knowledge* in industrial/organizational psychology and Paul Baltes's (1993) distinction between *cognitive mechanics* and *cognitive pragmatics* in research on cognitive ageing.

These concepts do not refer directly to literacy and numeracy as assessed in NEPS and PIAAC-L. However, a glance at the definition and assessment of competencies in NEPS clarifies that these surveys conceptualize literacy and numeracy as acquired functional capacities (Rammstedt, 2012; Weinert et al., 2011). This puts them into the same category as crystallized intelligence, intelligence-as-knowledge, and cognitive pragmatics. In the updated Cattell–Horn–Carrol (CHC) model (McGrew, 2009), one of the most influential structural models of cognitive abilities, the definitions of reading and writing ability (*Grw*)[2] and quantitative knowledge (*Gq*)—broad, acquired abilities at Stratum II—correspond closely to literacy and numeracy skills. At the same time, it is clear that literacy and numeracy require the operation of fluid-type cognitive basic skills such as reasoning and processing. Thus, competencies may be a blend of acquired (Gc-type) and inherited (Gf-type) abilities. This leads us to the hypothesis that the lifespan trajectories of Gf and Gc may be a blend of the ideal-typical trajectories of Gf and Gc hypothesized by Cattell (1971) and Baltes (1993). Figure 4.1 expresses this idea, which indeed receives some support from cross-sectional age profiles of literacy and numeracy presented by Paccagnella (2016) and ourselves (Lechner et al., 2021b, Supplementary Material).

A second theoretical perspective that hails from research on adult education is more specific to the competencies measured in studies such as NEPS and PIAAC-L: this is practice engagement theory (PET; Reder, 1994, 2009) developed by Steve

[1] As Brown (2016) cogently demonstrates, Cattell borrowed (or in fact stole) heavily from earlier work by Donald O. Hebb, who had introduced the distinction between Intelligence A (~problem solving) and Intelligence B (~acquired knowledge) as early as 1940 or 1941.

[2] It should be noted that the literacy assessments in PIAAC-L and NEPS focus on *text comprehension* but not on writing (text production) (Gehrer et al., 2013). Hence, literacy in these studies measures only part of *Grw* as conceived in the CHC model that comprises both reading and writing ability.

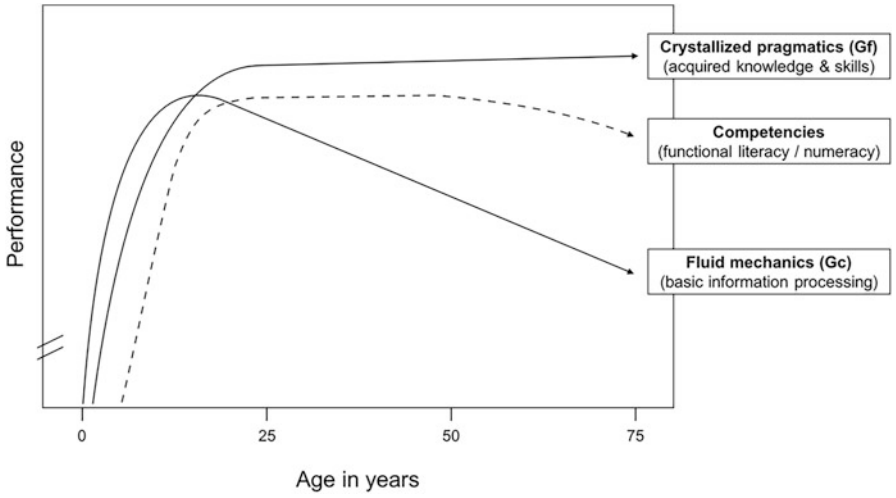


Fig. 4.1 Hypothesized age trajectories for different types of cognitive abilities. (*Note*. The figure shows hypothetical age trajectories of 'crystallized' and 'fluid' cognitive abilities according to the theories of Cattell (1971) and Baltes (1993). The age trajectory of competencies (literacy and numeracy) appears to be a blend of both, showing a prolonged plateau from early to middle adulthood and a decline slowing only in old age according to cross-sectional data reported in Paccagnella (2016) and also Lechner et al. (2021b))

Reder who was an international collaborator in our research project. PET posits that individuals' literacy proficiencies develop as a by-product of their engagement in everyday reading and writing practices. Reciprocally, literacy proficiencies affect levels of engagement in reading and writing practices. Thus, reminiscent of investment theory's postulate that growth in Gc results from the investment of Gf in a subject area (Ackerman, 1996; Cattell, 1971), PET assigns a pivotal role for competence development to individual engagement in literary and mathematical practices at work, in the family, or during leisure. At the same time, it highlights that engagement is itself dependent on prior proficiency and a set of structural influences such as race, gender, or socio-economic status (Reder, 2009; Reder et al., 2020; Wicht et al., 2021b). PET would predict that adults can experience both gains and losses in literacy and numeracy skills over time—depending on the extent to which they engage in attendant practices in their job, leisure, or other contexts. This central tenet of PET is compatible with investment theory or Baltes's research on ageing, but extends it by highlighting individual differences in skill development and identifying engagement as the core driver of these differences.

The third perspective, which has some prominence in life-course sociology, is the cumulative advantage or 'Matthew effects' hypothesis, which states that initial advantage (and disadvantage) accentuates over time. This perspective, applied to competence development, would suggest that 'skills beget skills' (Cunha & Heckman, 2007): from childhood on, people with higher initial levels of competencies (e.g., intelligence) and resources (e.g., higher socio-economic status) are selected

into more cognitively stimulating and demanding environments (e.g., tertiary education, complex white-collar jobs). These environments, in turn, allow them to expand their competencies further. Those at the lower end of the distribution of competencies and resources, by contrast, will lose further ground, leading to a growing competence gap.

Together, these theories suggest several hypotheses about adults' competence development. First, through being functional capacities that individuals acquire chiefly through education and practice during schooling age, literacy and numeracy should remain fairly stable across adulthood. However, they might remain malleable in principle ('lifelong plasticity'). Second, according to investment theory and PET, respectively basic cognitive skills (Gf) and practice engagement should rank among the strongest predictors of competence development: individual differences in Gf and the extent to which adults 'invest' their fluid intelligence in literacy and mathematics practices will determine whether they can maintain or even expand their competencies in adulthood. Third, sociodemographic and structural factors may be related to competence development through both selection effects (e.g., individuals with a higher SES are more likely to attend tertiary education) and socialization effects (e.g., individuals with tertiary education are more likely to have complex jobs that require reading and math). According to the 'Matthew effect', those with higher resources may be at an advantage in competence development. These hypotheses were among those that we hoped to put to a rigorous test in our research project.

4.3 NEPS and PIAAC-L: Opportunities and Challenges for the Study of Competencies

4.3.1 Research Designs of Prior Work

Prior research on competencies—summarized in informative reviews by Desjardins and Warnke (2012), Paccagnella (2016), and Nienkemper et al. (2021, focusing on low literacy) and expanded by recent studies (e.g., Kyröläinen & Kuperman, 2021)—offers several important insights into the age profiles and into the precursors and correlates of adults' competencies. Much prior research is limited, however, by the research designs that fall mainly into one of two categories: large-scale cross-sectional and small-scale longitudinal studies. Cross-sectional studies are often based on large-scale international assessments such as the Programme for the International Assessment of Adult Competencies (PIAAC) or the International Adult Literacy Survey (IALS) conducted by the OECD. Studies based on these surveys have made important contributions to our understanding of the correlates (i.e., potential antecedents and consequences) of consequences, cross-national differences, and trends over time (Paccagnella, 2016). They have also enabled insights into age-related differences in literacy and numeracy skills and into the correlates of

individual differences in skills. However, owing to their cross-sectional design, these studies can hardly inform us about the temporal dynamics of competence development in adulthood. These studies confound age effects with cohort (and, if they exist, period) effects, meaning that the alleged age trends they report might be biased. Cross-sectional designs cannot ascertain whether age differences reflect age-related changes or stem from pre-existing cohort differences in competencies (which may already have arisen in childhood or adolescence). They cannot provide indispensable statistics about change and stability. These statistics, for example, the change score or test–retest correlation, require repeated-measures designs to compute. Moreover, cross-sectional designs do not allow for the application of panel models such as fixed-effects (FE) regression to identify (or at least get closer to) *causal* effects of predictors of competence development.

Small-scale longitudinal studies are advantageous in this regard because they are truly developmental and allow competence development to be traced over time. Examples comprise the longitudinal study of adult learners (LSAL) that focuses on high-school dropouts in the US (Reder, 2009), studies on adults in basic skills programmes in the UK (Wolf & Jenkins, 2014), or studies on cognitive ageing in old age (Baltes, 1993). However, these studies, too, have limitations: because their samples are small and selective, their findings may not generalize to the population as a whole. Moreover, because they represent only specific subgroups of the population, they do not allow the study of differences in competence development across different subgroups of the population. Often, they may lack sample size and statistical power. Moreover, some of these studies did not contain as extensive assessments of competencies as those in the major international large-scale assessments such as PIAAC. Instead, many of them used ad hoc measures or established intelligence test batteries in which isolated verbal (e.g., vocabulary) or numerical abilities (e.g., number series) were only short subtests. Such assessments, though informative in their own right, do not provide the same depth of information on literacy and numeracy as PIAAC-L and NEPS.

4.3.2 The Unique Data Troves of NEPS and PIAAC-L

To answer the questions about the patterns and predictors of competence development posed at the outset, we need data that fulfil high requirements: large and diverse samples that allow for generalizable statements and cover relevant subgroups; a repeated-measures design that allows tracing change in competencies over time; and valid, reliable, objective, and longitudinally linked competence assessments. Until recently, such data were in short supply (Desjardins & Warnke, 2012; Reder & Bynner, 2009).

Fortunately, at least in Germany, this situation has changed with the advent of NEPS Starting Cohort 6 (SC6: Adults) and PIAAC-L. Both surveys assess literacy and numeracy in comparable ways. They offer repeated measures of adults' literacy and numeracy spaced 3 years (in PIAAC-L) to 6 years (in NEPS) apart. Both surveys

conceptualize literacy and numeracy from a functional perspective with assessment items reflecting problems and tasks encountered in everyday life (Gehrer et al., 2013). Despite some differences in the assessment approaches (for a detailed comparison of the literacy assessments in PIAAC-L and NEPS, see Durda et al., 2020), evidence from a linking study suggests high convergence between test takers' results in the PIAAC-L and NEPS assessments (Carstensen et al., 2017). Combining these data offered the opportunity to conduct what appeared to be the most comprehensive analyses to date of *change* in literacy and numeracy skills during adulthood in Germany.

4.3.3 Challenges and Pitfalls

Thus, PIAAC-L and NEPS are unique data troves that offer unprecedented analytical opportunities for the study of adult competencies. Nonetheless, there are a number of methodological challenges that complicate the study of change in competencies (Pohl & Carstensen, 2013; Pohl et al., 2015).

4.3.3.1 Retest Artefacts and Regression Toward the Mean

The first challenge pertinent to our project concerned the repeated assessment of skills. In traditional designs, the same set of items are administered on different occasions. This can lead to practice effects that bias estimates of change in competencies. Retest artefacts are among the reason why cross-sectional age profiles may sometimes capture age effects on cognitive abilities more accurately than repeated-measures designs (Salthouse, 2019a). With the help of computerized testing designs (which were also adapted in recent NEPS waves), such retest artefacts can be minimized because, apart from a few 'anchoring' items, individuals receive a different set of items on different occasions. Still, it is possible that repeated exposure to the assessment situation alters the test results to some extent.

Another complication of analyses of competence development is a specific form of change that occurs even in the absence of identifiable external influences: regression toward the mean, a ubiquitous phenomenon particularly in two-wave data (Furby, 1973; Nesselroade et al., 1980). Regression toward the mean moves extreme values (e.g., competence scores) in the initial assessment closer to the sample mean in the reassessment. Regression toward the mean is 'a feature, not a bug' of two-wave data, so to speak, because for any imperfectly correlated measure, the following relation holds: $E(X_2|X_1 = x) = corr(X_1, X_2) \times x$ (Nesselroade et al., 1980).

Although measurement error is often invoked as an explanation for regression toward the mean, this equation makes it clear that the phenomenon occurs even in the absence of measurement error. The explanation is that the total set of causal influences on performance in not only the literacy/numeracy assessment (e.g., the

actual competence level) but also situational factors (e.g., test motivation, fatigue, disturbances during the assessment) that lead to an extreme score at one measurement occasion are unlikely to re-occur at a second occasion, leading to less extreme scores. Whatever the reasons behind regression toward the mean, it complicates the study of competence development and makes it unlikely that 'the competent get more competent' over time, as a Matthew effect would imply.

4.3.3.2 Measurement Error

Another challenge regarding assessment, which we discuss in detail in a primer paper on the usage of data from large-scale assessments resulting from the research project (Lechner et al., 2021a), is measurement error in the target competencies. Competencies are latent variables that cannot be observed directly but only inferred indirectly from respondents' answers to a set of test items. Any point estimate of an individual's ability will inevitably contain measurement error. Measurement error, in turn, adds random noise that typically attenuates (i.e., biases downward) the test–retest correlation, a key indicator of stability (see below). Likewise, measurement error can attenuate regression coefficients when a pretest score of the competence is used as a predictor of a posttest score of that competence, as is the case in lagged dependent variable (LDV) models or when the competence score is used to predict some outcome (e.g., income).[3]

To avoid bias from measurement error, latent-variable modelling or plausible values (PV) methodology should be used instead of individual ability point estimates (i.e., 'test scores'; see Lechner et al., 2021a; von Davier et al., 2009; Wu, 2005). PIAAC-L has long included PVs. NEPS now also includes PVs and provides a state-of-art R tool for estimating a custom set of PVs (Scharl et al., 2020).

4.3.3.3 Selectivity

A third challenge is selective panel attrition. Even with the best of efforts by researchers, some respondents will inevitably drop out of a panel study, be it because they refuse to participate again, because they cannot be located, or for a variety of other reasons. NEPS and PIAAC-L are no exception in this regard. Dropout is particularly problematic if it is *selective*—that is, if certain individuals have a systematically higher likelihood of dropping out than others. Such selectivity can introduce bias in substantive findings. A study from the context of our research project (Martin et al., 2020) showed that this problem indeed plagues both surveys:

[3] A less well-known fact is that such classical measurement error (i.e., measurement error that is randomly distributed and uncorrelated with the competence in question) does not bias regression coefficients when the competence is used as a dependent variable in a regression; in this case, measurement error only inflates standard errors.

between ALWA (the predecessor of NEPS conducted in 2007/208) and the first NEPS wave in 2010/11, and between PIAAC 2012 and the first wave of PIAAC-L in 2014, individuals with lower education and—even after controlling for education—lower literacy were more likely to refuse to participate again and drop out than those with higher education and literacy. Although this effect might not be stationary (i.e., it might not remain as strong in subsequent waves; e.g., Hammon, 2018), it will lead to a sample that is somewhat skewed toward higher skills and education. To some extent, using longitudinal weights that adjust for selective attrition and/or modern missing data methods such as multiple imputation can remedy this problem. However, neither weights nor missing data can recover cases that are lost, and they may not even remove bias if dropout is conditional on unobserved covariates.

4.4 How Stable or Malleable Are Literacy and Numeracy in Adulthood?

Mindful of the methodological challenges facing any inquiry based on a repeated-measures design, I shall now review the most important substantive findings of the research project on the patterns and predictors of change in competencies in adulthood. Together, the findings from these studies suggest the four basic principles of competence development in adulthood visualized in Fig. 4.2. I shall discuss each of these principles in turn.

The first fundamental question about competence development in adulthood concerns the stability over time of literacy and numeracy skills. One can only answer this question with repeated-measures data. We (Lechner et al., 2021b) utilized NEPS and PIAAC-L to investigate stability and change in literacy and numeracy across 3–6 years of adulthood. We employed two complementary measures of change: mean-level change (i.e., the change score of competencies between two points in time, $\Delta T_1, T_2$) and rank-order consistency (i.e., the correlation between competencies assessed at two points in time, r_{T_1,T_2}). We inspected these measures of change in the total population and in major sociodemographic subgroups defined by age, gender, and educational attainment. The subgroup analyses aimed to identify potential social inequalities in competence development. In both surveys, we used PVs to account for measurement error in competencies and included information from background variables.

The analyses yielded several novel insights. First, mean-level change in the population was small: *on average*, adults experienced little change in either literacy or numeracy across the 3 years (PIAAC-L) to 6 years (NEPS) of adulthood covered by the surveys. Zooming in on potential differences across sociodemographic segments revealed that change was slightly more pronounced in some subgroups, but the extent of change was still small. Moreover, few of the subgroup differences in PIAAC-L were replicated in NEPS and vice versa. The only subgroup difference that was similar in both surveys was a tendency among young adults (18–34 years)

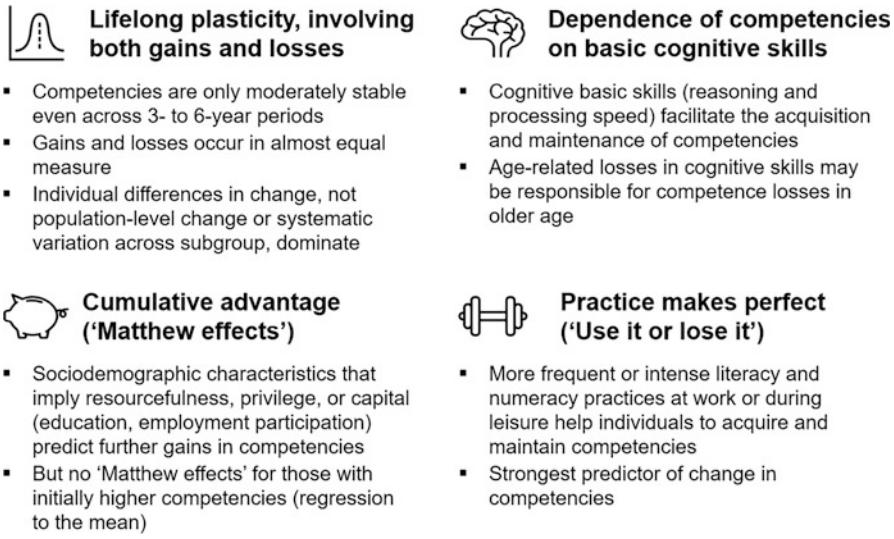


Fig. 4.2 Four principles of change in literacy and numeracy during adulthood that emerged from our project

to experience gains in literacy (and in PIAAC-L also numeracy), whereas other age groups experienced little change or showed a tendency toward losses, thereby resembling earlier findings from cross-sectional data from PIAAC (Paccagnella, 2016). As an aside, the mean-level change observed in this sample was smaller than the age differences in competencies implied by cross-sectional data from PIAAC (Paccagnella, 2016) as well as the cross-sectional age differences in competencies in PIAAC-L and NEPS Waves 1 (see Supplementary Material in Lechner et al., 2021b).

One might be tempted to conclude that 3–6 years are simply too short for substantial change to occur. A closer look at the distribution of change revealed, however, that behind the near-zero means of the change score, there were substantial shares of adults who experienced changes in literacy and numeracy in both surveys. Importantly, the distributions of the change score were approximately symmetric around zero, meaning that gains and losses were almost equally likely to occur. This suggests that looking only at mean-level change conceals a great deal of the heterogeneity in change that actually exists.

This impression was further reinforced by the rank-order consistencies r_{T_1,T_2}. The correlations across 3 years in the total population were .85 and .81 for literacy and numeracy in PIAAC-L, and the correlations across 6 years in NEPS were .61 and .70 respectively (accounting for measurement error through PV methodology). Albeit substantial, these correlations are far from unity. They are notably lower than the rank-order consistencies of basic cognitive skills over often much longer periods of time reported by studies on age trajectories of basic cognitive abilities (intelligence). For example, Gow et al. (2012) conducted one of the few longitudinal studies on the

stability of cognitive abilities across the life span on data from 1017 Scottish individuals from the Lothian Birth Cohort study. These authors found that general intelligence (*g*) measured with the Moray House Test No. 12 (MHT) at age 11 correlated at $r = .67$ ($r = .78$ after correcting for measurement error) with intelligence reassessed at age 70. Deary (2014) reported similar rank-order consistencies in data from another Scottish cohort study (one can only envy a country so blessed with data), although rank-order consistencies were lower because the age of individuals at retest increased into the eighth decade of life. Furthermore, Schalke et al. (2013) reported rank-order consistencies for general intelligence of $r = .85$ from age 12 to 52 in a sample of 344 individuals from Luxembourg. The rank-order consistencies of specific abilities (e.g., fluid reasoning, comprehension knowledge, visual processing) were only slightly lower. These findings underscore that the rank-order consistencies of literacy and numeracy in PIAAC-L and NEPS are relatively low in comparison to that of general intelligence over several life decades in these studies. The reasons for their relatively lower stability are not entirely clear. While it is possible that literacy and numeracy are more sensitive to lifestyle and contextual influences than basic cognitive abilities, further research is needed to exclude the possibility that methodological differences (e.g., assessment design, test length, type of tasks) or differences in motivation and effort among test-takers underlie these findings. At any rate, the far from perfect rank-order consistencies of literacy and numeracy across the relatively short periods of 3–6 years in PIAAC-L and NEPS imply that the relative position of adults in the competence distribution is subject to change over time, or, in other words, that individual differences in competencies are not fully stable over time.

Overall, then, the descriptive findings from Lechner et al. (2021b) paint a clear picture: although competencies change little on average, a sizeable share of adults do experience change in competencies over time even when accounting for measurement error in competencies through PV. This is evidenced by the distribution of the change score and the substantial but not perfect rank-order consistencies. This change comprises gains and losses in about equal measure.

4.5 What Factors Drive Gains and Losses in Competencies?

If competencies are not 'set like plaster' but can change in adulthood even over relatively short periods, and if competence gains are as likely to occur as competence losses, then the natural next question to ask is what drives gains or losses in competencies. Identifying individual and contextual factors that explain individual differences in change was the objective to which most of the remaining studies in our project were devoted.

In two studies (Gauly et al., 2020; Gauly & Lechner, 2019), we set out to unravel whether the previously reported effects of participation in continued education and training (CET) hold up in a longitudinal setting in PIAAC-L. In subsequent studies, we explored the role of a broad set of predictors (i.e., potential determinants) of

competence development in NEPS (Wicht et al., 2020, 2021a). To garner further insights into the role of motivational factors, additional studies (Lechner et al., 2019b; Miyamoto et al., 2020) expanded the project's focus to adolescence, for which NEPS SC3 (5th Graders) offers richer measures of motivational factors than SC6.

4.5.1 Cumulative Advantage ('Matthew Effects')

As discussed earlier, Matthew effects (resource amplification) are a widely discussed pattern in research on social inequality and education (Blossfeld et al., 2020; Cunha & Heckman, 2007). Our findings provide some evidence that Matthew effects occur in competence development, too. At the same time, Matthew effects are not the full story. They occur only for some sociodemographic characteristics but not for others.

4.5.1.1 Education, SES, and Cultural Capital

Our analyses brought to the fore several findings that are indeed reminiscent of Matthew effects. These findings concern the role of sociodemographic characteristics that indicate resourcefulness—or, sociologically speaking, endowment with economic and cultural capital. Most crucially, higher educational attainment predicted positive change in literacy (i.e., growth or slower decline) in LDV models across 6 years in NEPS (Wicht et al., 2020). LDV or 'residual change' models control for initial competence levels and thus predict change over the initial competence levels (e.g., Johnson, 2005). In cross-sectional analyses based on PIAAC and its predecessors, educational attainment has long been identified as the key determinant of literacy and numeracy (e.g., Desjardins, 2003; Kyröläinen & Kuperman, 2021; Paccagnella, 2016). Analyses in PIAAC-L replicated these Matthew effects of educational attainment for both literacy and numeracy (Reder et al., 2020). Given that many of the adults in the PIAAC-L and NEPS samples obtained their last educational degrees years or even decades ago, the abiding importance of educational attainment for subsequent competence development is impressive.

Above and beyond educational certificates, a higher number of books in the household—a classic indicator of cultural capital (Sieben & Lechner, 2019)—also predicted positive change in literacy (Wicht et al., 2020). Even parental socioeconomic status had a small positive association with literacy development, attesting to the 'long arm' of socialization and perhaps heritability. Several of these 'Matthew effects' were sizable, with standardized regression coefficients in excess of .20.

Although we could not test this explanation conclusively with the present data, it seems reasonable to assume that these effects reflect the selection of the higher-educated and more resourceful into more stimulating environments that require the

continued application of literacy and numeracy, which, in turn, fosters the development of these competencies and protects to some extent against age-related losses. Future research may be able to unpick the reciprocal influences of selection and socialization with designs that assess competencies from childhood or youth into adulthood.

4.5.1.2 No Matthew Effects for Competencies as Such

Whereas we found some evidence for Matthew effects for education and cultural capital, there were no Matthew effects for competencies themselves in the sense that adults with higher initial competence levels necessarily enjoy greater gains (or smaller losses) in competencies than adults with lower competencies. Quite the contrary, what we observed when splitting the initial competence levels into quartiles and analysing the distribution of change in competencies in each of these four quartiles was regression toward the mean. That is, adults from the fourth quartile—those with the highest literacy and numeracy level at the initial measurement occasion—experienced losses in these competencies on average, whereas adults from the first quartile—those with the lowest literacy and numeracy level—experienced gains on average (Lechner et al., 2021b). This might also indicate ceiling effects in the assessments.

4.5.1.3 No Clear Evidence of Gender Differences But Small Age Differences

Although several studies (e.g., Borgonovi et al., 2018; Paccagnella, 2016) have reported gender differences in literacy (favouring women) and numeracy (favouring men), no clear evidence of gender differences in the *change* in literacy and numeracy development emerged from LDV models analysing changes in competencies across 6 years in NEPS (Wicht et al., 2020) or 3 years in PIAAC-L (Reder et al., 2020). In the descriptive analyses of mean-level change and rank-order consistency in PIAAC-L and NEPS, gender differences were also small or non-existent (Lechner et al., 2021b).

Regarding age, LDV models and controlling for initial competence levels in NEPS (Wicht et al., 2020) and PIAAC-L (Reder et al., 2020) bore out with greater clarity what was only a slight tendency in the descriptive analyses of mean-level change (Lechner et al., 2021b): higher age is negatively related with change in literacy and numeracy. Younger adults (up to age 30 or 40) tend to gain, older adults (from age 50 or so onward) tend to lose competencies, although gains and losses in the repeated-measures data of PIAAC-L and NEPS are somewhat smaller than those suggested by cross-sectional age profiles (Gauly et al., 2020; Gauly & Lechner, 2019; Lechner et al., 2021b).

4.5.2 *Fluid Cognitive Abilities*

Another important factor that is known to govern adults' competence development are basic cognitive skills of the type that Cattell (1971) denoted as fluid intelligence (gf), Ackerman (1996) as 'intelligence-as-process', and (Baltes, 1993) as 'cognitive mechanics': reasoning ability (typically measure with matrices tests) and perceptual/processing speed (typically measured with digit–symbol substitution tests).

4.5.2.1 Basic Cognitive Skills Predict Positive Change in Competencies

Findings from our project make it abundantly clear that individuals with higher basic cognitive skills enjoy an advantage when it comes to acquiring literacy and numeracy in adolescence and maintaining or even expanding these competencies in adulthood. In a study in NEPS SC3 (Lechner et al., 2019b), higher levels of reasoning ability as measured in 5th grade predicted faster growth in both literacy and numeracy between 7th and 9th grade in secondary school students, especially in students who also had high interest in reading and math respectively.[4] Likewise, in adults, higher processing speed and especially higher reasoning ability measured in the first NEPS wave predicted positive change in literacy over the subsequent 6 years (Wicht et al., 2020). Thus, fluid-type cognitive abilities are tightly interwoven with the more crystallized-type literacy and numeracy competencies. This should come as no surprise to anyone familiar with structural models of intelligence in which various fluid and crystallized cognitive abilities all form a positive manifold (i.e., are all substantially positively correlated) from which a general (g factor) emerges (Lang et al., 2016; McGrew, 2009). It highlights that although fluid-type and crystallized-type abilities may indeed follow different age trajectories as hypothesized by Cattell, they are not fully independent of each other (see discussion on the meaning of 'g' in Nisbett et al., 2012).

4.5.2.2 'General Slowing' Might Impair Competencies

The aforementioned association between higher age and negative (relative) change in literacy that we observed in LDV models in NEPS (Wicht et al., 2020) shrank by about one third after adding reasoning ability (i.e., Gf) and processing speed to the model. This is compatible with the view that the literacy losses in older adults are

[4] In this context, it may be unsettling to learn that intrinsic reading motivation goes on a linear decline from Grade 5 through Grade 11 in both sexes (particularly in boys) and across all socioeconomic strata, and that declines in reading motivation are linked to slower growth in reading proficiency (Miyamoto et al., 2020).

partly due to 'general slowing'. The general slowing hypothesis states that cognitive abilities that depend on neural or biological efficiency decline with age (Choi & Feng, 2015). Similar to Cattell's view, this, in turn, may reduce the ability to learn novel things and ultimately impair even acquired (learned) abilities. As explained earlier, although literacy and numeracy are acquired abilities, acquiring and performing these competencies requires reasoning and processing speed. It is hence plausible that the well-established age-related declines in reasoning and processing speed (Deary, 2014; Salthouse, 2019a; Schalke et al., 2013) negatively affect literacy and numeracy, too. Only a few select skills—especially those that rely on long-term memory such as vocabulary—are largely exempt from age-related declines. For a more comprehensive and conclusive test of the general slowing hypothesis and its implications for competencies, repeated measures of both literacy/numeracy *and* basic cognitive skills would be required. This would allow the unravelling of different hypotheses about the causal relations between basic cognitive skills and competencies: (a) declines in basic cognitive skills precede and then lead to subsequent declines in competencies; (b) declines in basic cognitive skills co-occur at the same time as declines in competencies, and both are caused by general slowing. The relations among age, fluid-type abilities, and crystallized-type abilities is a longstanding matter of investigation in intelligence research (Nisbett et al., 2012; Salthouse, 2019b).

4.5.3 Practice Engagement

4.5.3.1 Engagement in Literacy and Numeracy Practice Ranks Among the Strongest Predictors of Competence Development

A third principle that governs competence development in adulthood is well captured by the adages that 'practice makes perfect' (Reder et al., 2020) and you 'use it or lose it' (Bynner & Parsons, 1998). These adages allude to the central position that practices occupy in competence development. Practices refer to the frequency and/or intensity with which individuals engage in literacy practices such as reading books, manuals, diagrams, or letters at work and during leisure; or engage in numeracy practices such as calculating prices, costs, or budgets; preparing charts or tables; or using a calculator.

In line with PET (Reder, 1994, 2009), LDV models demonstrate that practices predict positive change (i.e., growth or slower decline) over time in both literacy and numeracy and in both NEPS (Wicht et al., 2020, 2021a) and PIAAC-L (Reder et al., 2020). Indeed, in PIAAC-L, practices emerged as the strongest predictors of change in literacy and numeracy even after accounting for educational attainment and a range of other sociodemographic characteristics (Reder et al., 2020). Cross-sectional analyses (Wicht et al., 2021b) suggest that the same holds for 'digital literacy' or 'ICT competence' in NEPS and PIAAC-L, which proved to be strongly dependent

on the usage of digital technologies on the job and in everyday life (no repeated assessments of this competence are available in the data yet).

That practices contribute to competencies is intuitively plausible but far from trivial. First and foremost, practice effects presuppose that competencies—which are acquired mainly through schooling during childhood and adolescence—remain *plastic* (i.e., malleable) throughout adulthood. Only if competencies are sufficiently malleable can engagement in practices contribute to growth or maintenance in these competencies. Findings from our previously discussed descriptive analyses on stability and change (Lechner et al., 2021b) and the LDV results reported here suggest that this is the case. This is an important finding, because it suggests that adults' competencies are *in principle* amenable to policy programmes and interventions that target everyday practices.

Second, as already intimated by PET and as further elaborated in a theoretical framework presented in Wicht et al. (2021b), practices are themselves dependent upon a range of preconditions. For example, individuals with higher competencies or higher educational attainment as well as those in employment enjoy greater opportunities for engaging in literacy- and numeracy-related practices at work and leisure than those with lower competencies or lower attainment, or those who are unemployed (Reder, 1998). This suggests that practices and thereby the likelihood of competence growth are patterned and stratified by earlier selection processes that may increase inequality in competencies in the long run.

Our analyses were limited by the fact that they relied on practices as assessed on a single occasion and could not control for unobserved heterogeneity. Although we controlled for a range of possible confounders, we cannot exclude the possibility that unobserved confounders influenced both practices and competencies. The time scale on which potential practice effects operate also remains unclear. Future work relating changes in practices to changes in competencies over longer periods of time could prove insightful. Currently, however, long-running panel data comprising repeated assessments of both competencies and practices that would allow for such analyses are unavailable.

4.5.3.2 Job-Related Training per se Does Not Contribute to Literacy and Numeracy Growth

Despite the demonstrable importance of practices, not all 'practices' contribute to competence growth—especially if the indicators of practices are coarse and unspecific. This concerns, in particular, the alleged role of job-related training specifically for literacy and numeracy growth. Earlier large-scale cross-sectional and smaller-scale longitudinal studies focusing on lower-skilled or lower-educated individuals had reported a positive association between participation in job-related training and levels of literacy and numeracy (e.g., Cegolon, 2015; OECD, 2013). Some researchers and policymakers have interpreted this association as proof that job-related training can contribute to literacy and numeracy growth. Our project's findings using the repeated-measures data of PIAAC-L tell a different story.

Although we (Gauly & Lechner, 2019) indeed replicated the positive association between job-related training and change over 3 years in literacy in pooled ordinary least squares (POLS) and LDV models, this association vanished when using first-difference/fixed-effects (FE)[5] and instrumental variable (IV) estimators, which—in contrast to LDV and OLS models—control for unobserved time-invariant heterogeneity. Conversely, higher initial literacy levels predicted higher rates of participation in job-related training. We obtained essentially the same findings with numeracy and even after differentiating by training type and intensity (Gauly et al., 2020). This strongly suggests that the previously reported positive associations between competencies and participation in job-related training reflect self-selection of more competent (and highly educated) individuals into further training rather than training effects on competencies.

Despite the strong links between training and competencies in cross-sectional work, the absence of training effects should not come as a surprise. Job-related training is a broad category that comprises anything from presentation training for white-collar trainees to safety training for workers in a manufacturing plant or forklift license training for warehouse staff. These examples patently show that by far not all job-related training includes written material, let alone numerical material, and tasks of the sort that would count as 'practising' literacy and numeracy skills. Some training may be fully oral or rely on visual demonstration of motor skills only. Moreover, training often comprises short courses lasting only a few hours. It is unlikely that such training, designed to foster specific job-related skills, would have 'spillover' effects on literacy and numeracy. Of course, job-related training that involves a considerable amount of literacy- or numeracy-related tasks may well contribute to literacy and numeracy growth. For example, workplace-based literacy training and basic skills training may be effective in lifting low-literate adults, or at least in encouraging them to increase literary practices (Bynner & Parsons, 1998; Reder & Bynner, 2008; Sheehan-Holt & Smith, 2000; Wolf & Jenkins, 2014). However, such training effects cannot be detected with the relatively coarse measures of participation in (*any* type of) job-related training available in PIAAC-L (and NEPS, although we did not use these data for our papers on job-related training).

4.6 Avenues for Future Research

Our project was enabled by the unique large-scale two-wave competence data from PIAAC-L and NEPS. Our findings on change in competencies over a 3- to 6-year period constitute an important advancement that expands prior small-scale longitudinal and cross-sectional evidence. Nonetheless, our project still leaves many questions unanswered that call for further research—in particular, (a) how competencies develop over longer time periods and during major transitions; (b) which predictors

[5] For two waves, the first-difference (FD) and fixed-effects (FE) estimator are equivalent.

have the strongest influences on development, and which of them are *causal*; and (c) how other equally important competencies beyond literacy and numeracy develop. I shall discuss these in turn.

The PIAAC-L and NEPS data available to our project comprised two occasions on which literacy and numeracy were assessed spanning 3–6 years of adulthood. Although two measurement occasions for competencies are clearly better than one, a two-wave design is not a truly longitudinal design (e.g., Ployhart & MacKenzie Jr., 2015). Future research should extend our work to include additional measurement occasions and cover longer time spans during which more change might happen. Unlike PIAAC-L, NEPS is ongoing and will continue to grow in this regard. Tracing competence development over multiple occasions would provide deeper insights into average trends (e.g., age-related declines) and individual differences in change. A particularly important question is how competencies develop across key transitions such as job entry, parenthood and parental leave, unemployment and reemployment, or retirement. It is across these transitions that we expect competencies to change most strongly and perhaps most long-lastingly.

Additional assessment waves would also greatly expand the options available for causal identification. Our in-depth analyses of the link between job-related training and competencies (Gauly & Lechner, 2019; Gauly et al., 2020) illustrate the benefit of applying different estimators (OLS, LDV, FE, IV) to scrutinize potential causal effects on competencies. However, most studies in our project were limited in their ability to eliminate unobserved heterogeneity by, for example, applying panel (e.g., FE) regressions or related models, because some key predictors of competence development were measured only once. Thus, no causal claims can be made for findings reported herein, including those regarding the most important predictors of competence change (i.e., practice engagement, basic cognitive skills, education, and others). This, however, would be crucial in order for this type of research to inform policy and practice about the most potent causal influences on competence development that may prove to be apt targets (or target groups) for interventions and other measures.

Another question that we left largely unaddressed is how competencies other than literacy and numeracy develop in adulthood. For example, digital literacy (or 'ICT literacy') is a competence that is increasingly on-demand in the labour market (Wicht et al. 2021b). So far, these competencies have been assessed only cross-sectionally in PIAAC-L and NEPS SC6. Given how similar our results regarding literacy and numeracy were in general, and given that digital literacy depends strongly on reading literacy, it is an open question whether digital literacy is sufficiently distinct from literacy and numeracy. Comparing trajectories and precursors of digital literacy to those of literacy and numeracy may help resolve this question. It would be even more important to extend our work to include socio-emotional or 'non-cognitive' competencies. Related to the increasing penetration with technology, competencies such as communicating and cooperating with others or coping with uncertainty and insecurity may also become increasingly important for leading successful and healthy lives in the twenty-first century (e.g., Allen et al., 2020; Lechner et al. 2019a). Investigating the development of adults'

socio-emotional competencies and their interplay with literacy and numeracy may prove highly insightful and indeed indispensable if researchers are to gain a more complete understanding of how the competencies that are needed to lead a successful life in current societies develop in adulthood.

4.7 Conclusion

The findings from our project lead to the following broad conclusions about the development of competences in adulthood. First and foremost, literacy and numeracy are not 'set in stone' during adulthood. Instead, these competencies remain malleable and can change even over the relatively limited periods of 3–6 years observed in PIAAC-L and (thus far) in NEPS. Gains and losses occur in almost equal shares, which leads to a mean-level change of zero on the population level that conceals the fact that many adults do experience change in competencies. Future work needs to establish the extent to which this change reflects true change in competencies as opposed to or artifacts such as regression to the mean or flucations in test-takers' effort and motivation.

Three main groups of factors predict whether an individual is more likely to experience gains or losses in competencies over time: (1) sociodemographic characteristics that indicate resourcefulness or social advantage in which we observed a 'Matthew effect' for educational attainment and cultural capital (but no gender differences); (2) basic cognitive skills in which we observed that processing speed and especially reasoning ability predict change in competence, which partly explains age differences in competencies (increases in young adulthood, decreases in old age) in line with the 'general slowing' hypothesis; and (3) engagement in literacy and numeracy practices in which we observed that more frequent reading/math at work or during leisure robustly predicted positive change in competencies in line with the 'practice makes perfect' and 'use it or lose it' principle. These findings confirm and qualify some of the previous insights from previous small-scale longitudinal and large-scale cross-sectional research (Deary, 2014; Desjardins & Warnke, 2012; Nienkemper et al., 2021; Paccagnella, 2016).

Future work should replicate and expand our project's findings by analysing competence development over longer periods while addressing some of the methodological challenges we have outlined, especially selectivity and potential retest artefacts such as regression toward the mean and effects of prior exposure to the tests.

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References

Ackerman, P. L. (1996). A theory of adult intellectual development: Process, personality, interests, and knowledge. *Intelligence, 22*(2), 227–257.

Allen, J., Belfi, B., & Borghans, L. (2020). Is there a rise in the importance of socioemotional skills in the labor market? Evidence from a trend study among college graduates. *Frontiers in Psychology, 11*. https://doi.org/10.3389/fpsyg.2020.01710

Baltes, P. B. (1993). The aging mind: Potential and limits. *The Gerontologist, 33*(5), 580–594. https://doi.org/10.1093/geront/33.5.580

Billett, S. (2018). Distinguishing lifelong learning from lifelong education. *Journal of Adult Learning, Knowledge and Innovation, 2*(1), 1–7. https://doi.org/10.1556/2059.01.2017.3

Blossfeld, H.-P., Roßsbach, H.-G., & von Maurice, J. (Eds.). (2011). Education as a lifelong process: The German National Educational Panel Study (NEPS) [special issue]. *Zeitschrift für Erziehungswissenschaft, 14*(2), 19–34.

Blossfeld, H.-P., Kilpi-Jakonen, E., & de Vilhena, D. V. (2020). Gibt es im lebenslangen Lernen einen Matthäus-Effekt? Ergebnisse eines internationalen Vergleichs [Is there a Matthew effect in adult learning? Results from a cross-national comparison]. In J. Schrader, A. Ioannidou, & H.-P. Blossfeld (Eds.), *Monetäre und nicht monetäre Erträge von Weiterbildung: Monetary and non-monetary effects of adult education and training* (pp. 1–26). Springer Fachmedien. https://doi.org/10.1007/978-3-658-25513-8_1

Borgonovi, F., Choi, Á., & Paccagnella, M. (2018). *The evolution of gender gaps in numeracy and literacy between childhood and adulthood*. OECD iLibrary. https://doi.org/10.1787/0ff7ae72-en

Brown, R. E. (2016). Hebb and Cattell: The genesis of the theory of fluid and crystallized intelligence. *Frontiers in Human Neuroscience, 10*. https://doi.org/10.3389/fnhum.2016.00606

Bynner, J., & Parsons, S. (1998). *Use it or lose it? The impact of time out of work on literacy and numeracy skills*. ERIC. http://eric.ed.gov/?id=ED430160

Carstensen, C. H., Gaasch, J.-C., & Rothaug, E. (2017). *Kompetenzmodellierung in PIAAC-L aktueller Stand Welle 3 (2016)* [Modeling competencies in PIAAC-L].

Cattell, R. B. (1971). *Abilities: Their structure, growth, and action.* Houghton Mifflin. http://psycnet.apa.org/psycinfo/1973-02450-000

Cegolon, A. (2015). *Determinants and learning effects of adult education-training: A cross-national comparison using PIAAC data*. Department of Quantitative Social Science, UCL Institute of Education.

Choi, H., & Feng, J. (2015). General slowing hypothesis. In S. K. Whitbourne (Ed.), *The encyclopedia of adulthood and aging* (pp. 1–4). Wiley. https://doi.org/10.1002/9781118521373.wbeaa198

Cunha, F., & Heckman, J. (2007). The technology of skill formation. *American Economic Review, 97*(2), 31–47. https://doi.org/10.1257/aer.97.2.31

Deary, I. J. (2014). The stability of intelligence from childhood to old age. *Current Directions in Psychological Science, 23*(4), 239–245. https://doi.org/10.1177/0963721414536905

Desjardins, R. (2003). Determinants of literacy proficiency: A lifelong-lifewide learning perspective. *International Journal of Educational Research, 39*(3), 205–245. https://doi.org/10.1016/j.ijer.2004.04.004

Desjardins, R., & Warnke, A. J. (2012). Ageing and skills: A review and analysis of skill gain and skill loss over the lifespan and over time. *OECD Education Working Papers, 72*. https://doi.org/10.1787/5k9csvw87ckh-en

Durda, T., Gauly, B., Buddeberg, K., Lechner, C. M., & Artelt, C. (2020). On the comparability of adults with low literacy across LEO, PIAAC, and NEPS. Methodological considerations and empirical evidence. *Large-Scale Assessments in Education, 8*(1), 13. https://doi.org/10.1186/s40536-020-00091-0

Furby, L. (1973). Interpreting regression toward the mean in developmental research. *Developmental Psychology, 8*(2), 172–179. https://doi.org/10.1037/h0034145

Gauly, B., & Lechner, C. M. (2019). Self-perfection or self-selection? Unraveling the relationship between job-related training and adults' literacy skills. *PLoS One, 14*(5), e0215971. https://doi.org/10.1371/journal.pone.0215971

Gauly, B., Lechner, C. M., & Reder, S. (2020). Fördern berufliche Weiterbildungen alltagsmathematische Kompetenzen im Erwachsenenalter? Evidenz aus einer deutschen Längsschnittstudie [Does job-related training benefit adult numeracy skills? Evidence from a German panel study]. In J. Schrader, A. Ioannidou, & H.-P. Blossfeld (Eds.), *Monetäre und nicht monetäre Erträge von Weiterbildung* (Vol. 7, pp. 261–289). Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-25513-8_10

Gehrer, K., Zimmermann, S., Artelt, C., & Weinert, S. (2013). NEPS framework for assessing reading competence and results from an adult pilot study. *Journal for Educational Research Online, 2*, 50–79.

GESIS – Leibniz Institute for the Social Sciences, German Socio-Economic Panel (SOEP) at DIW Berlin, & LIfBi – Leibniz Institute for Educational Trajectories. (2017). *PIAAC-Longitudinal (PIAAC-L), Germany* (3.0.0) [Data set]. GESIS Data Archive. https://doi.org/10.4232/1.12925

Gow, A. J., Corley, J., Starr, J. M., & Deary, I. J. (2012). Reverse causation in activity-cognitive ability associations: The Lothian birth cohort 1936. *Psychology and Aging, 27*(1), 250–255. https://doi.org/10.1037/a0024144

Grotlüschen, A., Buddeberg, K., Dutz, G., Heilmann, L., & Stammer, C. (2020). Low literacy in Germany: Results from the second German literacy survey. *European Journal for Research on the Education and Learning of Adults, 11*(1), 127–143. https://doi.org/10.3384/rela.2000-7426.rela9147

Hammon, A. (2018). Samples, weights, and nonresponse: The adult cohort of the National Educational Panel Study (wave 7 to 9). *Neps Survey Papers*, p. 7. https://www.neps-data.de/Portals/0/Survey%20Papers/SP_VII.pdf

Hanushek, E. A., Schwerdt, G., Wiederhold, S., & Woessmann, L. (2015). Returns to skills around the world: Evidence from PIAAC. *European Economic Review, 73*, 103–130. https://doi.org/10.1016/j.euroecorev.2014.10.006

Johnson, D. (2005). Two-wave panel analysis: Comparing statistical methods for studying the effects of transitions. *Journal of Marriage and Family, 67*(4), 1061–1075. https://doi.org/10.1111/j.1741-3737.2005.00194.x

Kilpi-Jakonen, E., Vono de Vilhena, D., & Blossfeld, H.-P. (2015). Adult learning and social inequalities: Processes of equalisation or cumulative disadvantage? *International Review of Education, 61*(4), 529–546. https://doi.org/10.1007/s11159-015-9498-5

Kyröläinen, A.-J., & Kuperman, V. (2021). Predictors of literacy in adulthood: Evidence from 33 countries. *PLoS One, 16*(3), e0243763. https://doi.org/10.1371/journal.pone.0243763

Lang, J. W. B., Kersting, M., & Beauducel, A. (2016). Hierarchies of factor solutions in the intelligence domain: Applying methodology from personality psychology to gain insights into the nature of intelligence. *Learning and Individual Differences, 47*, 37–50. https://doi.org/10.1016/j.lindif.2015.12.003

Lechner, C. M., Anger, S., & Rammstedt, B. (2019a). Socio-emotional skills in education and beyond: Recent evidence and future avenues. In R. Becker (Ed.), *Research handbook on the sociology of education* (pp. 427–453). Edward Elgar Publishing.

Lechner, C. M., Miyamoto, A., & Knopf, T. (2019b). Should students be smart, curious, or both? Fluid intelligence, openness, and interest co-shape the acquisition of reading and math competence. *Intelligence, 76*, 101378. https://doi.org/10.1016/j.intell.2019.101378

Lechner, C. M., Bhaktha, N., Groskurth, K., & Bluemke, M. (2021a). Why ability point estimates can be pointless: A primer on using skill measures from large-scale assessments in secondary analyses. *Measurement Instruments for the Social Sciences, 3*(2). https://doi.org/10.1186/s42409-020-00020-5

Lechner, C. M., Gauly, B., Miyamoto, A., & Wicht, A. (2021b). Stability and change in adults' literacy and numeracy skills: Evidence from two large-scale panel studies. *Personality and Individual Differences, 180*, 110990. https://doi.org/10.1016/j.paid.2021.110990

Lunze, K., & Paasche-Orlow, M. K. (2014). Limited literacy and poor health: The role of social mobility in Germany and the United States. *Journal of Health Communication, 19*(sup2), 15–18. https://doi.org/10.1080/10810730.2014.946115

Martin, S., Lechner, C. M., Kleinert, C., & Rammstedt, B. (2020). Literacy skills predict probability of refusal in follow-up wave: Evidence from two longitudinal assessment surveys. *International Journal of Social Research Methodology, 24*(4). https://doi.org/10.1080/13645579.2020.1763715

McGrew, K. S. (2009). CHC theory and the human cognitive abilities project: Standing on the shoulders of the giants of psychometric intelligence research. *Intelligence, 37*(1), 1–10. https://doi.org/10.1016/j.intell.2008.08.004

Mills, M., & Blossfeld, H.-P. (2013). The second demographic transition meets globalisation: A comprehensive theory to understand changes in family formation in an era of rising uncertainty. In A. Evans & J. Baxter (Eds.), *Negotiating the life course* (Vol. 1, pp. 9–33). Springer.

Miyamoto, A., Murayama, K., & Lechner, C. M. (2020). The developmental trajectory of intrinsic reading motivation: Measurement invariance, group variations, and implications for reading proficiency. *Contemporary Educational Psychology, 63*, 101921. https://doi.org/10.1016/j.cedpsych.2020.101921

Nesselroade, J. R., Stigler, S. M., & Baltes, P. B. (1980). Regression toward the mean and the study of change. *Psychological Bulletin, 88*(3), 622–637. https://doi.org/10.1037/0033-2909.88.3.622

Nienkemper, B., Buddeberg, K., & Grotlüschen, A. (2021). Research review on the causality and variation of low literacy in adult life – Potential for adult learning, education and research. In A. Grotlüschen & L. Heilmann (Eds.), *Between PIAAC and the new literacy studies. What adult education can learn from large-scale assessments without adopting the neo-liberal paradigm* (pp. 91–112). Waxmann.

Nisbett, R. E., Aronson, J., Blair, C., Dickens, W., Flynn, J., Halpern, D. F., & Turkheimer, E. (2012). Intelligence: New findings and theoretical developments. *American Psychologist, 67*(2), 130–159. https://doi.org/10.1037/a0026699

OECD. (2012). *Literacy, numeracy and problem solving in technology-rich environments: Framework for the OECD survey of adult skills*. OECD Publishing.

OECD. (2013). *OECD skills outlook 2013: First results from the survey of adult skills*. OECD Publishing. https://doi.org/10.1787/9789264204256-en

OECD. (2016). *Skills matter: Further results from the survey of adult skills*. OECD Publishing. https://doi.org/10.1787/9789264258051-en

Paccagnella, M. (2016). Age, ageing and skills: Results from the survey of adult skills. *OECD Education Working Papers, 132*. https://doi.org/10.1787/5jm0q1n38lvc-en

PIAAC Literacy Expert Group. (2009). *PIAAC literacy: A conceptual framework* (No. 34; OECD Education Working Papers) (Vol. Vol. 34). OECD Publishing. https://doi.org/10.1787/220348414075

Ployhart, R. E., & MacKenzie, W. I., Jr. (2015). Two waves of measurement do not a longitudinal study make. In C. E. Lance & R. J. Vandenberg (Eds.), *More statistical and methodological myths and urban legends* (pp. 85–99). Routledge/Taylor & Francis Group.

Pohl, S., & Carstensen, C. H. (2013). Scaling of competence tests in the National Educational Panel Study—Many questions, some answers, and further challenges. *Journal for Educational Research Online, 5*, 189–216.

Pohl, S., Haberkorn, K., & Carstensen, C. H. (2015). Measuring competencies across the lifespan—Challenges of linking test scores. In M. Stemmler, A. von Eye, & W. Wiedermann (Eds.), *Dependent data in social sciences research* (pp. 281–308). Springer. https://doi.org/10.1007/978-3-319-20585-4_12

Pullman, A., Gauly, B., & Lechner, C. M. (2021). Short-term earnings mobility in the Canadian and German context: The role of cognitive skills. *Journal for Labour Market Research, 55*(1), 10. https://doi.org/10.1186/s12651-021-00292-2

Rammstedt, B. (Ed.). (2012). *Grundlegende Kompetenzen Erwachsener im internationalen Vergleich: Ergebnisse von PIAAC 2012*. Waxmann.

Reder, S. (1994). Practice engagement theory: A sociocultural approach to literacy across languages and cultures. In B. M. Ferdman, R.-M. Ferdmann, & A. Ramirez (Eds.), *Literacy across languages and cultures* (pp. 33–74). SUNY Albany Press.

Reder, S. (1998). Literacy selection and literacy development: Structural equation models of the reciprocal effects of education and literacy. In M. C. Smith (Ed.), *Literacy for the twenty-first century: Research policy, practices and the national adult literacy survey* (pp. 139–157). Praeger Publishers.

Reder, S. (2009). The development of literacy and numeracy in adult life. In S. Reder & J. Bynner (Eds.), *Tracking adult literacy and numeracy skills: Findings from longitudinal research* (pp. 59–84). Routledge. https://doi.org/10.4324/9780203888889-10

Reder, S., & Bynner, J. (2008). *Tracking adult literacy and numeracy skills: Findings from longitudinal research*. Routledge.

Reder, S., & Bynner, J. (2009). Introduction: The need for longitudinal studies in adult literacy and numeracy education. In S. Reder & J. Bynner (Eds.), *Tracking adult literacy and numeracy skills: Findings from longitudinal research* (pp. 1–26). Routledge. http://eprints.ioe.ac.uk/13792/

Reder, S., Gauly, B., & Lechner, C. (2020). Practice makes perfect: Practice engagement theory and the development of adult literacy and numeracy proficiency. *International Review of Education, 66*, 267–288. https://doi.org/10.1007/s11159-020-09830-5

Rosa, H. (2013). *Social acceleration: A new theory of modernity*. Columbia University Press.

Salthouse, T. A. (2019a). Trajectories of normal cognitive aging. *Psychology and Aging, 34*(1), 17–24. https://doi.org/10.1037/pag0000288

Salthouse, T. A. (2019b). Comparable consistency, coherence, and commonality of measures of cognitive functioning across adulthood. *Assessment, 26*(4), 726–736. https://doi.org/10.1177/1073191117721742

Schalke, D., Brunner, M., Geiser, C., Preckel, F., Keller, U., Spengler, M., & Martin, R. (2013). Stability and change in intelligence from age 12 to age 52: Results from the Luxembourg MAGRIP study. *Developmental Psychology, 49*(8), 1529–1543. https://doi.org/10.1037/a0030623

Scharl, A., Carstensen, C. H., & Gnambs, T. (2020). Estimating plausible values with NEPS data: An example using reading competence in starting cohort 6. *NEPS Survey Papers, 71*. https://doi.org/10.5157/NEPS:SP71:1.0

Sheehan-Holt, J. K., & Smith, M. C. (2000). Does basic skills education affect adults' literacy proficiencies and reading practices? *Reading Research Quarterly, 35*(2), 226–243. https://doi.org/10.1598/RRQ.35.2.2

Sieben, S., & Lechner, C. M. (2019). Measuring cultural capital through the number of books in the household. *Measurement Instruments for the Social Sciences, 1*(1). https://doi.org/10.1186/s42409-018-0006-0

Silbereisen, R. K., & Chen, X. (2010). *Social change and human development: Concepts and results*. Sage.

von Davier, M., Gonzalez, E. J., & Mislevy, R. J. (2009). What are plausible values and why are they useful? In M. von Davier & D. Hastedt (Eds.), *IERI monograph series: Issues and methodologies in large-scale assessments: Volume 2* (pp. 9–36).

Weinert, S., Artelt, C., Prenzel, M., Senkbeil, M., Ehmke, T., & Carstensen, C. H. (2011). Development of competencies across the life span. *Zeitschrift für Erziehungswissenschaft, 14*(S2), 67–86. https://doi.org/10.1007/s11618-011-0182-7

Wicht, A., Rammstedt, B., & Lechner, C. M. (2020). Predictors of literacy development in adulthood: Insights from a large-scale, two-wave study. *Scientific Studies of Reading*, 1–9. https://doi.org/10.1080/10888438.2020.1751635

Wicht, A., Durda, T., Krejcik, L., Grotlüschen, A., Rammstedt, B., & Lechner, C. M. (2021a). Low literacy is not set in stone: Longitudinal evidence on the development of low literacy during adulthood. *Zeitschrift Für Pädagogik* [Manuscript accepted for publication].

Wicht, A., Reder, S., & Lechner, C. M. (2021b). Sources of individual differences in adults' ICT skills: A large-scale empirical test of a new guiding framework. *PLoS One, 16*(4), e0249574. https://doi.org/10.1371/journal.pone.0249574

Wolf, A., & Jenkins, A. (2014). Do 'learners' always learn? The impact of workplace adult literacy courses on participants' literacy skills. *British Educational Research Journal, 40*(4), 585–609. https://doi.org/10.1002/berj.3110

Wu, M. (2005). The role of plausible values in large-scale surveys. *Studies in Educational Evaluation, 31*(2–3), 114–128. https://doi.org/10.1016/j.stueduc.2005.05.005

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Chapter 5
The Interplay Between Instructional Pace, Skill Externalities, and Student Achievement: An Empirical Assessment



David Kiss

Abstract This article empirically validates a theoretical model from Kiss (B.E. J Econ Anal Policy 17:1–10, 2017) that addresses the transmission channels through which increases in peer achievement levels may affect other students' achievement. In his model, a higher share of better students has two effects: first, weaker students benefit from skill externalities generated by their better classmates. At the same time, however, better students further induce teachers to instruct at a more demanding pace. Based on these two effects, I derive three hypotheses and test them on data on German secondary school students. Empirical findings are consistent with the model's predictions: increases in the share of better classmates (a) are always beneficial for good students, (b) may hurt weak students, and (c) boost weak students' achievement if the extent of interaction between better and weaker students is high. Taken together, these findings suggest that encouraging better and weaker students to interact more could be Pareto-improving.

5.1 Introduction

Peer characteristics are a key factor in parental school choice decisions (Bayer et al., 2007; Black, 1999), and therefore in discussions on both ability tracking (Duflo et al., 2011; Hanushek & Wößmann, 2006) and school competition (Altonji et al., 2015; Rouse, 1998). An important reason for this lies in the positive influence of good classmates on student achievement.[1] Nonetheless, little is known about the causes behind the positive relationship between peer and own achievement levels.

[1]This has been shown in numerous empirical studies that carefully account for potential endogeneity issues (see, for a summary, Sacerdote, 2011). These studies suggest that, on average, a one standard deviation increase in peer achievement levels boosts own achievement by 0.1 standard deviations. Throughout this article, the terms ability, (academic) achievement, skills, and

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However, any assessment of the expected consequences of interventions that change the skill composition of classes would require a profound understanding of transmission channels.

So far, the theoretical literature has identified disruptive student behaviour (Lazear, 2001), effort spillovers (Foster & Frijters, 2009; Fruehwirth, 2013), and parental investments in their child's education (Das et al., 2013; Pop-Eleches & Urquiola, 2013) as possible causes. This article empirically validates Kiss (2017), who provides an additional theoretical explanation. In his model, better students induce teachers to instruct their classes at a higher instructional pace. Whereas this is beneficial for good students because of their well-developed learning capabilities, weaker students struggle with a more demanding pace. Therefore, the so-called *pace effect* is positive for better students and negative for weaker students. The model further presumes that better students generate positive skill externalities (*spillover effects*) that enhance the learning potential of their weaker classmates. Consequently, better students improve weaker students' achievement only if (negative) pace effects are offset by (positive) spillover effects.

The most important variable in the theoretical model is the share of higher achieving students in a class, denoted by n. Because classes are populated by only two types of student (better and weaker ones), changes in n are equivalent to changes in the average achievement levels of classes. To see why, consider a class in which a weak student is replaced by a better one. Obviously, both the share of better students n and the average achievement level of the class would increase in this case.

Using longitudinal data on German secondary students, I empirically test the following three hypotheses derived from the theoretical model:

H1. Better classmates have a positive effect on good students' achievement.
H2. Better classmates *may* have a negative effect on weak students' achievement.
H3. Weak students benefit from better classmates if the extent of interaction between student types is high.

All three hypotheses are supported by empirical findings, because the signs of the estimated coefficients are in line with the model's predictions.[2] For math scores, results further indicate that skill externalities are stronger among students of the same gender. This chapter therefore contributes to the literature in two ways. First, empirical support for H2 challenges the general notion that better peers are always beneficial for students.[3] Second, the large heterogeneity in the magnitude of

(test) scores are used interchangeably, and 'peer' is just a synonym for 'classmate'. For better readability, the gender of students is female and that of teachers is male.

[2]The corresponding estimates tend to have the 'correct' signs; however, they turn out to be non-significant in most cases.

[3]Most of the theoretical (empirical) studies summarized by Epple and Romano (2011) and Sacerdote (2011) presume (report) positive ability peer effects. One of the few exceptions is research on ordinal rank effects: for example, Cicala et al. (2016) and Elsner and Isphording (2017) find that students experiencing a drop in their relative achievement (compared to their classmates) are more likely to have behavioural problems and lower secondary school graduation rates.

estimated ability peer effects found in the literature may stem (partly) from differences in the extent of interaction between student types.

In addition, I would like to highlight two aspects of this article: first, the purpose of this article is to provide empirical evidence that is primarily descriptive but consistent with the causal relationships outlined in the theoretical model. Second, to empirically detect diverging impacts of the interplay between pace and spillover effects on various student types, the empirical assessments only focus on students with higher or lower skills. According to the theoretical model, the impacts on the "median student" are expected to lie between the more polar cases that are analyzed here.

This chapter proceeds as follows: Sect. 5.2, "Model and hypotheses" briefly summarizes Kiss (2017) and derives the three hypotheses. Section 5.3, "Empirical strategy" presents the data and the empirical strategy. Section 5.5 "Results" reports the results. The final section provides a summary and conclusions.

5.2 Model and Hypotheses

5.2.1 Summary of the Theoretical Model

In Kiss (2017), classes are populated by two student *types*

$$\theta \in \{l, h\}$$

with l types denoting weaker students and h types denoting better students. Each type's learning capability or *potential* q_θ equals

$$\begin{aligned} q_h &= h \\ q_l &= l + s(n, i) \end{aligned}$$

with $q_h > q_l > 0$. That is, the largest amount of knowledge an h type can accumulate during a period (say, a school year) equals her potential $q_h = h$.

Regarding l types, their learning potential is determined by both their type and a non-negative function $s(n, i)$ that captures the extent of knowledge externalities ('spillovers') generated by their better classmates. *Spillovers* $s(n, i)$ are a positive function of two variables: $n \in (0, 1)$ denotes the *share* of h types (i.e. better peers) in a class. $s(n, i)$ is assumed to be increasing in n, because better peers may have a positive effect on l types' learning efforts or help them through study collaborations. The second variable $i \in (0, 1)$ denotes the extent of *interaction* between h types and l types, with larger values representing higher levels of interaction. Because of that,

$s(n, i)$ is also increasing in i.[4] If, for example, a student's type θ is correlated with socio-economic status, then i may vary across classes due to regional differences in the extent of social segregation.

Even though spillovers $s(n, i)$ are non-negative, they are further constrained from above, so that $q_h > q_l > 0$ holds for any n and i, meaning that h types have the potential to learn more than l types. The outcome of interest, however, is a student's final *achievement*

$$a_\theta(p) = q_\theta - |p - q_\theta|,$$

which is a function of her potential q_θ and the instructional *pace* p. The pace p is set by the teacher and reflects the amount of material covered during a school year. From this it becomes apparent that

$$a_\theta(p = q_\theta) = q_\theta > a_\theta(p \neq q_\theta). \tag{5.1}$$

Equation 5.1 means that a student can realize her full potential $q_\theta = \max_p a_\theta(p)$ only if the instructional pace is perfectly targeted. Consequently, final achievement a_θ is depressed whenever $p \neq q_\theta$. The intuition behind this is simple: a student cannot realize her full potential whenever she is bored ($p < q_\theta$) or overchallenged ($p > q_\theta$). Therefore, one can think of q_θ as both θ's learning potential and θ's *optimal pace*.

5.2.2 The Three Hypotheses

Figure 5.1 plots a_θ for each student type as a function of the share of better students n, while holding the extent of interaction i constant.[5] One can see that $a_h > a_l$ for any n, meaning that h types learn more than l types. Regarding the marginal effect of increases in n on each type's learning, two things become apparent. First,

H1: The higher the share of better students n, the more h types learn.

This is inferred simply from the fact that an h type's final achievement a_h has a positive slope for any n in Fig. 5.1. The reason for this lies in the endogenous variable p, the instructional pace set by the teacher. Teachers are assumed to choose p based on the following rule: the larger the share of student type θ in a class, the more closely the instructional pace is tailored to that group's potential $q_\theta = \arg\max_p a_\theta(p)$. In the model, teacher utility is therefore maximized at

[4] As will be shown later, changes in n and i affect weak students' achievement in different ways.

[5] All functional form choices (e.g. the teacher's utility function) are stated and discussed in Kiss (2017).

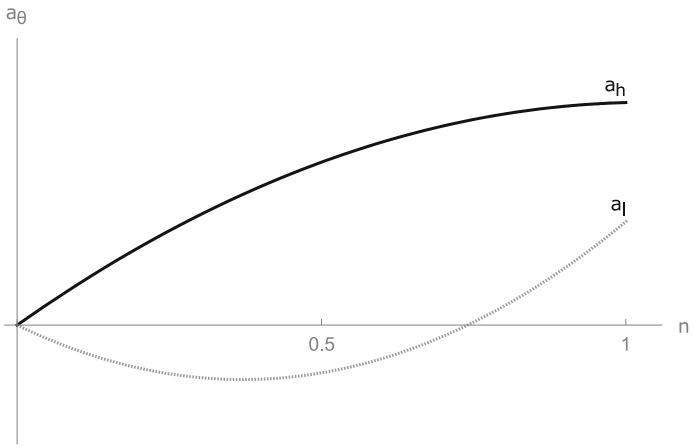


Fig. 5.1 Final achievement a_θ of each student type as a function of n. ($n \in (0, 1)$ denotes the share of better students (h types) in a class. Because there are only two student types $\theta \in \{h, l\}$, higher values of n are equivalent to higher average achievement levels in classes)

$$p^* = n \cdot q_h + (1 - n) \cdot q_l, \tag{5.2}$$

which is a convex combination of each type's potential q_θ. Obviously, if n was zero or one, then teachers would have chosen a pace that had maximized achievement growth of all students (recall Eq. 5.1 in conjunction with Eq. 5.2). However, as I am interested in mixed classes—which implies $0 < n < 1$—teachers are assumed to weigh each student type's optimal pace q_θ by her share in Eq. 5.2.

Because $q_h > q_l$, the teacher's *optimal pace* p^* is increasing in n—that is, a larger proportion of better students induces teachers to instruct at a more demanding level. In the lingo of the model, the so-called *pace effect* is positive for h types, because a more demanding pace allows h types to better realize their potential.[6]

Second, one can infer from graph a_l in Fig. 5.1 that

H2: The marginal effect of n on an l type's achievement is negative for small n, and becomes positive once n exceeds some threshold.

The model makes this interesting prediction because increases in the share of better students are accompanied by two opposing effects on l types' learning: on the one hand, better peers generate additional (positive) knowledge externalities, which is referred to as the *spillover effect*. At the same time, however, better peers further induce teachers to set a higher instructional pace, which turns out to be too demanding for weaker students. Therefore, the net effect of increases in n on a_l depends on the interplay between spillover and pace effects. For small n, positive spillover

[6] Additionally, note that changes in n and i affect p^* in different ways: both n and i are determinants of $q_l = l + s(n, i)$; however, the weighting of q_h and q_l in the teacher's utility-maximizing pace p^* depends solely on n.

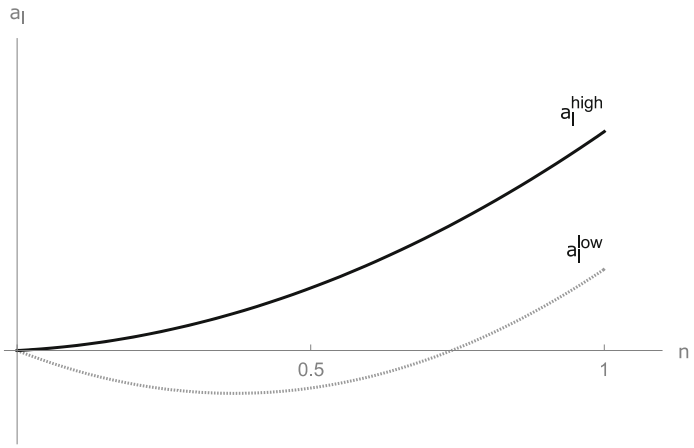


Fig. 5.2 Final achievement of *l* types (high vs. low levels of interaction). (Increases in the extent of interaction between better and weaker student types are represented by a counterclockwise rotation of the graph of a_l)

effects are dominated by negative pace effects. Once n is sufficiently large, however, further increases in n turn out to generate knowledge externalities that overcompensate negative pace effects.

So far, the extent of interaction between student types was held constant in Fig. 5.1. In Fig. 5.2, achievement of weaker students a_l is plotted twice—once for low and once for high levels of interaction. One can observe that

H3: An increase in the extent of interaction raises *l* types' achievement.

The reason for this is the following: higher interaction levels generate additional skill externalities that translate into higher achievement levels a_l. Put differently: increases in the extent of interaction are represented in Fig. 5.2 by a counterclockwise rotation of the graph of a_l. Figure 5.2 further suggests that the detrimental effect of better peers for low initial values of n—as stated in H2—may not exist if interaction levels are sufficiently high.

5.3 Empirical Strategy

5.3.1 Data, Institutions, and Descriptive Statistics

This study employs Starting Cohort 3 of the National Educational Panel Study (NEPS). In these data, students are assessed the first time in the autumn of 2010 after enrolling in 5th grade of German secondary school. Thereafter, their educational progress is tracked in yearly follow-up assessments. The key variables used in this study are math skills in Grades 5 and 7: math skills in Grade 5 are used to

classify students into *l* and *h* types that then allows me to compute the share of better students *n*. Math skills at Grade 7 serve as a proxy for the outcome of interest: final achievement a_θ.[7]

Even though NEPS students are also assessed at later grades, this study focuses on only the early stages of a student's secondary school career. The reason lies in the key explanatory variable *n* that is required to correlate as little as possible with other unobservable determinants of final achievement a_θ. Whereas the analysis presented here is primarily descriptive, biases due to self-selection or omitted variables can be reduced by exploiting the fact that new classes are created at 5th grade—the beginning of German secondary education.

Compared to later grades, potential confounding factors should correlate less with *n* among 5th graders for the following reasons: (a) students in newly formed 5th-grade classes usually graduated from different elementary schools; (b) parents who are sensitive to peer characteristics require some time to properly assess their child's new class environment; and (c) similarly, teachers also first have to interact with their new classes before they can decide whether, for instance, they are willing to continue instructing them in later grades.[8]

The analysed data are summarized by student type in Table 5.1. Based on the distribution of math scores of all 5th graders in the sample, a student is classified as *l* type if her 5th grade math score lies below the 25th percentile and as *h* type if her math score lies above the 75th percentile. As expected, average math percentile scores are much lower for *l* types than for *h* types (.12 vs. .87). The next row contains summary statistics for a student's math percentile score at the beginning of 7th grade that serves as the proxy for final achievement a_θ. There is some regression to the mean, because the percentile scores of *l* types are increasing and those of *h* types are decreasing over time. The remaining variables are self-explanatory: girls are somewhat over-represented among *l* types and under-represented among *h* types. In addition, *l* types are more likely to have less educated parents and to enrol in lower level secondary schools.

5.3.2 *Empirical Tests of H1 and H2*

To empirically test the relationship between final achievement and the share of better classmates, the following regression model is estimated:

[7] Unfortunately, math skills are assessed in NEPS only once every 2 years (see Bela et al., 2012, for details and Blossfeld et al., 2011, for a general introduction to the NEPS). However, this should not be a great cause for concern because (a) math skills are highly autocorrelated and (b) the composition of classes is relatively stable over time.

[8] Transitions from primary to secondary education serve as natural experiments in the ability peer effects studies conducted by Gibbons and Telhaj (2016), Kiss (2013), and Sund (2009).

Table 5.1 Descriptive statistics (German secondary students)

Student type	Weak (l type)		Good (h type)	
Variable	M	SD	M	SD
Math percentile (5th grade)	.12	.07	.87	.07
Math percentile (7th grade)	.18	.15	.75	.19
Female (5th grade)	.57		.39	
Age (in years, 5th grade)	10.6	.64	10.3	.53
Parental education				
Lower secondary	.10		.01	
Vocational training	.48		.19	
High school	.08		.08	
Tertiary	.34		.72	
Type of secondary school				
Lower secondary	.28		.01	
Multi-track	.13		.04	
Middle secondary	.30		.09	
Comprehensive	.12		.02	
Upper secondary	.17		.84	
N(students)	580		768	

Standard deviations not reported for dummy variables. Unit of analysis: secondary students who were enrolled in 5th grade when first assessed. A student is classified as *l* type below the 25th percentile in the math achievement distribution at the beginning of the 5th grade and as *h* type if her math score lies above the 75th percentile. 'Parental education' denotes the highest educational degree of a student's parents. It is classified according to the International Standard Classification of Education (ISCED) guidelines, see OECD (1999) for details

$$mpc_{i7} = \beta \cdot n_{c5} + \gamma \cdot n_{c5}^2 + \boldsymbol{\delta}' \cdot \boldsymbol{x}_{i5} + \varepsilon_{ic5} \tag{5.3}$$

in which $mpc_{i7} \in [0, 1]$ denotes the math achievement percentile of student i at the beginning of 7th grade, and serves as a proxy for final achievement a_θ. The variable of interest is n_{c5}, the share of higher achieving classmates in Grade 5. The c subscript indicates that n_{c5} is constant across students attending the same class. As shown in Fig. 5.1, the relationship between math skills and n is nonlinear—to account for this, Eq. 5.3 further includes a square of n_{c5}. $\boldsymbol{x}_{i5}$ denotes a vector of control variables (age, gender, indicators for parental education, and school type). Errors ε_{ic5} are clustered on the class level.

H1 is tested by first restricting the data to h types and then estimating Eq. 5.3. According to the theoretical model, returns to increases in n are positive, but diminishing for h types (see Fig. 5.1). Because

$$\frac{\partial mpc_{i7}}{\partial n_{c5}} = \beta + 2\gamma \cdot n_{c5}, \tag{5.4}$$

one would therefore expect $\widehat{\beta} > 0$ and $\widehat{\gamma} < 0$.

H2 is tested in the same fashion: the data are now constrained to l types before Eq. 5.3 is estimated. According to Fig. 5.1, $\frac{\partial mpc_{\Pi}}{\partial n_{c5}}$ is negative for small n and eventually becomes positive as n further increases—this is the case if $\widehat{\beta} < 0$ and $\widehat{\gamma} > 0$ in Eq. 5.4.

5.3.3 *The Empirical Test of H3*

It was stated in Sect. 5.2, "Model and hypotheses" that the extent of interaction may vary across classes due to regional differences in social segregation levels. The empirical test of H3, however, is based on the following assumption:

A1. Same-gender peers interact more than different-gender peers.

To exemplify A1, consider the following 5th-grade class of 22 students: 6 high-achieving girls, 5 high-achieving boys, 6 low-achieving girls, and 5 low-achieving boys. What would be the marginal effect of an additional high-achieving girl on the achievement levels of low-achieving girls and boys? Under A1, the positive effect of that additional high-achieving girl would be stronger on low-achieving girls than on low-achieving boys, because same-sex friendships and social ties are both more likely to develop and be sustained over time.

Under A1, the following procedure is implemented to test H3:

1. Based on a percentile-threshold π, each student (regardless of gender) is classified as *either h or l* type.[9]
2. Each class c is split into two subclasses $c1$ and $c2$. This is done in two different ways, called *scenarios*:
   - Scenario 1: The first subclass $c1$ consists of all high- and low-achieving girls who are enrolled in c. The second subclass $c2$ comprises all high- and low-achieving boys enrolled in c.
   - Scenario 2: $c1$ comprises all high-achieving girls and low-achieving boys enrolled in c. Similarly, all high-achieving boys and low-achieving girls in c are grouped into subclass $c2$.
3. For both scenarios (same- vs mixed-sex subclasses), the share of better students in each subclass is computed. To be precise,

[9] Table 4.1, for example, π is set to 25 to identify l types and to 75 to identify h types.

- n either equals $n^{gg}_{c1,5}$, the share of high-achieving girls in $c1$, the 'girls-only' subclass (in 5th grade). Alternatively, $n = n^{bb}_{c2,5}$ equals the share of high-achieving boys in the 'boys-only' subclass $c2$.
- Under the second scenario, n equals either $n^{gb}_{c1,5}$ or $n^{bg}_{c2,5}$.[10]

4. Estimate Eq. 5.3 and treat subclasses $c1$ and $c2$ as if they were separate classes

This estimation procedure has the appealing property of using the same data to construct subclasses in two different ways. A comparison of estimates therefore allows inferences to be drawn on the effect of changes in the extent of interaction on the achievement growth of l types: because the same data are used in both scenarios, differences in results can emerge only from differences in the way subclasses were constructed. Under A1, the extent of interaction is higher in same-sex subclasses (see H3 and Fig. 5.2). In terms of marginal effects (see Eq. 5.4 in conjunction with H2), these considerations translate into $\widehat{\beta}^{\text{low}} < \widehat{\beta}^{\text{high}}$ and $\widehat{\gamma}^{\text{low}} > \widehat{\gamma}^{\text{high}}$, with 'low' indicating whether the analysis was based on the mixed-sex sample in which I assume interaction levels to be low between student types, and 'high' indicating whether the analysis was based on the same-sex sample in which I assume interaction levels to be high between student types.

5.4 Results

5.4.1 Main Findings

H1 is tested with the following three-step procedure:

1. Based on a percentile threshold $\pi \in \{75, \ldots, 85\}$, the h type dummy is coded as follows:

   $$h\,\mathsf{type}_{i5} = \begin{cases} 1 & \text{if } mpc_{i5} \geq \pi \\ 0 & \text{if } mpc_{i5} < \pi \end{cases},$$ that is, $h\,\mathsf{type}_{i5} = 1$ if i's math skill (measured at the beginning of the 5th grade) is equal or greater than the π^{th} percentile. Otherwise, $h\,\mathsf{type}_{i5} = 0$ for any student i scoring below π.
2. Based on $h\,\mathsf{type}_{i5}$, the share of high achievers n_{c5} is computed for each class c.
3. Before Eq. 5.3 is estimated, the data are restricted to h types only.

Point estimates of β and γ are plotted against π in Fig. 5.3: for any $75 \leq \pi \leq 85$, estimates of β turn out to be positive—that is, the larger the share of high-achieving students in a class, the more h types learn. However, the graph of a_h is only concave for negative values of γ (recall Eq. 5.4). Because $\widehat{\gamma}$ turns out to be positive in some cases, Fig. 5.3. confirms H1 only partially—it should be noted, however, that the

[10] In our hypothetical class of 22 students (before the high-achieving girl was added), these shares are $n^{gg}_{c1,5} = \frac{6}{12}$, $n^{bb}_{c2,5} = \frac{5}{10}$, $n^{gb}_{c1,5} = \frac{6}{11}$, and $n^{bg}_{c2,5} = \frac{5}{11}$.

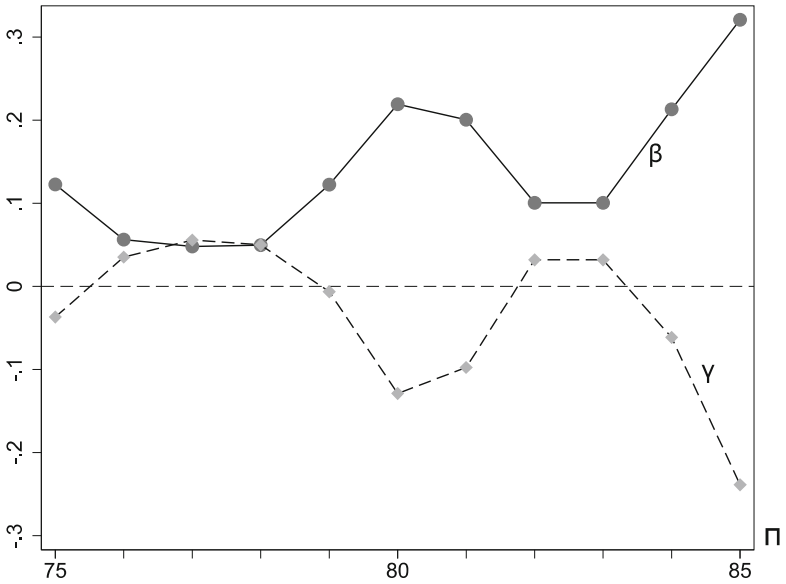


Fig. 5.3 Empirical test of H1 (estimates of β and γ for h types). (This figure reports estimates of β (solid line) and γ (dashed line) for h types for various thresholds $\pi \in \{75, \ldots, 85\}$. H1 is derived from the theoretical model that predicts $\widehat{\beta} > 0$ and $\widehat{\gamma} < 0$ for h types. Sample sizes range from 449 ($\pi = 85$) to 768 ($\pi = 75$). Both the estimation procedure and the relationship between β and γ are discussed at the beginning of Sect. 5.5, "Results")

sign of $\widehat{\gamma}$ is of secondary importance with respect to the theoretical prediction that final achievement of h types is increasing in n. The average values of $\widehat{\beta}$ and $\widehat{\gamma}$ are .14 and $-$ .03, respectively, and non-significant for any $\pi \in \{75, \ldots, 85\}$.[11]

H2 is tested in the same manner. The l type dummy

$$l\,\text{type}_{i5} = 1(mpc_{i5} \leq \pi) \text{ for } \pi \in \{15, \ldots, 25\}$$

identifies students who score at the πth percentile or below, and π now takes on values between 15 and 25. The share of l types is computed for each class and interpreted as $1 - n_{c5}$. Similar to the empirical test of H1, the data are restricted to l types before Eq. 5.3 is estimated.

[11] One might be puzzled by the fact that the graphs of β and γ are symmetric along some horizontal axis. Recalling Fig. 4.1 in conjunction with Eq. 5.3, note that any specific trajectory in Fig. 4.1 is represented by a unique combination of β and γ. Therefore, similar values of $\widehat{\beta}$ and $\widehat{\gamma}$ under two different π imply that the graphs of a_h are (almost) overlapping. The symmetry arises for the following reason: because $mpc_7 \in [0, 1]$ is bounded from above, the curvature of 'initially steep' graphs of a_h (that is, for large $\widehat{\beta}$) must be more pronounced, which implies a large absolute value of $\widehat{\gamma}$. Put differently, the degree of curvature of the positively sloped, concave, and bounded graph a_h imposes a mechanical relationship between β and γ.

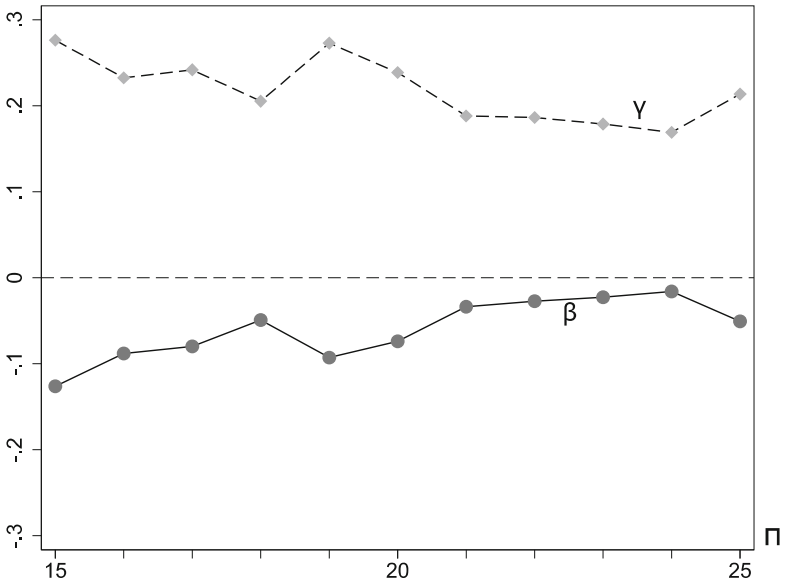


Fig. 5.4 Empirical test of H2 (estimates of β and γ for l types). (This figure reports estimates of β (solid line) and γ (dashed line) for l types under various thresholds $\pi \in \{15, \ldots, 25\}$. Here, the share of l types in a class is interpreted as $1 - n$. H2 is derived from the theoretical mode, that predicts $\widehat{\beta} < 0$ and $\widehat{\gamma} > 0$ for l types. Sample sizes range from 334 ($\pi = 15$) to 580 ($\pi = 25$))

Point estimates of β and γ are plotted against π in Fig. 5.4. Consistent with H2, point estimates of β are now negative and point estimates of γ are now positive for any π, and the average value of $\widehat{\beta}$ is .06 and of $\widehat{\gamma}$ is .21. All estimates of β turn out to be non-significant and all estimates of γ to be significant. It should further be noted that the point estimates of β become positive if $\pi > 30$, i.e., if the threshold to identify l-types takes on "too large" values.[12]

To test H3, each class c is split into subclasses $c1$ and $c2$ in two different ways (see Sect. 5.3.3, "The empirical test of H3" for details). In both cases, each subclass encompasses h and l types. Under the first scenario, $c1$ contains only girls and $c2$ only boys. In the second scenario, high-achieving girls and low-achieving boys constitute $c1$, and subclass $c2$ comprises high-achieving boys and low-achieving girls. The marginal effect of increases in n should therefore depend on the way subclasses are constructed (same-sex vs mixed-sex). Based on the theoretical model, one would expect larger marginal effects in classes with higher levels of interaction (see Eq. 5.4). In terms of regression coefficients on the marginal effect of increases in the share of better classmates on l types, this notion translates into $\widehat{\beta}^{\text{high}} > \widehat{\beta}^{\text{low}}$ and $\widehat{\gamma}^{\text{high}} < \widehat{\gamma}^{\text{low}}$ —with 'high' indicating whether the analysis was conducted on the

[12] Put differently: to empirically assess the model's predictions, there must be a sufficiently large skill gap between l and h types.

same-sex sample and 'low' indicating whether it was conducted on the mixed-sex sample.

Estimates of Eq. 5.3 are plotted in Fig. 5.5 for same-sex (top figure) versus mixed-sex subclasses (bottom figure). One can see that $\widehat{\beta}^{\text{high}} > \widehat{\beta}^{\text{low}}$ for any threshold $\pi \in \{15, \ldots, 25\}$ at which students are classified into l and h types. The average values of $\widehat{\beta}^{\text{high}}$ are -0.01, and the mean values of $\widehat{\gamma}^{\text{high}}$ are 0.10. The average values of $\widehat{\beta}^{\text{low}}$ are -0.08, and the mean values of $\widehat{\gamma}^{\text{low}}$ are 0.21.[13] In essence, this set of findings resembles the two graphs of a_l in Fig. 5.2, therefore empirically supporting H3: this can be inferred from a_l^{high} being steeper than a_l^{low}, which is reflected by $\widehat{\beta}^{\text{high}}$ being larger than $\widehat{\beta}^{\text{low}}$. In addition, both a_l^{high} and a_l^{low} are convex, which is also confirmed by the data because $\widehat{\gamma} > 0$ in both scenarios.

5.4.2 Robustness Checks Based on Reading Scores

To check the robustness of the results, the analyses from Sect. 5.5.1, "Main findings" are repeated with reading (rather than math) scores—that is, students are classified into l and h types based on their reading scores at the beginning of 5th grade, and final achievement is now proxied by reading scores measured in Grade 7.

The empirical findings reported in Fig. 5.6 are mostly in line with the theoretical model: $\widehat{\beta}$ is positive among h types (top figure) and negative for l types (bottom figure). As before, H1 is confirmed only partially, because $\widehat{\gamma}$ is negative in only 50% of cases (top figure). However, as implied by H2, $\widehat{\gamma}$ is positive among l types for any $\pi \in \{15, \ldots, 25\}$. Again, most of the estimated β and γ are non-significant.[14]

H3, however, is not empirically supported for reading scores. According to H3, $\widehat{\beta}$ should be larger in high-interaction (i.e. same-sex) subclasses. This is not confirmed by the data because $\text{mean}\left(\widehat{\beta}^{\text{high}}\right) \approx -0.08 < \text{mean}\left(\widehat{\beta}^{\text{low}}\right) \approx -0.06$. One may wonder whether this finding invalidates H3 or could be explained by some systematic differences in the acquisition of math and reading skills. It might be the case, for instance, that math skills are more easily transferable between student types who are collaborating in study groups. In addition, weaker students (or their parents) may have a greater awareness of both their math deficits and the need to overcome them.

[13] Regarding significance levels, none of the $\widehat{\beta}$ and 59% of the $\widehat{\gamma}$ are significant.

[14] In the top figure, only 9% of the $\widehat{\beta}$ and none of the $\widehat{\gamma}$ are significant at the 10% level; in the bottom figure, none of the $\widehat{\beta}$ and 27% of the $\widehat{\gamma}$ are significant.

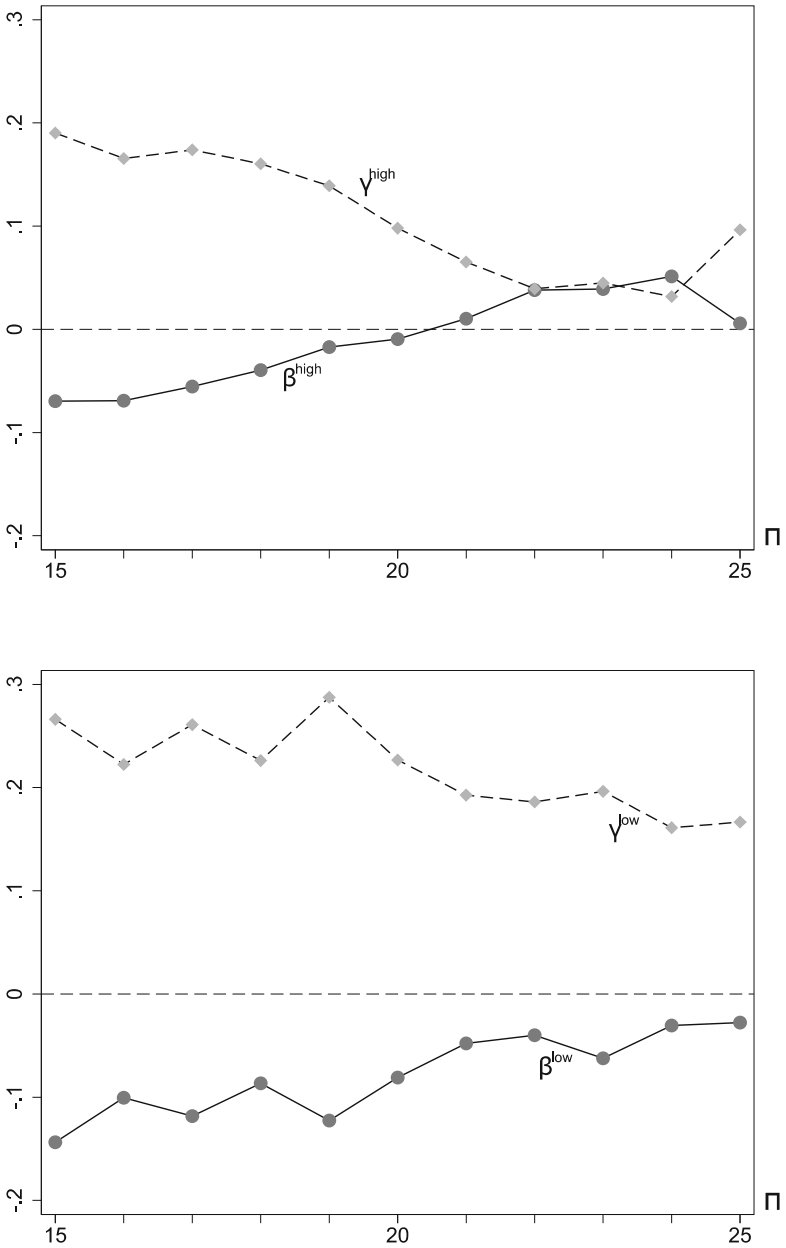


Fig. 5.5 Empirical test of H3 (estimated β and γ in high- and low-interaction classes). (H3 translates into $\widehat{\beta}^{\text{high}} > \widehat{\beta}^{\text{low}}$ and $\widehat{\gamma}^{\text{high}} < \widehat{\gamma}^{\text{low}}$—that is, the marginal effect of better peers is increasing in the extent of interaction between student types. Interaction levels are assumed to be higher in same-sex subclasses (top figure) than in mixed-sex subclasses (bottom figure), see Sect. 5.3.3, "The empirical test of H3" for details)

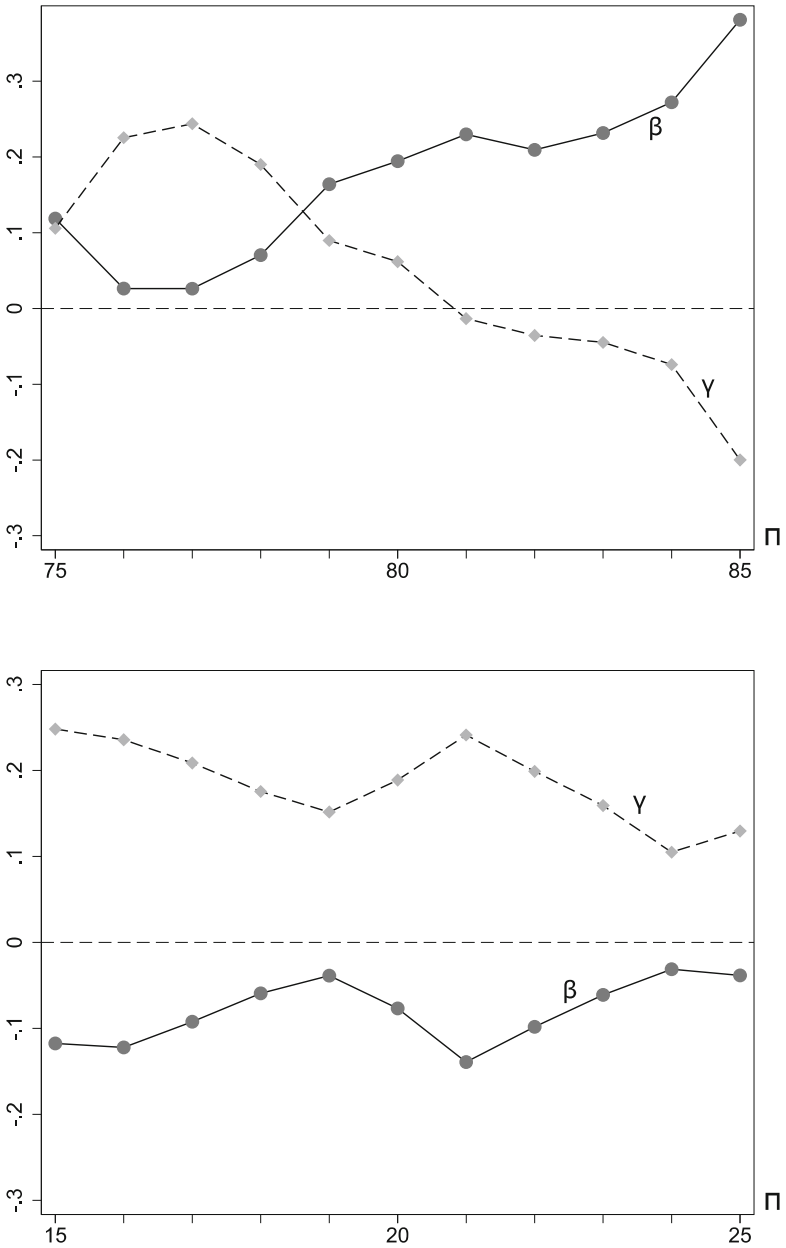


Fig. 5.6 Robustness checks for H1 and H2 based on reading scores. (Unlike Figs. 5.3 and 5.4, students are now classified as *l* or *h* types based on their reading scores at the beginning of 5th grade, and final achievement a_θ is proxied by reading scores at the beginning of 7th grade. The top figure reports estimates of β (solid line) and γ (dashed line) for *h* types under various thresholds $\pi \in \{75, \ldots, 85\}$, therefore providing an empirical test for H1. The bottom figure tests H2 by reporting estimates of β and γ for *l* types for $\pi \in \{15, \ldots, 25\}$. Sample sizes range between 445 and 741 in the top figure and between 328 and 589 in the bottom figure)

5.5 Summary and Conclusions

Though there is compelling empirical evidence that students tend to learn more in classrooms with higher shares of good peers, little is still known about the causes behind this relationship. This article complements our understanding about transmission channels by empirically validating the theoretical model on the interplay between instructional pace, skill externalities, and student achievement formulated by Kiss (2017). Three hypotheses on the impact of better peers on student achievement are tested with data on German secondary students. To minimize biases, all analyses are based on a sample of newly formed 5th-grade classes at the beginning of German secondary education.

The empirical findings for math achievement support each hypothesis. Better peers (a) boost good students' achievement, (b) can have a detrimental effect on weak students (presumably because they induce teachers to set a too demanding instructional pace), and (c) raise weaker students' achievement if the extent of interaction between student types is high. Results (a) and (b) are confirmed by robustness checks based on reading scores. However, the third hypothesis is empirically supported only for math scores—one plausible explanation might be the greater awareness of weaker students for both their math deficits and the need to overcome them.

A more profound understanding of transmission channels allows a better assessment of the expected consequences of interventions that change the skill composition of classes. In addition, it may help to identify potentially Pareto-improving interventions—in our case, all students may benefit from learning environments that encourage them to interact more.

References

Altonji, J., Huang, C.-I., & Taber, C. (2015). Estimating the cream skimming effect of school choice. *Journal of Political Economy, 123*(2), 266–324.

Bayer, P., Ferreira, F., & McMillan, R. (2007). A unified framework for measuring preferences for schools and neighborhoods. *Journal of Political Economy, 115*(4), 588–638.

Bela, D., Pink, S., & Skopek, J. (2012). *Data manual. Starting cohort 3 – From lower to upper secondary school. neps sc3 1.0.0.* Research data article. NEPS, University of Bamberg.

Black, S. (1999). Do better schools matter? Parental valuation of elementary education. *Quarterly Journal of Economics, 114*(2), 577–599.

Blossfeld, H.-P., Rossbach, H.-G., & von Maurice, J. (2011). Education as a lifelong process. The German National Educational Panel Study (NEPS). *Zeitschrift für Erziehungswissenschaft, Sonderheft, 14*, 19–34.

Cicala, S., Fryer, R. G., Jr., & Spenkuch, J. (2016). *Self-selection and comparative advantage in social interactions*. Retrieved February 1, 2018, from https://articles.ssrn.com/sol3/articles.cfm?abstract_id=1780652roprofilöe.com

Das, J., Dercon, S., Habyarimana, J., Krishnan, P., Muralidharan, K., & Sundararaman, V. (2013). School inputs, household substitution, and test scores. *American Economic Journal: Applied Economics, 5*(2), 29–57.

Duflo, E., Dupas, P., & Kremer, M. (2011). Peer effects, teacher incentives, and the impact of tracking: Evidence from a randomized evaluation in Kenya. *American Economic Review, 101*(5), 1739–1774.
Elsner, B., & Isphording, I. (2017). A big fish in a small pond: Ability rank and human capital investment. *Journal of Labor Economics, 35*(3), 787–828.
Epple, D., & Romano, R. (2011). Peer effects in education: A survey of the theory and evidence. In J. Benhabib, A. Bisin, & M. O. Jackson (Eds.), *The handbook of social economics* (Vol. 1, pp. 1053–1163). Elsevier.
Foster, G., & Frijters, P. (2009). *Are there complementarities in educational peer effects?* Retrieved May 3, 2021, from http://research.economics.unsw.edu.au/gfoster/peer_welfare_max_20.pd
Fruehwirth, J. (2013). Identifying peer achievement spillovers: Implications for desegregation and the achievement gap. *Quantitative Economics, 4*(1), 85–124.
Gibbons, S., & Telhaj, S. (2016). Peer effects: Evidence from secondary school transition in England. *Oxford Bulletin of Economics and Statistics, 78*(4), 548–575.
Hanushek, E., & Wößmann, L. (2006). Does educational tracking affect performance and inequality? Differences-in-differences evidence across countries. *Economic Journal, 116*(510), 63–76.
Kiss, D. (2013). The impact of peer achievement and peer heterogeneity on own achievement growth: Evidence from school transitions. *Economics of Education Review, 37*, 58–65.
Kiss, D. (2017). A model about the impact of ability grouping on student achievement. *B.E. Journal of Economic Analysis & Policy, 17*(3), 1–10.
Lazear, E. (2001). Educational production. *Quarterly Journal of Economics, 116*(3), 777–803.
OECD. (1999). *Classifying educational programmes: Manual for ISCED-97 implementation in OECD countries*. OECD Publishing.
Pop-Eleches, C., & Urquiola, M. (2013). Going to a better school: Effects and behavioral responses. *American Economic Review, 103*(4), 1289–1324.
Rouse, C. E. (1998). Private school vouchers and student achievement: An evaluation of the Milwaukee parental choice program. *Quarterly Journal of Economics, 113*(2), 553–602.
Sacerdote, B. (2011). Peer effects in education: How might they work, how big are they and how much do we know thus far? In E. Hanushek, S. Machin, & L. Woessmann (Eds.), *Handbook of the economics of education* (Vol. 3, pp. 249–277). Elsevier.
Sund, K. (2009). Estimating peer effects in Swedish high school using school, teacher, and student fixed effects. *Economics of Education Review, 28*(3), 329–336.

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Chapter 6
Addressing Environmental and Individual Factors in Early Secondary School: The Roles of Instruction Techniques and Self-Perception

Jeffrey M. DeVries, Carsten Szardenings, Philipp Doebler, and Markus Gebhardt

Abstract Risk factors for poor academic performance include variables such as lower socio-economic status, migrant status, and the presence of special education needs. These risk factors can be mediated by the self-concept of the learner, instructional techniques, and classroom size. Due to the diverse nature of these factors, a comprehensive approach is needed to examine their role. This chapter reports on two NEPS (National Education Panel Study) analyses that examined teaching styles ($N = 1072$ students in math classes and $N = 794$ in reading classes) and the mediating role of self-concept and self-esteem ($N = 5923$ in math classes and $N = 5919$ in reading classes) along with different sets of risk factors. Results showed that group work related to better outcomes for second-language learners in math and reading, and discussions related to worse outcomes in math for the same group. Further, self-concept and self-esteem partially mediated the effects of gender, special education needs, and non-verbal reasoning on both reading and math competence. These results highlight the importance of varied instructional styles and classroom size, as well as the important role of self-concept and self-esteem as partial mediators of risk factors.

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6.1 Introduction

Education systems are frequently designed to provide instructional opportunities for a heterogeneous group of learners. Especially since the ratification of the UN Convention on the Rights of Persons with Disabilities (CRPD) in 2009 (United Nations, 2006), there is an obligation to provide good and effective education for all children in Germany. Since this ratification, school inclusion is now a mandate for all educational institutions (KMK, 2011). The goal is therefore to produce the best possible academic and social development for all students. Previous studies have shown that the school system has not been well adapted to children at risk (e.g., children from poorer families, children with parents/legal guardians with low educational achievement, children from migration backgrounds, and children with special education needs: SEN). Such inclusive classrooms may contain students with differing backgrounds. For example, children may differ in terms of socioeconomic status (SES), or their first language might differ from the one used in class. The same classroom may also contain students with differing prior ability levels, SEN, and academic self-perceptions. Moreover, instructors may also employ a varied set of instructional techniques (e.g., group work and classroom discussions) that are not always optimally suited to their diverse classrooms. These individual, environmental, and classroom factors are only a small part of the complex classroom environment. This chapter will examine these factors via two studies that draw on the German National Education Panel Study (NEPS; Blossfeld et al., 2011).

6.2 The Multilevel-Supply-Use Model

The multilevel-supply-use model (German; *Angebots-Nutzungs-Model*; Brühwiler & Blatchford, 2011; Helmke, 2009; Seidel, 2014) encompasses both individual and environmental learning factors. Within this model, instructional supply may be used by individual learners to reach educational outcomes. Instructional supply is defined as an interaction of classroom variables such as teaching methods, teacher characteristics, and classroom environment along with school-level variables. However, the use of the supply by the learner depends on an interaction with individual learning processes (e.g., instructional activities), individual preconditions (e.g., cognitive processes, self-perceptions, SENs), and their learning environments (e.g., family background, SES, migrant status). Subsequent sections will focus mostly on these three use aspects (for a more comprehensive review, see Brühwiler & Blatchford, 2011).

Within this context, risk factors may be individual or environmental. Individual risk factors may include the presence of SEN or low pre-existing ability levels, whereas environmental factors may include being a second-language learner or coming from a lower SES background. In addition, individual self-perceptions such as self-esteem and self-concept interact with both these risk factors and the

instructional activities to produce learning outcomes. For instance, a child with a higher self-concept in math who comes from a poorer economic background may be at a lower risk of poor performance.

6.2.1 Environmental Learning Factors

Having a low SES has been frequently linked to worse educational outcomes. The link to lower SES is found in many countries and has been shown to contribute to a diverse set of learning outcomes (Bjorklund & Salvanes, 2011; Currie, 2009; DeVries et al., 2018a; Rambo-Hernandez & McCoach, 2014; White, 1982; White et al., 1993). Moreover, these findings generally hold regardless of SES or the other variables employed (e.g. Sirin, 2016). Being a second-language learner is also tied to a multitude of worse academic outcomes (Crosnoe & Fuligni, 2012; Duong et al., 2016; Solari et al., 2014). Within the multi-level supply-use model, these environmental risk factors are themselves associated with individual learning factors through which they interact with instructional activities. For example, a child who is a second-language learner may have trouble understanding longer, language-heavy instructions (e.g., lectures) due to increased cognitive demand.

6.2.2 Individual Learning Factors

Individual factors themselves may also present a risk for poorer educational outcomes. For instance, learners with SEN often attain worse academic outcomes (Gebhardt et al., 2015; Korhonen et al., 2014). This is complicated by additional factors such as higher levels of social exclusion (DeVries et al., 2018b; Schwab et al., 2014) and a lower academic self-concept and self-esteem (Gurney, 2018; Novita, 2016). These risks also may relate to subject-specific effects and differing instructional methods (Savolainen et al., 2018), and both risks and subject-specific effects vary greatly from individual learner to learner (Cambra & Silvestre, 2003; Möller et al., 2009).

6.2.3 Instructional Activities

Different teaching activities such as group work and individualized assignments have been shown to reduce the effects of not only disadvantaged backgrounds but also personal factors (Bešić et al., 2016; Tomlinson & Imbeau, 2011; Torres, 2018). Individualized instruction involves providing tailored tasks adapted to varying individual learners' needs and ability levels. Moreover, group learning may mitigate risks of social exclusion and boost engagement (Cohen et al., 2014; Miller et al.,

2017; Roseth et al., 2008). In particular, groups involving learners of differing ability levels have shown better learning outcomes than more homogeneous groups (Igel & Urquhart, 2015; Marzano et al., 2003). Conversely, classroom discussions may foster learning in some (e.g., Jocz et al., 2014) but not in other students (e.g., Kang & Keinonen, 2018).

However, classroom size may also interact with instructional activities. Within the multilevel-supply-use model, classroom size may affect teacher activities and, as a result, learning. For instance, in a larger classroom, a teacher may be less able to monitor multiple diverse group activities or each individual learner's reactions during a classroom discussion. When considered alone, larger class sizes are often shown to have a small, but significant negative effect on a diverse set of learning outcomes (Brühwiler & Blatchford, 2011; Krassel & Heinesen, 2014; Watson et al., 2016). However, other evidence has shown that reduced class size does not relate directly to better outcomes (e.g., Hattie, 2002, 2005; Phelps, 2011). Instead, it may have an indirect effect through classroom management and differing instructional activities (Blatchford et al., 2011; Blatchford & Russell, 2018; Harfitt & Tsui, 2015; Wright et al., 2017).

6.2.4 Mediating Factors

As described above, individual learning factors strengthen environmental risk factors. For instance, there is a higher rate of SEN diagnoses in individuals from minority backgrounds (de Valenzuela et al., 2006). However, other individual learning factors such as self-concept and self-esteem may also mediate risks. In classical self-concept theory (Shavelson et al., 1976), the self-concept represents numerous aspects of self-perception in multiple contexts (Marsh, 1986, 1990). One of these aspects—academic self-concept—is of particular interest in the educational context (Marsh, 2014; Marsh & Martin, 2011). Academic self-concept relates to self-perceptions regarding academic and scholastic activities, and it may be further differentiated by academic subject (e.g., math or reading; Gogol et al., 2016). Subject-specific self-concept relates to current and future subject-specific achievement (Susperreguy et al., 2018).

Another relevant self-perception in the academic context is self-esteem. Generalized measures of self-esteem have been shown to also relate to academic achievement (Di Giunta et al., 2013; Diseth, 2011; Ferla et al., 2009), For instance, Valentine et al. (2004) found in a meta-analysis that significant effects of self-esteem measures remained after accounting for subject-specific measures such as self-concept. Valentine and DuBois (2005) have developed this further in a combined model to account for the roles of both subject-specific self-concept and generalized self-esteem.

The relationship of these self-perception measures to academic outcomes is correlated most commonly in self-perception theories (Marsh & Craven, 2006) as well as the multilevel-supply-use model (Brühwiler & Blatchford, 2011). For

example, a child's ability level may influence self-concept, which, in turn, influences later achievement. A recent large-scale assessment demonstrated that variables of self-efficacy and self-concept both relate similarly to subsequent achievement, but that both self-perception variables were also separate constructs (Arens et al., 2020). However, instead of merely covarying with background and achievement, self-perceptions may mediate the effect priors (e.g., prior achievement, SEN, SES) on academic outcomes (e.g., Diseth, 2011).

6.2.5 Present Studies and Research Questions

This chapter presents two studies investigating the role of individual, environmental, and classroom-level factors in learning outcomes. Each study was conducted with data from NEPS (Blossfeld et al., 2011). NEPS provides the opportunity to conduct large-scale, longitudinal analyses that incorporate a diverse and comprehensive set of variables. Both studies utilized data from the third cohort (SC3; starting in the fifth school year). The first study examined the effects of SES and second-language learning on the development of math and reading skills in secondary students between Grades 7 and 9 (DeVries et al., 2020). It simultaneously investigated the effects of teaching techniques (i.e., individualized assignments, group work, and discussions) and their interactions with other variables; and it also evaluated the relationship between class size and teaching techniques. This study focused on the first three of the following research questions:

1. How do low SES and second-language learning affect the development of reading and math competence in secondary school? Both of these factors were expected to impact negatively on competence gains in reading and math (DeVries et al., 2018a; Gebhardt et al., 2015; Solari et al., 2014).
2. How does the use of individualized assignments, group work, and discussions affect the development of reading and math competence in secondary schools? In particular, individualized assignments and group work were expected to produce better outcomes overall and more benefits for learners with SEN, of lower SES, or who were second-language learners (Miller et al., 2017; Roseth et al., 2008; Tomlinson & Imbeau, 2011; Tomlinson & Moon, 2013).
3. How does class size affect the development of reading and math competence in secondary school, and does it interact with specific group work, classroom discussions, and individualized assignments? Class size was expected to relate negatively to learning gains, (Glass & Smith, 1979; Phelps, 2011), and to interact negatively with teaching techniques that require more teacher–student interactions (i.e., group work and individualized assignments; Blatchford et al., 2011; Harfitt & Tsui, 2015; Wright et al., 2017).

The second study used a latent growth model to examine changes in achievement from 5th to 9th grade (DeVries et al., 2021). Within this framework, SES, the presence of SEN, gender, non-verbal reasoning, and school track (*Gymnasium* or

academic track vs other tracks) were related to the overall level (intercept) and rate of change (slope). Further, generalized self-esteem and subject-specific self-concept were introduced as partial mediators between predictors and outcomes. This modelling structure was designed to address the final two research questions:

4. How do SES, SEN, gender, reasoning ability, and school track relate to starting level and rate of change in reading and math competence in secondary school? SES and non-verbal reasoning were expected to relate positively to both starting competence and rate of competence growth in the model (intercept and slope), whereas children with SEN were expected to have a lower starting level (intercept), but not necessarily slower growth (slope). A gender effect in which girls had higher starting levels in reading and boys had higher starting levels of achievement in math was also expected.
5. Do generalized self-esteem and subject-specific self-concept mediate the relationship? Both generalized measures of self-esteem and subject-specific self-concept were expected to be significant mediators.

6.3 Study 1

6.3.1 Methods

Complete data from parents, teachers, and student self-reports were available for 724 students for reading competence (47.7% male) and 1072 students for math competence (48.5% male) in Starting Cohort 3 (SC3; starting in the fifth school year). Separate math and reading models were created with corresponding Grade-9 competence levels as dependent variables.

6.3.1.1 Models

Each model included Grade-7 competence, low parental education level (both parents lacking a university degree), second-language learner status, school track (academic track vs others) as predictors. Also included were the Grade-7 teacher's self-reported use of group work, discussions, and individualized assignments together with class size. Cases in which the child's competence data, the teacher's self-reports, or the parents' data were missing were excluded entirely. Other missing values were omitted via pairwise deletion. Furthermore, all two-way interactions between the instructional techniques (i.e., group work, discussions, and individualized assignments) and all other variables were also considered. Finally, a random intercept was incorporated on the classroom level to account for the hierarchical structure of the data.

6.3.1.2 Notes on Variables Used

Reading and math competence were treated as separate variables and used only in their corresponding models (i.e., math competence in the math model). Values were taken from Warm's Likelihood Estimates (WLEs) calculated from NEPS competence testing (Pohl & Carstensen, 2012). Grade-7 competence was included as a predictor to control for starting level competence when predicting Grade-9 competence. Low parental education was converted into a binary variable indicating whether both parents lacked a university degree. These data came from parental responses. Second-language learner status was also converted into a binary variable indicating whether German was the second-language of the learner (i.e., L2). These data were based on self-reports of the learners. School track was divided into academic tracks and compared to all others. Only students attending a *Gymnasium* school were defined as being in the academic track. The use of group work was based on teacher responses to how often they 'work with small student groups' and use 'partner work'. Discussions were based on teacher responses to how often they use 'discussion rounds' and how often 'the class and I have discussions'. Individualized assignments came from five questions about how they vary their instruction, teaching techniques, and assignments based on the ability of their students (e.g., 'I give students homework ranging in complexity based on their capability', and 'If students have difficulties in understanding, I give them additional assignments').

6.3.2 Results

6.3.2.1 Student Background Variables

Table 6.1 gives an overview of the results of both reading and math models. In both models, competence at Grade 7 was a significant predictor of competence at Grade 9, but parental education level and second-language status were not significant predictors. Thus, the *rate of change* between Grades 7 and 9 was not related to parental education or second-language status. However, attending the academic track did predict greater increases in both models.

6.3.2.2 Teaching Techniques

Table 6.1 also gives the main effects of teaching techniques on 9th-grade competence. In neither model were any teaching techniques by themselves related to greater competence gains. However, there were also several significant interactions between teaching techniques and other variables in both models. Group work in math classes related to larger gains for second-language learners, but also to smaller gains for academic track students. Meanwhile, discussions in math classes related to smaller gains for second-language learners, and discussions did not relate to

Table 6.1 Mixed-effects regression coefficients for math and reading competencies in Grade 9

	Math model		Reading model	
	β	*SE*	β	*SE*
Intercept	.78***	0.24	0.59	0.33
Main effects				
Grade-7 competence	.56***	.10	.51***	.10
Low parental education	.29	.18	.27	.29
Second-language learner	.22	.30	−.52	.45
Academic track	.53*	.25	.76*	.36
Group work	.15	.14	.33	.21
Discussions	.11	.10	.09	.16
Individualized assignments	.04	.11	−.03	.15
Class size	.03	.03	.04	.03
Interactions				
Low parental edu. × Group work	−.10	.13	−.03	.18
Low parental edu. × Discussions	−.05	.09	−.08	.14
Low parental edu. × Individualized assignments	−.13	.09	−.11	.14
Second language × Group work	.48*	.20	−.01	.27
Second language × Discussions	−.36**	.14	−.28	.21
Second language × Individualized assignments	−.14	.13	.25	.18
Grade-7 competence × Group work	.06	.06	−.17**	.06
Grade-7 competence × Discussions	−.04	.04	−.03	.05
Grade-7 competence × Individualized assignments	−.01	.04	.04	.05
Academic track × Group work	−.41*	.16	−.30	.23
Academic track × Discussions	−.03	.12	.08	.17
Academic track × Individualized assignments	.11	.12	−.05	.17
Class size × Group work	−.03	.02	−.01	.02
Class size × Discussions	.03**	.01	−.03	.02
Class size × Individualized instruction	.00	.01	.01	.02

Mixed-effects regression coefficients for math and reading competencies in Grade 9
Note: *SE* standard error, *Second language* second-language learners (2 L), *Low Parental Edu.* learners whose parents both lacked a university degree
*$p < .05$; **$p < .01$; ***$p < .001$

improvements for other learners. In German classes, learners with higher reading ability in Grade 7 demonstrated smaller gains from group work in reading classes.

6.3.2.3 Class Size

In Table 6.1, it is important to note that class size is centred on the median classroom size. These results showed a small but significant interaction ($\beta = .03$) with class size and the use of discussions in math classrooms. Thus, as class sizes increase above the

median, a small, but significant gain in Grade-9 competence can be expected when more classroom discussions are used. In the same sense, as class sizes decrease below the median, discussions relate to smaller gains in math competence.

6.3.3 *Brief Discussion*

Study one showed a number of lasting effects of Grade-7 instructional techniques that resulted in identifiable changes in Grade-9 competence levels, particularly in math classrooms. Furthermore, in some cases, these effects interacted with second-language status and school track. These are summarized in Figs. 6.1 and 6.2, which show the predicted gains for using group work in 7th grade. The crossover effects demonstrate the value of group work for second-language learners in math classrooms. Notably, whereas group work leads to significantly greater gains in math competence for second-language learners, there are significantly smaller gains in math competence for academic-track students. Although discussions relate to worse math competence gain for second-language learners overall, in larger classrooms, they relate to slightly greater increases in math competence.

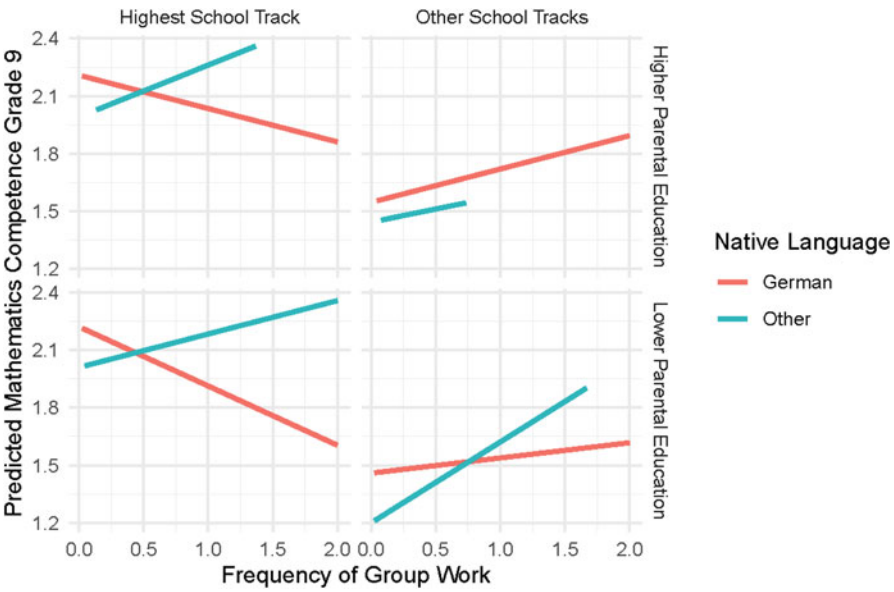


Fig. 6.1 The effect of group work in 7th-grade math classes on 9th-grade math competence. (Note: Figure originally published in DeVries et al., 2020; CC-BY license. Plotted are the predicted values based upon our regression models for a classroom of typical size and ability level. Lines are not interpolated past the values extant in the data, which results in a shorter line in some cases)

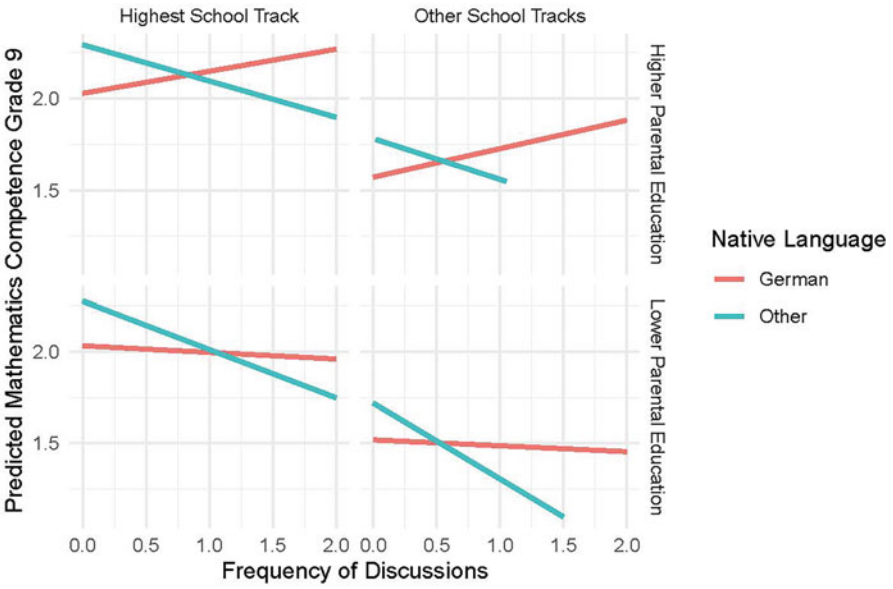


Fig. 6.2 The effect of discussions in 7th-grade math classes on 9th-grade math competence. (Note: Figure originally published in DeVries et al., 2020; CC-BY license. Plotted are the predicted values based upon our regression models for a classroom of typical size and ability level. Lines are not interpolated past the values extant in the data, which results in a shorter line in some cases)

6.4 Study 2

6.4.1 Methods

Study 2 used self-report responses from 5923 students in its math model and 5919 students in its reading model. Responses were taken from SC3 with data collected longitudinally in Grades 5, 7, and 9. Data came from student self-reports, competence tests, and parent responses. These included both reading and math competence, end-year grades, the presence of SEN, SES-related factors, migration background, gender, generalized self-esteem, and both math and German academic self-concepts.

Among other NEPS measures, reading competence (Gehrer et al., 2013) and mathematics competence (Schnittjer & Duchhardt, 2015) were assessed. Additionally, student reports of grades, socio-economic factors, migration background, gender, year of birth, self-efficacy, and self-concept were recorded. Caregivers answered—among others—questions regarding migration background and school track attended by the respective child (*Gymnasium* or academic track vs other tracks).

Due to the large-scale nature of NEPS, many cases include missing values on one or more variables of interest. Ignoring missing cases can introduces bias due to sample selection (Schafer & Graham, 2002). Therefore, multiple imputation was

used to deal with missing data. Specifically, multiple imputation with chained equations was used to repeatedly sample missing values according to the predictions of an imputation model (van Buuren & Groothuis-Oudshoorn, 2011; see DeVries et al., 2021, for a full description of the imputation model).

Separate latent growth models were calculated for reading and math competence changes over Grades 5, 7, and 9. In each case, both a partial mediation and a direct effects model was calculated for a total of four models. In each model, the intercept (i.e., starting competence level) and slope (i.e., rate of change) were then regressed on the presence of SEN, gender, reasoning ability, school track, and a latent variable for SES. In the partial mediation models, the intercept and slope were also regressed on ratings of general self-esteem and of the participant's subject-specific self-concept, which were then also regressed on all predictor variables. Finally, each model also introduced a cluster variable to account for classroom-specific effects. An overview of the partial mediation models can be seen in Figs. 6.3 and 6.4.

The ratio of direct effects between both models and the ratio of indirect effects between both models were calculated to investigate the presence of mediation (MacKinnon et al., 2007; Wen & Fan, 2015). The direct ratio (DR) was given by the formula

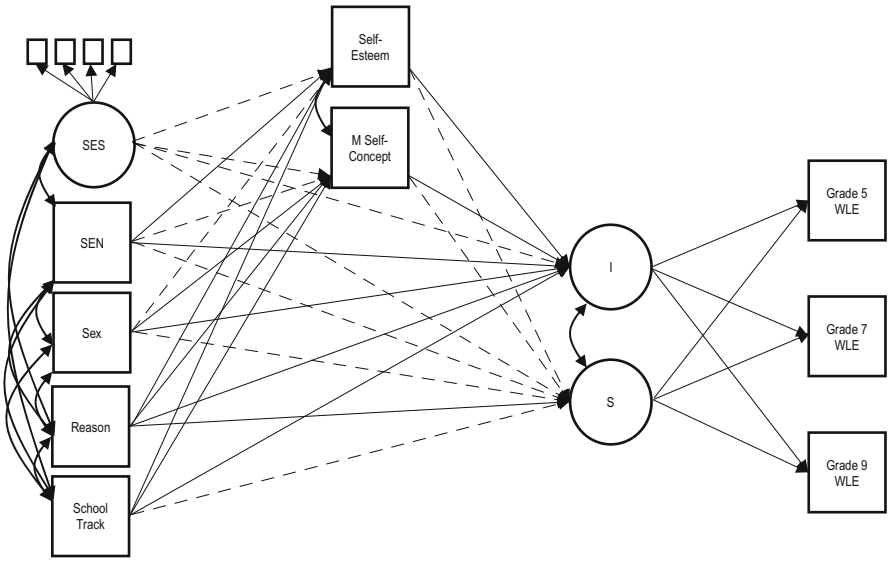


Fig. 6.3 Background variables affecting math competence growth mediated by self-esteem and self-concept. (Note: Figure originally published in DeVries et al., 2021; CC-BY license. This figure describes all pathways used in the mediation model. The no mediation model was calculated by zeroing out regressions from and onto the mediators. Solid lines indicate significant paths, and dashed lines indicate non-significant paths. WLE is based on achievement on the NEPS math competence test. *I* intercept, *S* slope, *M. Self-Concept* math self-concept, *SES* socioeconomic status, *SEN* special education needs, *Reason* non-verbal reasoning scores)

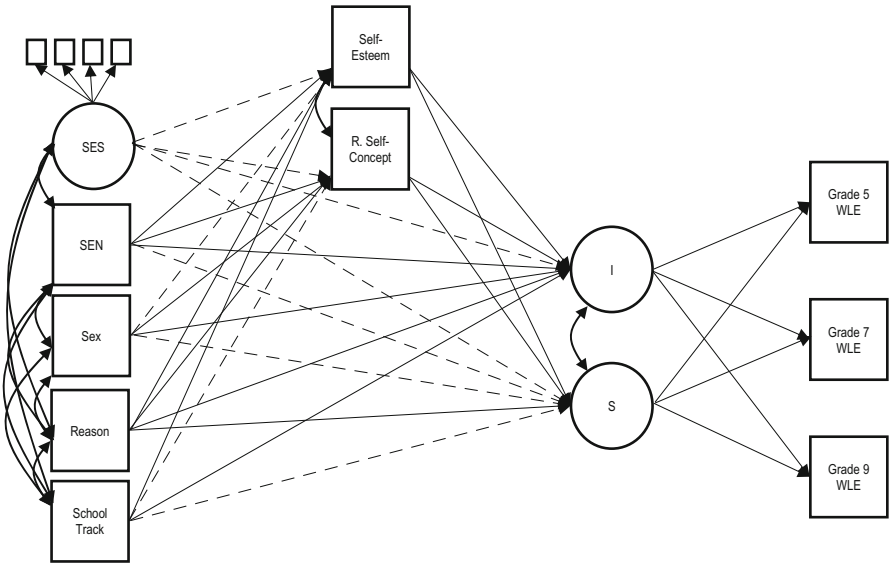


Fig. 6.4 Background variables affecting reading competence growth mediated by self-esteem and self-concept. (Note: Figure originally published in DeVries et al., 2021; CC-BY license. This figure describes all pathways used in the mediation model. The no mediation model was calculated by zeroing out regressions from and onto the mediators. Solid lines indicate significant paths and dashed lines indicate non-significant paths. WLE is based on achievement on the NEPS math competency test. *I* intercept, *S* slope, *M. Self-Concept* math self-concept, *SES* socioeconomic status, *SEN* special education needs, *Reason* non-verbal reasoning scores)

$$DR = \frac{c'}{c} \quad ,$$

where c is the standardized path coefficient for the non-mediation model of the predictor onto the outcome (intercept or slope) and c′ is the same standardized coefficient in the mediation model. The indirect ratio (IR) was given by the formula

$$IR = \frac{ab}{c} \quad ,$$

where c is the same as above, a is the path onto either mediator (self-esteem or subject specific self-concept), and b is the path from that mediator onto either outcome (intercept or slope).

6.4.1.1 Notes on Variables Used in the Final Models

Similar to Study 1, competence was determined separately for German and math and was based on WLEs of ability from NEPS. However, in this study, competence from

Grades 5, 7, and 9 was used to create a growth model across early secondary school. Differing from Study 1, we used student statements about what resources they had in the home (e.g., own desk, own computer, a private study area) to assess SES. We chose this method because it provided a direct assessment of available academic resources in the home (see Sirin, 2016, for more on differing measures of SES in academic research).

6.4.2 Results

Figures 6.3 and 6.4 show the significant and non-significant paths in the math and reading partial mediation models. In both the direct-effects and the partial mediation models, the presence of SEN related to lower 5th-grade competence values, whereas higher non-verbal reasoning and attending the academic track related to higher values. In the reading model, girls had a higher starting competence; and in the math model, boys had a higher starting competence. The only effect on rate of change (slope) showed that children with higher non-verbal reasoning ability had a slightly slower rate of growth.

In the mediation models, both generalized self-esteem and subject-specific self-concept related to higher math and reading competence in Grade 5. These values also related to the predictor variables. Students in the academic track had higher subject-specific self-concept and generalized self-esteem. Students with higher non-verbal reasoning had generalized self-esteem and math-specific self-concepts, whereas students with SEN had lower levels of self-esteem and lower reading self-concept. Moreover, girls had a higher reading self-concept and boys had a higher math self-concept.

Furthermore, both generalized self-esteem and subject-specific self-concept mediated the effects of SEN, gender, non-verbal reasoning, and school track on 5th-grade math and reading competence. An overview of the direct ratio and indirect ratio of these mediations can be seen in Table 6.2. Notably, math self-concept mediated nearly one third of the effect of gender on 5th-grade math competence and approximately one sixth of the effect on 5th-grade reading competence. Also, nearly one sixth of the effect of SEN on 5th-grade competence was mediated by the combination of reading self-concept and generalized self-esteem. Smaller, but significant mediations were shown for non-verbal reasoning and school track. Because SES was not a significant predictor in the direct effect models, a significant mediation effect could not be observed. Although not shown in Table 6.2, inconstant mediation effects were shown for both mediators between non-verbal reasoning and learning growth.

Table 6.2 Mediation effect sizes on 5th-grade competencies in Study 2

	Math			Reading		
	DR	IR of self-concept	IR of self-esteem	DR	IR of self-concept	IR of self-esteem
SEN	.985	*ns*	.052	.851	.083	.062
Gender	.729	.321	*ns*	.821	.178	*ns*
Reasoning	.945	.062	.007	.982	*ns*	.011
School track	.938	.047	.024	.876	.087	.038
SES	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*

Note: *ns* = calculations involving non-significant path values, which are excluded here for ease of interpretation. DR refers to the ratio of the direct effect in the mediation model over the direct effect in the non-mediation model. IR refers to the indirect ratio of product of the regression pathway of predictor on mediator and mediator onto outcome over the direct effect in the no-mediation model. All values are standardized

6.4.3 Brief Discussion

Study 2 used multiple imputation and latent growth modelling to examine the role that subject-specific self-concept and generalized self-esteem play as mediators between environmental and personal variables and math and reading competence. The first important finding was a confirmation that the set of background variables played a significant role on 5th-grade math and reading competence; however, they did not relate to the change of competence between Grades 5 and 9. In other words, rates of change were similar across all background variables. The second important finding is the role that both generalized self-esteem and subject-specific self-concept play as mediators. Whereas there was significant mediation for all background variables except SES, mediation was particularly strong for gender and the presence of SEN. This further highlights the important role that individual learning factors play in the educational process.

6.5 General Discussion

The two studies presented here examined several key factors affecting classroom learning. These included environmental and individual effects as well as the effects of different instructional techniques. Many different, but important environmental factors were investigated in both of these studies, including the role of SES, gender, school track, and second-language learner status. Also, several interrelated individual learning factors were examined such as non-verbal reasoning ability, the presence of SEN, self-concept, and self-esteem. Finally, learning processes were examined through teachers' use of group work, discussions, and individual assignments. These factors are all key concerns within a typical inclusive classroom (Capp, 2017; Miller et al., 2017). Several of these factors are discussed in more detail below.

6.5.1 Environmental Factors

6.5.1.1 Socio-economic Status

In both studies, SES did not have a significant effect on the rate of improvement throughout early secondary education, and in Study 2, it was also not related to math or reading competence levels in 5th grade. Furthermore, Study 1 also did not find any interactions with SES and the use of group work, discussions, or individualized assignments. Additionally, both studies used slightly differing measures of SES. Study 1 used parental education level, whereas Study 2 developed a latent variable based on student responses about what resources they had in their home. The second study definition was intended to identify more specifically the resources available to higher SES learners that may support learning (see Sirin, 2016), but there was still no significant identifiable effect of SES. At first glance, this appears to be a surprising finding. An effect of SES is commonly identified across many diverse studies (e.g., Bjorklund & Salvanes, 2011; Currie, 2009; DeVries et al., 2018a; Kim & Quinn, 2013; Rambo-Hernandez & McCoach, 2014). However, these results do not indicate that there is no effect of SES within these samples, but instead suggest that the effects of other modelled variables sufficiently explain the observed variance. Notably, both studies used attendance in the academic track (German *Gymnasium* schools). This particular variable has been demonstrated repeatedly to have a large effect in German school systems, and moreover has also been shown to correlate with measures of SES in Germany (e.g., Dumont et al., 2019; Skopek & Passaretta, 2020). In line with this interpretation, it remains important to examine multiple indicators of SES alongside of school track when looking at data from countries with stratified educational systems such as Germany.

6.5.1.2 Second-Language Learners

Study 1 examined the role of being a non-native speaker on achievement. Although mean-level differences were identifiable when comparing native speakers to second-language learners, there was no significant difference in Grade-9 competencies once prior levels were taken into account. In other words, there was a similar rate of change in both groups. However, an important caveat to this is the multiple interactions found between second-language learner status and instructional techniques in math classes. When 7th-grade math teachers used more group work, their students had higher levels of math achievement, which was detectable 2 years later. The opposite was true for 7th-grade math teachers who used more discussions. This highlights the value of group work as an instructional method for second-language learners in which such learners may receive extra peer support in their learning processes (Miller et al., 2017).

6.5.2 Individual Learning Factors

6.5.2.1 Special Education Needs

Study 2 examined the effects of SEN status within regular classrooms. Findings demonstrated nuanced effects in relation to competence and to self-perceptions. Learners with SEN had a lower overall competence level, but their rate of growth in math and reading competence was similar to learners without SEN. Moreover, they demonstrated lower levels of generalized self-esteem as well as reading self-concept. These findings mirror other results relating to risk of exclusion and achievement (DeVries et al., 2018b; Gebhardt et al., 2015; Möller et al., 2009; Schwab et al., 2014). However, as noted below, there was also a significant mediation for self-perceptions and competence.

6.5.2.2 Self-Perceptions

Study 2 considered both generalized self-esteem and subject-specific self-concept as important mediators relating to other individual and environmental variables and competence. For instance, after accounting for these self-perceptions, the effects of SEN on reading competence were reduced by nearly 15%. Whereas no significant mediation was found for math self-concept, self-esteem also reduced the effects on math competence by a modest, but significant amount. Moreover, the effects of gender on math and reading competence were greatly mediated by subject-specific self-concepts. Modest mediation effects for self-perceptions were also seen with non-verbal reasoning and school track. These findings highlight the key role of individual factors as both risks and mediators of risk in the learning process.

6.5.3 Classroom Factors

Study 1 examined two important classroom factors: instructional techniques and class size. Results suggested that group work was generally an effective technique for second-language learners in math classrooms, whereas discussions related to lower-than-expected gains. Simultaneously, group work showed worse gains for German learners with higher pre-existing competence. Moreover, discussions related to modestly higher subsequent achievement in larger 7th-grade math classrooms. Unfortunately, these nuanced findings do not provide a single ‘best practice’ for instructors, but instead point to the importance of varied instructional techniques that best match the learning environment and classroom composition.

6.5.4 *Supply and Use*

These nuanced findings can be understood best when related back to the multilevel-supply-use model described in the introduction. The studies focused on the three main factors governing the 'use' of educational supply (i.e., environmental factors, individual learning factors, and classroom factors). In this sense, learning outcomes are determined by the interactions found within these three areas. An instructor provides a lesson. That lesson may use more group work, discussions, or other instructional techniques. Some of these techniques may be more suited to certain environmental factors or to individual learners. The interpretation of the lesson then depends on environmental factors (e.g., SEN status and language background) that are also filtered through individual learning processes such as self-perceptions (e.g., 'I am good at math'), non-verbal reasoning, and other factors. Thus, learning outcomes depend not just on any individual factors, but on the complex system of factors at play. Smaller experimental and quasi-experimental studies are well suited to examine such individual factors as well as specific interventions, but they should also be accompanied by large-scale assessments such as these studies that examine these variables in an interconnected system.

6.6 Conclusions

The studies summarized here highlight the importance of varied learning and instructional processes. Highlighted are certain factors related to worse academic achievement including SEN status, lower SES, and migration background. Similarly, other factors that affect the learning process such as gender, non-verbal reasoning, prior attainment, and gender were also related to academic achievement. However, these relationships depended heavily on both teaching instructional techniques in math classrooms as well as generalized self-esteem and subject-specific self-concept in both math and German classrooms. Group work in math classrooms related more strongly than expected to math achievement levels detectable up to 2 years later. Both self-concept and self-esteem mediated the effects of school track, non-verbal reasoning, SEN status, and gender on both math and reading ability. Taken as a whole, these results highlight the importance of considering a system of variables in the educational process, the role of teaching techniques suited to the learners, and the role of self-perception on educational outcomes.

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References

Arens, A. K., Frenzel, A. C., & Goetz, T. (2020). Self-concept and self-efficacy in math: Longitudinal interrelations and reciprocal linkages with achievement. *The Journal of Experimental Education, 1–19*, 615–633. https://doi.org/10.1080/00220973.2020.1786347

Bešić, E., Paleczek, L., Krammer, M., & Gasteiger-Klicpera, B. (2016). Inclusive practices at the teacher and class level: The experts' view. *European Journal of Special Needs Education, 32*(3), 329–345. https://doi.org/10.1080/08856257.2016.1240339

Bjorklund, A., & Salvanes, K. G. (2011). Education and family background: Mechanisms and policies. In E. A. Hanushek, S. Machin, & L. Woessmann (Eds.), *Handbooks in economics: Vol. 26. Handbook of the economics of education* (Vol. Vol. 3, 1st ed., pp. 201–247). North-Holland.

Blatchford, P., & Russell, A. (2018). Class size, grouping practices and classroom management. *International Journal of Educational Research*. Advance online publication. https://doi.org/10.1016/j.ijer.2018.09.004

Blatchford, P., Bassett, P., & Brown, P. (2011). Examining the effect of class size on classroom engagement and teacher–pupil interaction: Differences in relation to pupil prior attainment and primary vs. secondary schools. *Learning and Instruction, 21*(6), 715–730. https://doi.org/10.1016/j.learninstruc.2011.04.001

Blossfeld, H.-P., Rossbach, H.-G., & von Maurice, J. (Eds.). (2011). Education as a lifelong process: The German National Educational Panel Study (NEPS) [Special issue]. *Zeitschrift Für Erziehungswissenschaft, 14*.

Brühwiler, C., & Blatchford, P. (2011). Effects of class size and adaptive teaching competency on classroom processes and academic outcome. *Learning and Instruction, 21*(1), 95–108. https://doi.org/10.1016/j.learninstruc.2009.11.004

Cambra, C., & Silvestre, N. (2003). Students with special educational needs in the inclusive classroom: Social integration and self-concept. *European Journal of Special Needs Education, 18*(2), 197–208. https://doi.org/10.1080/0885625032000078989

Capp, M. J. (2017). The effectiveness of universal design for learning: A meta-analysis of literature between 2013 and 2016. *International Journal of Inclusive Education, 21*(8), 791–807. https://doi.org/10.1080/13603116.2017.1325074

Cohen, E. G., Lotan, R. A., Darling-Hammond, L., & Goodlad, J. I. (2014). *Designing groupwork: Strategies for the heterogeneous classroom* (3rd ed.). Teachers College Press.

Crosnoe, R., & Fuligni, A. J. (2012). Children from immigrant families: Introduction to the special section. *Child Development, 83*(5), 1471–1476. https://doi.org/10.1111/j.1467-8624.2012.01785.x

Currie, J. (2009). Healthy, wealthy, and wise: Socioeconomic status, poor health in childhood, and human capital development. *Journal of Economic Literature, 47*(1), 87–122. https://doi.org/10.1257/jel.47.1.87

de Valenzuela, J. S., Copeland, S. R., Qi, C. H., & Park, M. (2006). Examining educational equity: Revisiting the disproportionate representation of minority students in special education. *Exceptional Children, 72*(4), 425–441. https://doi.org/10.1177/001440290607200403

DeVries, J. M., Rathmann, K., & Gebhardt, M. (2018a). How does social behavior relate to both grades and achievement scores? *Frontiers in Psychology, 9*, 857. https://doi.org/10.3389/fpsyg.2018.00857

DeVries, J. M., Voß, S., & Gebhardt, M. (2018b). Do learners with special education needs really feel included? Evidence from the perception of inclusion questionnaire and strengths and difficulties questionnaire. *Research in Developmental Disabilities, 83*, 28–36. https://doi.org/10.1016/j.ridd.2018.07.007

DeVries, J. M., Szardenings, C., Doebler, P., & Gebhardt, M. (2020). Individualized assignments, group work and discussions: How they interact with class size, low socioeconomic status, and second language learners. *Frontiers in Education, 5*. https://doi.org/10.3389/feduc.2020.00065

DeVries, J. M., Szardenings, C., Doebler, P., & Gebhardt, M. (2021). Subject-specific self-concept and global self-esteem mediate risk factors for lower competency in mathematics and reading. *Social Sciences, 10*(1), 11. https://doi.org/10.3390/socsci10010011

Di Giunta, L., Alessandri, G., Gerbino, M., Luengo Kanacri, P., Zuffiano, A., & Caprara, G. V. (2013). The determinants of scholastic achievement: The contribution of personality traits, self-esteem, and academic self-efficacy. *Learning and Individual Differences, 27*, 102–108. https://doi.org/10.1016/j.lindif.2013.07.006

Diseth, Å. (2011). Self-efficacy, goal orientations and learning strategies as mediators between preceding and subsequent academic achievement. *Learning and Individual Differences, 21*(2), 191–195. https://doi.org/10.1016/j.lindif.2011.01.003

Dumont, H., Klinge, D., & Maaz, K. (2019). The many (subtle) ways parents game the system: Mixed-method evidence on the transition into secondary-school tracks in Germany. *Sociology of Education, 92*(2), 199–228. https://doi.org/10.1177/0038040719838223

Duong, M. T., Badaly, D., Liu, F. F., Schwartz, D., & McCarty, C. A. (2016). Generational differences in academic achievement among immigrant youths. *Review of Educational Research, 86*(1), 3–41. https://doi.org/10.3102/0034654315577680

Ferla, J., Valcke, M., & Cai, Y. (2009). Academic self-efficacy and academic self-concept: Reconsidering structural relationships. *Learning and Individual Differences, 19*(4), 499–505. https://doi.org/10.1016/j.lindif.2009.05.004

Gebhardt, M., Sälzer, C., Mang, J., Müller, K., & Prenzel, M. (2015). Performance of students with special educational needs in Germany: Findings from Programme for International Student Assessment 2012. *Journal of Cognitive Education and Psychology, 14*(3), 343–356. https://doi.org/10.1891/1945-8959.14.3.343

Gehrer, K., Zimmermann, S., Artelt, C., & Weinert, S. (2013). NEPS framework for assessing reading competence and results from an adult pilot study. *Journal for Educational Research Online, 5*(2), 50–79. https://doi.org/10.25656/01:8424

Glass, G. V., & Smith, M. L. (1979). Meta-analysis of research on class size and achievement. *Educational Evaluation and Policy Analysis, 1*(1), 2–16. https://doi.org/10.2307/1164099

Gogol, K., Brunner, M., Preckel, F., Goetz, T., & Martin, R. (2016). Developmental dynamics of general and school-subject-specific components of academic self-concept, academic interest, and academic anxiety. *Frontiers in Psychology, 7*, 356. https://doi.org/10.3389/fpsyg.2016.00356

Gurney, P. W. (2018). *Self-esteem in children with special educational needs*. Routledge. https://doi.org/10.4324/9780429503627

Harfitt, G. J., & Tsui, A. B. M. (2015). An examination of class size reduction on teaching and learning processes: A theoretical perspective. *British Educational Research Journal, 41*(5), 845–865. https://doi.org/10.1002/berj.3165

Hattie, J. (2002). Classroom composition and peer effects. *International Journal of Educational Research, 37*(5), 449–481. https://doi.org/10.1016/S0883-0355(03)00015-6

Hattie, J. (2005). The paradox of reducing class size and improving learning outcomes. *International Journal of Educational Research, 43*(6), 387–425. https://doi.org/10.1016/j.ijer.2006.07.002

Helmke, A. (2009). *Unterrichtsqualität und Lehrerprofessionalität: Diagnose, Evaluation und Verbesserung des Unterrichts*. Klett-Kallmeyer.

Igel, C., & Urquhart, V. (2015). Generation Z, meet cooperative learning. *Middle School Journal, 43*(4), 16–21. https://doi.org/10.1080/00940771.2012.11461816

Jocz, J. A., Zhai, J., & Tan, A. L. (2014). Inquiry learning in the Singaporean context: Factors affecting student interest in school science. *International Journal of Science Education, 36*(15), 2596–2618. https://doi.org/10.1080/09500693.2014.908327

Kang, J., & Keinonen, T. (2018). The effect of student-centered approaches on students' interest and achievement in science: Relevant topic-based, open and guided inquiry-based, and discussion-based approaches. *Research in Science Education, 48*(4), 865–885. https://doi.org/10.1007/s11165-016-9590-2

Kim, J. S., & Quinn, D. M. (2013). The effects of summer reading on low-income children's literacy achievement from Kindergarten to Grade 8. *Review of Educational Research, 83*(3), 386–431. https://doi.org/10.3102/0034654313483906

KMK (Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland). (2011). *Inklusive Bildung von Kindern und Jugendlichen mit Behinderungen in Schulen* (Beschluss der Kultusministerkonferenz vom 20.10.2011).

Korhonen, J., Linnanmäki, K., & Aunio, P. (2014). Learning difficulties, academic well-being and educational dropout: A person-centred approach. *Learning and Individual Differences, 31*, 1–10. https://doi.org/10.1016/j.lindif.2013.12.011

Krassel, K. F., & Heinesen, E. (2014). Class-size effects in secondary school. *Education Economics, 22*(4), 412–426. https://doi.org/10.1080/09645292.2014.902428

MacKinnon, D. P., Fairchild, A. J., & Fritz, M. S. (2007). Mediation analysis. *Annual Review of Psychology, 58*, 593–614. https://doi.org/10.1146/annurev.psych.58.110405.085542

Marsh, H. W. (1986). Global self-esteem: Its relation to specific facets of self-concept and their importance. *Journal of Personality and Social Psychology, 51*(6), 1224–1236. https://doi.org/10.1037/0022-3514.51.6.1224

Marsh, H. W. (1990). A multidimensional, hierarchical model of self-concept: Theoretical and empirical justification. *Educational Psychology Review, 2*(2), 77–172. https://doi.org/10.1007/BF01322177

Marsh, H. W. (2014). Academic self-concept: Theory, measurement, and research. In J. Suls (Ed.), *Psychological perspectives on the self* (Vol. 4, pp. 59–98). Psychology Press.

Marsh, H. W., & Craven, R. G. (2006). Reciprocal effects of self-concept and performance from a multidimensional perspective: Beyond seductive pleasure and unidimensional perspectives. *Perspectives on Psychological Science: A Journal of the Association for Psychological Science, 1*(2), 133–163. https://doi.org/10.1111/j.1745-6916.2006.00010.x

Marsh, H. W., & Martin, A. J. (2011). Academic self-concept and academic achievement: Relations and causal ordering. *The British Journal of Educational Psychology, 81*(Pt 1), 59–77. https://doi.org/10.1348/000709910X503501

Marzano, R. J., Pickering, D. J., & Pollock, J. E. (2003). *Classroom instruction that works: Research-based strategies for increasing student achievement*. Association for Supervision and Curriculum Development.

Miller, N. C., McKissick, B. R., Ivy, J. T., & Moser, K. (2017). Supporting diverse young adolescents: Cooperative grouping in inclusive middle-level settings. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 90*(3), 86–92. https://doi.org/10.1080/00098655.2017.1285661

Möller, J., Streblow, L., & Pohlmann, B. (2009). Achievement and self-concept of students with learning disabilities. *Social Psychology of Education, 12*(1), 113–122. https://doi.org/10.1007/s11218-008-9065-z

Novita, S. (2016). Secondary symptoms of dyslexia: A comparison of self-esteem and anxiety profiles of children with and without dyslexia. *European Journal of Special Needs Education, 31*(2), 279–288. https://doi.org/10.1080/08856257.2015.1125694

Phelps, J. L. (2011). Another look at the Glass and Smith study on class size. *Educational Considerations, 39*(1). https://doi.org/10.4148/0146-9282.1100

Pohl, S., & Carstensen, C. H. (2012). *NEPS technical report – Scaling the data of the competence tests* (NEPS Working Paper No. 14). Otto-Friedrich-Universität, Nationales Bildungspanel. https://www.neps-data.de/Portals/0/Working%20Papers/WP_XIV.pdf

Rambo-Hernandez, K. E., & McCoach, D. B. (2014). High-achieving and average students' reading growth: Contrasting school and summer trajectories. *The Journal of Educational Research, 108*(2), 112–129. https://doi.org/10.1080/00220671.2013.850398

Roseth, C. J., Johnson, D. W., & Johnson, R. T. (2008). Promoting early adolescents' achievement and peer relationships: The effects of cooperative, competitive, and individualistic goal structures. *Psychological Bulletin, 134*(2), 223–246. https://doi.org/10.1037/0033-2909.134.2.223

Savolainen, P. A., Timmermans, A. C., & Savolainen, H. K. (2018). Part-time special education predicts students' reading self-concept development. *Learning and Individual Differences, 68*, 85–95. https://doi.org/10.1016/j.lindif.2018.10.005

Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods, 7*(2), 147–177. https://doi.org/10.1037//1082-989X.7.2.147

Schnittjer, I., & Duchhardt, C. (2015). *Mathematical competence: Framework and exemplary test items*. University of Bamberg.

Schwab, S., Gebhardt, M., Krammer, M., & Gasteiger-Klicpera, B. (2014). Linking self-rated social inclusion to social behaviour. An empirical study of students with and without special education needs in secondary schools. *European Journal of Special Needs Education, 30*(1), 1–14. https://doi.org/10.1080/08856257.2014.933550

Seidel, T. (2014). Angebots-Nutzungs-Modelle in der Unterrichtspsychologie. Integration von Struktur- und Prozessparadigma [Utilization-of-learning-opportunities models in the psychology of instruction: Integration of the paradigms of structure and of process]. *Zeitschrift Für Pädagogik, 6*, 850–866.

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self-concept: Validation of construct interpretations. *Review of Educational Research, 46*(3), 407–441. https://doi.org/10.3102/00346543046003407

Sirin, S. R. (2016). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of Educational Research, 75*(3), 417–453. https://doi.org/10.3102/00346543075003417

Skopek, J., & Passaretta, G. (2020). Socioeconomic inequality in children's achievement from infancy to adolescence: The case of Germany. *Social Forces*. Advance online publication. https://doi.org/10.1093/sf/soaa093

Solari, E. J., Petscher, Y., & Folsom, J. S. (2014). Differentiating literacy growth of ELL students with LD from other high-risk subgroups and general education peers: Evidence from grades 3–10. *Journal of Learning Disabilities, 47*(4), 329–348. https://doi.org/10.1177/0022219412463435

Susperreguy, M. I., Davis-Kean, P. E., Duckworth, K., & Chen, M. (2018). Self-concept predicts academic achievement across levels of the achievement distribution: Domain specificity for math and reading. *Child Development, 89*(6), 2196–2214. https://doi.org/10.1111/cdev.12924

Tomlinson, C. A., & Imbeau, M. B. (2011). *Managing a differentiated classroom: Grades K-8; a practical guide*. Scholastic.

Tomlinson, C. A., & Moon, T. R. (2013). *Assessment and student success in a differentiated classroom*. ASCD. Retrieved from http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10774725

Torres, R. (2018). Tackling inequality? Teacher effects and the socioeconomic gap in educational achievement. Evidence from Chile. *School Effectiveness and School Improvement, 29*(3), 383–417. https://doi.org/10.1080/09243453.2018.1443143

United Nations. (2006). Convention on the rights of persons with disabilities. *Treaty Series, 2515*, 3.

Valentine, J. C., & DuBois, D. L. (2005). Effects of self-beliefs on academic achievement and vice-versa: Separating the chicken from the egg. In H. W. Marsh, R. Craven, & D. M. McInerney (Eds.), *International advances in self research: Volume 2. New frontiers for self research* (pp. 53–78). Information Age Publishing.

Valentine, J. C., DuBois, D. L., & Cooper, H. (2004). The relation between self-beliefs and academic achievement: A meta-analytic review. *Educational Psychologist, 39*(2), 111–133. https://doi.org/10.1207/s15326985ep3902_3

Van Buuren, S., & Groothuis-Oudshoorn, K. (2011). Mice: Multivariate imputation by chained equations in R. *Journal of Statistical Software, 45*(3), 1–67.

Watson, K., Handal, B., & Maher, M. (2016). The influence of class size upon numeracy and literacy performance. *Quality Assurance in Education, 24*(4), 507–527. https://doi.org/10.1108/QAE-07-2014-0039

Wen, Z., & Fan, X. (2015). Monotonicity of effect sizes: Questioning kappa-squared as mediation effect size measure. *Psychological Methods, 20*(2), 193–203. https://doi.org/10.1037/met0000029

White, K. R. (1982). The relation between socioeconomic status and academic achievement. *Psychological Bulletin, 91*(3), 461–481. https://doi.org/10.1037/0033-2909.91.3.461

White, S. B., Reynolds, P. D., Thomas, M. M., & Gitzlaff, N. J. (1993). Socioeconomic status and achievement revisited. *Urban Education, 28*(3), 328–343. https://doi.org/10.1177/0042085993028003007

Wright, M. C., Bergom, I., & Bartholomew, T. (2017). Decreased class size, increased active learning? Intended and enacted teaching strategies in smaller classes. *Active Learning in Higher Education, 20*(1), 51–62. https://doi.org/10.1177/1469787417735607

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Chapter 7
An Illustration of Local Structural Equation Modeling for Longitudinal Data: Examining Differences in Competence Development in Secondary Schools

Gabriel Olaru, Alexander Robitzsch, Andrea Hildebrandt, and Ulrich Schroeders

Abstract In this chapter, we discuss how a combination of longitudinal modeling and local structural equation modeling (LSEM) can be used to study how students' context influence their growth in educational achievement. LSEM is a nonparametric approach that allows for the moderation of a structural equation model over a continuous variable (e.g., socio-economic status; cultural identity; age). Thus, it does not require the categorization of continuous moderators as applied in multi-group approaches. In contrast to regression-based approaches, it does not impose a particular functional form (e.g., linear) on the mean-level differences and can spot differences in the variance-covariance structure. LSEM can be used to detect nonlinear moderation effects, to examine sources of measurement invariance violations, and to study moderation effects on all parameters in the model. We showcase how LSEM can be implemented with longitudinal of the *National Educational Panel Study* (NEPS) using the R-package *sirt*. In more detail, we examine the effect of parental education on math and reading competence in secondary school across three measurement occasions, comparing LSEM to regression based approaches and multi-group confirmatory factor analysis. Results provide further evidence of the

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strong influence of the educational background of the family. This chapter offers a new approach to study inter-individual differences in educational development.

7.1 Introduction

Research on education as a lifelong process often deals with questions addressing the trajectories of abilities and competencies across the lifetime of individuals (longitudinal design) or differences between individuals of different ages (cross-sectional design). The *National Educational Panel Study* (NEPS) combines both approaches in a multi-cohort sequence design providing access to high quality, nationally representative, longitudinal data on educational careers and on the developing competencies of preschoolers, students, and adults in Germany (Blossfeld et al., 2011). Educational studies are often concerned with identifying contextual factors (e.g., Hattie, 2009; Sirin, 2005; Watermann & Baumert, 2006) that might promote or impede learning beyond factors that can be identified on the individual level (e.g., prior knowledge, self-efficacy, grit).

To understand how such context variables moderate learning, it is vital to incorporate them adequately into longitudinal data analysis techniques. However, broadly applied traditional data analysis approaches for examining the influence of context variables in educational research (multiple regression, differences between extreme groups, etc.) have several major drawbacks. Regression analytic approaches only focus on mean-level differences across the covariate. Moderating effects are often studied categorically by comparing a small number of artificially created groups (e.g., with low vs. high socio-economic status). Unfortunately, in such multi-group confirmatory factor analysis, it is the statistical method and not the nature of the observed context variable that determines the way in which the data analysis is performed. To enrich the methodological toolbox of social and behavioural scientists, including researchers analysing the intensive longitudinal data of NEPS, we describe in this chapter a recently developed statistical data analysis technique that is suitable to examine moderation effects of continuous background variables—*local structural equation models* (LSEM; Hildebrandt et al., 2009, 2016)—and apply this technique to longitudinal data.

7.2 Longitudinal Local Structural Equation Modeling

7.2.1 Longitudinal Structural Equation Models

To examine the effects of educational and familiar context on educational trajectories in a longitudinal structural equation modeling framework, we first aim to set the methodological ground for the upcoming explanation. We neither elaborate on issues of assessment such as the need to develop and compile theoretically sound

and age-appropriate measures (for this purpose, see e.g., Coaley, 2014; Embretson & Reise, 2013), nor we detail core principles of structural equation modeling (see Hoyle, 2012; Kline, 2015). Also, we refer the interested reader to excellent and comprehensive textbooks and articles topic (e.g., Little, 2013; McArdle, 2009; Mund & Nestler, 2019), when it comes to in-depth discussions and applications of structural equation modeling with longitudinal data. Nonetheless, we want to mention that any longitudinal data analysis within the SEM framework should start by establishing and scrutinizing the measurement models within each measurement occasion. The aim is to probe the stability of the measured construct and to spot potential fluctuations in the factorial structure, which is commonly referred to as measurement invariance testing (Meredith, 1993; Little et al., 2007). In a subsequent step, the model is extended by specifying relations across measurement occasions. Structural equation modeling with longitudinal data has to tackle several modeling decisions, which will be explained in more detail in the following, including (a) the longitudinal measurement invariance, (b) the scaling of latent factors, and (c) the choice among different structural models to depict change.

From a measurement point of view, the basic question in longitudinal research is whether the same construct is being assessed over time. This is known as longitudinal measurement invariance. Similar to the cross-sectional case (Cheung & Rensvold, 1999; Meredith, 1993; Vandenberg & Lance, 2000), longitudinal measurement invariance requires the specification of several parameter constraints (e.g. Little et al., 2007; Liu et al., 2016). In general, the procedure for testing measurement invariance consists of a sequence of models with increasingly restrictive constraints on the measurement parameters. As a baseline model, a model without any constraints is specified, in which only same structure across time is estimated (i.e., configural invariance). Next, a model with equal factor loadings across time (i.e. metric invariance) is tested. Finally, in addition to the constrained factor loadings, the item intercepts are also constrained to equality across time (i.e., scalar invariance). The scalar level of measurement invariance is required to answer questions concerning mean level change across time. If introducing additional equality constraints on parameters were to result in a substantial deterioration of the model fit (e.g., Chen, 2007; Cheung & Rensvold, 2002), the assumption of measurement invariance would have to be discarded.

Factor scaling (also called factor identification) means that a metric needs to be established for the latent variable (or factor). There are several options for scaling latent variables. Preferably, the choice of scaling is led by considerations related to parameter interpretation according to the scientific hypotheses to be addressed. The factor identification method in longitudinal modeling also determines the metric in which changes in parameters across time are expressed and have to be interpreted (see Little et al., 2006). For instance, when using the reference variable method, in which the factor loading and the item intercept of a single indicator per factor is constrained to 1 and 0, respectively, the metric of the latent variable is equivalent to that of the chosen reference indicator. In the case of constraining the variance of the factor to 1 and its mean to 0 at the first measurement occasion (i.e., reference-group scaling), factor variances and means at subsequent measurement occasions are

identified and scaled relative to the first measurement occasion. Both scaling methods have some disadvantages: Differences cannot be interpreted in the original item metric and constraining the factor mean at the first measurement time point to 0 discards the possibility of examining factor mean differences across the moderator at baseline. One potential way to overcome these disadvantages is the so called effects coding method for scaling latent variables (Little et al., 2006). According to this approach, factors are taken to reflect a weighted composite of all items (i.e., weighted by the factor loadings). This is implemented by constraining factor loadings of a common factor to an average of 1 and item intercepts belonging to the same factor to an average of 0. This procedure allows researchers to estimate factor means and variances that correspond to the metric of the items at every measurement occasion.

Finally, there is a wide range of longitudinal modeling approaches from which researchers are expected to select the one that best fits their analysis objectives (for overviews, see McArdle, 2009; Mund & Nestler, 2019; Usami et al., 2019). These include autoregressive models (Selig & Little, 2012), cross-lagged panel models (Mund & Nestler, 2019), change score models (Ferrer & McArdle, 2010), latent growth curve models (McArdle & Bell, 2000), and their variants. These modeling approaches differ in how they conceptualize and assess sources of variance (i.e., between-person variance, within-person variance, and error variance; see Bainter & Howard, 2016). Thus, depending on the specific research question and the number of time points available, researchers have to select the most appropriate model: For example, autoregressive models are suitable for testing rank-order stability and variability across time, whereas change score models are suitable for investigating general developmental trajectories and individual differences therein. Some models incorporate both within- and between-persons differences, as well as inter-individual differences in intra-individual change (e.g., autoregressive latent trajectory model with structured residuals; Mund & Nestler, 2019).

For the application described in this chapter, we used a bivariate latent growth curve model (LGCM; see Fig. 7.1), because we aimed to examine academic achievement and growth and co-development in two core competencies (math and reading) from 5th to 9th grade. The focus is on modeling the influence of a contextual variable (educational background) on the structural parameters. A LGCM allows differentiating between the initial level of academic competencies (the intercept) and its growth (the slope) across the study period. Moreover, they are suitable to examine how the initial level is related to subsequent growth, or how initial values and growth on one competence are associated with the other competence and its growth. However, the data-analytic methods with respect to the moderator variable we describe in this chapter can be similarly applied to other families of longitudinal structural equation models.

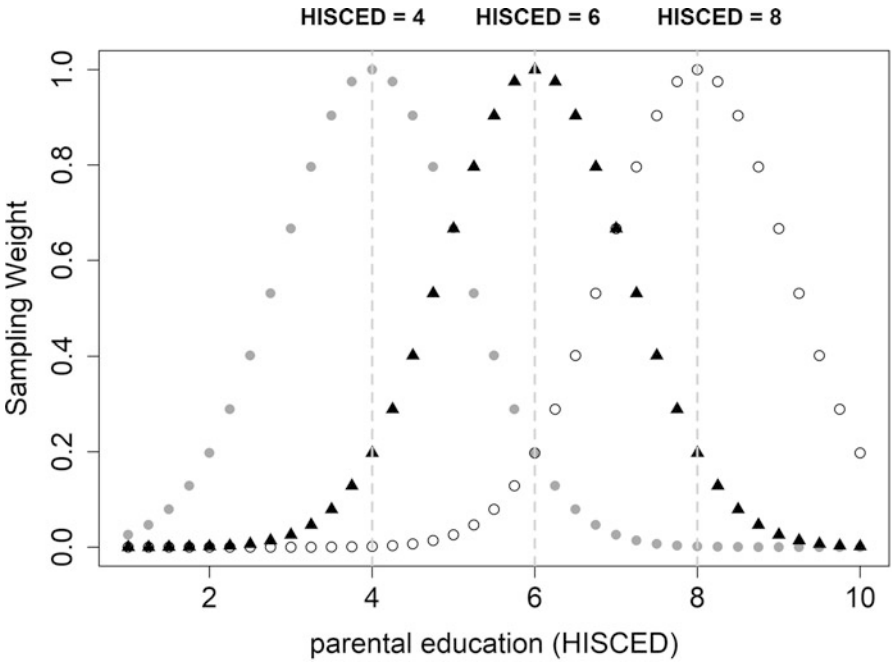


Fig. 7.1 Weighting functions for parental education (HISCED)

7.2.2 Including Covariates in a Longitudinal Structural Equation Model

The influence of background or context variables on parameters in a longitudinal model can be examined in various ways. The most broadly used approach is to include the context variable (e.g., parental SES) as a predictor of all latent variables. Thus, the (linear) relation of the context variable is accounted for, and factor residuals are interpreted as latent variables that were adjusted for the influence of the context variable. The downside of this approach is that it estimates only mean differences in the factor across the covariate. However, the covariates may also modulate other model parameters such as factor variances or factor covariances. In many applications, it is highly relevant to examine how individual differences in covariates are associated with the constructs and their growth, because this will help understand the processes of development more comprehensively than by examining a simple mean difference.

To examine the effect of a covariate on other model parameters than the mean, the covariate needs to be modelled as a moderator, which is often done with multi-group confirmatory factor analysis (MGCFA). In MGCFA, differences in model parameter are tested across a categorical moderator such as gender. For this purpose, model parameters are typically fixed to equality across groups, and deterioration in model

fit is tested following a straightforward procedure (for a detailed explanation, see Schroeders & Gnambs, 2018). MGCFAs are widely used and accepted for investigating model parameter differences across categorical context variables. However, to employ this method for continuous context variables such as SES, MGCFAs require one to first artificially categorize the context variable (e.g., into low vs. high SES groups by median split). But, artificially categorizing a continuous moderator has several disadvantages (see MacCallum et al., 2002; Preacher et al., 2005). First, nonlinear trends and complex patterns of moderation effects might be overlooked if too few groups have been analysed (e.g., Hildebrandt et al., 2016). Second, categorization results in a loss of any information on individual differences within a given moderator group. That means, when observations that differ across the range of a continuous variable are grouped, variation within these groups can no longer be detected. Third, setting cut-offs to split the distribution of a moderator into several parts is often arbitrary and might severely affect the results (e.g., Hildebrandt et al., 2009; MacCallum et al., 2002).

7.2.3 Local Structural Equation Modeling

In the following, we extend a recently developed method, *local structural equation modeling* (LSEM; Hildebrandt et al., 2009, 2016; Olaru et al., 2019), to longitudinal data aiming to overcome the aforementioned methodological issues. LSEM does not require an artificial categorization of moderators, renounces a pre-analytical specification of the relationship between moderator and psychological constructs, and can moderate both the mean and covariance structure. For these reasons, LSEM provides a very powerful approach with which to examine educational development across a wide range of background variables.

Next, we explain LSEM along an empirical example, demonstrating how researchers can examine contextual effects across a wide range of continuous moderators such as socio-economic status, years of formal education, or cultural embeddedness and a wide variety of models. LSEM has already been applied successfully to cross-sectional data to examine structural and mean-level differences in cognitive abilities across age or years of education (e.g., Gnambs & Schroeders, 2020; Hartung et al., 2018; Hülür et al., 2011; Schroeders et al., 2015) or to study age-related differences in personality (Olaru et al., 2019; Wagner et al., 2019). For instance, Wagner et al. (2019) and Olaru and Allemand (2022) used a combination of longitudinal models and LSEM to examine differences in the stability of personality traits and correlated change across the adult lifespan, respectively. In contrast to the current gap in the literature for such applications, combining LSEM and longitudinal SEMs is particularly important in educational research in which a wide range of different contexts (e.g., class, schools, peers, families) are theorized to have an important impact on the academic and extracurricular development of students and adults.

To achieve sufficiently stable parameter estimations, LSEM needs sufficiently large samples at each potential moderator value. Note that sample size restrictions are often the reason why naturally continuous moderators are categorized for MGCFA. This is because estimating a model at each moderator value (e.g., for each SES level) is not possible if only very few observations are available along single moderator values. As an alternative to achieve sufficiently stable parameter estimates, LSEM uses a sample weighting function to include observations from the neighbouring values on the moderator, albeit with smaller weights. The samples are weighted so that persons close to the targeted moderator value are weighted more strongly than persons farther away from this point. More specifically, the weighting function follows a Gaussian kernel function with a maximum of 1 at the focal point of the moderator considered (e.g., HISCED[1] = 6) and increasingly smaller weights for persons with a larger distance to the relevant moderator value (see Fig. 7.1). This approach assumes that observations close to each other on the moderator are more similar than distal observations. Figure 7.1 shows exemplarily (for three weight functions) that observations at the focal points receive a weight of 1, whereas observations with increasing distance from a focal point receive smaller weights. Because the Gaussian kernel function always attains values larger than zero, all observations will enter all models at each focal point in LSEM; but distant observations have very small values (below 0.01) resulting in no practical influence on the model parameter estimation at a given focal point.

After introducing the general idea of LSEM (for more details, see Hildebrandt et al., 2016; Olaru et al., 2019), we shall now illustrate the usefulness and versatility of the approach for analysing educational achievement outcomes in combination with contextual factors. More precisely, we apply LSEM to investigate mean, variance, and covariance differences in math and reading competencies[2] from the 5th to 9th grade of school (Starting Cohort 3; Blossfeld et al., 2011; https://doi.org/10.5157/NEPS:SC3:9.0.0) across educational levels of the family. To model mean-level performance and growth in the two domains as well as their interaction, we apply a bivariate latent growth curve model (see Fig. 7.2). Subsequently, we used LSEM to study the moderating effects of parental education within this model. We also compared the findings to a model in which the HISCED was included as a linear predictor of the factors, and to a model in which the HISCED was included as a categorical moderator (i.e., a multi-group confirmatory factor analysis across a low and high parental education group).

[1] HISCED is an acronym for highest international standard classification of education.

[2] For similarities and possible differences between the terms ability, skill, competence, and so forth, please see Schroeders (2018). In the present case, we use the terms synonymously.

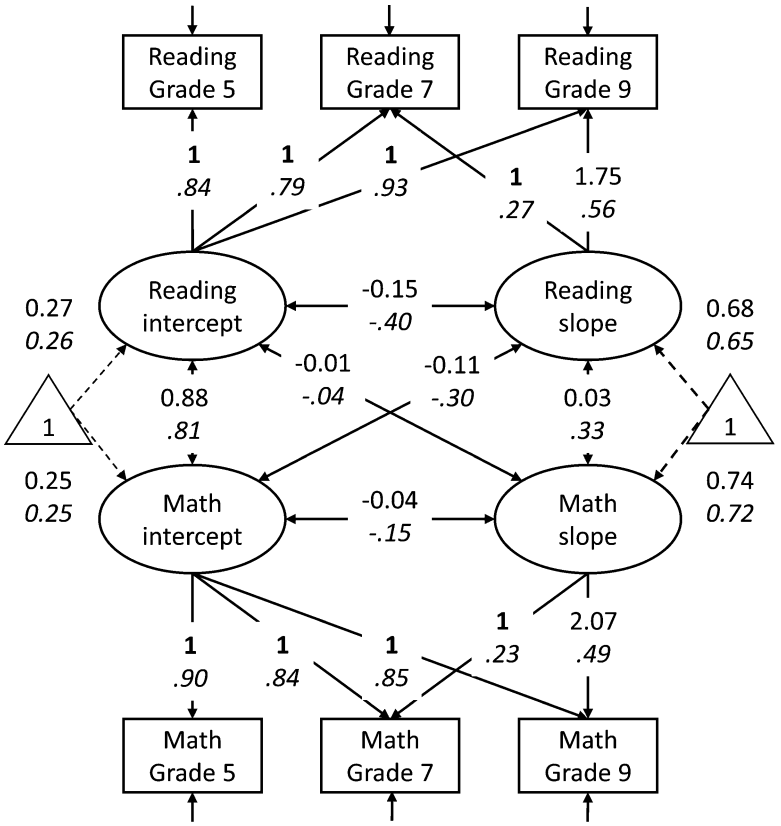


Fig. 7.2 Bivariate latent growth curve model of reading and math competence from Grade 5 to 9. Numbers show the estimated factor loadings, covariances, and means (triangles) on the full sample. Numbers in italics represent the standardized parameters; those in bold, constrained parameters

7.3 Method

7.3.1 Sample

The following illustration is applied to data from the National Educational Panel Study (NEPS): Starting Cohort Grade 5 (Blossfeld et al., 2011; https://doi.org/10.5157/NEPS:SC3:9.0.0). From 2008 to 2013, NEPS data was collected as part of the Framework Programme for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, NEPS is carried out by the Leibniz Institute for Educational Trajectories (LIfBi) in cooperation with a nationwide network. Of the Starting Cohort Grade 5 sample, we used only the 2037 students who had provided complete data on math

and reading competencies across the three measurement occasions together with their parents' education. Gender was balanced (50% female students). The mean age was 10.75 ($SD = 0.51$) in 5th grade, 12.75 ($SD = 0.49$) in 7th grade, and 14.92 ($SD = 0.46$) in 9th grade. Note that LSEM requires moderator values for each case used for model estimation, but can account for missing values in the indicators using pairwise estimation, imputed datasets, or model-based imputation (e.g., full information maximum likelihood; for an overview, see Lüdtke et al., 2007).[3] Because missing values in the data used for this demonstration indicated that some students did not participate in one or more measurement occasions (thus not being missing at random), we used only cases with full data.

7.3.2 Measures

7.3.2.1 Mathematical Competence

Mathematical competence in NEPS is a measure of mathematical literacy (OECD, 2009) requiring students to apply mathematics in realistic everyday situations. It combines content-related components (i.e., quantity, space, and shape; change and relationships; data and chance) with process-related components (i.e., applying technical skills, modeling, arguing, communicating, representing, and problem solving). For instance, the content-related facet of 'quantity' ranges from basic arithmetic operations (e.g., adding), over the use of different units, to simple equation systems. On the process-related side, the component 'technical skills' encompasses using known algorithms and calculation methods. The process 'representing' requires students to interpret tables, charts, or graphs, whereas 'problem solving' assesses students' ability to solve a problem with no obvious solution, typically by trying, generalizing, or examining exceptional cases.

7.3.2.2 Reading Competence

Reading competence is conceptualized in NEPS as competent handling of texts in different typical everyday situations. This operationalization of reading competence is based on the Anglo-Saxon literacy concept (also see OECD, 2009). The NEPS reading competence test combines different text forms, tasks, and response formats. Text forms consist of (a) factual texts (e.g., educational texts), (b) commenting texts (e.g., texts discussing a controversial question), (c) literary texts (e.g., short stories), (d) instructions (e.g., engineering manuals, cooking recipes), and (e) advertising

[3] Note that an imputation model has to be at least as flexible as the analysis model. For LSEM, the imputation of variables appearing in the SEM should allow relationships among variables to depend nonlinearly on moderators.

texts (e.g., job advertisements, recreational programmes) for which the lexical, semantic, and grammatical properties have been adapted to fit different age groups.

The reading comprehension tests require students to fulfil three types of tasks that were identified based on the reading comprehension literature (e.g., Kintsch, 1998; Richter & Christmann, 2002). These tasks are specified as (a) 'finding information in the text' (e.g., identifying information and recognizing statements), (b) 'drawing text-related conclusions' (e.g., relating several statements to each other in order to identify general propositions or the thoughts expressed in the text), and (c) 'reflecting and assessing' (e.g., deriving a situation model or understanding the central message of the text). Tasks and text forms are combined in a balanced manner to cover all possible text–task combinations.

7.3.2.3 Parental Education

We used the *international standard classification of education* (ISCED) as an indicator of parental educational levels. The ISCED provides information on educational attainment in terms of both the highest school certificate and the highest occupational qualification. The ISCED used in the NEPS study ranges from 0 = *no formal education* to 10 = *doctoral degree*. We used the highest ISCED (HISCED) of both parents at the first measurement occasion as an indicator of educational levels in the family. If the ISCED was not measured in the first wave, we used the ISCED from subsequent measurement occasions. The average HISCED in the sample was 6.60 ($SD = 2.55$). It remained stable across the 4 years examined in this study (i.e., 95% of participants did not change in their value).

7.3.3 Statistical Analysis

7.3.3.1 Latent Growth Curve Model

As a starting point for our analyses, we used a bivariate latent growth curve model (LGCM; McArdle, 2009) on the math and reading competence ability estimates from an item response model linked across measurement occasions included in the NEPS SC3 dataset (Blossfeld et al., 2011). We modelled an intercept factor with loadings of 1 on all indicators. For the slope factor, we constrained the factor loadings to 0 and 1 for the first and the second measurement occasion respectively, while freely estimating the loading for the third measurement occasion. In contrast to other LGCM applications, the last slope loading was not constrained to 2 in order to allow nonlinear growth trajectories across time. All indicator intercepts were fixed to 0, so that factor means could be estimated. We allowed the intercept and slope factors of math and reading competence to covary. The model was estimated in *lavaan* (Rosseel, 2012) with maximum likelihood estimation. The *lavaan* code for

the model specification was as follows (please note that we use the original variable labels so that readers can replicate our example):

```
LGCM <- "
  # model intercept and slope factors
  math.inter =~ 1*mag5_sc1u + 1*mag7_sc1u + 1*mag9_sc1u
  math.slope =~ 0*mag5_sc1u + 1*mag7_sc1u + mag9_sc1u
  read.inter =~ 1*reg5_sc1u + 1*reg7_sc1u + 1*reg9_sc1u
  read.slope =~ 0*reg5_sc1u + 1*reg7_sc1u + reg9_sc1u

  # fix indicator intercepts to 0
  mag5_sc1u ~ 0*1
  mag7_sc1u ~ 0*1
  mag9_sc1u ~ 0*1
  reg5_sc1u ~ 0*1
  reg7_sc1u ~ 0*1
  reg9_sc1u ~ 0*1

  # estimate factor means
  math.inter ~ 1
  math.slope ~ 1
  read.inter ~ 1
  read.slope ~ 1"
```

7.3.3.2 Examining the Effect of Parental Education

We then compared three different approaches to examining the effect of parental education on math and reading competence: (a) a model with parental education as a linear predictor of the factors, (b) a MGCFA across two groups (constructed by median split), and (c) the LSEM approach. For the first approach, we regressed the intercept and slope factors on the HISCED (for the commented syntax, please see online supplement https://osf.io/vn297/). For the MGCFA approach aiming to examine differences in all model parameters, we split the sample into two groups around the median of 8 (participants with HISCED >7 were allocated to the group of individuals with higher education) and estimated the model simultaneously for the two groups without equality constraints across groups.

For LSEM, the `lsem.estimate()` function has been implemented in the *sirt* R-package (Robitzsch, 2019). We moderated the LGCM across HISCED values ranging from 3 to 9 in steps of 0.25 to provide a more nuanced picture than estimating the models only at full HISCED values. We excluded values at the borders of the distribution (0, 1, 2, and 10), because the effective sample size was low for these moderator values. Thus, the symmetric weighting function used in LSEM would create weighted samples skewed towards the middle of the distribution (because no participants can be found beyond the extremes; for an illustration see

Olaru et al., 2019). Based on suggestions in the literature (Hildebrandt et al., 2016), we used a bandwidth parameter of 2. The code used to run LSEM was as follows (for more information on the arguments of the function `sirt::lsem.estimate`, please refer to the manual or Olaru et al., 2019).

```
lsem.fit <- sirt::lsem.estimate(

  # data set
  data = mydata,

  # name of moderator
  moderator = 'hisced',

  # moderator levels to estimate model on
  # here from 3 to 9 in steps of 0.25
  moderator.grid = seq(3,9,0.25),

  # lavaan model syntax
  lavmodel = LGCM,

  # bandwidth parameter
  h = 2,

  # additional settings to estimate factor means
  residualize = FALSE,
  meanstructure = TRUE)

# return and plot the results
summary(lsem.fit)
plot(lsem.fit)
```

7.4 Results

The sample size for the baseline model used for the regression-based approach was $N = 2{,}037$. For the MGCFA approach, the sample was split into two groups with $n = 922$ (low education) and $n = 1{,}115$ (high education). In the LSEM approach, the weighted sample sizes ranged from $n = 479.15$ at HISCED = 3 to $n = 937.79$ at HISCED = 9 (the lowest weighted sample size was $n = 401.77$ at HISCED = 6).

Figure 7.2 shows the bivariate LGCM estimated on the full sample. Baseline performance in math and reading competence were strongly related ($\rho = .81$). The intercept factors were negatively related to growth, indicating that initially lower-performing students showed a higher increase in the competencies across school years. The growth of math competency was approximately linear (as indicated by the second slope factor loading of $\lambda = 2.08$), and the growth of reading competence was slightly smaller from Grade 7 to 9 (second slope factor loading of $\lambda = 1.72$).

7.4.1 Mean Level Differences

Figure 7.3 shows mean-level differences in the math and reading intercept and slope factors across parental education that can be displayed using the generic `plot()` function on the LSEM object (note that we also included the MGCFA and regression results in the figures). The LSEM plots of parameter estimates across parental education show that baseline math and reading competence are generally higher for students from families with a higher educational background providing a cognitively stimulating environment. Whereas math competence also shows a higher

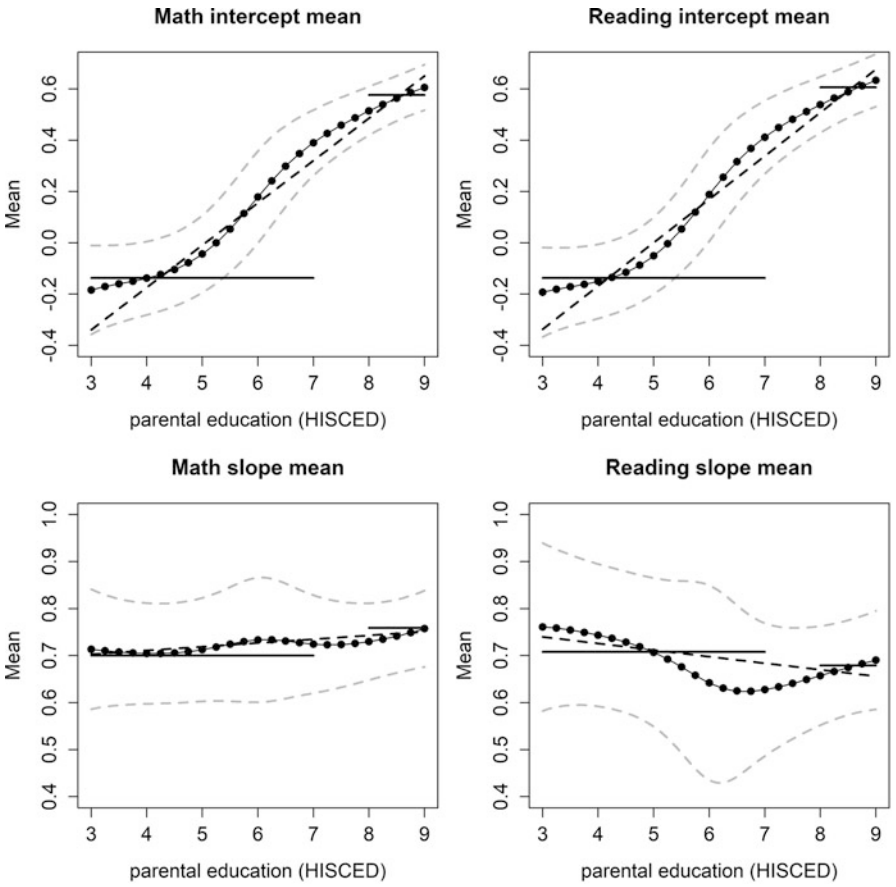


Fig. 7.3 Comparison of mean-level differences in mathematical and reading competence across three different methods. The dashed black line represents estimates based on the regression model. The black horizontal lines show estimates in the median-split MGCFA. The dotted black lines represent LSEM point estimates (i.e. each dot is the parameter estimate from a SEM at the corresponding moderator level). The dashed grey lines show the 95% confidence intervals for LSEM estimates

growth for these students, the effect seems to be negative for reading competence. Generally speaking, all three methods indicate the same pattern. However, the LSEM estimates show that the mean-level differences in the intercept factors are not perfectly linear across parental education, but have the steepest slope in the mid-range of the HISCED.

7.4.2 Differences in Variances and Covariances

The only moderation effect detected on the variance level was for the math intercept factor on which variance decreased across HISCED levels. Because of space restrictions here, we refrain from a detailed description, but point out that differences in factor variance might lead to biased results and should be investigated carefully. Additionally, they can also indicate meaningful differences in the distribution of inter-individual differences across the moderator. Concerning the correlations between the intercept and slope factors across parental education (see Fig. 7.4), the relation between math and reading growth decreases substantially across educational levels. This pattern suggests that growth trajectories in both competencies are more strongly related for students from a lower educational background. However, the large confidence intervals indicate that this effect might not be significant (for significance tests, see the section on 'Testing parameter equivalence'). The relationship between all other factor combinations remains stable across the HISCED. Again, the MGCFA and LSEM generally yield the same trends, but LSEM provides a much more detailed picture of the moderating effect.

7.4.3 Testing Moderation Effects

LSEM is primarily an exploratory method used to uncover potential effects across a continuous moderator. In general, examining potential moderations should start by examining the graphs provided by the `plot()` function on the output of the `lsem.estimate()` function. The plotted confidence intervals indicate whether parameter differences may be significant across the moderator. If point estimates at one moderator value are outside the confidence intervals at another moderator value, moderation effects can be concluded to be substantial. However, model parameter equivalence or measurement invariance cannot be tested by traditional means of inference testing (e.g., χ^2 difference tests) because the weighted samples used by LSEM overlap. Hence, alternative methods have been proposed to examine whether moderation effects are statistically significant: a permutation test (`lsem.permutationTest()` function) that has been used previously (Hildebrandt et al., 2016; Hülür et al., 2011; Schroeders et al., 2015) and joint estimation (setting the argument `est_joint = TRUE` within the `lsem.estimate()` function). The latter method is described for the first time in this chapter.

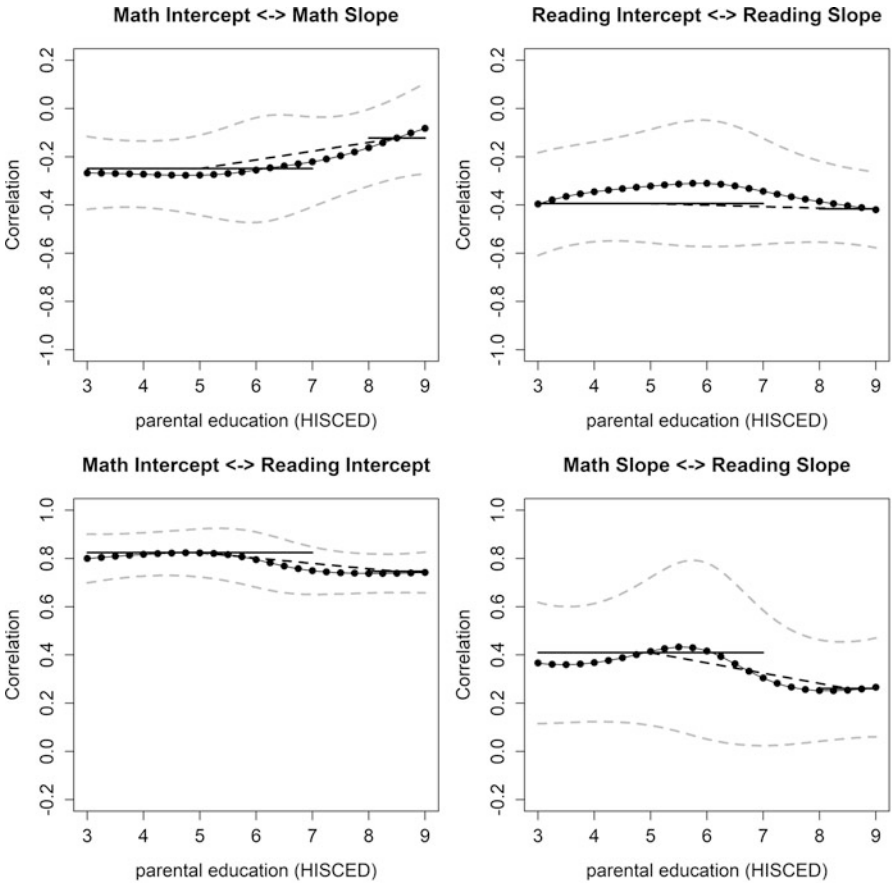


Fig. 7.4 Comparison of factor covariances across parental education for MGCFA and LSEM. Black horizontal lines show the estimates in the median-split MGCFA; dashed black lines, the linear approximation of the MGCFA differences; dotted black lines, the LSEM point estimates (i.e. each dot derives from a SEM). The dashed grey lines show the 95% confidence intervals for the LSEM estimates

The permutation test resembles traditional significance testing approaches in which the parameter values are tested against a distribution that can be expected to occur because of sampling error. To create such a distribution, the permutation test creates 1000 resampled copies of the dataset (on default settings). Within each dataset, the moderator values are shuffled around randomly across individuals (Hülür et al., 2011; Jorgensen et al., 2018). This removes all systematic moderation effects from the data. LSEM is then run on each dataset to derive the model parameters. This procedure results in a distribution of estimates for each parameter in which the parameter is independent of the moderator. The original LSEM parameter estimates are then compared to the corresponding distribution under the

null hypothesis. The permutation test function provides mean average distance, linear slope, and *p* values for each model parameter along the moderator. This allows users to identify which parameters change significantly across the values of the moderator, and whether the shape is linear or nonlinear. The permutation test can be run in R using the `lsem.permutationTest()` function on the `lsem.estimate()` object:

```
lsem.perm <- sirt::lsem.permutationTest(

  # lsem.estimate fit object
  lsem.object = lsem.fit,

  # number of permutations
  B = 1000,

  # allow mean-level differences
  residualize = FALSE)

# examine results
summary(lsem.perm)
```

The permutation test indicated that the reading and math intercept factor means differ significantly across parental education (see Table 7.1). As indicated by the significant linear slope value, the trajectories are approximately linear. The only other parameter that shows a significant moderation effect is the math intercept factor variance ($M = 0.970$; mean absolute distance = 0.131; mean absolute distance *p*-value = .008; linear slope = −0.066; linear slope *p*-value = .006) that decreases linearly across parental education. Whereas the decrease in the correlation between the growth factors from approximately $\rho = .70$ to .40 seems substantial, this effect is not significant, as also indicated by the large confidence intervals (Fig. 7.4).

Whereas the permutation test can be used to test moderation effects for each parameter separately, a more global approach of equivalence testing—similar to traditional MGCFA approaches—using a joint estimation procedure has been implemented recently in the *sirt* R-package (Robitzsch, 2019). The joint estimation procedure mirrors the approach used in MGCFA measurement invariance testing.

Table 7.1 Results of the permutation test for factors means

par	*M*	*SD*	*SD_p*	*MAD*	*MAD_p*	*lin_slo*	*lin_slo_p*
math.inter~1	0.235	0.320	0.000	0.306	0.000	0.153	0.000
math.slope~1	0.730	0.016	0.532	0.014	0.547	0.007	0.480
read.inter~1	0.247	0.337	0.000	0.322	0.000	0.161	0.000
read.slope~1	0.687	0.042	0.146	0.036	0.185	−0.015	0.248

Note. *M* = average parameter estimate across models, *SD* = standard deviation of parameter estimates, *MAD* = average absolute distance of parameter estimates from overall average, *lin_slo* = linear slope of the parameter estimates across the moderator, *_p* = corresponding global significance values

More specifically, each weighted sample in LSEM is treated as an independent group. By using a common likelihood function across groups, parameter estimates can then be derived across all moderator values simultaneously. In contrast, in the regular LSEM application, models are estimated separately, and parameter values can be constrained to equivalence only by specifying the values manually in the model. The joint estimation function allows users to estimate one parameter value across the moderator instead (if invariance assumptions are desired). Rather than providing model fit indices for each model across the moderator (e.g., CFI at each moderator level), the joint estimation procedure will also provide global fit indices (e.g., one global CFI value). By constraining parameters and examining the resulting model fit differences between the constrained and unconstrained model, measurement invariance or parameter equivalence in general can be evaluated in a similar way to MGCFA procedures. To use the joint estimation instead, the corresponding argument within the `lsem.estimate()` function has to be set to `est_joint = TRUE`. The resulting output will then correspond to a model with configural invariance (i.e., all parameters are unconstrained across the weighted samples). To constrain parameters to equality across the moderator, these need to be specified in the `par_invariant` argument. Parameters can also be constrained to follow a linear pattern by specifying the respective parameters with the `par_linear` argument. To constrain a parameter, it has to be included in the aforementioned arguments with the *lavaan* terminology. For instance, `par_invariant = c("factor1=~item1", "factor1=~item2")` will constrain the loadings of Factor 1 on Item 1 and 2 to equality across the moderator. LSEM will then return only one value for these parameters. The following code shows how LSEM with joint estimation and invariant parameters can be run:

```
lsem.fit.joint <- sirt::lsem.estimate(

  # LSEM parameters (see first code example)
  data = mydata,
  moderator = 'hisced',
  moderator.grid = seq(3,9,.25),
  lavmodel = LGCM,
  h=2,
  residualize = FALSE,
  meanstructure = TRUE,

  # joint estimation options
  est_joint = TRUE,

  # parameter equality constraints (examples)
  par_invariant = c(
    # invariant loading
    "math.slope=~mag9_sc1u",
    # invariant mean/intercept
    "math.slope~1",
```

(continued)

```
    # invariant covariance
    "math.slope~~math.inter",
    # invariant variance
    "math.slope~~math.slope",
    # invariant residual variance
    "mag9_sc1u~~mag9_sc1u")
  )

# examine results
summary(lsem.fit.joint)
```

The `summary()` output resembles the standard LSEM output except for global model fit indices. Both the permutation test and joint estimation can be used to investigate parameter equivalence, but the approach by which they do so differs between the methods. The strength of the permutation test is that it provides easy-to-use functionality for testing moderation effects on each parameter separately. The test results can be interpreted easily because they provide *p* values for each parameter moderation effect. The joint estimation procedure provides a global indication (e.g., CFI or RMSEA differences) of parameter equivalence that can be used to detect whether sets of parameters (e.g., all factor loadings) are equivalent across the moderator. Similar to MGCFA measurement invariance testing approaches, this can be done by comparing the model fit indicators across nested models (e.g., CFI differences between nested models should be below a value of .01; Cheung & Rensvold, 2002). Generally, it is advisable to run the permutation test first to identify which parameters are affected by the moderator. The joint estimation function can be used to impose constraints on the measurement model to investigate moderation effects in the structural model without bias—for example, by constraining all factor loadings before examining factor covariances. If the increase in misfit is too large as a result of the additional constraints, the most problematic parameters—as indicated by the permutation test—can be freed to achieve partial measurement invariance. Because both procedures can be used to test moderation effects on all model parameters, the two approaches can also be used to test invariance beyond traditional levels of measurement invariance that generally focus on factor loadings, item intercepts, and item residuals.

7.5 Discussion

This chapter illustrated different methodological approaches to the study the influence of contextual factors on educational achievement longitudinally. Traditional data analytic approaches—such as controlling for their influence by means of regressions or categorizing a continuous moderator and using MGCFA—are associated with a number of methodological limitations. LSEM, however, enables a detailed examination by providing nonlinear moderation effects on all parameters of

a SEM. The readily implemented functions of the *sirt* R-package allow educational researchers to scrutinize and test for measurement invariance. In the current example, we found that at Grade 5, students from families with higher education were better in math and reading than students from lower educational backgrounds. These differences due to parental education remained stable up to Grade 9, as indicated by the stable slope factor means. That is, the initial differences in the students' math and reading competencies across educational backgrounds remained stable in secondary school. Moreover, no moderation effect was found for the relation between initial competencies and growth. Formal education, however, seemed to help initially less capable students to catch up (see the stable negative correlations between the intercept and slope factors in both reading and math; Fig. 7.4), but this effect was similar across all educational backgrounds. On a more general stance, examining such structural differences in models of educational development is important to understand the processes underlying education and learning. For instance, one can assess whether the relation between mother-language competence and other academic competencies changes as a function of SES or cultural integration. Such an investigation would help to understand which students' language competence acquisition needs to be supported to improve knowledge in other academic fields.

7.5.1 Extensions of the LSEM Method

The nonparametric influence of moderators on parameters has a long tradition in varying coefficient regression models (Park et al., 2015). However, the principle of local estimation based on weights can be applied to any other model class that allows the use of sampling weights such as multilevel models (Wu & Tian, 2018), item response models, latent class models, mixture models, or survival models, to name a few. For longitudinal data, continuous-time models (Voelkle et al., 2012) are particularly attractive alternatives to the discrete-time models that were discussed in this chapter. In our empirical application, we also focused on only one moderator variable. Multiple moderator variables can be handled by replacing the unidimensional Gaussian kernel function for computing the weights with a multivariate Gaussian kernel function (see Hartung et al., 2018, for such an application). With many moderators, such an approach would lead to very sparse data, because only a few combinations of values would be available for multiple moderator values. Moreover, the interpretation of LSEM findings would be intricate in the multidimensional setting. One possibility would be to assume that only a subset of moderators affects a particular parameter. Essentially, this means that this parameter would be invariant with respect to the complementary set of moderators. This strategy can be implemented by using the joint estimation approach (see section 'Testing moderation effects'). Bolsinova and Molenaar (2019) discuss an LSEM application in which each item has its own moderator. They circumvent the problem of high dimensionality in the estimation by proposing an alternative estimation algorithm (Bolsinova & Molenaar, 2019). In their model, the set of parameters is

partitioned into subsets that depend on only one moderator variable (i.e. all parameters referring to an item depend only on the moderator corresponding to this item). The LSEM estimation is conducted by cycling through conditional estimation steps concerning the subsets of item parameters. Thereby only one subset of parameters is estimated, while holding all other parameters fixed. This principle can be generalized to LSEM applications with multiple moderators. This then results in an additive nonparametric model for the moderated parameter functions.

In the present demonstration, we used parental education (i.e., HISCED) at the first measurement occasion as a moderator that differs between participants but not within participants (i.e., across time). Because the HISCED values changed for only about 5% of the sample across the 4 years examined in this study, treating it as time-invariant was, in our opinion, a reasonable approximation. However, when using NEPS cohorts with younger participants (e.g., newborns and Kindergarten) and moderators with potentially stronger fluctuations across time (e.g., parental involvement; SES), the moderator values for each participant may change across time. It seems reasonable for model parameters referring to a particular time point to depend only on the moderator variable at this time point, as is done in the approach by Bolsinova and Molenaar (2019). For example, in a latent growth curve model, residual variances at a time point should depend only on the moderator assessed at this time point. However, it is less clear how intercept and slope variances depend on the time-varying moderator variables. One could argue that they depend only on the mean across time of the time-varying moderators, but they could alternatively depend on a measure of within-subject variability of the moderator or even depend on the moderator variables at all time points.

7.5.2 Alternative Modeling Approaches

Occasionally, the LSEM approach is computationally demanding, especially in cases with large models or more than one moderator variable. Alternatively, a computationally more parsimonious approach based on individual parameter contribution regressions (IPC) can be used to investigate relationships of model parameters to moderators (Arnold et al., 2019; Oberski, 2013). Both nonparametric approaches, LSEM and IPC, can be utilized to investigate whether a parametric approach such as moderated factor analysis (MFA) can be used (Hessen & Dolan, 2009; Molenaar et al., 2010; see also Hildebrandt et al., 2016, for a comparison). MFA allows for the inclusion of single or multiple parameter moderation effects in a structural equation model. For example, Molenaar et al. (2010) used it to study differentiation in a higher-order model of intelligence by examining moderation effects of age and ability levels on the factor and residual variances. MFA has the advantage that the test of moderation effects and model comparisons follows standard maximum likelihood or Bayesian theory. For example, moderation effects can be tested using χ^2-difference tests between nested models (e.g., by dropping or including single moderation effects in the model).

7.5.3 Conclusion

In our opinion, LSEM is an important tool for educational research because it can help to understand the underlying conditions of learning and to optimize education from the perspective of education policy. Uncovering which school, family, or child-related characteristics or backgrounds have a detrimental or favourable effect on learning is vital when it comes to identifying disadvantaged students and offering support that is targeted on the underlying mechanisms. Because the majority of these background variables are either continuous or are being understood increasingly as continuous concepts (e.g., cultural identity instead of categorical migration status), continuous moderation procedures are required to study these effects adequately. Whereas traditional measurement invariance approaches often focus only on the item level (i.e., factor loadings, item intercepts, and residuals), the procedures presented here provide equivalence tests for all model parameters that can be used to uncover differences across persons in the structure and mean levels of the latent variables as well.

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References

Arnold, M., Oberski, D. L., Brandmaier, A. M., & Voelkle, M. C. (2019). Identifying heterogeneity in dynamic panel models with individual parameter contribution regression. *Structural Equation Modeling, 27*(4), 613–628. https://doi.org/10.1080/10705511.2019.1667240

Bainter, S. A., & Howard, A. L. (2016). Comparing within-person effects from multivariate longitudinal models. *Developmental Psychology, 52*(12), 1955–1968. https://doi.org/10.1037/dev0000215

Blossfeld, H. P., Rossbach, H. G., & von Maurice, J. (2011). The German National Educational Panel Study (NEPS). *Zeitschrift für Erziehungswissenschaft: Sonderheft 14*.

Bolsinova, M., & Molenaar, D. (2019). Nonlinear indicator-level moderation in latent variable models. *Multivariate Behavioral Research, 54*, 62–84. https://doi.org/10.1080/00273171.2018.1486174

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal, 14*(3), 464–504. https://doi.org/10.1080/10705510701301834

Cheung, G. W., & Rensvold, R. B. (1999). Testing factorial invariance across groups: A reconceptualization and proposed new method. *Journal of Management, 25*, 1–27. https://doi.org/10.1177/014920639902500101

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*, 233–255. https://doi.org/10.1207/S15328007SEM0902_5

Coaley, K. (2014). *An introduction to psychological assessment and psychometrics*. Sage.

Embretson, S. E., & Reise, S. P. (2013). *Item response theory*. Psychology Press.

Ferrer, E., & McArdle, J. J. (2010). Longitudinal modeling of developmental changes in psychological research. *Current Directions in Psychological Science, 19*, 149–154. https://doi.org/10.1177/0963721410370300

Gnambs, T., & Schroeders, U. (2020). Cognitive abilities explain wording effects in the Rosenberg Self-Esteem Scale. *Assessment, 27*, 404–418. https://doi.org/10.1177/1073191117746503

Hartung, J., Doebler, P., Schroeders, U., & Wilhelm, O. (2018). Dedifferentiation and differentiation of intelligence in adults across age and years of education. *Intelligence, 69*, 37–49. https://doi.org/10.1016/j.intell.2018.04.003

Hattie, J. (2009). The black box of tertiary assessment: An impending revolution. In L. H. Meyer, S. Davidson, H. Anderson, R. Fletcher, P. M. Johnston, & M. Rees (Eds.), *Tertiary assessment & higher education student outcomes: Policy, practice & research* (pp. 259–275). Ako Aotearo.

Hessen, D. J., & Dolan, C. V. (2009). Heteroscedastic one-factor models and marginal maximum likelihood estimation. *British Journal of Mathematical and Statistical Psychology, 62*, 57–77. https://doi.org/10.1348/000711007X248884

Hildebrandt, A., Wilhelm, O., & Robitzsch, A. (2009). Complementary and competing factor analytic approaches for the investigation of measurement invariance. *Review of Psychology, 16*, 87–102.

Hildebrandt, A., Lüdtke, O., Robitzsch, A., Sommer, C., & Wilhelm, O. (2016). Exploring factor model parameters across continuous variables with local structural equation models. *Multivariate Behavioral Research, 51*, 257–258. https://doi.org/10.1080/00273171.2016.1142856

Hoyle, R. H. (Ed.). (2012). *Handbook of structural equation modeling*. Guilford Press.

Hülür, G., Wilhelm, O., & Robitzsch, A. (2011). Intelligence differentiation in early childhood. *Journal of Individual Differences, 32*, 170–179. https://doi.org/10.1027/1614-0001/a000049

Jorgensen, T. D., Kite, B. A., Chen, P. Y., & Short, S. D. (2018). Permutation randomization methods for testing measurement equivalence and detecting differential item functioning in multiple-group confirmatory factor analysis. *Psychological Methods, 23*(4), 708–728. https://doi.org/10.1037/met0000152

Kintsch, W. (1998). *Comprehension: A paradigm for cognition*. Cambridge University Press.

Kline, R. B. (2015). *Principles and practice of structural equation modeling*. Guilford Press.

Little, T. D. (2013). *Longitudinal structural equation modeling*. Guilford Press.

Little, T. D., Slegers, D. W., & Card, N. A. (2006). A non-arbitrary method of identifying and scaling latent variables in SEM and MACS models. *Structural Equation Modeling, 13*, 59–72. https://doi.org/10.1207/s15328007sem1301_3

Little, T. D., Preacher, K. J., Selig, J. P., & Card, N. A. (2007). New developments in latent variable panel analyses of longitudinal data. *International Journal of Behavioral Development, 31*, 357–365. https://doi.org/10.1177/0165025407077757

Liu, Y., Mo, S., Song, Y., & Wang, M. (2016). Longitudinal analysis in occupational health psychology: A review and tutorial of three longitudinal modeling techniques. *Applied Psychology, 65*, 379–411. https://doi.org/10.1111/apps.12055

Lüdtke, O., Robitzsch, A., Trautwein, U., & Köller, O. (2007). Umgang mit fehlenden Werten in der psychologischen Forschung: Probleme und Lösungen. *Psychologische Rundschau, 58*, 103–117. https://doi.org/10.1026/0033-3042.58.2.103

MacCallum, R. C., Zhang, S., Preacher, K. J., & Rucker, D. D. (2002). On the practice of dichotomization of quantitative variables. *Psychological Methods, 7*(1), 19–40. https://doi.org/10.1037/1082-989x.7.1.19

McArdle, J. J. (2009). Latent variable modeling of differences and changes with longitudinal data. *Annual Review of Psychology, 60*, 577–605. https://doi.org/10.1146/annurev.psych.60.110707.163612

McArdle, J. J., & Bell, R. Q. (2000). An introduction to latent growth models for developmental data analysis. In T. D. Little, K. U. Schnabel, & J. Baumert (Eds.), *Modeling longitudinal and multilevel data: Practical issues, applied approaches, and specific examples* (pp. 69–107, 269–281). Lawrence Erlbaum Associates Publishers.

Meredith, W. (1993). Measurement invariance, factor analysis and factorial invariance. *Psychometrika, 58*, 525–543. https://doi.org/10.1007/BF02294825

Molenaar, D., Dolan, C. V., Wicherts, J. M., & van der Maas, H. L. (2010). Modeling differentiation of cognitive abilities within the higher-order factor model using moderated factor analysis. *Intelligence, 38*, 611–624. https://doi.org/10.1016/j.intell.2010.09.002

Mund, M., & Nestler, S. (2019). Beyond the cross-lagged panel model: Next-generation statistical tools for analyzing interdependencies across the life course. *Advances in Life Course Research, 41*, 100249. https://doi.org/10.1016/j.alcr.2018.10.002

Oberski, D. (2013). Individual differences in structural equation model parameters. *arXiv*: 1304.3608.

OECD. (2009). *PISA: Take the test*. OECD Publications.

Olaru, G., & Allemand, M. (2022). Correlated personality change across time and age. *European Journal of Personality, 36*(5), 729–749. https://doi.org/10.1177/08902070211014054

Olaru, G., Schroeders, U., Hartung, J., & Wilhelm, O. (2019). Ant colony optimization and local weighted structural equation modeling: A tutorial on novel item and person sampling procedures for personality research. *European Journal of Personality, 33*, 400–419. https://doi.org/10.1002/per.2195

Park, B. U., Mammen, E., Lee, Y. K., & Lee, E. R. (2015). Varying coefficient regression models: A review and new developments. *International Statistical Review, 83*, 36–64.

Preacher, K. J., Rucker, D. D., MacCallum, R. C., & Nicewander, W. A. (2005). Use of the extreme groups approach: A critical reexamination and new recommendations. *Psychological Methods, 10*(2), 178–192. https://doi.org/10.1037/1082-989X.10.2.178

Richter, T., & Christmann, U. (2002). Lesekompetenz: Prozessebenen und interindividuelle Unterschiede. In N. Groeben & B. Hurrelmann (Eds.), *Lesekompetenz: Bedingungen, Dimensionen, Funktionen* (pp. 25–58). Juventa.

Robitzsch, A. (2019). *sirt: Supplementary item response theory models.* R package version 3.6-21. https://CRAN.R-project.org/package=sirt

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling and more Version 0.5–12 (BETA). *Journal of Statistical Software, 48*(2), 1–36.

Schroeders, U. (2018). Ability. In M. H. Bornstein (Ed.), *The SAGE encyclopedia of lifespan human development* (pp. 1–5). SAGE. https://doi.org/10.4135/9781506307633.n8

Schroeders, U., & Gnambs, T. (2018). Degrees of freedom in multigroup confirmatory factor analyses: Are models of measurement invariance testing correctly specified? *European Journal of Psychological Assessment, 36*, 105–113. https://doi.org/10.1027/1015-5759/a000500

Schroeders, U., Schipolowski, S., & Wilhelm, O. (2015). Age-related changes in the mean and covariance structure of fluid and crystallized intelligence in childhood and adolescence. *Intelligence, 48*, 15–29. https://doi.org/10.1016/j.intell.2014.10.006

Selig, J. P., & Little, T. D. (2012). Autoregressive and cross-lagged panel analysis for longitudinal data. In B. Laursen, T. D. Little, & N. A. Card (Eds.), *Handbook of developmental research methods* (pp. 265–278). Guilford Press.

Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of Educational Research, 75*, 417–453. https://doi.org/10.3102/00346543075003417

Usami, S., Murayama, K., & Hamaker, E. L. (2019). A unified framework of longitudinal models to examine reciprocal relations. *Psychological Methods, 24*, 637–657. https://doi.org/10.1037/met0000210

Vandenberg, R. J., & Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods, 3*, 4–70. https://doi.org/10.1177/109442810031002

Voelkle, M. C., Oud, J. H. L., Davidov, E., & Schmidt, P. (2012). An SEM approach to continuous time modeling of panel data: Relating authoritarianism and anomia. *Psychological Methods, 17*, 176–192. https://doi.org/10.1037/a0027543

Wagner, J., Lüdtke, O., & Robitzsch, A. (2019). Does personality become more stable with age? Disentangling state and trait effects for the Big Five across the life span using local structural equation modeling. *Journal of Personality and Social Psychology, 116*(4), 666–680. https://doi.org/10.1037/pspp0000203

Watermann, R., & Baumert, J. (2006). Entwicklung eines Strukturmodells zum Zusammenhang zwischen sozialer Herkunft und fachlichen und überfachlichen Kompetenzen: Befunde national und international vergleichender Analysen. In J. Baumert, P. Stanat, & R. Watermann (Eds.), *Herkunftsbedingte Disparitäten im Bildungswesen: Differenzielle Bildungsprozesse und Probleme der Verteilungsgerechtigkeit* (pp. 61–94). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-531-90082-7_3

Wu, C. O., & Tian, X. (2018). *Nonparametric models for longitudinal data*. Chapman and Hall. https://doi.org/10.1201/b20631

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Part II
Educational Transitions and Pathways: Influencing Factors and Outcomes

Chapter 8
Inequality in Educational Transitions During Secondary School: Results from the German National Educational Panel Study



Florian Wohlkinger and Hartmut Ditton

Abstract The German educational system generally allows for transitions between different types of secondary school. This so called 'openness' is supposed to enable a correction of misallocated students and thereby respond appropriately to delays in the improvement of children's academic performance. Both transition directions are feasible: downward movements from upper to lower types of secondary school and upward movements from lower to upper types of secondary school. This research aims to determine whether transitions in secondary schooling exhibit patterns of social selectivity. Using data from the National Educational Panel Study, we begin our analyses with an overview of the initial distribution of students over the different types of secondary school. Afterwards, we distinguish different transitions from different initial types of secondary school. We compare the various subgroups in terms of several factors that are well known to be related to educational inequalities. Results confirm that even after controlling for performance, transitions during secondary schooling are linked to students' social background and gender.

8.1 Introduction

Countries differ widely in the organization of their educational systems. Considering the stage of secondary education, these systems range from comprehensive forms without ability grouping until the end of compulsory schooling (e.g., Nordic countries) to models in which students are assigned to different and clearly distinguishable educational programmes early on in secondary education (e.g., Austria, Germany, the Netherlands, and Switzerland; cf. H.-P. Blossfeld et al., 2016). There is an ongoing controversy regarding how ability grouping contributes to

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educational success and to the inequality of educational opportunities (Esser, 2016; OECD, 2016). For Germany, the discussion on the advantages and disadvantages of early selection into different types of school has been going on for generations and has recently been fuelled by findings from international comparative studies (e.g., PISA). Currently, most of the 16 German federal states are working on refining their secondary education systems by means of manifold structural reforms. At present, it seems that, in the long run, some form of a two-tier system with a differentiation between the highest programme (the traditional *Gymnasium* as the highest form of secondary education) and various combinations of the other programmes may become dominant. Discussions on the consequences of ability grouping and on external differentiation into different types of school are based on questions such as how much this change would affect social inequalities and whether current pathways in education are actually equally open to everyone. We contribute to the current state of research in this area by examining mobility between the types of schools available during secondary schooling in Germany.

8.2 Secondary Education in Germany

In the Federal Republic of Germany, the individual states are responsible for the organization of education. Because of this federalism, there is not *one* common German education system, but rather, *sixteen* distinct education systems that exist in parallel. However, many states share certain characteristics regarding educational structures.[1] In general, education in Germany can be characterized as being highly stratified, particularly when considering the field of secondary schooling (Allmendinger, 1989; Buchholz et al., 2016). After jointly attending primary school for 4 years (apart from in the federal states of Berlin and Brandenburg where children regularly attend primary school for 6 years), stratification begins, and children are allocated to different types of school. Traditionally, three distinct types of schools are available. The only type of school that can be found in all German federal states is the *Gymnasium* (i.e., upper secondary schooling; henceforth abbreviated *USS*). This type of school ends after Class 12 or 13 with a final examination (*Abitur*) that functions as a university entrance qualification. In addition to the *Gymnasium*, the most common types of school are the *Realschule* (middle secondary schooling; henceforth *MSS*) and the *Hauptschule* (lower secondary schooling; henceforth *LSS*), in which middle and low school-leaving certificates can be obtained, respectively. These certificates are not sufficient for accessing higher education; rather, they serve as certificates of entry into vocational training and they regulate access to further education. In some federal states, comprehensive schools are also available,

[1] For a detailed overview of the German educational system as a whole, see Secretariat of the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany (2017).

whereas other states offer types of school that integrate *LSS* and *MSS*. We address all types of school that offer more than one type of school-leaving certificate under the label 'schools offering several courses of education' (*SCE*).

Independently of the available types of school, the transition from primary to secondary education can be regarded as an important milestone of the individual educational trajectory in all German federal states. However, the federal states have quite different regulations for this transition. In many states, a certain grade point average in selected subjects is a necessary precondition to choosing a higher programme of secondary education. Some states additionally require a recommendation by the primary school teacher, which is usually based on marks in core subjects and/or additional criteria such as learning behaviour. If parents prefer a higher type of school than that recommended by the teacher, some states require an extensive entrance exam. In the majority of states, however, parents can freely choose the type of secondary school for their children; nevertheless, schools and teachers are supposed to offer parents counselling regarding the 'right' choice of school type for their child.

After the initial decision on a type of secondary school has been taken, children attend the different types of school. Many federal states have an orientation phase (*Orientierungsstufe*) that typically lasts 2 years. During this time, teachers systematically monitor and evaluate the children's progress in order to make sure that they are at the appropriate type of school. At the end of the school year, the initial decision can be either confirmed or revised, with a revision leading to a change in the initial type of school. Such *changes* can occur in both directions—that is, *upwards* to a type of school with a more ambitious curriculum (and a higher school-leaving certificate) or *downwards* to a type of school with a less demanding curriculum (and a lower school-leaving certificate). Furthermore, transitions to, from, and within comprehensive schools are also feasible.

Altogether, the highly stratified secondary education system in Germany results in a great variety of possible pathways between initial enrolment and final graduation. Our article aims to shed greater light on the social selectivity that originates in transitions during the phase of secondary education. We concentrate on mobility between the traditional types of school and do not include transitions to comprehensive schools or to schools that offer several courses of education that would be difficult to classify as either upward or downward moves.

8.3 State of Research

8.3.1 Social Selectivity in Secondary Education in Germany

International comparative studies such as PISA, PIRLS, and TIMSS consistently identify Germany as a country with pronounced social inequalities in education. Among the explanations given for the persistence of educational disparities, the early timing of allocating students to different educational programmes is often considered

a major factor (Brunello & Checci, 2006). As a consequence, the bulk of research has investigated social selectivity during the transition from primary to secondary schooling (e.g., Pietsch & Stubbe, 2007). Following Boudon's (1974) theoretical distinction between primary and secondary effects of stratification, various studies have investigated the impact of students' social origins on their academic achievement ('primary effect') and on the choice of which type of secondary school they enter ('secondary effect') after primary schooling (Ditton, 2010, 2013b; Dollmann, 2016; Müller-Benedict, 2007; Schimpl-Neimanns, 2000). Based on Boudon's ideas, several formalized models of 'rational choice' have been developed with which to investigate the influence of social origin on educational attainment and achievement (e.g., Breen & Goldthorpe, 1997; Erikson & Jonsson, 1996; Esser, 1999). These models share the basic assumption that 'rational' actors take a decision by consciously considering the benefits, costs, and the probability of success for each option. Findings on the decomposition of primary and secondary effects vary considerably depending on the characteristics of the database being utilized (particularly the regions/federal states included), the methodological approach, the dependent variable (marks, test results, recommendations, types of schools, etc.), and the independent variables included. However, there is a general consensus regarding the fundamental importance of this early transition in terms of the emergence of social inequalities.

In addition to the rational choice tradition, another well-established research tradition has developed on the basis of Bourdieu's (1977) theory of cultural and social reproduction. Bourdieu assumes that the educational system reproduces the unequal distribution of economic and cultural capital that families in different social positions maintain. Families from different social classes equip their children differently with skills and attitudes before they enter school, and these differences persist throughout schooling and result in unequal educational outcomes. The key component in Bourdieu's theoretical framework is what he calls *habitus*—a 'system of dispositions which acts as a mediation between structures and practice' (Bourdieu, 1977, p. 487). The basic idea of habitus is that people internalize their surrounding social structures through daily practice and interactions with others. As a result of this habitualization, people produce thoughts, perceptions, expressions, and actions that tend to reproduce these structures. Bourdieu refers to habitus as a 'generative grammar' (Bourdieu, 2002, p. 30) that engenders thoughts and actions within the limits of the particular conditions of its production. Hence, habitus can be considered 'a sense of one's (and others') place' (Hillier & Rooksby, 2002, p. 5). In contrast to the assumptions of rational choice models, Bourdieu's conception of habitus includes both conscious and unconscious aspects of behaviour. Current research on educational inequalities has further developed Bourdieu's ideas by investigating the fit between children's academic habitus and the demands of distinct school cultures (see e.g., Kramer, 2013, 2017). Depending on this fit, children develop a feeling of being either 'in the right place' or 'out of place' and obtain educational outcomes accordingly. In a similar fashion but with a particular focus on the perspective of the different ways in which parents structure their children's everyday

life, Lareau (2011) asserts that children develop either a 'sense of entitlement' or a 'sense of constraint' in their interactions with institutions.

Based on these two approaches, numerous studies have examined social selectivity during the stage of primary schooling and the allocation of students to different types of secondary school. However, empirical findings on the transitions that occur during secondary schooling remain relatively scarce. According to official school statistics, downward transitions by far outweigh upward transitions between Classes 7 and 9 (Authoring Group Educational Reporting, 2008). In a meritocratic system, *academic performance* would be expected to be the main driving force behind school changes. However, it remains unclear exactly how the openness of the educational system affects social selectivity. Some scholars assume that increased openness leads to a greater equality of chances (e.g., Bellenberg & Forell, 2012), whereas others are less optimistic about the categorical advantage of open educational pathways. Buchholz et al. (2016, p. 90) find that 'existing social inequalities are deepened further because it is already privileged social groups that profit most from atypical paths to higher secondary education.' According to their analyses, the *parental level of education* plays a significant role in educational mobility, even after controlling for differences in performance. Similarly, for students from Bavaria or Saxony, Ditton (2013a) has observed that upgrades from *LSS* are clearly associated with various other indicators of *social background* such as parents' rating of the accessibility of higher school-leaving certificates, cultural capital, and parental support for learning. Furthermore, *academic performance in primary school* turns out to be an important predictor for both upward and downward transitions. In an analysis of the development of academic competencies after entering *USS* in the federal states of Hesse or Bavaria, Pfost et al. (2018) observed significant differences between students who had versus had not received a *recommendation* for *USS*. By the end of Class 7, the latter group had attained considerably lower marks in German and mathematics, and they even performed slightly worse in comparison with students from *LSS* and *MSS*. Roeder and Schmitz (1995) found effects of *migration status* on downward transitions from *USS* in a study of students from Hamburg. In another study in Hamburg, Stubbe (2009) reported significant effects on the decision to leave *USS* for *academic performance* (tests and marks) and *social background* (ISEI) as well as for *migration status* and *gender*. With data from the adult cohort of the National Educational Panel Study, Blossfeld (2018) found effects for parental education and gender on both downward and upward mobility in West Germany.

8.3.2 Research Questions

Only a small number of studies have examined mobility in secondary school thus far. Because the share of students with a change in type of school varies considerably between the federal states (Bellenberg, 2012), the results of the few available studies are further limited in terms of their comparability and generalizability. Hence, there is still a lack of studies that investigate inequalities in educational transitions during

secondary school, and there is a particular need for analyses that utilize comprehensive data from more than just a few selected regions in Germany. This article seeks to contribute to research in this area by describing and analysing educational trajectories across Germany as a whole and focusing on changes in the type of school between Classes 5 and 9. Our main interest lies in determining the extent to which such transitions in secondary schooling exhibit patterns of social selectivity. Which factors are important for educational trajectories and educational success? In line with the literature, we assume that in addition to academic performance, socioeconomic background plays an important role in educational mobility. We expect that children from less advantaged social backgrounds more often move downwards to less demanding education programmes, whereas children from more privileged families should be less prone to leaving *USS* before graduation. Furthermore, we consider migration status and the child's gender as influences on school changes during secondary schooling in order to ascertain whether these factors play a role in the social selectivity of transitions.

8.4 Data and Methods

8.4.1 Sample

To examine the development of educational trajectories during secondary schooling and answer our research questions, we used data from Starting Cohort 4 of the German National Educational Panel Study (NEPS; see H.-P. Blossfeld et al., 2011).[2] The sample of 16,425 students attending Class 9 was established in a stratified multistage sampling design with a selection of schools during the first stage and a selection of two classes within each school during the second stage (Skopek et al., 2013). Because this article focused on changes between the various regular types of school, we restricted our analyses to *students attending regular schools* in Germany and excluded a subsample consisting of children attending a school for students with special educational needs. All types of school that offer more than one kind of school-leaving certificate or in which a decision is not necessarily taken from the beginning (e.g., due to an orientation phase) were subsumed under the label 'schools offering several courses of education' (*SCE*). We put specific emphasis on describing and analysing transitions between the three regular types of school (*LSS*, *MSS*, and *USS*; i.e., *Hauptschule*, *Realschule*, and *Gymnasium*).

[2]This chapter uses data from the National Educational Panel Study (NEPS): Starting Cohort Grade 9, doi:https://doi.org/10.5157/NEPS:SC4:9.1.0. From 2008 to 2013, NEPS data was collected as part of the Framework Programme for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, NEPS is carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in cooperation with a nationwide network.

Retrospective data on the children's educational trajectory form the basis of this examination. We reconstructed the educational trajectory until the students attended Class 9 during the 2010/2011 school year with manifold information on the school biography collected from parents and children over all available panel waves. We excluded cases with incomplete or inconsistent information (e.g., missing school-entry or -leaving dates, missing information on the type of school, gaps or overlaps in the educational trajectory, etc.) from our analyses. Furthermore, we excluded cases with episodes in a Waldorf school or in a school for students with special educational needs prior to Class 9, because we argue that these cases' educational trajectories contain particular features that inevitably differ from 'typical' school careers in Germany.

Finally, even though the information from later panel waves would theoretically cover a longer time span, we restricted our analyses to *the phase of secondary schooling*. Therefore, our analyses covered the educational trajectory between the end of primary schooling and the time the first panel wave was conducted. After all exclusions, data on 12,434 cases remained for analyses.

8.4.2 Variables and Data Handling

Educational Trajectory The central dependent variable in this examination is the development of students' educational careers during the stage of secondary schooling. In order to analyse and compare diverging trajectories, we disassembled the educational pathways into their most basic components. We distinguished between *students who remain at their initial type of secondary school* without a transition and *students with a school change* during the stage of secondary schooling. Among those who did change between the *LSS*, *MSS*, and *USS* types of school, we furthermore differentiated between *upward transitions* to a more prestigious type of school and *downward transitions* to a less prestigious type of school. Because the possible directions of a transition depend on the type of school attended, we always specified the *initial type of secondary school*. Because transitions to and out of *SCE* may also occur without aiming for a higher or lower school-leaving certificate, school changes involving an *SCE* were simply considered changes without further differentiation of direction. Because our main interest lies in changes between types of school, changes within comprehensive schools are not reported here.

Academic Performance Considering academic performance is crucial when assessing educational trajectories and the social selectivity processes involved in them. Unfortunately, the retrospective data utilized here do not contain any direct performance measures such as test results or marks in the students' educational trajectory prior to Class 9. Therefore, evaluating the adequacy of the initial choice of secondary school or the necessity of school changes during secondary schooling is a challenging task. However, we do possess information from the parent interviews on *primary school teachers' recommendations* for the most suitable type of school. This

variable correlates strongly with academic performance at the end of primary schooling. Furthermore, in some federal states, this recommendation serves as 'gatekeeper' that keeps low-performing students out of the more demanding types of school. Thus, we used the primary school teachers' recommendations as an indicator for students' academic performance when entering the phase of secondary schooling. Consistent with the type of school information, we coded the recommendation as a nominal variable with four possible values (i.e., *SCE*, *LSS*, *MSS*, or *USS*).

As to academic performance at the end of secondary schooling, we could draw on results of competence tests in the domains of *reading* (for detailed information, see Haberkorn et al., 2012), *mathematics* (Duchhardt & Gerdes, 2013), and *science* (Schöps & Saß, 2013) and could thereby rely on a more elaborated measure. These tests were designed specifically to allow for systematic comparisons of students in different educational programmes (Weinert et al., 2011) and were captured in Class 9. We utilized standardized weighted maximum likelihood estimates as point estimates of the individual competence scores in all three domains (Pohl & Carstensen, 2012).

Socio-economic Status As a measure of the family's socio-economic status, we use the *parental level of education* in our analyses. Respondents provided information on both their own and their partner's education, and we combined these into a single variable indicating the highest level of parental education. The categories are *LSS or lower*, *MSS*, and *USS or higher*.

Migration Status To test whether children from families with migrant backgrounds display different mobility in secondary school than children from native German families, we considered whether their parents had been born in Germany or abroad. The variable employed in our analyses was coded as a dummy variable with 0 for Germans and 1 if at least one parent had been born abroad.

Gender We considered the gender of the child as a dummy variable with 0 for girls and 1 for boys.

8.4.3 Analytical Strategy and Limitations

Missing Values A typical problem with survey data is missing values (Little, 1988; Rubin, 1987). Within the dataset utilized here, apart from the educational trajectory (for which missing information led to the elimination of a case), all independent variables displayed at least a small degree of missing values. We estimated these missing values by using the 'multiple imputation of chained equations' technique (van Buuren & Oudshoorn, 1999, 2000; White et al., 2011). The reported findings are averaged results over all of the 10 complete datasets that were generated.

Analytical Strategy We began our analyses with an overview of how students in our sample were initially distributed over the different types of secondary school.

Furthermore, we examined the connection between registered types of school and primary teachers' recommendations while considering socio-economic status, migration status, and gender. In a next step, we quantified the number of school changes and determined the ratio between stable students and school leavers for each type of school. To identify patterns of social selectivity, we compared the various subgroups in relation to each covariate separately. Because there is an ongoing debate over the feasibility of pooling results from Chi^2 tests across multiply imputed datasets, we calculated Chi^2 test results separately for each imputed dataset and reported them on a significance level of $p < .05$. In a final step, we merged the results of all independent variables in a multivariate analysis in which we used a logistic regression analysis to test their effects on the likelihood of experiencing a downward transition from *USS*. In this way, we aimed to improve our understanding of mobility in the German education system and of the mechanisms of social selectivity at work.

Limitations Describing and comparing educational trajectories within the diversified educational landscape in the 16 federal states of Germany is possible only within certain boundaries. In addition to considering only the most common types of school and restricting the educational trajectory to the phase of secondary schooling, we had to accept some further limitations. First, we accounted exclusively for the *first* change of type of school. Some students, however, changed their type of school more than once, and there may even have been a few cases in which a student made more than two changes. As interesting as such uncommon pathways are for research on educational mobility, due to space limits, they cannot be considered in detail here. Accordingly, we report only results on the first transition. Second, our analyses ignored the individual *timing* of the transition within secondary schooling. For research interested in the development of cognitive competencies or non-cognitive factors (such as academic self-concept), it would be important to consider whether a school change occurred early or late in the phase of secondary schooling. However, with this chapter, our focus lies on gathering knowledge about *which* cases experienced a school change rather than analysing *when* the school change happened. This is why we did not consider any effects of transition timing.

8.5 Results

8.5.1 Initial Distribution of Students in Secondary Schools

The educational trajectories of all available cases include at least an initial episode in a primary school and a subsequent episode in a secondary school. By the end of their time in primary school, students are sorted into the different types of school in the secondary school system. In all, 82.7% of the students in the sample changed to one of the three major types of school (*LSS*, *MSS*, or *USS*), whereas 17.3% changed to *SCE*. The largest share of students in the sample began their phase of secondary

Table 8.1 Registered type of school by primary school teachers' recommendation (row percentages)

Primary school teachers' recommendation	Registered type of school			
	LSS	MSS	USS	SCE
Lower secondary schooling (LSS; *Hauptschule*)	69.0	13.1	1.2	16.8
Middle secondary schooling (MSS; *Realschule*)	14.4	54.6	10.3	20.7
Upper secondary schooling (USS; *Gymnasium*)	0.9	8.2	82.0	8.9
Schools offering several courses of education (SCE; comprehensive schools)	22.7	8.3	7.5	61.6
Total	18.4	24.3	40.0	17.3

Source: Own calculations based on data from NEPS Starting Cohort 4 (Release 9.1.0)

schooling in a *USS* ($n = 4968$, 40.0%). About one quarter of the students ($n = 3022$, 24.3%) attended an *MSS*, and 18.4% ($n = 2289$) began at an *LSS*.

To evaluate the adequacy of the initial choice of secondary school, we took the primary school teachers' recommendations for the most appropriate type of school into account. Table 8.1 presents the distribution of registered types of school by recommended type of school. Children were most likely to attend the recommended type of school within all recommendation groups; however, there were differences regarding the share of families who followed the recommendations. Of the children who had received a recommendation for *LSS*, about two thirds (69.0%) attended *LSS* subsequent to primary school. Among the children with a recommendation for *MSS*, about one half (54.6%) initially registered at an *MSS*. Of the children who had received a recommendation for a *USS*, 82.0% subsequently attended a *USS*. Recommendations for *SCE* were followed in 61.6% of all cases.

Altogether, 69.5% of the children attended their recommended type of school after primary school. The remaining 30.5% began their time in secondary school in a type of school that deviated from their primary teachers' professional counsel. Considering socio-economic status, the distribution of children in the different secondary schools reveals the well-known stratified pattern of social origin (cf. Appendix, Table 8.A1). Children in an *LSS* came most frequently from a family in which the parents had obtained a school-leaving certificate from an *LSS* (45.8%) or an *MSS* (40.5%). At the *MSS*, the majority of children had parents who had also graduated from an *MSS* (50.6%); and at the *USS*, the greatest share of parents (65.5%) held a school-leaving certificate from a *USS*. For migration status, there were only minor differences across the different types of school (cf. Appendix, Table 8.A2). The share of children from migrant families was highest at the *LSS* (11.4%) and lowest at the *USS* (8.2%). The gender distribution also varied only moderately across types of school (cf. Appendix, Table 8.A3). At the *LSS*, there were more boys than girls (56.0%), whereas at the *USS*, the girls were the largest group (54.0%). At the *MSS* and *SCE*, gender was distributed evenly.

8.5.2 *Quantifying Changes Between Different Types of Secondary School*

The type of school that students attended at the beginning of their secondary education was not always identical with the type of school at which they completed their compulsory education. In total, 1658 cases (i.e., 13.3% of all cases in the sample) experienced at least one change in type of school during their time in secondary education. Table 8.2 reveals the volume of transitions between the different types of secondary school. The denoted percentages refer to the children who initially began their phase of secondary schooling in the respective learning environment.

Subsequent to primary school, the largest share of students in the sample switched to *USS*. From there, 427 children (8.6%) descended to *MSS*, and 13 children (0.3%) even dropped to *LSS*. Among the children beginning secondary schooling in *MSS*, 365 students (12.1%) changed downwards to an *LSS*, whereas only 81 students (2.7%) moved upwards to a *USS*. From *LSS*, 131 children (5.7%) experienced an upward transition to an *MSS*. Nineteen children (0.8%) even managed to take a big step forward and change from an *LSS* directly to a *USS*.

Table 8.2 Transitions between different types of secondary school

Initial type of secondary school	Transition to...	Freq.	%
Lower secondary (LSS; *Hauptschule*)	(no transition)	1988	86.9
	MSS	131	5.7
	USS	19	0.8
	SCE	151	6.6
		2289	100
Middle secondary (MSS; *Realschule*)	LSS	365	12.1
	(no transition)	2490	82.4
	USS	81	2.7
	SCE	86	2.9
		3022	100
Upper secondary (USS; *Gymnasium*)	LSS	13	0.3
	MSS	427	8.6
	(no transition)	4407	88.7
	SCE	121	2.4
		4968	100
Schools offering several courses of education (SCE; comprehensive schools)	LSS	90	4.2
	MSS	76	3.5
	USS	98	4.6
	(no transition)	1891	87.8
		2155	100

Source: Own calculations based on data from NEPS Starting Cohort 4 (Release 9.1.0)

Comparing the different student outflows, mobility turned out to be greatest in the *MSS*. In sum, 82.4% of students remained there steadily by Class 9, whereas 17.6% of the children who had begun in *MSS* left to attend another type of school. Furthermore, the number of children arriving from other types of school was highest in *MSS*, and the total student number thus grew noticeably during the time of secondary schooling. The largest share of stable students could be found in *USS* at 88.7%. However, because the number of children entering was smaller than the number of children leaving, student numbers at *USS* diminished over time. This finding is in contrast with the comparatively high entry quota at the beginning of secondary schooling. Altogether, downward mobility was considerably higher than upward mobility during the phase of secondary schooling.

8.5.3 *Identifying Selectivity in Upward and Downward Transitions*

To learn more about how the educational trajectory develops and which factors participate in shaping it, we examined a set of variables that we expected to contribute significantly to educational inequalities. In this section, we merely distinguish between downward and upward transitions without further differentiating between the different possible types of targeted school.[3]

Teachers' Recommendations

Teachers' recommendations played an important role in determining which children would go to the which type of school at the beginning of their time in secondary education. Additionally, we utilized the teachers' recommendations as an indicator as to how successful a child would be in progressing through schooling in the new learning environment. We would expect to find differential shares of children remaining in one type of school or leaving it before graduation depending on the fit between teachers' recommendations and the initial registration at a type of school. Children with a lower recommendation than their registration should be more likely to experience a downward transition, whereas children with an equal or higher recommendation than their registration should be more likely to remain stable or even achieve an upward transition. Table 8.3 displays the results of comparing the information regarding whether a student registered at the recommended type of school with her or his educational trajectory. For each type of secondary school, there is a row displaying whether the registration at this type of school was higher, equal to, or lower than the level recommended by the primary school teacher. Because there is no possible recommendation lower than registration in *LSS* and

[3] Because transitions involving *SCE* may be ambiguous in matters of direction (e.g., a change from *SCE* to *MSS* may be an upward move from an *LSS* programme or a downward move from a *USS* programme), *SCE* was excluded as a type of school before and after a change and as a recommendation. Therefore, we report findings on $n = 9921$ cases in this section.

Table 8.3 Transitions by teachers' recommendations and initial registration at a type of secondary school (row percentages)

Type of school	Recommendation vs. Initial registration	Downward transition	No transition	Upward transition
Lower secondary	Recommendation < Registration	n/a	n/a	n/a
	Recommendation = Registration	n/a	94.0	6.0
	Recommendation > Registration	n/a	89.7	10.4
Middle secondary	Recommendation < Registration	38.7	60.8	0.6
	Recommendation = Registration	10.7	87.1	2.2
	Recommendation > Registration	4.0	89.8	6.2
Upper secondary	Recommendation < Registration	27.7	72.4	n/a
	Recommendation = Registration	7.3	92.7	n/a
	Recommendation > Registration	n/a	n/a	n/a

Source: Own calculations based on data from NEPS Starting Cohort 4 (Release 9.1.0)

there is likewise no possible recommendation higher than registration in *USS*, these rows remain empty. For the same reason, the columns of downward transition to *LSS* and upward transition to *USS* are not available. The table displays row percentages that can be interpreted as a student's chances of undergoing a transition depending on the particular recommendation and registration.

Among the children who began secondary schooling in *LSS* and who received the corresponding recommendation, 94.0% remained there without transition, whereas 6.0% attained a more prestigious type of school before graduation. The group of children with a recommendation for a more ambitious type of school had a slightly higher chance of upgrading (10.4%). Chi^2 was significant in nine out of the 10 imputed datasets.

For children attending *MSS*, transitions were possible in both directions. In this educational environment, the interplay of recommendation and observable mobility prospects revealed a very clear pattern. A large portion of students with a lower recommendation changed downwards (38.7%), whereas students who had registered there in accordance with their recommendation had a significantly lower risk of a downward transition (10.7%). The group of students who had registered at an *MSS* regardless of their higher recommendation displayed the lowest downward transition rate. This group also displayed the highest share of steady students (89.8%) and the highest share of upward transitions (6.2%). These numbers additionally illustrate the great discrepancy between upward and downward transitions: chances were considerably higher for dropping down than for moving up. Chi^2 was significant in all 10 datasets.

In *USS*, the risk of dropping out was about four times higher for children who had not received the corresponding recommendation (27.7%) compared with those who had (7.3%). However, it is important to emphasize that almost three quarters (72.4%) of the children who had begun attending *USS* without having received the respective recommendation remained there without dropping out until at least Class 9. The

transition rate for this group (27.7%) was thus considerably lower than that for its equivalent in *MSS* (38.7%). Chi^2 was significant in all 10 datasets.

Overall, findings confirmed our expectations regarding the connection between teachers' recommendations, the initial type of secondary school, and upward and downward mobility during secondary schooling. The recommendation was clearly associated with both the chances of remaining in and the risk of dropping out of a particular learning environment. This observation may be taken as a sign for the high prognostic validity of primary teachers' recommendations and thus confirms their pedagogical value.

Parental Level of Education

As a second important factor influencing educational success and mobility in secondary schooling, we considered the association between changes in the type of school and the parents' level of education. Figure 8.1 illustrates this relationship graphically. White bars indicate upward transitions; black bars, downward transitions. The given percentages relate to the share of children who experienced a transition within each type of school and the parental level of education. All Chi^2 tests resulted in significant differences.

The bar graph reveals very clear trends for the association between parental education and children's educational trajectory. In *LSS*, only 4.7% of children from families with a low level of education accomplished an upward transition, whereas 8.1% of children from families with a middle level of education and 11.7% of children from families with a high level of education managed to upgrade their initial type of secondary school. A similar albeit less pronounced pattern emerged for *MSS* in which upward transition rates covaried with parental education and ranged from 2.1% to 3.3%.

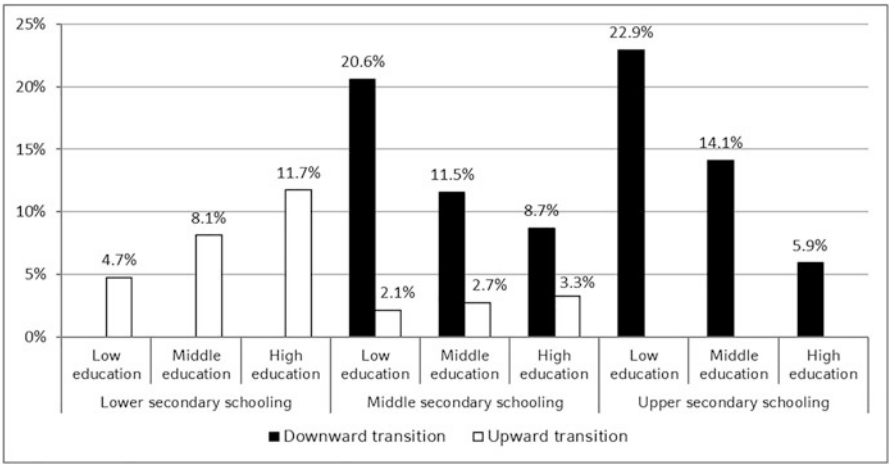


Fig. 8.1 Transitions by parental level of education. (*Source*: Own calculations based on data from NEPS Starting Cohort 4 (release 9.1.0))

With downward transitions, an inverted trend could be found for both *MSS* and *USS*. The risk of dropping down was substantially higher for children from low-educated families and lowest for children from higher-educated families.

Altogether, the higher the parental level of education, the lower the risk for a downward transition and the higher the chance for an upward transition. This pattern could be found in all three learning environments, and it appeared to be stronger for downward than for upward transitions.

Migration Status

Another traditional factor in research on education inequalities is the migration status of the family. Various disadvantages for foreign children have been well-documented in the German education system (Diefenbach, 2010). Considering the transition from primary to secondary school, children from migrant families have a lower chance of receiving a recommendation for *USS* and a higher risk of changing to *LSS* (Kristen, 2002). In our sample, the initial share of children with a migrant background was 11.4% in *LSS*, 10.4% in *MSS*, and 8.2% in *USS*, which is in line with the literature and our expectations. Table 8.4 displays the share of students with and without transitions both for children from German families and for children from families with a migrant background.

In *LSS*, 6.7% of the German children changed to a higher type of school, whereas 9.6% of children from families with a migration background managed to improve their learning environment. The slightly lower upward transition ratio for German children was a surprising finding, because we would have expected another disadvantage for migrant children here. However, differences (Chi^2) were significant in only four of the 10 imputed datasets.

In *MSS*, we monitored a similar pattern, although the difference was even less pronounced (Chi^2 was significant in only two imputed datasets). Whereas 2.7% of German children moved upwards from *MSS*, the rate for children from families with

Table 8.4 Transitions by migration status (row percentages)

Type of school	Migration status	Downward transition	No transition	Upward transition
Lower secondary	Both parents born in Germany	n/a	93.3	6.7
	At least one parent born abroad	n/a	90.4	9.6
Middle secondary	Both parents born in Germany	12.1	85.2	2.7
	At least one parent born abroad	15.1	81.8	3.1
Upper secondary	Both parents born in Germany	8.9	91.1	n/a
	At least one parent born abroad	10.9	89.1	n/a

Source: Own calculations based on data from NEPS Starting Cohort 4 (Release 9.1.0)

a migration background was slightly higher at 3.1%. For downgrades, however, the trend was reversed, with 12.1% of German children and 15.1% of children from migrant families changing to a lower type of school.

Among students beginning secondary education in *USS*, 8.9% of those from German families experienced a downward transition, whereas 10.9% of those from families with a migration background changed schools to attend a less ambitious type of school. Chi^2 was significant in four out of the 10 imputed datasets.

Gender

In research on inequalities in education, testing for gender differences has a long tradition. As with the dimensions detailed above, we compared the proportions of upward and downward transitions for boys and girls separately over all initial types of school (see Table 8.5). In *LSS*, 8.7% of the female students changed to a more prestigious type of school, whereas the share of male students with such a transition was slightly lower (5.7%). A similar picture was visible in *MSS* in which 3.7% of the girls and only 1.9% of the boys experienced an upward transition. In contrast, the girls' share in downward transitions (11.3%) was lower than the boys' (13.5%). From *USS*, 7.6% of the female students and 10.8% of the male students moved downwards to a less demanding type of school. Even though the difference in transition rates was comparatively small, girls clearly performed better than boys across all three types of school. All Chi^2 tests resulted in significant differences.

Academic Performance

Finally, we considered academic performance as an important dimension of mobility during secondary education. In our retrospective data, only performance test results for Class 9 were available to us. This meant that we could not consider academic performance prior to the transition in our analyses. However, assuming that academic performance at a certain point in the educational trajectory is determined largely by previous performance in the respective domain, we expected to find differential competence profiles for varying transition types. In the domain of reading, the students achieved a mean test score of $\bar{x} = 0.131$. In mathematics, the mean test score was $\bar{x} = 0.221$, and in science, it was $\bar{x} = 0.140$ (cf. Appendix, Table 8.A4). Because test scores were standardized over the initial sample, these

Table 8.5 Transitions by gender (row percentages)

Type of school	Gender	Downward transition	No transition	Upward transition
Lower secondary	Female	n/a	91.3	8.7
	Male	n/a	94.3	5.7
Middle secondary	Female	11.3	85.0	3.7
	Male	13.5	84.6	1.9
Upper secondary	Female	7.6	92.4	n/a
	Male	10.8	89.2	n/a

Source: Own calculations based on data from NEPS Starting Cohort 4 (Release 9.1.0)

Table 8.6 Competence scores by initial type of school

Type of school	Competence domain	Mean	*SE*	95% CI
Lower secondary	Reading	−0.894	0.024	[−0.941, −0.848]
	Mathematics	−0.721	0.019	[−0.758, −0.684]
	Science	−0.664	0.018	[−0.698, −0.630]
Middle secondary	Reading	−0.173	0.020	[−0.212, −0.134]
	Mathematics	−0.212	0.017	[−0.246, −0.178]
	Science	−0.107	0.016	[−0.138, −0.076]
Upper secondary	Reading	0.767	0.016	[0.735, 0.799]
	Mathematics	0.900	0.017	[0.866, 0.933]
	Science	0.644	0.013	[0.619, 0.670]

Note: *SE* standard error, *CI* confidence interval
Source: Own calculations based on data from NEPS Starting Cohort 4 (Release 9.1.0)

results suggest that our analysis sample was somewhat positively biased in terms of academic performance.

When differentiating performance by initial type of school, we found the expected pattern. For all three competence domains, students beginning secondary education in *LSS* achieved the lowest test scores (see Table 8.6); students beginning secondary education in *MSS* achieved test scores that were a bit lower than the overall average scores; and children in *USS* achieved the highest test scores.

So far, these results confirm the common view that different types of school constitute different learning environments. After primary school, the performance-based preselection of students into different educational programmes is reinforced by differences in curricula and style of instruction, and this results in different learning paces and consequently in diverging competencies. For students with a change in their type of school during secondary schooling, two distinct environments influence competence development. Therefore, we would expect such cases to feature a level of competence that lies between the typical levels of either of the two types of school. Figure 8.2 illustrates the differential competence averages in reading, mathematics, and science for stable students within each type of school and for students with an upward or downward transition (for additional information on standard errors and confidence intervals, see Appendix, Table 8.A5). Changes of the initial type of school indeed resulted in quite different levels of competencies compared with students who remained continuously in one type of school. All differences in competence scores between stable students and those who left their initial type of school (in either direction) were significant without exception. Cases of students with an upward transition from *LSS* had significantly higher skill levels on average in all three competence domains than stable *LSS* students. However, the group of former *LSS* students did not attain the average competence level of stable *MSS* students in the fields of reading or science and therefore assumed a position among the weaker students in their new learning environment. In contrast, even

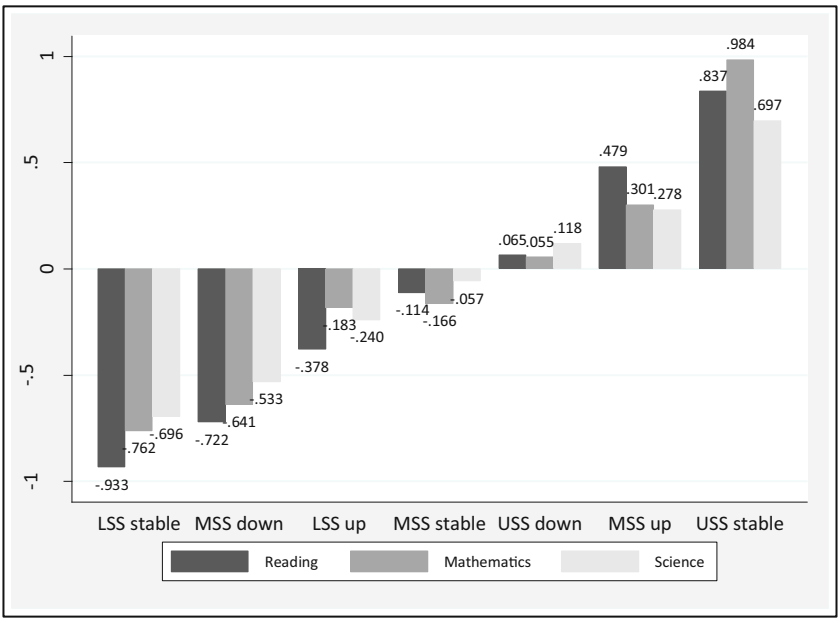


Fig. 8.2 Competence scores by transition type. (*Source*: Own calculations based on data from NEPS Starting Cohort 4 (Release 9.1.0))

though their competence levels were significantly lower than those of their former schoolmates, students with a downward transition from *MSS* outperformed their new peers in reading and science and therefore assumed a leading position in the new learning environment. The same patterns relating to competence differences in all three domains appeared for students with an upward change from *MSS* and for students with a downward change from *USS*.

In total, upward transitions in education seemed to come at the expense of a reduced competence development relative to the new reference group, whereas a downward transition turned out to be of advantage in terms of a leading position among the new peers. As we know from studies investigating reference-group effects such as the big-fish-little-pond effect (see e.g., Marsh & Hau, 2003), a change in the learning environment is closely connected to the development of the academic self-concept, effort, and motivational dimensions. We hence conclude that considering upward and downward transitions as either mere advantages or disadvantages respectively means taking a one-sided perspective that ignores the other side of the coin. Our findings suggest that students considering an upward transition have to deliberate about whether they prefer achieving a higher school-leaving certificate that is nonetheless below average or achieving a lower school-leaving certificate that is nonetheless above average.

8.5.4 Multivariate Findings: Downward Transitions from USS

As a final step of our analyses, we merged all variables into a single model with a logistic regression analysis. The dependent variable was downward transition from *USS*. Table 8.7 displays the results (y-standardized coefficients). We found that a *recommendation of the primary school teacher* for *LSS* increased the downward transition risk considerably (.783). A recommendation for *MSS* also led to a higher chance of dropping out (.456), and only a recommendation for *SCE* had no different effect than a *USS* recommendation. The *parental level of education* had a substantial impact on downgrade transitions for both parents with an *LSS* school-leaving certificate (.482) and for parents with an *MSS* school-leaving certificate (.334). The *migration status* had no effect on downgrades. For *gender*, we found that boys had a considerably higher risk of dropping out of *USS* by Class 9 (.332) than girls did. *Competence* had a negative effect on transitions, with mathematics asserting the strongest influence (−.308), followed by reading (−.137). After controlling for the other variables, science literacy did not additionally affect the transition risk.

Table 8.7 Downward transition from USS (logistic regression models)

	Downgrade from upper secondary schooling	
	r	*SE*
Teachers' recommendations (ref: upper secondary schooling)		
Lower secondary schooling	.783*	0.325
Middle secondary schooling	.456***	0.095
Schools offering several courses of education	−.359	0.484
Parental level of education (ref: upper secondary schooling)		
Lower secondary schooling	.482***	0.119
Middle secondary schooling	.334***	0.068
Migration status (ref: both parents born in Germany)		
At least one parent born abroad	−.011	0.167
Gender (ref: female)		
Male	.332***	0.051
Competence in Class 9		
Reading	−.137***	0.030
Mathematics	−.308***	0.031
Science	−.073	0.040
Constant	1.183***	0.062
N	4847	
Pseudo R^2 (McKelvey & Zavoina, 1975)	0.336	0.336

Note: Coefficients are y-standardized
Source: Own calculations based on data from NEPS Starting Cohort 4 (Release 9.1.0)
SE standard error
***$p < .001$. **$p < .01$. *$p < .05$

Apart from migration status and science literacy, all the factors considered had a significant effect on the risk of leaving *USS* by Class 9. In total, the influences lead to a pseudo R^2 of .336, which can be seen as a reasonable fit for a model that does not consider the particular transition timing and marks.

8.6 Discussion

International comparisons reveal striking differences in educational systems, especially according to the forms of ability grouping that are applied. Moreover, there are ongoing disputes about the advantages and disadvantages of ability grouping and its consequences for educational success and for inequalities in educational opportunity (OECD, 2016). We analysed mobility between different types of school in the German secondary school system with reference to rational choice and cultural reproduction theories. We assumed that the processes behind mobility were comparable with those that lie behind entering a type of school for the first time. The dataset we used was a nationwide German sample from the National Educational Panel Study (NEPS, Starting Cohort 4). Our findings reveal that the most common occurrence is remaining in the initial type of school, and that moving down is generally much more likely than moving up. There is little evidence to suggest that the openness of secondary schooling in Germany offers any great opportunity to catch up to the level of a higher type of school if this level has not been reached immediately after primary schooling. At the initial transition from primary to secondary schooling, most parents opt for the type of school recommended by their child's teacher. If they decide to deviate from this recommendation, the probability of moving up or down later on is considerably higher. Both performance measures that we used (teachers' recommendations and competence tests) influenced the risk of leaving *USS* by Class 9 comparatively strongly. This indicates that the openness of the education system leads to a continued sorting of children according to their ability during the phase of secondary schooling. However, of particular relevance to educational inequalities is the observation that even after controlling for performance, the parental level of education still has a significant effect on the risk of experiencing a downward transition. Considering the observation that students from higher-educated parents have a greater chance of entering *USS*, this result reveals that children from low-educated parents are sorted out even further during secondary schooling. Hence, the social composition of children at *USS* becomes more and more selective over time. Given that upward transitions from *USS* and *LSS* are also more likely with increasing levels of parental education, the German educational system appears to stratify children continuously according to their ability *and* their socioeconomic status. This finding implies that the gap between more and less privileged groups is hardly narrowed but rather widened over time by opportunities to move between types of schools, which indicates a continuing process of 'cumulative advantage' (cf. DiPrete & Eirich, 2006). Furthermore, our analyses reveal a persistent disadvantage for boys in the selection processes during secondary schooling.

Overall, mobility in secondary education remains at a moderate level and represents more of an exception than the rule. Although not all students undergo a transition during secondary schooling, our findings suggest that selectivity during this stage is quite similar to the mechanisms that are at play during the transition from primary to secondary schooling. In addition to academic achievement, the effects of social origin on educational trajectories persist or even increase during the stage of secondary schooling. In terms of both rational choice and cultural reproduction theories, these results raise several implications. Because upward moves are not obligatory, secondary effects as defined by Boudon may be of particular relevance for students who exhibit the necessary performance. Downward moves, on the other hand, can occur either as a free decision or out of necessity, which indicates a potentially higher relevance of primary effects for low-performing students in *MSS* and *USS*. Unfortunately, we have no measure indicating the voluntariness of a downgrade; thus, clear statements on the proportion of primary and secondary effects of social origin remain a task for future research. Considering Bourdieu's theoretical framework, downward moves can be regarded as a consequence of a poor fit between a student's academic habitus and the overwhelming demands of the initial school culture. After the transition, an improvement of this fit and hence an improvement in school outcomes were to be expected. In contrast, upward moves should be more likely to hinder the apparently extraordinarily good fit between a student's habitus and the former school environment. In such cases, the chances of obtaining a higher school-leaving certificate would come at the expense of giving up a top-ranking position among former classmates and having to adjust to the demands of a new environment and reference group. From this perspective, deciding *against* a transition and remaining in a relatively advantageous position may even be regarded as a worthwhile option. Follow-up analyses could aim to confront the consequences of these vastly different strategies and assess which one turns out to be more successful in terms of later social position or occupational success.

Finally, there are some limitations to the present analyses. The performance measures from Class 9 were gathered *after* a transition had occurred between different secondary schools. Although this situation is not ideal, we consider these measures to be feasible proxies. Ideally, instead of using retrospective information on education, concurrent longitudinal follow ups would have been better. However, using data from other sources or another cohort in the German NEPS (SC2; Starting Cohort 2) would have implied other and even more severe shortcomings (dropout rates for school leavers who have been followed up individually, sample selectivity, missing data). Moreover, we ignored transitions concerning different types of comprehensive schools in Germany, because it would have made no sense to classify them as upward or downward moves. The highly stratified system of secondary schooling in Germany makes it very difficult to come to an exhaustive valuation of mobility during school years. With our analyses, we concentrated on so called *horizontal mobility* (within an education stage). However, this needs to be complemented by reflected *vertical mobility* (across stages) in order to create a comprehensive picture. In fact, an increasing number of students continue schooling *after* initially obtaining a low or middle school-leaving certificate. However, there is

strong evidence suggesting that the decision to continue education after the time of compulsory schooling is based on similar factors to those examined here, indicating that it is again privileged social groups that benefit most from these options (Buchholz & Schier, 2015).

School systems within Europe apply different forms of ability grouping or differentiation, especially in secondary schools. Selection into different types of school is not the most common form applied—at least, not in an early stage. From our results, it seems that external differentiation is not an ideal method of avoiding social selectivity. Our next step will be to investigate which school-leaving certificates students earn by staying in or leaving their initial type of school. Concerning research in the future, it would also be of interest to compare the different systems within Europe in respect to openness, levels of achievement, (social) selectivity, and the school-leaving certificates obtained.

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Appendix

Table 8.A1 Parental level of education by initial type of secondary school (row percentages)

	Parental level of education		
Initial type of secondary school	Max. LSS	MSS	USS
Lower secondary	45.8	40.5	13.7
Middle secondary	19.7	50.6	29.8
Upper secondary	4.6	29.9	65.5
SCE (schools offering several courses of education)	20.0	50.9	29.1
Total	18.5	40.5	41.0

Source: Own calculations based on data from NEPS Starting Cohort 4 (Release 9.1.0)

Table 8.A2 Migration status by initial type of secondary school (row percentages)

	Migration status	
Initial type of secondary school	Both parents born in Germany	At least one parent born abroad
Lower secondary	88.6	11.4
Middle secondary	89.6	10.4
Upper secondary	91.8	8.2
SCE (schools offering several courses of education)	90.2	9.8
Total	90.4	9.6

Source: Own calculations based on data from NEPS Starting Cohort 4 (Release 9.1.0)

Table 8.A3 Gender by initial type of secondary school (row percentages)

Initial type of secondary school	Gender	
	Female	Male
Lower secondary	44.0	56.0
Middle secondary	49.2	50.8
Upper secondary	54.0	46.0
SCE (schools offering several courses of education)	49.2	50.8
Total	50.2	49.9

Source: Own calculations based on data from NEPS Starting Cohort 4 (Release 9.1.0)

Table 8.A4 Overall mean competence scores in Class 9

Competence domain	Mean	*SE*	95% CI
Reading	0.131	0.013	[0.105, 0.156]
Mathematics	0.221	0.012	[0.197, 0.246]
Science	0.140	0.010	[0.120, 0.160]

Note: *SE* standard error, *CI* confidence interval
Source: Own calculations based on data from NEPS Starting Cohort 4 (Release 9.1.0)

Table 8.A5 Competence scores by transition type

Transition type	Competence domain	Mean	*SE*	95% CI
LSS stable	Reading	−0.933	0.024	[−0.981, −0.885]
	Mathematics	−0.762	0.020	[−0.800, −0.723]
	Science	−0.696	0.018	[−0.731, −0.661]
MSS downward transition	Reading	−0.722	0.059	[−0.838, −0.605]
	Mathematics	−0.641	0.045	[−0.729, −0.554]
	Science	−0.533	0.044	[−0.620, −0.447]
LSS upward transition	Reading	−0.378	0.082	[−0.539, −0.217]
	Mathematics	−0.183	0.072	[−0.324, −0.042]
	Science	−0.240	0.063	[−0.364, −0.116]
MSS stable	Reading	−0.114	0.021	[−0.155, −0.073]
	Mathematics	−0.166	0.019	[−0.202, −0.129]
	Science	−0.057	0.017	[−0.090, −0.023]
USS downward transition	Reading	0.065	0.054	[−0.042, 0.171]
	Mathematics	0.055	0.047	[−0.037, 0.147]
	Science	0.118	0.042	[0.036, 0.199]
MSS upward transition	Reading	0.479	0.133	[0.219, 0.740]
	Mathematics	0.301	0.120	[0.066, 0.537]
	Science	0.278	0.088	[0.105, 0.451]
USS stable	Reading	0.837	0.017	[0.805, 0.870]
	Mathematics	0.984	0.017	[0.950, 1.018]
	Science	0.697	0.013	[0.671, 0.723]

Note: *SE* standard error, *CI* confidence interval
Source: Own calculations based on data from NEPS Starting Cohort 4 (Release 9.1.0)

References

Allmendinger, J. (1989). Educational systems and labor market outcomes. *European Sociological Review, 5*(3), 231–250.

Authoring Group Educational Reporting. (Ed.). (2008). *Education in Germany 2008: An indicator-based report including an analysis of transitions subsequent to lower secondary education*. wbv. https://www.bildungsbericht.de/de/bildungsberichte-seit-2006/bildungsbericht-2008/pdf-bildungsbericht-2008/summary08.pdf

Bellenberg, G. (2012). *Schulformwechsel in Deutschland: Durchlässigkeit und Selektion in den 16 Schulsystemen der Bundesländer innerhalb der Sekundarstufe I.* Bertelsmann Stiftung.

Bellenberg, G., & Forell, M. (2012). Erhöhung der Chancengleichheit durch mehr Durchlässigkeit? In BMBF – Bundesministerium für Bildung und Forschung (Ed.), *Bildungsforschung: Band 40. Bildungsforschung 2020 – Herausforderungen und Perspektiven: Dokumentation der Tagung des Bundesministeriums für Bildung und Forschung vom 29.-30. März 2012* (pp. 8–18). BMBF.

Blossfeld, P. N. (2018). Social background and between-track mobility in the general education system in West Germany and in East Germany after German unification. *Zeitschrift für Soziologie, 47*(4), 255–269. https://doi.org/10.1515/zfsoz-2018-0117

Blossfeld, H.-P., Rossbach, H.-G., & von Maurice, J. (Eds.). (2011). *Education as a lifelong process: The German National Educational Panel Study (NEPS).* Zeitschrift für Erziehungswissenschaft: Sonderheft 14. VS Verlag für Sozialwissenschaften.

Blossfeld, H.-P., Buchholz, S., Skopek, J., & Triventi, M. (Eds.). (2016). *Models of secondary education and social inequality*. Edward Elgar Publishing. https://doi.org/10.4337/9781785367267

Boudon, R. (1974). *Education, opportunity, and social inequality: Changing prospects in Western Society*. Wiley-Interscience.

Bourdieu, P. (1977). Cultural reproduction and social reproduction. In J. Karabel, A. H. Halsey, & Karabel-Halsey (Eds.), *Power and ideology in education* (pp. 487–511). Oxford University Press.

Bourdieu, P. (2002). Habitus. In J. Hillier & E. Rooksby (Eds.), *Habitus: A sense of place* (pp. 27–34). Ashgate.

Breen, R., & Goldthorpe, J. H. (1997). Explaining educational differentials: Towards a formal rational action theory. *Rationality and Society, 9*(3), 275–305.

Brunello, G., & Checci, D. (2006). *Does school tracking affect equality of opportunity? New international evidence* (IZA Discussion Paper No. 2348). Forschungsinstitut zur Zukunft der Arbeit.

Buchholz, S., & Schier, A. (2015). New game, new chance? Social inequalities and upgrading secondary school qualifications in West Germany. *European Sociological Review, 31*(5), 603–615.

Buchholz, S., Skopek, J., Zielonka, M., Ditton, H., Wohlkinger, F., & Schier, A. (2016). Secondary school differentiation and inequality of educational opportunity in Germany. In H.-P. Blossfeld, S. Buchholz, J. Skopek, & M. Triventi (Eds.), *Models of secondary education and social inequality* (pp. 79–92). Edward Elgar Publishing. https://doi.org/10.4337/9781785367267.00014

Diefenbach, H. (2010). Bildungschancen und Bildungs(miss)erfolg von ausländischen Schülern oder Schülern aus Migrantenfamilien im System schulischer Bildung. In R. Becker & W. Lauterbach (Eds.), *Bildung als Privileg: Erklärungen und Befunde zu den Ursachen der Bildungsungleichheit* (4. Aufl., pp. 221–245). VS Verlag für Sozialwissenschaften.

DiPrete, T. A., & Eirich, G. M. (2006). Cumulative advantage as a mechanism for inequality: A review of theoretical and empirical developments. *Annual Review of Sociology, 32*, 271–297. https://doi.org/10.1146/annurev.soc.32.061604.123127

Ditton, H. (2010). Schullaufbahnen und soziale Herkunft – eine Frage von Leistung oder Diskriminierung? In S. Aufenanger, F. Hamburger, L. Ludwig, & R. Tippelt (Eds.), *Bildung in der Demokratie* (pp. 79–99). Barbara Budrich.

Ditton, H. (2013a). Bildungsverläufe in der Sekundarstufe: Ergebnisse einer Längsschnittstudie zu Wechseln der Schulform und des Bildungsgangs. *Zeitschrift für Pädagogik, 59*(6), 887–911.

Ditton, H. (2013b). Wer geht auf die Hauptschule? Primäre und sekundäre Effekte der sozialen Herkunft beim Übergang nach der Grundschule. *Zeitschrift für Erziehungswissenschaft, 16*(4), 731–749. https://doi.org/10.1007/s11618-013-0440-y

Dollmann, J. (2016). Less choice, less inequality? A natural experiment on social and ethnic differences in educational decision-making. *European Sociological Review, 32*(2), 203–215. https://doi.org/10.1093/esr/jcv082

Duchhardt, C., & Gerdes, A. (2013). *NEPS technical report for mathematics – Scaling results of starting Cohort 4 in ninth grade* (NEPS Working Paper Nr. 22).

Erikson, R., & Jonsson, J. O. (1996). Explaining class inequality in education: The Swedish test case. In R. Erikson (Ed.), *Can education be equalized? The Swedish case in comparative perspective* (pp. 1–63). Westview Press.

Esser, H. (1999). *Soziologie: Spezielle Grundlagen*. Band 1: Situationslogik und Handeln. Campus.

Esser, H. (2016). The model of ability tracking – Theoretical expectations and empirical findings on how educational systems impact on educational success and inequality. In H.-P. Blossfeld, S. Buchholz, J. Skopek, & M. Triventi (Eds.), *Models of secondary education and social inequality* (pp. 25–41). Edward Elgar Publishing.

Haberkorn, K., Pohl, S., Hardt, K., & Wiegand, E. (2012). *NEPS technical report for reading – Scaling results of starting Cohort 4 in ninth grade* (NEPS Working Paper Nr. 16). Otto-Friedrich-Universität, Nationales Bildungspanel.

Hillier, J., & Rooksby, E. (2002). Introduction. In J. Hillier & E. Rooksby (Eds.), *Habitus: A sense of place* (pp. 3–25). Ashgate.

Kramer, R.-T. (2013). Bildungshabitus und Schulkultur – Zu einer kulturtheoretischen Perspektive auf Bildungsungleichheiten und die Gestaltung schulischer Übergänge. In G. Bellenberg & M. Forell (Eds.), *Bildungsübergänge gestalten: Ein Dialog zwischen Wissenschaft und Praxis* (pp. 151–173). Waxmann.

Kramer, R.-T. (2017). „Habitus" und „kulturelle Passung": Bourdieusche Perspektiven für die ungleichheitsbezogene Bildungsforschung. In M. Rieger-Ladich & C. Grabau (Eds.), *Pierre Bourdieu: Pädagogische Lektüren* (pp. 183–205). Springer Fachmedien Wiesbaden.

Kristen, C. (2002). Hauptschule, Realschule oder Gymnasium? *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 54*(3), 534–552.

Lareau, A. (2011). *Unequal childhoods: class, race, and family life* (2nd ed., with an update a decade later). University of California Press.

Little, R. J. A. (1988). Missing-data adjustments in large surveys. *Journal of Business & Economic Statistics, 6*(3), 287–296.

Marsh, H. W., & Hau, K.-T. (2003). Big-fish-little-pond effect on academic self-concept: A cross-cultural (26-country) test of the negative effects of academically selective schools. *American Psychologist, 58*(5), 364–376.

McKelvey, R. D., & Zavoina, W. (1975). A statistical model for the analysis of ordinal level dependent variables. *Journal of Mathematical Sociology, 4*(1), 103–120.

Müller-Benedict, V. (2007). Wodurch kann die soziale Ungleichheit des Schulerfolgs am stärksten verringert werden? *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 59*(4), 615–639. https://doi.org/10.1007/s11577-007-0080-4

OECD. (2016). *PISA 2015 results (Volume II): Policies and practices for successful schools*. OECD Publishing. https://doi.org/10.1787/9789264267510-en

Pfost, M., Rausch, T., Schiefer, I. M., & Artelt, C. (2018). Zur Entwicklung von Gymnasiastinnen und Gymnasiasten ohne Gymnasialempfehlung. *Zeitschrift für Erziehungswissenschaft, 21*(3), 511–534. https://doi.org/10.1007/s11618-017-0787-6

Pietsch, M., & Stubbe, T. C. (2007). Inequality in the transition from primary to secondary school: School choices and educational disparities in Germany. *European Educational Research Journal, 6*(4), 424–445. https://doi.org/10.2304/eerj.2007.6.4.424

Pohl, S., & Carstensen, C. H. (2012). *NEPS technical report – Scaling the data of the competence tests* (NEPS Working Paper Nr. 14). Otto-Friedrich-Universität, Nationales Bildungspanel.

Roeder, P. M., & Schmitz, B. (1995). *Der vorzeitige Abgang vom Gymnasium*. Max-Planck-Institut für Bildungsforschung.

Rubin, D. B. (1987). *Multiple imputation for nonresponse in surveys. Wiley series in probability and mathematical statistics: Applied probability and statistics*. Wiley.

Schimpl-Neimanns, B. (2000). Soziale Herkunft und Bildungsbeteiligung: Empirische Analysen zu herkunftsspezifischen Bildungsungleichheiten zwischen 1950 und 1989 [Social origin and educational participation: empirical analyses of educational inequality by social origin from 1950 to 1989]. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 52*(4), 636–669.

Schöps, K., & Saß, S. (2013). *NEPS technical report for science – Scaling results of starting Cohort 4 in ninth grade* (NEPS Working Paper Nr. 23). Otto-Friedrich-Universität, Nationales Bildungspanel.

Secretariat of the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany. (Ed.). (2017). *The education system in the Federal Republic of Germany 2014/2015: A description of the responsibilities, structures and developments in education policy for the exchange of information in Europe*. https://www.kmk.org/fileadmin/Dateien/pdf/Eurydice/Bildungswesen-engl-pdfs/dossier_en_ebook.pdf

Skopek, J., Pink, S., & Bela, D. (2013). *Starting Cohort 4: Grade 9 (SC4) SUF version 1.1.0 data manual*. National Educational Panel Study (NEPS).

Stubbe, T. C. (2009). Bildungsentscheidungen in der Sekundarstufe I – Sekundäre Herkunftseffekte an Hamburger Schulen. *Zeitschrift für Soziologie der Erziehung und Sozialisation, 29*(4), 419–436.

van Buuren, S., & Oudshoorn, K. (1999). *Flexible multivariate imputation by MICE* (TNO Report PG/VGZ/99.054). TNO Institute Prevention and Health.

van Buuren, S., & Oudshoorn, C. (2000). *Multivariate imputation by chained equations: MICE V1.0 user's manual* (TNO Report PG/VGZ/00.038). TNO Institute Prevention and Health. http://www.stefvanbuuren.nl/publications/MICE%20V1.0%20Manual%20TNO00038%202000.pdf

Weinert, S., Artelt, C., Prenzel, M., Senkbeil, M., Ehmke, T., & Carstensen, C. H. (2011). Development of competencies across the life span. In H.-P. Blossfeld, H.-G. Rossbach, & J. von Maurice (Eds.), *Education as a lifelong process: The German National Educational Panel Study (NEPS). Zeitschrift für Erziehungswissenschaft: Sonderheft 14* (pp. 67–86). VS Verlag für Sozialwissenschaften.

White, I. R., Royston, P., & Wood, A. M. (2011). Multiple imputation using chained equations: Issues and guidance for practice. *Statistics in Medicine, 30*(4), 377–399.

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Chapter 9
Alternative Routes to Higher Education Eligibility: Inclusion, Diversion and Social Inequality on the Way to Higher Education



Steffen Schindler and Felix Bittmann

Abstract This chapter summarizes key findings from the research project *Alternative Routes to Higher Education Eligibility (ARtHEE)*. Based on data from the German National Educational Panel Study (NEPS), we show that the expansion of alternative routes to higher education eligibility, which has followed from reforms in the 1960s, has been largely ineffective in reducing social inequality in access to higher education. We argue that this is due partly to unintended effects of this expansion of alternative pathways that resulted in diversion processes among students of disadvantaged social origin. These diversion effects channel such students into non-academic secondary school tracks and expose them to learning environments that differ from that of the academic school track. We provide empirical evidence suggesting that exposure to these learning environments affects students' educational aspirations and cognitive development in a way that eventually lowers their chances of staying on a trajectory leading into higher education.

9.1 Introduction and Background

The German education system consists of several important branching points on the way to higher education. One of these is higher education eligibility—a formal certification allowing students to access universities or universities of applied sciences. The traditional form of higher education eligibility is the *Abitur* that students obtain when successfully completing the academic stream (*Gymnasium*) of the tracked secondary education system. Because, historically, social inequality in access to higher education was very pronounced in Germany, an obvious

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explanation for this was that large shares of the students from disadvantaged social origins do not even reach eligibility for higher education because they attend one of the non-academic secondary education tracks (cf. Neugebauer & Schindler, 2012). As a reaction to this, designed to increase overall participation in upper secondary and higher education, Germany initiated a series of reforms in the 1960s (cf. Schindler, 2014). While maintaining the tracked secondary school system, reforms were directed at establishing various options for second-chance education. By introducing add-on upper secondary schools and other institutions of further education, students could reach higher education eligibility even if they did not attend the academic track in lower secondary education.

Previous studies evaluating the influence of these second-chance options are quite reluctant to conclude that they actually have contributed to an actual decrease of social inequality in access to higher levels of education (Hillmert & Jacob, 2010; Schindler, 2014; Buchholz & Schier, 2015; Kurz & Böhner-Taute, 2016). Whereas alternative pathways to higher education eligibility do indeed seem to be particularly attractive to students of disadvantaged social origin (Schindler, 2014; Buchholz & Pratter, 2017), one striking observation is that these pathways are also connected to very low transition rates to higher education compared to the transition rates among students with the traditional *Abitur* (Schindler, 2014; Schneider & Franke, 2014). It has been suggested that this pattern could follow from the fact that enhanced competition for vocational training programmes requires students to possess an upper secondary educational credential that can be achieved most easily via alternative routes (Müller & Pollak, 2004; Schindler, 2014). Because these students do not intend to enter the higher education system, alternative routes might be more influential in raising higher education eligibility rates than in raising higher education attainment rates. However, the causal mechanism behind this pattern would be related to competition for training opportunities and not result from the introduction of alternative routes as such. Whether or not the introduction of second-chance options in itself contributed to an overall decrease of social inequality in higher education eligibility and higher education attainment rates has yet to be answered with sufficient empirical evidence from rigour counterfactual analytical approaches. In addition, whereas theoretical arguments about the social mechanisms triggered by the reforms have been suggested (Schindler, 2014), empirical tests have not been conducted so far.

These research desiderata constituted the starting point for the research project *Alternative Routes to Higher Education Eligibility (ARtHEE)*. As part of the DFG Priority Programme 1646 *Education as a Lifelong Process*, the project sought to take advantage of the newly established data infrastructure of the German National Educational Panel Study (NEPS) in order to address the research gaps outlined above. The project pursued two overarching targets:

1. To evaluate whether the introduction of alternative pathways contributed to an overall reduction of social inequality in higher education eligibility and higher education attainment

2. To spell out which social mechanisms have been stimulated by the introduction of alternative routes to higher education eligibility and provide empirical evidence for them

This chapter provides a summary of the project's outcomes and findings. To provide a frame of reference, we start by giving a brief overview of the changes in the educational system brought about by the reforms. Then, we sketch our main theoretical arguments as to how these reforms can be expected to interfere with the generating factors behind social inequalities on the way to higher education. We provide a short description of the NEPS data that form the basis for all our empirical analyses before summarizing our main findings and conclusions with respect to the two targets outlined above.

9.2 The Context: Reforms and Alternative Routes to Higher Education Eligibility

The traditional German secondary education system begins with Grade 5 and comprises three hierarchical school tracks: the 5-year lower secondary school track (*Hauptschule*), the 6-year intermediate track (*Realschule*), and the 9-year academic track (*Gymnasium*). The latter is the only track that awards higher education eligibility (*Abitur*). Before the reforms, only few institutionalized options existed to upgrade school-leaving certificates to a higher level credential, and upward mobility between tracks was difficult. Hence, it was very uncommon for students who did not start secondary education in the academic track to reach higher education eligibility later on (Schindler, 2017).

The aim of the reforms in the 1960s was to reduce the dead-end character of the tracked school system by establishing more opportunities for upward track mobility (Schindler 2014). All federal states introduced new add-on upper secondary schools at which students could go on from an intermediate school leaving degree (*Mittlere Reife*) to obtain eligibility for higher education. Usually, these schools comprise 2- to 3-year programmes with a strong vocational focus.

The reforms also introduced a differentiation of higher education eligibility. Most vocational schools award a restricted version of the higher education entrance qualification (*Fachhochschulreife*). This qualification provides access to universities of applied sciences (*Fachhochschulen*) that have been established as a vocationally oriented second tier of the higher education system. It does not provide access to the traditional universities.

In addition to these second-chance options in the vocational school sector, some federal states have introduced comprehensive schools next to the traditional tracked tripartite school system. Figure 9.1 displays how the relative importance of different pathways to higher education eligibility changed for different school-leaving cohorts between 1967 and 2017. School-leaving cohorts of the mid-1970s were the first to

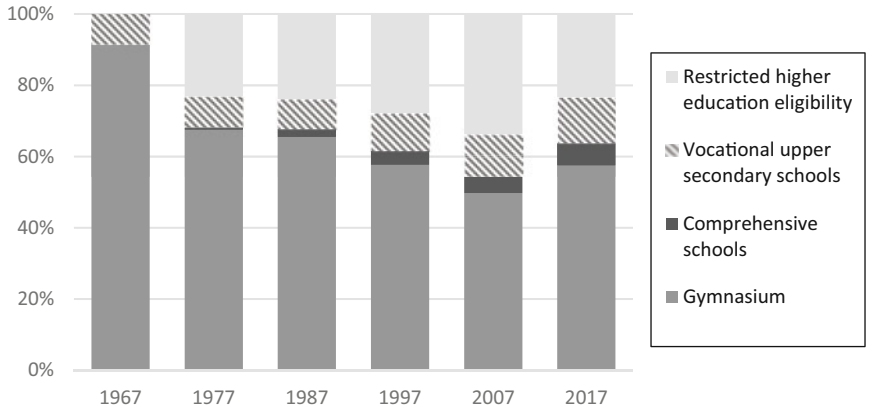


Fig. 9.1 Routes to higher education eligibility—school-leaver cohorts 1967–2017. (Source: Statistisches Bundesamt (1967, 1979a, b, 1989a, b, 2019a, b). West Germany only. The increase in the Gymnasium share 2017 partly results from a change of classification in official statistics)

display substantive fractions of students who received their higher education eligibility via the newly established alternative routes.

9.3 Social Mechanisms: Intended and Unintended Consequences of the Reforms

In this section, we want to describe the social mechanisms that can be expected to follow from the reforms. We argue that the reforms' influence on social inequalities in higher education eligibility and attainment results from both intended and unintended consequences. We shall only summarize the main lines of argumentation here, and provide a more detailed and formalized account in Schindler and Bittmann (2021).

Conceptually, we can divide the pathway to higher education completion into two important sequences: the first is the attainment of higher education eligibility; the second, the completion of higher education, given eligibility. Equation (9.1) differentiates the role of (a) traditional and (b) alternative routes to higher education eligibility in this process.

$$P^o_{he} = \underbrace{P^o_{gym} * P^o_{he|gym}}_{\text{a}} + \underbrace{P^o_{alt} * P^o_{he|alt}}_{\text{b}} + \underbrace{P^o_{non} * 0}_{\text{c}} \tag{9.1}$$

P^o_{he} describes the propensity to attain a higher education degree in a given population of social origin o. The term a refers to the stream through the traditional academic track (*Gymnasium*): the product of the propensity to reach higher education

eligibility at the *Gymnasium* P^o_{gym} and the propensity to attain a higher education degree, given that eligibility has been attained at the *Gymnasium* $P^o_{he|gym}$. The term *b* refers to alternative streams: attaining higher education eligibility through any alternative route P^o_{alt} and the respective conditional propensity to attain a higher education degree $P^o_{he|alt}$. The term *c* describes the propensity not to reach higher education eligibility P^o_{non} and, relatedly, not to reach a higher education degree. Adding up P^o_{gym}, P^o_{alt}, and P^o_{non} results in the full population of students from social origin *o*. Differences in the higher education attainment rates P^o_{he} between students of different social origins are a function of the differences in the single parameters on the right-hand side of Eq. (9.1).

The intended consequences of the reforms were to increase the *b term* at the expense of the *c term*: students who otherwise would not have reached higher education eligibility in the absence of alternative pathways might now take advantage of these new opportunities. We refer to this process as *inclusion*. If we consider participation in upper secondary education as the result of a cost–benefit assessment as suggested by the standard rational choice frameworks (Erikson & Jonsson, 1996; Breen & Goldthorpe, 1997), we can conceive of alternative pathways as a less costly or less demanding option compared to the standard route through the traditional *Gymnasium*. This might be particularly appealing for students of disadvantaged origin. In this group, a substantial number of students might prefer option *b* over option *c*, while preferring option *c* over option *a*.

On the other hand, the availability of alternative pathways might also create inclusion for students of privileged social origin who—for whatever reason—did not manage to reach higher education eligibility directly through the academic track. This group of students should have particularly high incentives to reach higher educational levels due to status maintenance pressures (Breen & Goldthorpe, 1997). Hence, the inclusion mechanism works in favour of a reduction of inequalities in access to higher education eligibility and attainment only if it creates more inclusion for students of disadvantaged than of privileged origin.

The creation of alternative pathways might not only lead to shifts from the *c term* to the *b term* of Eq. (9.1), but also stimulate shifts from the *a term* to the *b term*. We refer to this latter process as *diversion*. Whereas such diversion processes do not necessarily alter the overall higher education eligibility rates as such, they might have implications for the subsequent transition to higher education. Diversion means that students who—in the absence of alternative pathways—would have obtained a traditional *Abitur* at the *Gymnasium* now start secondary education in a lower-level track and obtain their higher education eligibility via second-chance education, most of which is located in the vocational education sector. It follows that these students are exposed to substantially different learning environments. This relates to various influences such as teacher quality, peer group compositions, or curricula. These factors can influence a student's cognitive development and occupational and educational aspirations—both of which are important determinants for the transition to higher education. In addition, if the alternative route leads to a restricted higher education entrance qualification, it also creates barriers to university enrolment and

the related fields-of-study choice set. If we again consider the choice between the direct route through the *Gymnasium* and alternative routes as the outcome of a cost–benefit assessment, the latter option appears as the less demanding and less risky option due to its sequential trajectory (intermediate school degree plus add-on higher education eligibility). Taking into account that students of disadvantaged social origin tend to be more risk-averse than students of privileged social origin (Breen et al., 2014; Barone et al., 2018), it is plausible to assume that diversion processes will be less common in the latter group. Hence, an unintended consequence of introducing alternative routes to higher education eligibility could have been that the reforms stimulated diversion processes that are more pronounced among students of disadvanteged than privileged origin. This mechanism works in favour of reinforcing social inequalities in access to higher education.

The remainder of this chapter will describe empirical findings from the ARtHEE project that correspond to these theoretical considerations. We shall present two sets of analyses: the first set seeks to answer the question whether the mechanisms outlined above—in total—have led to a significant reduction (or amplification) of social inequalities in higher education eligibility and higher education attainment. The findings stem from simulation analyses that we undertook to detect the likelihood that the reforms did indeed have an attenuating (or amplifying) effect on the levels of social inequalities. The second set is devoted to the implications of the diversion mechanism. We seek to identify whether and to what extent students who can be considered as being diverted into alternative pathways differ from students in the academic track with respect to their cognitive development and the adjustment of their educational goals.

9.4 Data

Like all contributions in this volume, our analyses are based on data from the German National Educational Panel Study (NEPS, Blossfeld & Rossbach, 2019). To evaluate whether the expansion of alternative routes to higher education eligibility led to an overall reduction of social inequalities, we draw on NEPS Starting Cohort 6 (SC6). SC6 is a sample of adults born between 1944 and 1986 and contains longitudinal information on their complete educational and occupational histories. This information was collected retrospectively in the first wave, which took place in 2009/2010, and has been updated annually in a subsequent panel design.[1] Apart from the longitudinal information on education and employment, the data also contain rich sociodemographic information and various indicators of social origin.

[1] A subsample of an identical precursor study (Arbeiten und Lernen im Wandel—ALWA) conducted in 2007/2008 has been integrated into the first wave of the NEPS SC6. An additional refreshment sample was drawn in 2011/2012. See also https://www.neps-data.de/Data-Center/Data-and-Documentation/Start-Cohort-Adults

For our analyses, we restrict the sample further to synchronize it with our research interests. We shall display the sample selection criteria next to the description of the results below.

To test our expectations that the different learning environments associated with alternative routes to higher education eligibility have a differential influence on the individual development of cognitive competencies and aspirations, we focus on the sequence of lower secondary education that begins with 5th grade in Germany. For this purpose, we draw on NEPS Starting Cohort 3 (SC3). SC3 comprises a sample of students in Grade 5 who were surveyed in the autumn or winter of 2010.[2] The students have been followed up annually in a prospective panel design. The data contain repeated measurements of educational aspirations and cognitive competencies in different domains. In our analyses, we are able to draw on five consecutive waves until Grade 9. Like all NEPS data sets, SC3 contains rich information on social background collected via parent questionnaires.

9.5 Alternative Routes and Overall Social Inequality

In this section, we report our main findings on whether the expansion of alternative routes to higher education eligibility contributes to a reduction (or reinforcement) of social inequalities in access to higher education eligibility and attainment. The full set of analyses can be found in Schindler & Bittmann (2021).

For the purpose of this study, we have to restrict the NEPS SC6 sample further. We consider only two birth cohorts to identify the reform effect: 1944–1950 and 1965–1980. The former cohort was largely unaffected by the educational reforms, whereas students born in the second cohort had access to the full range of alternative routes to higher education eligibility. For the sake of simplicity, we compare only two social classes as indicators of social origin: the working and the salariat class, following the EGP class approach and based on the highest class among parents (cf. Erikson, 1984). Table 9.1 summarizes these and all further sample restrictions.

The height of the bars in Fig. 9.2 indicates the higher education eligibility rates by cohort and social origin. The light grey areas represent the traditional *Abitur* obtained at a *Gymnasium* whereas the dark grey areas represent alternative routes

Table 9.1 Sample selection criteria (1)

Birth cohorts	1944–1950 ($N = 1045$) and 1965–1980 ($N = 2765$)
Social origin	EGP I + II (salariat) and EGP IIIb + VI + VII (working class)
Place of birth	West Germany
Immigration status	Born in Germany or immigrated before age 6
Handling of missing data	Listwise deletion

[2] See also https://www.neps-data.de/Data-Center/Data-and-Documentation/Start-Cohort-Grade-5

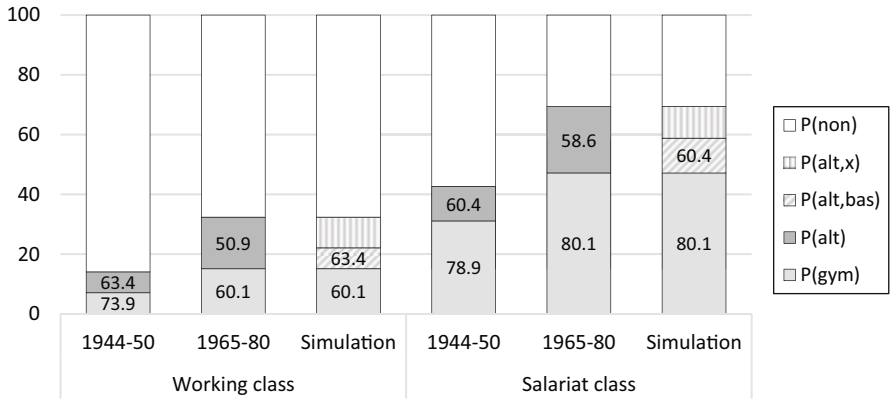


Fig. 9.2 Eligibility rates and conditional higher education graduation rates by pathways to eligibility—factual and simulated. (Source: Own illustration based on Schindler and Bittmann (2021). Numbers in bars indicate conditional higher education attainment rates)

to higher education eligibility. We can make the following observations: first, the eligibility rates in the older cohort differ dramatically by social origin. Whereas, for both groups, the eligibility rates have expanded in the younger cohort, there are still very pronounced differences between them. Second, alternative routes to higher education eligibility are visible even in the older cohort. In relative terms, they have been more important for students with a working-class background than for students from salariat-class families. However, between the older and the younger cohort, alternative routes have expanded more than the traditional pathway. For students from the working class, they have become slightly more important than the traditional pathway; whereas for students from the salariat class, the traditional pathway is still the predominant way of reaching eligibility for higher education

The numbers in the bars indicate the conditional higher education attainment rates. For example, among working-class students born in the 1965–1980 cohort who obtained their higher education eligibility through alternative routes, 50.9 per cent attained a higher education degree. We can observe the following patterns: first, the conditional transition rates tend to be larger for salariat-class students than for working-class students—except for the alternative routes in the older cohort. Second, differences have become larger in the younger cohort. This is true for both the traditional and the alternative pathways. This can be attributed to decreasing transition rates among working-class students, whereas the rates of the salariat-class students have remained quite stable

The bars labelled 'simulation' exemplify the assumptions that we have to make for our simulation analyses. We consider a counterfactual situation, in which the reforms introducing new alternative routes would not have been implemented. We assume that this would not affect the baseline rates of students in the traditional pathway (P_{gym}) and their conditional higher education attainment rates. However, this certainly would reduce the rates of students obtaining higher education

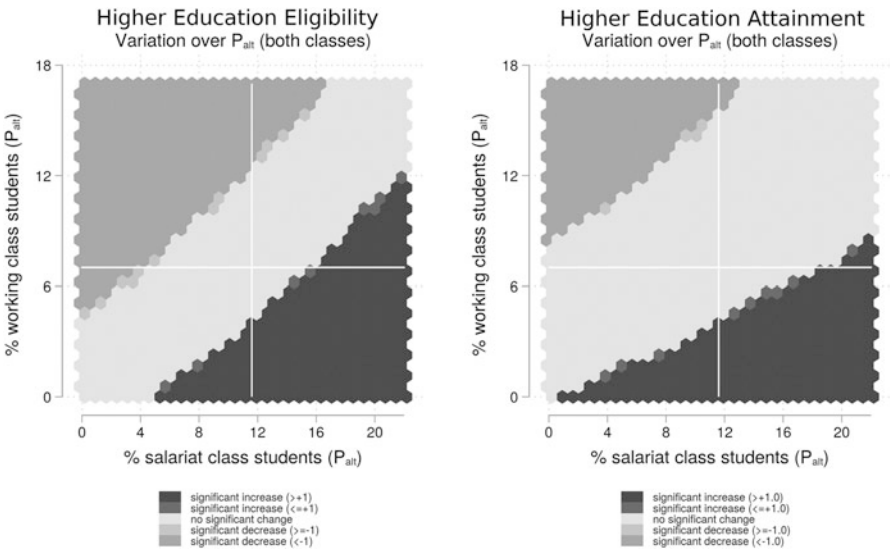


Fig. 9.3 Simulated changes in odds ratios compared to factual situation. (Source: Own illustration based on Schindler and Bittmann (2021))

eligibility through alternative routes. Because some alternative routes already existed before the reforms, we assume that the respective rates in the counterfactual situation are equal to those from the older cohort ($P_{alt,bas}$). We also assume that the conditional higher education attainment rates in this category are identical to those from the older cohort.

Whereas these assumptions can be made rather plausibly, it is less straightforward to come up with assumptions about the rates in the area of the bars denoted with $P_{alt,x}$. This area represents the combination of students who—in the factual situation—are either diverted from the traditional pathway or obtain the higher education eligibility as a result of the inclusion mechanism. In the counterfactual scenario, this would mean that students affected by the inclusion mechanism would not obtain higher education eligibility, whereas students affected by the diversion mechanism would obtain higher education eligibility through the traditional pathways on top of those denoted by P_{gym}. Hence, we have to identify the percentage of students in each group that is affected by the latter mechanism if we want to calculate counterfactual higher education eligibility rates. However, it is not possible to determine these shares analytically. We only know that, theoretically, it can be as high as the part of the bar denoted by $P_{alt,x}$ (10.3 percentage points for the working class and 10.6 percentage points for the salariat). Note that this maximum value reflects a rather unrealistic factual situation in which the reforms cause only diversion and no inclusion.

Based on these considerations, the left-hand panel of Fig. 9.3 simulates how inequalities in higher education eligibility rates (as indicated by the odds ratio) change compared to the factual situation if we vary the percentages of working-

and salariat-class students in alternative routes. The shaded areas indicate whether the respective combination of percentages leads to significant changes in the level of inequality in higher education eligibility rates compared to the factual situation (as indicated by the odds ratio). We indicate both whether the change is statistically significant and whether it is substantial (a change in the odds ratio larger or smaller than 1). The lower left-hand corner indicates a situation in which all students who obtain their eligibility via alternative routes in the factual situation would not obtain any higher education eligibility at all in the counterfactual scenario. The upper right corner is identical to the factual situation. The white lines indicate our assumed values for $P_{alt,bas}$, namely the percentages of students who would obtain their eligibility via alternative routes even in the absence of reforms

This means that we can conceive of the upper right-hand quadrant as an area representing the $P_{alt,x}$ from Fig. 9.2. We can use this area to simulate changes in the odds ratio that result from different combinations of diversion rates between working- and salariat-class students: the more we move to the right, the more diversion (and less inclusion) we assume for salariat-class students; the more we move up, the more diversion (and less inclusion) we assume for working-class students. Among the different combinations in this quadrant, we see a broad corridor indicating no significant change in the odds ratio. The counterfactual scenario is connected to a substantial and statistically significant increase in inequalities in access to higher education eligibility only if there is much diversion among the salariat-class students and much inclusion among working-class students (lower right-hand corner of the quadrant). This scenario would mean that the reforms were successful in reducing social inequality in access to higher education eligibility. Likewise, the reforms increased the level of inequality if they led to much diversion among working-class students and much inclusion among salariat-class students (upper left-hand corner of the quadrant). Whereas we consider it rather unlikely that the reforms had such pronounced differential implications for students of different social backgrounds (cf. our theoretical arguments above) and because the areas indicating significant changes are rather small, we tend to conclude that, overall, it is very unlikely that the reforms had a substantial causal influence on the level of social inequalities in higher education eligibility rates.

The right-hand panel of Fig. 9.3 repeats the same exercise for social inequalities in higher education attainment. The simulation works in a quite similar way to the one presented above. We just have to make additional assumptions about the conditional higher education attainment rates as indicated in Fig. 9.2.[3] We can see that the corridor indicating no significant change is even broader than in the previous analysis. In the upper right-hand quadrant, significant changes occur only for very small and extreme combinations. Hence, with regard to higher education attainment,

[3] For students in the diversion category, we make the assumption of a linear decrease of the conditional attainment rate (from 63.4 to 50.9 for the working class and from 60.4 to 58.6 for the salariat) as $P_{alt,x}$ increases in our simulation.

we conclude that it is very unlikely that the reforms led to changes in the level of social inequality.

9.6 Diversion Mechanisms

In the second part of our project, we were concerned with the social mechanisms stimulated by the reforms. In particular, we wanted to take a closer look at students who are affected by the diversion mechanism—namely, those who would have attended the traditional pathway in the absence of the reforms, but now want to acquire higher education eligibility via alternative routes. Whereas it is not possible to identify what students would have done in a counterfactual world, we tried to identify certain characteristics that can be assumed to be typical for students who could have attended the *Gymnasium* but chose to attend a lower level track in lower secondary education. We shall summarize the results from two analyses that sought to investigate the consequences of attending a lower level track instead of the *Gymnasium* with respect to educational aspirations and the development of cognitive competencies.

9.6.1 Aspirations

In this section, we report our main findings on whether attending a non-academic school track in secondary education has different consequences for the further development of idealistic educational aspirations than attending *Gymnasium*. Following our theoretical arguments from above, we expect that learning environments in alternative routes (here: non-academic lower secondary education) will have adverse effects on the maintenance of aspirations for higher education eligibility. The full set of analyses can be found in Bittmann and Schindler (2021).

This study is based on NEPS SC3. We have to restrict the sample further for the purpose of our analyses. To come as close as possible to an approximation of students that can be considered as diverted, our sample contains only students who attended the same secondary school track throughout our whole observation window, who show academic performance that would have allowed them to complete the *Gymnasium* successfully, and who stated idealistic aspirations for a higher education eligibility at Grade 5. Table 9.2 summarizes these and all further sample restrictions and lists the variables used in the analyses.

Figure 9.4 presents a descriptive overview of how idealistic aspirations develop across successive school years between Grades 5 and 9 for different school tracks. Whereas almost none of the students in the academic track change their initial aspirations for higher education eligibility, we observe a substantial drop for students in the non-academic tracks. In Grade 9, fewer than 80 per cent of these students report idealistic aspirations for higher education eligibility

Table 9.2 Sample selection criteria and variables (2)

Excluded from sample	Students attending special needs schools Students who switched tracks between Grades 5 and 9 Students whose combined math and reading competencies (composite score) in survey wave 1 (Grade 5) are below the sample median Students who do not state idealistic aspirations for higher education eligibility in Grade 5 Observations outside common support (as derived from propensity score matching models)
Independent variable	School track: Non-academic ($N = 185$) vs academic ($N = 978$)
School-level mediators	Share of students with aspirations for higher education eligibility Share of students with academically educated parents Average academic competencies (based on composite score)
Control variables (propensity score models)	Gender, age at time of interview, migration background (none vs one parent vs both parents born abroad), parents' education (below upper secondary vs upper secondary vs higher education), competence measures (math performance, reading performance, reasoning score, perceptual speed score), whether the parents are living together, place of residence (West vs East Germany)
Handling of missing data	Listwise deletion

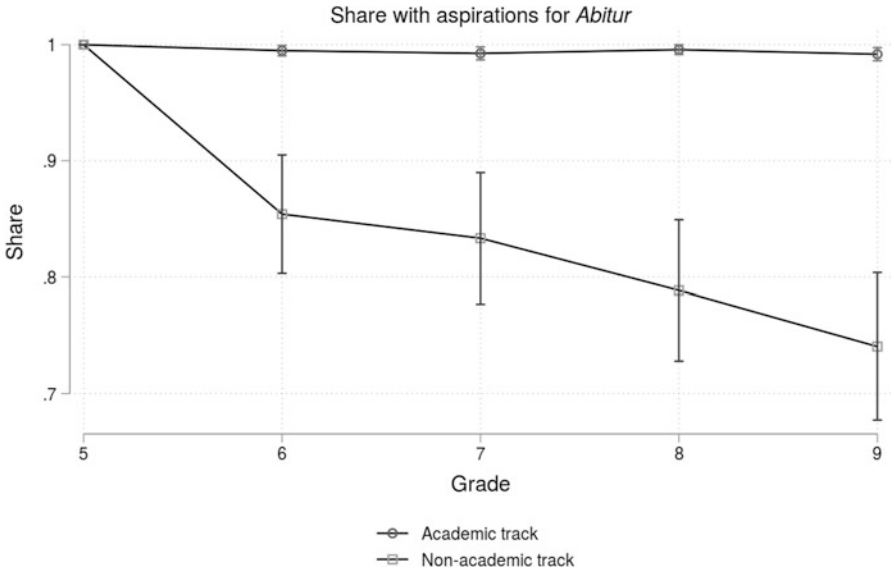


Fig. 9.4 Development of idealistic aspirations by track attendance and social origin. (Source: Own illustration based on Bittmann and Schindler (2021). 95% confidence bands depicted)

To control for selection into school tracks, we draw on propensity score matching. The propensity scores are predicted from the variables listed in Table 9.2. The results of the matching analyses are displayed in Table 9.3. The

Table 9.3 Logistic regression of aspirations for higher education eligibility on school track attendance and mediators (Grade 9)

	M0 (Reduced)	M1 (Full)	Diff
Academic school track	0.174*** (0.032)	0.087* (0.035)	0.086 (−)
			49.7%
Average share of parents with higher education		0.015 (0.001)	23.0%
Average share of students with high aspirations		0.026 (0.012)	39.7%
Average competencies		−0.008 (0.014)	−13.0%

Source: Bittmann and Schindler (2021)
N = 1063. Average partial effects (standard errors in parentheses). Models controlling for propensity scores
Standard errors clustered within school
*p < 0.05, **p < 0.01, ***p < 0.001

analysis relates to the difference in aspirations for higher education eligibility between students in the academic and the non-academic track. Model 1 controls only for the propensity scores. The positive and statistically significant coefficient for the academic track replicates the gap found in the descriptive analyses in Fig. 9.4. In Model 2, we add a set of school-level variables that we assume will explain why students in non-academic tracks lose their aspirations for higher education eligibility more often than students in the academic track (cf. Table 9.2). We calculate the contribution of these mediators in explaining the gap between tracks by drawing on the method suggested by Karlson et al. (2012).[4] In total, these mediators are able to account for about 50 per cent of the gap in aspirations between tracks in Grade 9. However, the largest contribution (40 per cent) comes from the variable indicating the school composition of students with aspirations for higher education eligibility. Another contribution (23 per cent) comes from the variable indicating the school-level percentage of academically educated parents. The third school-level indicator (average academic competencies) does not contribute to explaining the gap

Our analyses show that learning environments make a difference. With our sample restriction criteria and the propensity score matching procedure, we sought to approximate a comparison of students who enter lower secondary education with aspirations for higher education eligibility and who are otherwise similar except for in their school tracks. Our results suggest that exposure to non-academic learning environments, which is a consequence of the diversion mechanism stimulated by the reforms, can cause students to abandon their initial educational goals. In that sense, we can provide empirical evidence for one of the unintended consequences of the reforms that we have outlined in our theoretical discussion above.

[4] Our calculations are based on the *khb* package for Stata (Kohler et al., 2011).

Table 9.4 Sample selection criteria and variables (3)

Excluded from sample	Not participating in first wave of survey Not in same school from Wave 1 to 5 Not attending the academic (*Gymnasium*) or intermediate track (*Realschule*) Students in classes with fewer than 10 responding students Students with special needs or dyslexia or dyscalculia
Independent variable	School track: non-academic ($N = 475$) vs. academic ($N = 1143$)
Classroom-level mediators	Instructional quality index Share of students with academically educated parents Share of students with migrant background Average mathematics/reading competence
Control variables (entropy balancing) Individual-level controls	Gender, age at Wave 1, highest parental educational qualification, highest parental ISEI, migrant background, number of books in household, parents living together, number of siblings, time child spends reading, reasoning score, perceptual speed score, grade repetition, federal state school system (binary) Individual mathematics/reading competence of the previous wave
Handling of missing data	Multiple imputation (20 complete datasets)

9.6.2 Competence Development

In this section, we report our main findings regarding whether attending a non-academic school track in secondary education has different consequences for the further development of academic competencies than attending *Gymnasium*. The results presented here stem from a collaboration with Claudia Traini and Corinna Kleinert (Traini et al., 2021). Similar to our arguments related to aspirations, we expect that the differential learning environments in academic and non-academic lower secondary tracks will create differences in the development of students' cognitive competencies. This study is again based on NEPS SC3. We summarize all sample restrictions and variables in Table 9.4.

In this study, missing information in the data is imputed using multiple imputation with chained equations to account for selective dropout and to reduce bias. This generated 20 complete datasets. To account for the selection into tracks, we apply a statistical matching procedure based on entropy balancing. This procedure achieves comparability of students in the different tracks through the assignment of individual student weights. These weights are computed by predicting track allocation with the control variables listed in Table 9.4. Further details about the method can be found in Traini et al. (2021)

The analyses comprise two dependent variables: competencies in math and competencies in reading—each measured in Grade 7 and Grade 9. Figure 9.5 displays the differences between the school tracks represented by coefficients from a linear regression model. The coefficients refer to attending the *Gymnasium* instead of the non-academic track. Model 1 depicts the gross differences in average student competencies. Students at the *Gymnasium* show statistically significantly higher

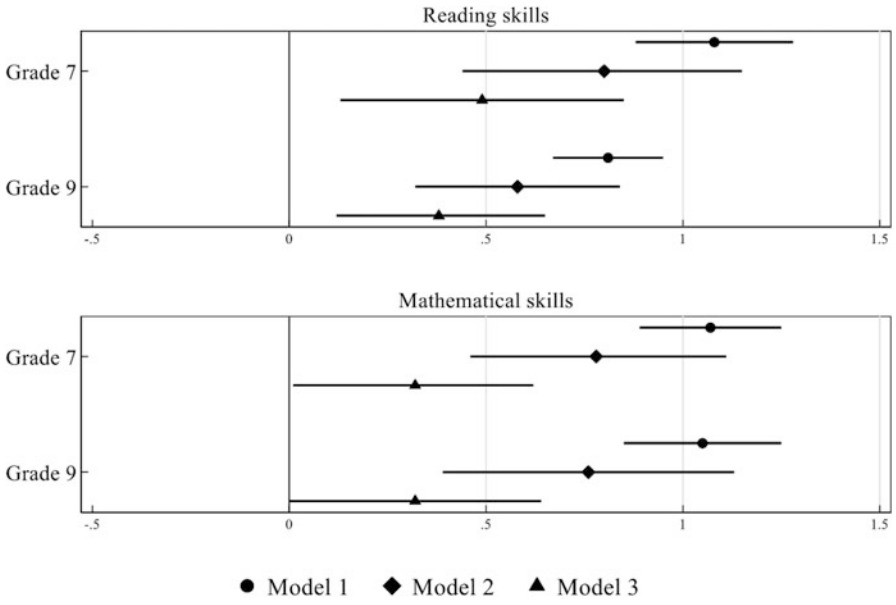


Fig. 9.5 Competence advantages in the Gymnasium (reading and math), by school grade. (Source: Own illustration based on Traini et al. (2021). Coefficients for the academic track (vs. non-academic tracks) with 95% confidence bars from linear regression models. Model 1: no adjustment, Model 2: controlling for initial performance, Model 3: controlling for initial performance and applying matching weights)

academic competencies in both math and reading and also regardless of whether competencies are measured in Grade 7 or 9. This result is to be expected, because students select into the different school tracks based on their cognitive ability. To see whether differences between tracks persist that are independent from selection into tracks, Model 2 controls for the respective competencies in Grade 5; and Model 3 additionally applies the entropy balancing matching. Both subsequent steps of accounting for selection into school tracks reduce differences. However, statistically significant differences in competence levels remain even in the matching model. This means that learning progress between Grade 5 and 9 appears to be steeper in the *Gymnasium* than in the non-academic tracks—even after adjusting for initial differences among the students.

To analyse whether the steeper learning progress in the *Gymnasium* can be ascribed to more supportive learning environments, the following analyses add a series of classroom-level variables to the models to account for contextual influences. The following mediators are selected as indicators of learning environments: instructional quality index (a composite measure of students' ratings regarding the quality of instruction), social background composition (the share of parents with at least one higher education degree), the share of students with a migrant background, and the average classroom-level competencies (derived from a composite measure of math and reading).

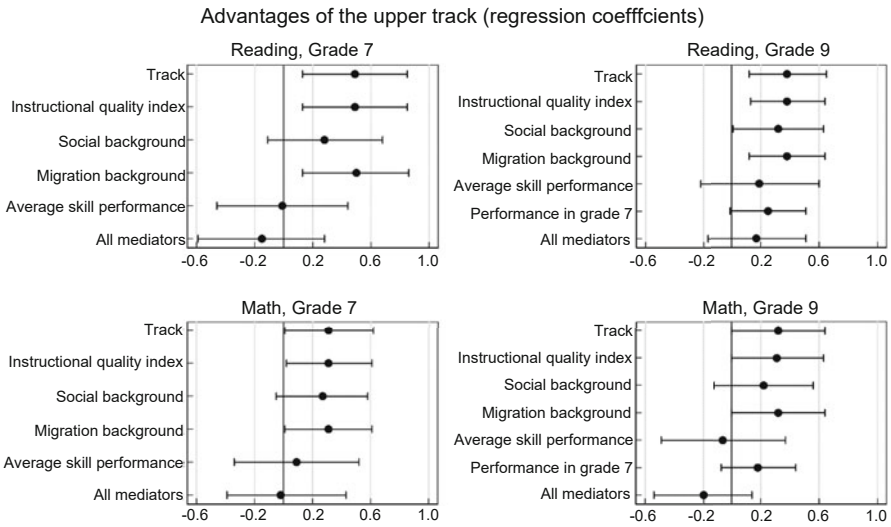


Fig. 9.6 Accounting for competence advantages in the Gymnasium (reading and math) by school grade. (Source: Own illustration based on Traini et al. (2021). Coefficients for the academic track (vs. non-academic tracks) with 95% confidence bars from linear regression models, controlling for mediator variables as indicated in the graph)

Fig. 9.6 summarizes the results of the mediation analyses. The first line in each sub-graph displays the coefficient associated with attending *Gymnasium* instead of the non-academic tracks. This coefficient corresponds to the one from Model 3 in Fig. 9.5 that controls for Grade-5 cognitive competencies and is based on entropy balancing matching. The subsequent rows indicate how this coefficient changes when single mediators are added to the model. The final row displays the coefficient from a model controlling for all mediators jointly. For the Grade 9 models, this also includes controlling for Grade 7 competencies. As can be deducted from the figure, the only classroom-level mediator that substantively and significantly accounts for the differences between school tracks is the average level of students' competencies, whereas the other mediators contribute less to the explanation of the gap. Among these other mediators, social background (measured through parents' education) appears to make the largest contribution. Together, the classroom-level indicators fully account for the differences in cognitive development between *Gymnasium* the non-academic tracks.

9.7 Conclusions

The aim of this chapter was to provide empirical evidence on two research questions that arose out of a concern that the expansion of alternative pathways to higher education eligibility might have led to unintended consequences

regarding the inclusion of students with disadvantaged social backgrounds in higher education.

The first question simply targeted on an assessment of the leverage of these alternative routes in reducing social inequality in access to higher education. Previous research already expressed doubts as to whether an expansion of alternative pathways to higher education eligibility is a suitable measure to reduce social inequality in a sustainable way, and the findings from our *ARtHEE* project further corroborate these doubts. By providing more rigorous evidence with our simulation analyses, we can only conclude that it is very unlikely that the expansion of alternative routes has caused any meaningful reduction in the level of social inequality in access to higher education. It appears that the reforms have not even contributed much to a reduction of inequalities in access to higher education eligibility.

The second question was directed towards explanations for why the expansion of alternative routes did not have an effect on the level of inequality. We argued that the reforms triggered unintended diversion processes that ran counter to the initially intended inclusion effects. A consequence of these diversion processes is that students are exposed to learning environments that can affect both their educational or occupational goals and their cognitive development. We have provided empirical evidence for either mechanism. First, students in non-academic secondary school tracks are more likely than students in the academic track to adjust their educational aspirations in a downward direction. Second, the development of cognitive competencies in the former group clearly falls behind that of the latter group. We have done our best to be able to ascribe those differences to influences of the school track net of all variation in the characteristics of their students. We also found evidence that these differences are routed in contextual factors and influences of the different learning environments that the school tracks represent.

Taken together, the findings of our project clearly indicate that one goal that has been associated with the educational reforms—namely, opening up access routes to higher education for students of disadvantaged origin and thus reducing social inequalities in higher education attainment—has not been reached. Our theoretical explanations and the empirical evidence we found for them showed that policy measures that do not take into account socially selective behavioural incentives can suffer from serious limitations in their effectiveness.

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References

Barone, C., Triventi, M., & Assirelli, G. (2018). Explaining social inequalities in access to university: A test of rational choice mechanisms in Italy. *European Sociological Review, 34*(5), 554–569.

Bittmann, F., & Schindler, S. (2021). Analysing diversion processes in German secondary education: School track effects on educational aspirations. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 73*(2), 231–257. https://doi.org/10.1007/s11577-021-00789-1

Blossfeld, H.-P., & Rossbach, H.-G. (Eds.). (2019). *Education as a lifelong process: The German National Educational Panel Study (NEPS)*. Springer.

Breen, R., & Goldthorpe, J. H. (1997). Explaining educational differentials: Towards a formal rational action theory. *Rationality and Society, 9*(3), 275–305. https://doi.org/10.1177/104346397009003002

Breen, R., van de Werfhorst, H. G., & Jæger, M. M. (2014). Deciding under doubt: A theory of risk aversion, time discounting preferences, and educational decision-making. *European Sociological Review, 30*(2), 258–270.

Buchholz, S., & Pratter, M. (2017). Wer profitiert von alternativen Bildungswegen? Alles eine Frage des Blickwinkels! *Kölner Zeitschrift Für Soziologie Und Sozialpsychologie, 69*(3), 409–435. https://doi.org/10.1007/s11577-017-0484-8

Buchholz, S., & Schier, A. (2015). New game, new chance? Social inequalities and upgrading secondary school qualifications in West Germany. *European Sociological Review, 31*(5), 603–615. https://doi.org/10.1093/esr/jcv062

Bundesamt, S. (1967). *Statistisches Jahrbuch für die Bundesrepublik Deutschland 1967*. Metzler-Poeschel.

Erikson, R. (1984). Social class of men, women and families. *Sociology, 18*(4), 500–514. https://doi.org/10.1177/0038038584018004003

Erikson, R., & Jonsson, J. O. (1996). *Can education be equalized? The Swedish case in comparative perspective*. Westview Press.

Hillmert, S., & Jacob, M. (2010). Selections and social selectivity on the academic track: A life-course analysis of educational attainment in Germany. *Research in Social Stratification and Mobility, 28*(1), 59–76. https://doi.org/10.1016/j.rssm.2009.12.006

Karlson, K. B., Holm, A., & Breen, R. (2012). Comparing regression coefficients between same-sample nested models using logit and probit: A new method. *Sociological Methodology, 42*(1), 286–313. https://doi.org/10.1177/0081175012444861

Kohler, U., Karlson, K. B., & Holm, A. (2011). Comparing coefficients of nested nonlinear probability models. *The Stata Journal, 11*(3), 420–438.

Kurz, K., & Böhner-Taute, E. (2016). Wer profitiert von den Korrekturmöglichkeiten in der Sekundarstufe? *Zeitschrift für Soziologie, 45*(6). https://doi.org/10.1515/zfsoz-2015-1025

Müller, W., & Pollak, R. (2004). Weshalb gibt es so wenige Arbeiterkinder in Deutschlands Universitäten? In R. Becker & W. Lauterbach (Eds.), *Bildung als Privileg? Erklärungen und Befunde zu den Ursachen der Bildungsungleichheit* (pp. 311–352). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-322-93532-8_11

Neugebauer, M., & Schindler, S. (2012). Early transitions and tertiary enrolment: The cumulative impact of primary and secondary effects on entering university in Germany. *Acta Sociologica, 55*(1), 19–36.

Schindler, S. (2014). *Wege zur Studienberechtigung – Wege ins Studium?: Eine Analyse sozialer Inklusions- und Ablenkungsprozesse*. VS Verlag für Sozialwissenschaften. Retrieved from // www.springer.com/de/book/9783658038403

Schindler, S. (2017). School tracking, educational mobility and inequality in German secondary education: Developments across cohorts. *European Societies, 19*(1), 28–48. https://doi.org/10.1080/14616696.2016.1226373

Schindler, S., & Bittmann, F. (2021). Diversion or inclusion? Alternative routes to higher education eligibility and inequality in educational attainment in Germany. *European Sociological Review, 37*(6), 972–986. https://doi.org/10.1093/esr/jcab025

Schneider, H., & Franke, B. (2014). *Bildungsentscheidungen von Studienberechtigten—Studienberechtigte 2012 ein halbes Jahr vor und ein halbes Jahr nach Schulabschluss*. DZHW Forum Hochschule 6/14. Retrieved from https://www.uni-heidelberg.de/md/journal/2014/06/fh201406_bildungsentscheid.pdf

Statistisches Bundesamt. (1979a). *Fachserie 11 Reihe 1. Allgemeines Schulwesen 1977*. W. Kohlhammer.

Statistisches Bundesamt. (1979b). *Fachserie 11 Reihe 2. Berufliches Schulwesen 1977*. W. Kohlhammer.

Statistisches Bundesamt. (1989a). *Fachserie 11 Reihe 1. Allgemeinbildende Schulen 1987*. Metzler-Poeschel.

Statistisches Bundesamt. (1989b). *Fachserie 11 Reihe 2. Berufliche Schulen 1987*. Metzler-Poeschel.

Statistisches Bundesamt. (2019a). *Fachserie 11 Reihe 1. Allgemeinbildende Schulen 2018*. Statistisches Bundesamt.

Statistisches Bundesamt. (2019b). *Fachserie 11 Reihe 2. Berufliche Schulen 2018*. Statistisches Bundesamt.

Traini, C., Kleinert, C., & Bittmann, F. (2021). How does exposure to a different track influence learning progress? Explaining scissor effects by track in Germany. *Research in Social Stratification and Mobility, 76*, 100625. Retrieved from. https://doi.org/10.1016/j.rssm.2021.100625

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Chapter 10
Dropping Out of Higher Education in Germany: Using Retrospective Life Course Data to Determine Dropout Rates and Destinations of Non-completers



Nicole Tieben

Abstract In recent years, the high rates of higher education dropout have raised attention of education research and policy makers in Germany. However, due to data privacy legislation, it remains challenging to obtain information about the individual progress of students through higher education and the destinations of non-completers. With conventional administrative or cross-sectional data, it is not possible to distinguish non-completion from dropout, so that it mostly has to remain unclear if non-completers reach graduation elsewhere. This contribution uses the retrospective life course data of the NEPS starting cohort 6 to empirically disentangle non-completion and dropout of full-time students in higher education. We discuss the methodological challenges of conventional approaches and show how the advantages of retrospective life course data can be exploited for higher education research. We furthermore examine the destinations of non-completers and dropouts as well as the labour market returns of dropouts, using sequence data analyses and logistic regressions. Our results show that conventional designs possibly are prone to overestimate dropout rates. Longitudinal analyses of destinations after dropout reveal that the permeability between vocational training and higher education is not unidirectional. Vocational training is a relevant absorber of higher education dropouts, but at the same time, vocational qualifications that were gained prior to higher education work as safety-net that buffers labour market risks of dropouts.

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10.1 Introduction

Dropping out of higher education attracted increasing attention of education research and policy. The individual reasons for dropping out of higher education in Germany are fairly well-examined (for a recent overview see Neugebauer et al. (2019)). We nevertheless know little about the exact pathways into, through and out of higher education. Few studies suggest that dropouts do not seem to have problems entering the labour market (Becker et al., 2010; Schnepf, 2017; Stegmann & Kraft, 1988). Recent research reports that a vocational training certificate, which was gained prior to higher education, can act as a safety-net and prevent protracted transitions into the labour market (Scholten & Tieben, 2017). Tieben (2020a) discusses the 'paradoxical double buffer' function of prior vocational training: A full qualification for the skilled labour market on the one hand can deliver skills, knowledge and experiences that are useful in higher education and prevent dropout (Tieben, 2020b; Tieben & Knauf, 2019). On the other hand, a full qualification can also act as pull-factor, because these students also have good alternatives in the skilled labour market, which may (for some) decrease the incentive to strive for a degree. Vocational training also seems to be an important absorbing state for students who dropped out of higher education (Daniel et al., 2019; Ebbinghaus et al., 2014; Heublein et al., 2018; Tieben, 2016b). This illustrates how important it is to examine higher education dropout from a life course perspective and to consider previously acquired qualifications and destinations of students who leave higher education without a degree. Existing research largely ignores the complexity of the progression through the post-secondary education system. This is due to several reasons: First, the term 'dropout' is not defined in a consistent way throughout previous research, which may cause confusion regarding dropout and attrition rates. Second, life course-oriented dropout research calls for a particular data structure, which has not been available before the German National Education Panel Study (NEPS) was published.

This contribution will therefore start with a discussion of different methods of dropout and life course research and highlight some problems in the calculation of dropout rates with conventional data and methods. We then discuss how some of the issues can be tackled by using retrospective life course data, such as the NEPS starting cohort 6. This will be followed by data analyses that illustrate the application of such data for dropout research. The core research questions we aim to answer are the following:

1. Which individual and institutional characteristics predict non-completion, re-entry and dropout of full time students?
2. What are the short- and long-term destinations after non-completion and dropout?
3. Which role do vocational qualifications play for non-completion and dropout?
4. Which role do vocational qualifications play for the placement of dropouts in the labour market?

10.1.1 Definitions and Methodological Challenges

A program in higher education can be terminated with or without a graduation certificate. For this reason, dropout research often uses a binary (yes/no) dependent variable. However, when a course is terminated without graduation, this does not necessarily mean that the student leaves higher education without a degree. A considerable proportion remains in higher education or re-enters and transfers to another program or institution. This has led to conceptual ambiguities in the past and to the development of diverging terms, definitions, measurements and methodological approaches to determine dropout rates (Heublein et al., 2012; Hovdhaugen, 2009; Ziegele, 1997). Heublein et al. (2012) distinguish dropout and attrition rates: Following this definition, dropouts are students who entered higher education through matriculation but leave the higher education system without ever graduating. Students who transfer to another program or institution and students who enter a second course after having obtained a first degree, are excluded by the definition. The dropout rate hence is the ratio of students who entered and students who leave without degree. The attrition rate rather examines the outflow relative to a specific starting cohort, no matter if the starting cohort consists of genuine "freshmen", students who transferred from another program or institution or of students who have gained a degree previously and entered a second course. Both definitions are legitimate and frequently used in higher education research. It is a question of the research objective, which of the measurements is adequate. For the decision, Schröder-Gronostay's (1999) distinction between individual and institutional perspectives proved helpful, which will be summarized in the following section.

10.1.2 The Institutional Perspective

From an institutional perspective it is primarily interesting, how many students who enrol in a particular program reach graduation in that program. These institutional graduation rates are relevant for program evaluation and quality management, but also for predictions of student in- and outflows and corresponding budget allocations (Klein & Stocké, 2016; Tieben, 2016a). From this perspective, the prior educational pathways and subsequent destinations of leaving students are of minor interest. For the calculation of institutional graduation rates, administrative data, collected by institutions, hence are suitable. Figure 10.1 shows how graduation rates and attrition rates can be calculated from the headcounts of enrolled students and those who graduated or not. The attrition rates reported by German official statistics are high and triggered initiatives to reduce student attrition in recent years. However, attrition rates do not always indicate institutional or individual problems. It is for example common practice among German students to transfer to alternative programs or to enrol in comparable programs at alternative institutions during the course of higher education. Students who aim to enroll in a selective program may also initially choose an alternative (less selective) program and transfer later on. This practice occurs often to gain access to particular programs with high admission

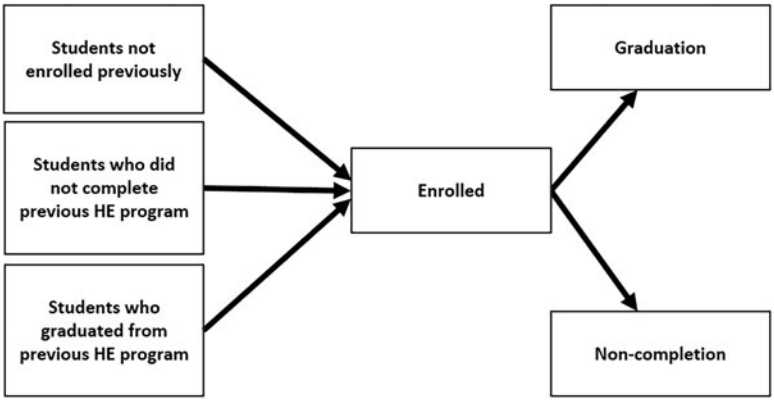


Fig. 10.1 Calculation of attrition rates as ratio of enrollment and non-completion

restrictions, as it may be worthwhile to gain transferable credits in similar, less restricted programs first and transfer after a while. Some students enroll but do not start the program. They do not strive to gain a degree but rather want to gain or maintain the student status and profit from discounts and tax-reliefs. This strategy pays off where tuition fees are low or zero.

10.1.3 The Individual Life Course Perspective

From an individual life course perspective, educational attainment is the result of a sequential decision process (Mare, 1980). Following this logic, a higher education degree is the result of continuation decisions that also are made during enrolment (Goldrick-Rab & Pfeffer, 2009; Haas & Hadjar, 2020; Manski & Wise, 1983; Tieben, 2016a, 2020a). From this perspective, pre-tertiary educational pathways, such as the type of the entrance certificate or vocational qualifications, gain relevance. Moreover, the sequential consideration of the progression through higher education allows tracking of multiple study episodes, such as changes of field, type of degree or institution. The distinction between the institutional and the individual life course perspective allows us to distinguish (institutional) attrition rates from (individual) rates of non-completion and dropout. We also can identify relevant individual predictors of non-completion and dropout. Figure 10.2 shows the sequential progression through higher education. The first episode can result in graduation or non-completion. Whereas graduation is a final state, non-completion calls for a decision between continuing higher education in an alternative program (transfer) and dropping out. It is obvious that from this perspective the "dropout rate" deviates from the "attrition rate". The same person can enrol, graduate and drop out more than once and these multiple episodes are aggregated for the calculation of attrition rates. The individual life course perspective takes the entire sequence of enrolment(s),

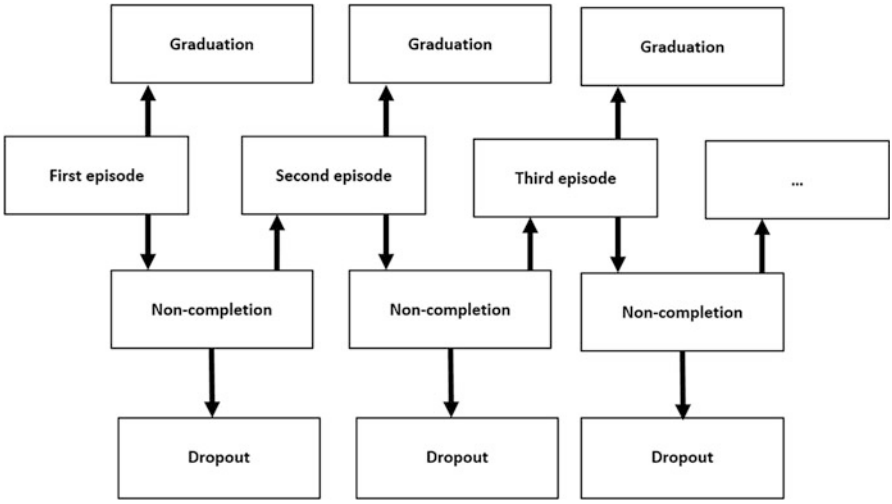


Fig. 10.2 Calculation of dropout rates

non-completion and graduation into account and therefore allows a unique identification of the status as dropout.[1] A major challenge in this approach is the definition of "transfer": An increasing share of students does not complete the initially chosen program but transfers to the same type of program at another institution or to a different program within the same field of study. The diversification of study programmes and increasing student mobility hence can increase attrition and transfer rates even when the actual dropout rate remains stable. The application of clear definitions and detailed coding rules is of high importance (Tieben, 2016a).

10.1.4 Research Designs and Data Structures

In order to capture the complex higher education trajectories and the destinations after dropout, it is necessary to collect longitudinal data and to track students from enrolment until the final occupational placement. To this end, it is necessary that students receive a unique identifier at their first enrolment, which is transferred to all subsequent episodes in higher education. While this strategy is technically feasible and a well-established standard procedure in most higher education systems, Germany implements a very strict data privacy protection legislation that did not allow the tracking of students across institutions until a reform that took effect in 2016. Currently, anonymized student trajectory data are only available for selected official reports of the federal statistical office. Scientific use files of student trajectory data are not available for research purposes and may not be merged with other

[1] In a strict sense, the status „dropout" is a temporary one, because returning to higher education and graduation is possible throughout the entire life course.

individual data sources. It therefore is not possible to gain information about trajectories and destinations after exmatriculation from the centralized administrative data. In order to derive information about individual trajectories and dropout rates, it hence is necessary to use surveys. The following sections will briefly summarize different survey designs before we discuss the advantages of a retrospective life course survey, such as the NEPS Starting Cohort 6, for these purposes.

10.1.5 Exmatriculation Surveys and Prospective Panel Designs

In order to determine the destinations of students after non-completion, an exmatriculation survey can deliver valuable insights (Blüthmann et al., 2012; Heublein et al., 2017, 2018; Schröder-Gronostay, 2000), but in the German context, this method has two drawbacks. First, the samples of these surveys often are drawn from the administrative data of higher education institutions, but these deliver only contact information given by the students during administrative processes. Students who have left their institutions are hard to reach, because they are highly mobile and, in many cases, relocate to another address. Email-addresses and phone numbers are also unreliable, because of provider switches or because institutions assign internal email addresses that become invalid after exmatriculation. Moreover, these surveys come with all drawbacks of cross-sectional designs – researchers have to determine the field time and have only limited access to longitudinal information.

If we want to track the progression through higher education, including time-varying individual predictors of non-completion and dropout as well as the destinations after non-completion or dropout, we need a prospective panel design. The NEPS Starting Cohort 5 is an example for such a study: students were sampled and interviewed for the first time when they entered their first higher education episode in 2010/11 and yearly follow-ups ensure that the information is updated on a regular basis, even after graduation, non-completion or dropout. Such a prospective panel ideally would track the respondents for several years after leaving the educational system, so that labour market transition processes can be tracked until most respondents are placed in a stable employment. Such a panel is very comprehensive and flexible but has the disadvantage of being complex, time consuming and it comes with a high risk of panel attrition in the long run.

10.1.6 Retrospective Life Course Data: NEPS Starting Cohort 6 as Database for Dropout Research

These drawbacks can be avoided with a retrospective life course design. This design allows the collection of complete and detailed information about previous educational and occupational careers. A de facto cross-sectional design hence delivers longitudinal life course data of extended individual trajectories without the risk of

massive panel attrition (Trahms et al., 2016). These data are particularly suitable to examine the long-term destinations of higher education dropouts. The NEPS Starting Cohort 6 applies such a retrospective life course design. Many of the respondents have left higher education several years ago, so that labour market transitions as well as alternative qualification strategies can be traced. With these data, we are also able to identify transfers to different institutions or re-entries several years after non-completion (e.g., after episodes of family formation or labour market participation). The NEPS Starting Cohort 6 covers birth cohorts from 1944 to 1986, so that cohort comparisons can deliver insights into changes in the life courses of higher education non-completers across time. A possible problem often mentioned with regard to retrospective data is recall bias, but in case of objectifiable facts, such as educational and occupational life courses, the bias proved to be negligible (Dex, 1995; Dürnberger et al., 2011; Reimer, 2001).

10.2 Methods

10.2.1 Sample

The sample of NEPS SC6 (Blossfeld et al., 2011a) comprises approximately 12,000 German residents born between 1944 and 1986. The design combined a prospective panel with a yearly follow-up and a "retrospective module" as part of the first wave. In the retrospective module, respondents gave information about their past life course (education, occupation, partnership and family formation, etc.). Although the data of the retrospective module were collected in the first wave and therefore bear characteristics of a cross-sectional design, the information was recorded in longitudinal format. The life histories contain the start and end dates of each episode, so that a chronological structure of different life course transitions could be obtained (Blossfeld et al., 2011b). Our final sample was restricted to respondents who were enrolled in higher education at least once in their life course. This caused a sharp drop in sample size as only approximately one third of all respondents have ever enrolled in higher education. Students from universities of cooperative education (*Berufsakademie*), business academies (*Wirtschaftsakademien*) and academies of public administration (*Verwaltungsakademien*) were excluded from the sample. These institutions offer hybrid programs that cannot be clearly defined as full-time higher education. We excluded all students who have started the first higher education episode abroad or who have obtained their higher education entrance certificate in the German Democratic Republic[2] (former East Germany). The sample was

[2]The higher education system of the GDR followed planned economy principles in admission and graduation of students. Especially the selection of students was based on academic merits, but also on compliance with the socialist government values, which lead to a highly selected student population and low dropout rates. We do, however, include Eastern German citizens who entered higher education after the reunion.

restricted to respondents who were between 17 and 35 years old at the time of their first enrolment in higher education. We excluded older students because mature students in many cases have goals, motivations and time-use patterns that deviate from those of younger students. Our final dataset contained 4309 cases.

10.2.2 Analytical Approach

In a first step, we examined the rates of non-completion, re-entry and dropout across cohorts. We apply uni- and bivariate approaches to determine the distributions. As the main interest of this contribution is the destinations of non-completers and dropouts, we use the subpopulation of the non-completers and examine their rate of re-entry after the first non-completion. Multivariate binary logistic regressions will deliver an overview of individual and institutional predictors of non-completion, re-entry and dropout.

In a second step, we exploit the longitudinal data structure and determine the destination throughout the first 10 years after non-completion and dropout. We will apply sequence analysis methods to gain an overview of the state distributions at certain points in time after non-completion and dropout. We apply this method on the total sample and on selected subgroups, such as education of parents and prior vocational qualifications.

A third step will show the qualification dynamics of the dropouts within 10 years of dropping out of higher education. State distribution plots will show year by year the share of dropouts who already entered higher education with a vocational qualification, who gained a vocational qualification after dropping out and of the dropouts who did not gain a vocational qualification within 10 years after dropping out.

Step four examines the labour market returns of the subgroup of the dropouts who entered employment within 5 years and within 10 years. For a general overview, we examine the skill-level of the current job (i.e., the skill-level that is usually necessary to enter the job) 5 and 10 years after dropout. In order to gain information about the association between formal qualifications and skill-level, we include the time-varying information on vocational qualifications before entering higher education and the current vocational qualification in year 5 and 10. We ran a set of additional multinomial logistic regression models to account for selected predictor/control variables.

10.2.3 Variables

Following the above definitions, we use three outcome variables to describe the individual pathway through higher education.

Non-completion consists of all respondents who did not complete their first higher education episode with a degree (N = 1054). We count non-completion only once, although students can re-enter more than once and therefore all subsequent episodes may result in multiple non-completion. Around 12% of the sample enters a second episode after first non-completion but less than 1% of the sample re-enter more than once.

From the sub-sample of the non-completers, we select those who entered a second episode in higher education (N = 541). The coding is insensitive regarding type of institution or field of study. Any change, either of type of institution or field of study or both, counts as re-entry.

The third outcome variable tells us whether the respondent ever graduated. This comprises those who graduated from the initially chosen program without transfers and those who transferred at least once but graduated from any of the subsequent episodes after re-entry.

For the descriptive analyses, we use two time indicators: the birth cohort and the elapsed time after non-completion. The elapsed time is taken from event history techniques and counts the months since the end of the first respectively the last higher education episode if this was not terminated with a degree.

The three outcome variables are used as dependent variables in the multivariate logistic regressions. In the regressions, we use the following variables as predictors/controls: Birth cohort (1944–1984, 10-year intervals), region of birth (West Germany, East Germany, abroad), sex, education of parents (at least one parent has gained a higher education degree yes/no), type of entrance certificate (full, restricted, second chance), vocational qualification (VQ) before first entry to higher education (yes/no), type of institution (university/university of applied sciences), field of study.

The destinations comprise NEET (not in education, employment or training), employment (irrespective of type or duration of employment), vocational training (only if the training leads to a full qualification for skilled employment), and higher education (university or university of applied sciences). NEET comprises registered unemployment, but also parental leave, vacation and gap years, travel abroad, sick leave and military/voluntary service.

See Table 10.1 for a descriptive overview of the predictor variables and Table 10.2 for distributions of the outcome variables. As destinations and skill-levels are time-varying variables, we refer to the state distribution plots (Figs. 10.3, 10.4, 10.5, 10.6, 10.7 and 10.8) for a descriptive overview.

10.3 Results

10.3.1 Non-completion, Re-entry and Graduation

The left panel of Table 10.2 shows that on average a quarter of all students do not reach graduation in their first higher education episode. This share increases across cohorts and reaches almost 30% in the youngest cohort. The middle panel shows

Table 10.1 Distributions of predictor variables

	N	Mean	Std. Dev.	Min	Max
Birth cohort					
1944–54	878	0.20	0.40	0	1
1955–64	1424	0.33	0.47	0	1
1965–74	1095	0.25	0.44	0	1
1975–84	912	0.21	0.41	0	1
Place of birth					
West Germany	3315	0.77	0.42	0	1
East Germany	848	0.20	0.40	0	1
Abroad	146	0.03	0.18	0	1
Sex					
Male	2427	0.56	0.50	0	1
Female	1882	0.44	0.50	0	1
Age at first entry higher education	4309	21.54	2.70	17	35
Education parents					
No higher education degree	2767	0.64	0.48	0	1
Higher education degree	1542	0.36	0.48	0	1
Type of entrance certificate					
Full	3168	0.74	0.44	0	1
Restricted	477	0.11	0.31	0	1
Second chance	664	0.15	0.36	0	1
Vocational qualification (before first entry)					
No	2857	0.66	0.47	0	1
Yes	1452	0.34	0.47	0	1
Type of institution					
University of applied sciences	1473	0.34	0.47	0	1
University	2836	0.66	0.47	0	1
Field of study					
Education	661	0.15	0.36	0	1
Arts/humanities	405	0.09	0.29	0	1
Social/behavioural sciences	335	0.08	0.27	0	1
Business/admin./services	781	0.18	0.39	0	1
Natural sciences/mathematics/ict	555	0.13	0.34	0	1
Engineering/manufacture/construction	1096	0.25	0.44	0	1
Life sciences	476	0.11	0.31	0	1
Total	**4309**				

Source: NEPS SC 6 11-1-0, own calculations

how many of these non-completers entered a second higher education episode: More than half of them did so (this corresponds to 12% of the total sample). Entering a second higher education episode quite likely results in graduation, approximately 80% (not in table) of the non-completers who re-entered higher education, graduated later. The total graduation rate is displayed in the right panel of Table 10.2. On average across all cohorts, 85.6% of all students reach a degree either in the initially

Table 10.2 Rates of non-completion, re-entry and dropout by birth cohort

	Non-completion of first higher education episode (N = 4309)			If non-completion: entered second higher education episode (N = 1054)			Ever graduated (N = 4309)		
	N	No	Yes	N	No	Yes	N	No	Yes
1944–54	878	83.9	16.1	141	46.8	53.2	878	9.3	90.7
1955–64	1424	74.4	25.6	365	55.1	44.9	1424	16.9	83.2
1965–74	1095	74.7	25.3	277	46.2	53.8	1095	14.6	85.4
1975–84	912	70.3	29.7	271	43.5	56.5	912	15.4	84.7
Total		**75.5**	**24.5**		**48.7**	**51.3**		**14.4**	**85.6**
N		**3255**	**1054**		**513**	**541**		**622**	**3687**

Source: NEPS SC 6 11-1-0, own calculations

chosen program or in an alternative program after first non-completion. This ratio has decreased from 90.7% since the oldest birth cohort, but, unlike the rate of non-completion, remained fairly stable since the 1955–64 cohort. Table 10.2 illustrates quite impressively, how misleading it may be not to distinguish between non-completion and dropout: Whereas the rate of non-completion in the youngest cohort has reached almost 30% of all beginning students, the actual dropout rate is considerably lower, at 15.4%.

Table 10.3 shows the results of three binary logistic regressions non-completion, re-entry and dropout. The average marginal effects suggest that, except from birth cohort, socio-demographic characteristics of students are weak predictors of non-completion. Compared to a full entrance certificate, a restricted entrance certificate increases the risk of non-completion by 6 percentage points. A vocational qualification does neither increase nor decrease the risk of non-completion. Type of institution and field of study seem to be the most relevant predictors of non-completion.

Enrolling in a university increases the risk of non-completion by 12 percentage points, compared to enrolment in a university of applied sciences. The second column shows the average marginal effects for re-entry for the selected sample of the non-completers. Female non-completers re-enter slightly less often than males and having parents with a higher education degree increases the probability to re-enter by 10 percentage points. Non-completers with a vocational qualification are 20 percentage points less likely to re-enter than non-completers without such a qualification. This highlights the relevance of attractive alternative options for the choice between dropping out and re-entering (see Tieben (2020a) for a theoretical framework). Whereas the type of institution is a strong predictor, the initial field of study does not seem to be of much relevance. In column 3, the results for dropout are displayed. The dropout risk increases across cohorts, but less than the risk of non-completion. Place of birth and sex do not predict dropout, but students are 3 percentage points less likely to dropout when one of their parents has a higher education degree. The average marginal effects for prior vocational qualifications and type of institutions demonstrate how the probability of re-entry moderates the difference between non-completion and dropout.

Table 10.3 Binary logistic regressions of non-completion, re-entry and dropout, average marginal effects

	Non-completion of 1st HE episode	If non-completion: started 2nd HE episode	Dropout
Birth cohort			
1944–54 (ref.)			
1955–64	0.08***	−0.09*	0.07***
1965-74	0.08***	−0.01	0.05**
1975–84	0.13***	0.00	0.06***
Place of birth			
West Germany (ref.)			
East Germany	−0.03	−0.08	−0.01
Abroad	0.02	0.04	0.03
Sex			
Male (ref.)			
Female	0.00	−0.06*	0.01
Education parents			
No higher education degree (ref.)			
Higher education degree	−0.02	0.10**	−0.03**
Type of entrance certificate			
Full (ref.)			
Restricted	0.06*	0.01	0.05*
Second chance	−0.03	−0.01	−0.02
Vocational qualification (before first entry)			
No (ref.)			
Yes	0.01	−0.20***	0.04**
Type of institution			
University of applied sciences (ref.)			
University	0.12***	0.20***	0.05***
Field of study			
Education (ref.)			
Arts/humanities	0.12***	−0.03	0.07**
Social/behavioural sciences	0.17***	−0.03	0.11***
Business/admin./services	0.05*	−0.12*	0.05**
Natural sciences/mathematics/ict	0.11***	0.04	0.06**
Engineering/manufacture/construction	0.06**	0.03	0.04*
Life sciences	−0.05*	0.01	−0.02
N	**4309**	**1054**	**4309**

Source: NEPS SC 6 11-1-0, own calculations
*p < 0.05; **p < 0.01; ***p < 0.001, *HE*=higher education

10.3.2 Destinations After Non-completion

The above analysis illustrates that alternative higher education programs are an important destination for non-completers but that approximately half of the non-completers leave higher education. This raises the question where non-completers (and dropouts) end up. Figure 10.3 shows that not only the "where?" question is important but that we also have to ask "when?". It may be misleading to examine the destination only at one given timepoint after non-completion. Especially in the first 1–6 months after non-completion, a considerable proportion of the non-completers is not in employment, education or training (NEET). This proportion decreases to less than 20% after 12 months, so that we can assume that many do not enter alternative destinations immediately but take bridging episodes outside education and labour market. The figure also reveals that during the first 3 years after non-completion, only a quarter of the non-completers enter employment. Most non-completers seem to strive for a formal qualification, either in higher education or in vocational training. Sixty months after non-completion, 30% of the non-completers are enrolled in higher education, 4,8% are in vocational training and 50,7% are in employment. The share of over 30% in higher education after 60 months may suggest that these non-completers are "still" in higher education after 5 years, but the diagram does not show how many of these delayed the start of their second higher education episode. Moreover, extended higher education episodes can also be explained by a high proportion of students who study part time.

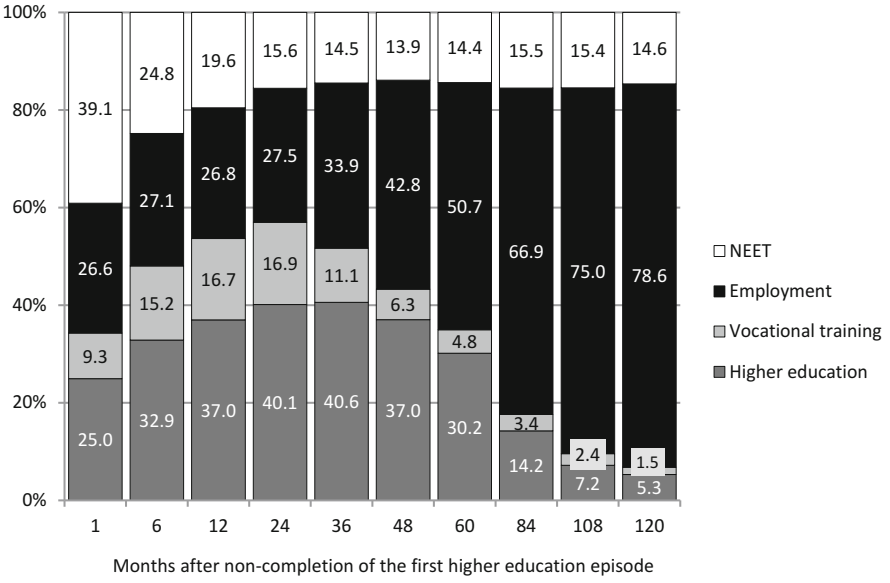


Fig. 10.3 State distribution plot of non-completers, months 1–120 after non-completion of the first higher education episode (N = 1054)

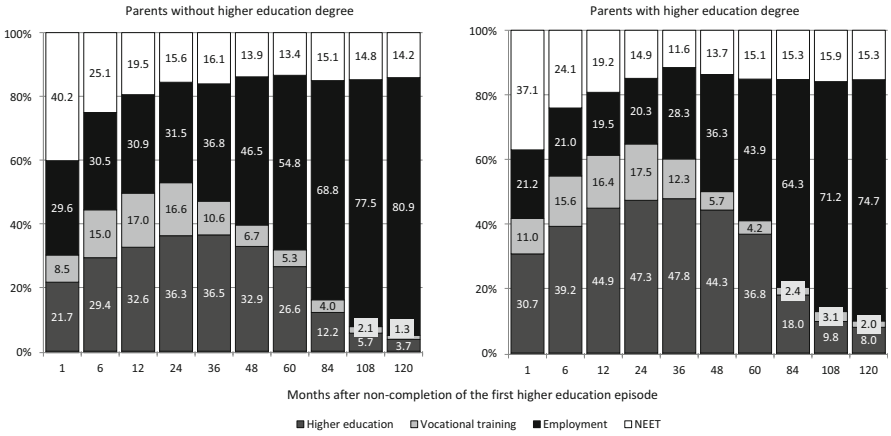


Fig. 10.4 State distribution plots of non-completers, months 1–120 after first non-completion, by education of parents

Figure 10.4 shows the destinations across time, separately by parental education. The proportions in NEET are comparable across the entire observation period of 10 years. We do, however, observe pronounced differences in the distribution of the other destinations. Non-completers from highly educated families are more likely to re-enter higher education and they are less likely to enter the labour market (as already suggested by the above logistic regressions). The group differences in the transition to vocational training are less pronounced. At first glance, these figures suggest that non-completers from lower educated families are more successful in finding a job after non-completion. There are, however, several explanations for this observation. First, these non-completers may not have sufficient financial resources to re-enter higher education. Germany offers generous (means-tested) student grants and loans, but these are conditional upon demonstrated progress in higher education. Those who do not rely on government financial support hence probably face lower financial constraints. This leads to the assumption that non-completers from lower educated backgrounds are diverted to vocational training. The "diversion thesis" is discussed in several studies examining social disparities in the transition from secondary education to higher education (Hillmert & Jacob, 2003; Shavit & Müller, 2000). Our results, however, suggest that the diversion thesis does not necessarily hold for non-completers: non-completers from higher educated families generally seem to be more inclined to invest in both types of education (vocational training and higher education), whereas non-completers from lower educated families more often enter the labour market directly. This might indicate that non-completers from lower backgrounds are diverted to immediate employment and therefore possibly have a higher risk of unfavourable labour market outcomes than non-completers from more privileged backgrounds who have more resources to invest in a degree or vocational qualification. However, we may speculate that non-completers from lower educated families are more likely to hold a vocational qualification already before entering higher education, so that this risk might be mitigated through qualifications gained previously.

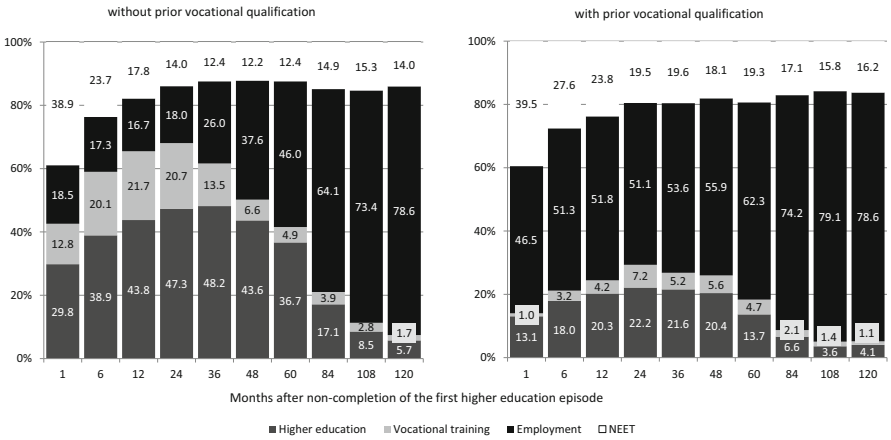


Fig. 10.5 State distribution plots of non-completers, months 1–120 after first non-completion, by prior vocational qualification

Approximately one third of all students has entered higher education with a full qualification for the skilled labour market (vocational training certificate). In case of non-completion, their pressure to obtain another formal labour market qualification is low. We hence observe that their destinations deviate considerably from the destinations of non-completers without vocational qualifications (Fig. 10.5). There seems to be a certain interest to gain an academic degree, but only a small proportion of these non-completers chooses a second vocational training. Already in the first year, half of them has entered employment. We nevertheless observe that across time, the destination distributions converge and that the distributions after 120 months are comparable.

10.3.3 Destinations after Dropout

In case of dropping out altogether, the destinations are vocational training, employment or NEET. Figure 10.6 shows the state distributions across 120 months after dropping out for dropouts with and without prior vocational qualification. For dropouts, prior vocational qualifications seem to be helpful for the transition to the labour market. More than half of the dropouts with vocational qualifications enters the labour market immediately after leaving higher education, but only 26% of the dropouts without prior qualifications. This difference is not fully explained through a higher rate of transitions to vocational training, as we also observe that a larger proportion of this group remains in NEET during the first 2 years after dropout. We nevertheless also observe that the state distributions of the two groups converge at the end of the observation period and that after 120 months, no pronounced differences occur. As a considerable proportion of the dropouts enters vocational

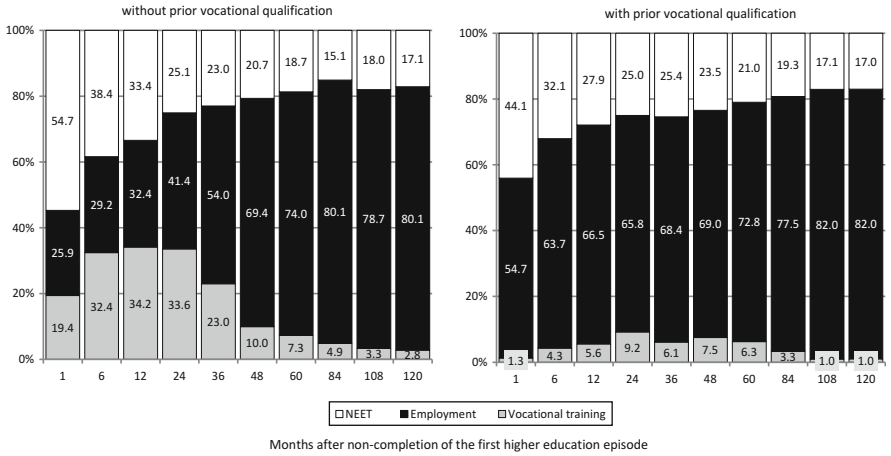


Fig. 10.6 State distribution plots of dropouts, months 1–120 after dropout, by prior vocational qualification

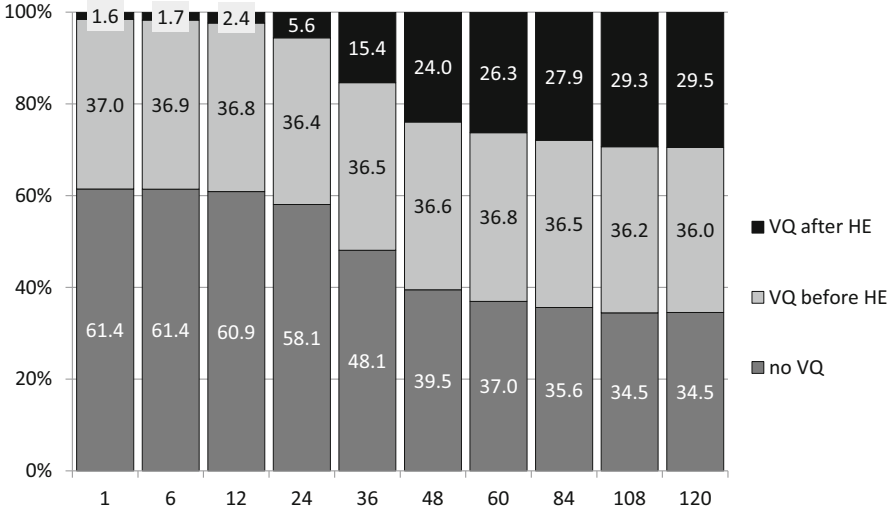


Fig. 10.7 Qualification levels of dropouts, months 1–120 after dropout

training after leaving higher education, we examined the resulting qualification levels of the dropouts. Figure 10.7 shows the distribution of vocational qualifications, gained before or after dropping out, across 120 months after leaving higher education. A small proportion of respondents reports that they gained a vocational certificate within a year after dropping out. This is intuitively not possible as vocational training lasts at least 2 years. We nevertheless did not code these cases as mistakes because students are not obliged to sign out of their higher education

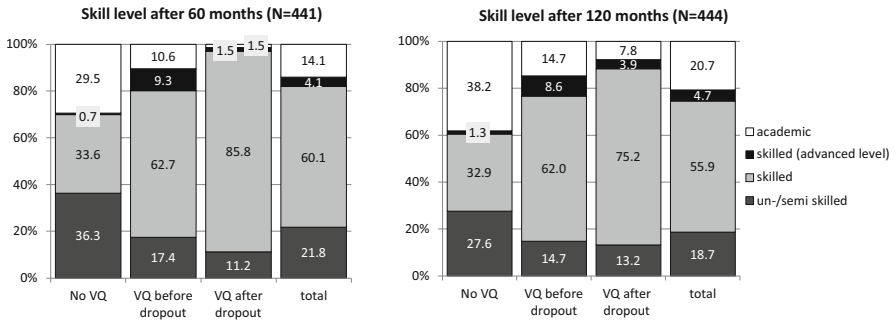


Fig. 10.8 Skill-level of employed dropouts, 60 and 120 months after dropout

program when they start vocational training. We may speculate that some actually remain enrolled in order to benefit from student status privileges (e.g., free public transport). Of all dropouts, almost 30% gain a vocational qualification within 120 months.

Regarding the type of employment of the dropouts who are in employment 60 months after leaving higher education (Fig. 10.8, left panel), we observe that a considerable proportion (14,1%) of the employed dropouts reports that they entered a degree-level occupation, 60,1% report that they entered a skilled occupation and 28,1% entered an un- or semi-skilled occupation. The skill-level, however, is highly dependent on the formal qualification, we therefore examine the skill-level for dropouts who never obtained a formal vocational qualification, who gained a formal vocational qualification before entering higher education and who gained a formal vocational qualification after dropping out of higher education. It is not surprising that those without a formal vocational qualification have the highest risk of entering un- or semi-skilled occupations. At the same time, this group is also most likely to enter a degree-level job. Given that the German labour market is considered as highly credentialistic, hence relying on formal qualifications, this is surprising: This group neither holds a higher education degree nor a vocational certificate. A possible explanation is that some students drop out of higher education because they have an attractive alternative in the labour market (see Scholten and Tieben (2017) for a theoretical discussion). Dropouts who entered higher education with a vocational qualification are more likely than other groups to enter an advanced-level skilled occupation. They possibly can build upon their prior qualification and use the advanced level as an alternative to the initially planned degree-level career. Dropouts who entered higher education without a vocational qualification, but who obtained a vocational qualification after leaving higher education are most likely to be in a skilled occupation after 60 months. Compared to those who already had a vocational qualification, this group possibly is at the beginning of their career development 60 months after leaving higher education, as they have to invest 2–3 additional years to obtain their vocational certificate. The right panel of Fig. 10.8 therefore shows the

skill-level distribution after 120 months.[3] We observe a certain general dynamic, but also that the group that entered vocational training after dropout catches up to some extent. They nevertheless are least likely to be in degree-level and advanced-level skilled occupations at the end of the observation period.

In order to test these results for significant group differences and to exclude some of the possible spurious effects, we replicate these analyses, using multinomial logistic regressions. Table 10.4 shows the average marginal effects of a binary model that includes the skill-level after 120 months as dependent variable and the formal qualification as predictor. The coefficients inform us about the percentage-point-difference between the test group and the reference group. Those who did not obtain a vocational qualification within 120 months after dropping out, are 14 percentage points more likely to be in an un- or semi-skilled occupation than those who obtained a vocational qualification after dropping out.[4] The average marginal effects validate the values from the bar chart (Fig. 10.8). However, the contrast 'VQ before dropout versus VQ after dropout' only results in significant group differences for entering skilled employment, which indicates that a vocational qualification gained before higher education is not necessarily a superior pathway into higher-status occupations. We nevertheless want to point out that – taken together – dropouts who gained a vocational qualification after dropout are significantly more likely to be in skilled employment than dropouts who gained their vocational qualification before entering higher education – but at the expense of higher ranked occupations rather than at the expense of un- or semi-skilled occupations.

Adding controls to the models does not alter the main conclusions drawn from the bivariate analysis (Table 10.5). We nevertheless observe that women are 7 percentage points less likely to enter advanced-level skilled occupations than men. This may

Table 10.4 Multinomial logistic regression on skill-level 120 months after dropout (Average marginal effects of bivariate model)

	Un−/semiskilled	Skilled	Skilled (Advanced level)	Academic
Vocational qualification				
No VQ vs. VQ after dropout	0.14^{**}	-0.42^{***}	−0.03	0.30^{***}
No VQ vs. VQ before dropout	0.13^{**}	-0.29^{***}	-0.07^{**}	0.23^{***}
VQ before dropout vs. VQ after droput	0.02	-0.13^{*}	0.05	0.07
N	**444**	**444**	**444**	**444**

Source: NEPS SC 6 11-1-0, own calculations
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

[3] Note that the left and right panel of Fig. 10.8 are based on slightly different samples due to fluctuation in the groups that are employed after 60 and 120 months.

[4] We are aware that this information is redundant and can easily be calculated from the values given in Fig. 10.7. We added the regression for a convenient execution of a z-test on between-group differences.

Table 10.5 Multinomial logistic regression on skill-level 120 months after dropout. (Average marginal effects of full model)

	Un−/ semiskilled	Skilled	Skilled (Advanced level)	Academic
Vocational qualification				
No VQ vs. VQ after dropout	0.13**	−0.40***	−0.04	0.30***
No VQ vs. VQ before dropout	0.09	−0.25***	−0.05*	0.21***
VQ before dropout vs. VQ after droput	−0.04	0.15*	−0.02	−0.09*
Education parents				
No higher education degree (ref.)	−0.04	0.04	−0.01	0.00
Higher education degree				
Birth cohort				
1944–54 (ref.)				
1955–64	0.06	0.00	0.01	−0.07
1965–74	0.10	−0.03	0.01	−0.08
1975–84	0.00	0.01	−0.01	0.00
Sex				
Male (ref.)				
Female	−0.03	0.08	−0.07***	0.01
Place of birth				
West Germany (ref.)				
East Germany	−0.09*	0.13*	−0.03	−0.01
Abroad	−0.02	0.1	−0.01	−0.08
Type of entrance certificate				
Full (ref.)				
Restricted	−0.07	0.04	0.04	−0.01
Second chance	−0.04	0.08	0.01	−0.04
N	**437**	**437**	**437**	**437**

Source: NEPS SC 6 11-1-0, own calculations
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

be due to the fact that these occupations often are in the male-dominated mechanical or industrial crafts sector. Dropouts from East Germany are less likely to be in un- or semi-skilled occupation, and more likely to be in skilled occupations than dropouts from West Germany. This possibly is due to specific regional labour market structures in Germany. Neither the education of the parents nor a migration background seem to be relevant for the skill-level of dropouts. Moreover, the type of entrance certificate does not seem to be significantly associated with the skill-level. Note, however, that the sample is $N = 437$ and that some sub-samples are small. Given that the average marginal effects indicate probability differences of up to 10 percentage points, it may be premature to conclude that there is no association at all.

10.4 Conclusions and Discussion

The aim of this contribution was to examine the trajectories and destinations of higher education dropouts. We set out to disentangle the concepts of non-completion, re-entry and dropout of higher education and to examine the destinations after non-completion and dropout. Using the Starting Cohort 6 of the National Education Panel Study (NEPS), we were able to exploit the advantages of the detailed retrospective life course data of respondents who have entered higher education at least once in their educational career. Prior research examining higher education dropout in Germany usually relied on exmatriculation surveys, on administrative data or on panel studies with shorter observation periods. These approaches have the disadvantage that non-completion and dropout cannot be disentangled and that a long-term observation of the destinations of non-completers and dropout is not possible. As a result, the share of students who do not reach graduation is often examined from an institutional perspective, which rather looks at attrition rates than at dropout rates. Our results show that attrition rates and dropout rates are not congruent, because approximately half of the non-completers transfers to an alternative program in higher education and has a certain probability to graduate later. We showed that rates of non-completion increased across cohorts and reach approximately 30% in the birth cohort 1975–84, but that the rate of re-entry also increased so that in the birth cohort 1975–84 only 15% leave higher education without a degree.

Apart from this methodological contribution, we aimed to present some applications of retrospective life course data and answered the following research questions:

1. Which individual and institutional characteristics predict non-completion, re-entry and dropout?
2. What are the short- and long-term destinations after non-completion and dropout?
3. Which role do vocational qualifications play for non-completion and dropout?
4. Which role do vocational qualifications play for the placement of dropouts in the labour market?

Regarding the first question, we found that the institutional setting seems to matter most for non-completion. It highly depends on the field of study and on the type of institution if students graduate in the initially chosen program or not. We may speculate that non-completion in many cases rather is driven by institutional than individual characteristics and that highly selective programs benefit from an inflow of students with a low risk of non-completion. Moreover, the probability of non-completion increases across cohorts. This possibly is partly driven by a certain tendency to transfer to a similar program within the same field, which is further enhanced by the increasing diversification of programmes (see Tieben (2016a) for a discussion). Individual predictors, such as sex, parental education and prior educational biographies do not play a pronounced role in non-completion, except from the

type of the entrance certificate. When it comes to re-entry, however, parental education and prior vocational qualifications are strong predictors. Having parents with a degree seems to increase the incentive to gain a degree for oneself, which is in line with previous research (Müller et al., 2017; Shavit et al., 2007). The positive effect of parental education also suggests that family resources help to compensate failures or suboptimal initial choices. This finding, however, indicates that students from lower status backgrounds are not necessarily more likely to have performance problems than students from higher backgrounds, but rather struggle with financial restrictions. This possibly is enhanced by the policy that the means-tested interest free student loans in Germany are granted only when students study without delays. Regarding prior vocational qualifications, we observe that a formal qualification for the skilled labour market increases the chances of non-completers to leave higher education instead of re-entering by 20 percentage points. As discussed by Tieben (2020a), vocational qualifications hence can be seen as 'paradoxical double buffer', which on the one hand may deliver skills that are helpful in higher education, but also work as pull-factor and draw non-completers into the labour market where vocational qualifications ensure access to skilled occupations.

After non-completion, the majority of non-completers choses destinations that (potentially) result in a formal qualification, thus either an alternative program in higher education or vocational training. As suggested above, prior qualification plays an important role: Those who have entered higher education with a vocational qualification, largely do not consider vocational training as an option, but approximately 20% re-enters higher education. However, in this group, the labour market clearly is the preferred destination.

Our results regarding the labour market placement of dropouts are ambiguous. Dropouts who did not gain a vocational qualification before or after dropout have a high risk of entering un- or semi-skilled occupations, but at the same time, they have the highest probability of entering degree-level jobs. Apparently, some dropouts have good labour market prospects, so that for them further investment in formal qualifications is not necessary. This probably applies to dropouts from certain fields of study, where the supply-demand-ratio works in favour of jobseekers. We also must bear in mind that dropping out of higher education becomes more likely when good alternatives are within reach. We therefore may speculate that some students leave higher education despite being successful when they get an attractive job offer. This also can explain why students who did not enter higher education with a vocational qualification, but entered vocational training after dropout, seem to have a disadvantage in entering degree-level jobs: It is likely that certain selection mechanisms are at work here. Those who struggle to enter attractive jobs immediately, have high incentives to gain a vocational qualification in order to improve their labour market prospects.

Taken together, our contribution highlights the importance of applying long-term life course data to get an overview of the destinations of non-completers and dropouts. The transition to the labour market may comprise additional qualification

phases and career progression dynamics after labour market entry. These are not covered by conventional exmatriculation surveys as long-term follow ups are usually flawed by high sample attrition. This contribution also highlights that in the German educational system, vocational training and higher education are not mutually exclusive and that the conception of two separate pathways into the labour market (the 'vocational pathway' and the 'academic pathway') is not accurate. Educational careers are not set in stone after leaving secondary education. Students constantly revise their educational plans as they progress, and it is not a small minority in Germany who use the permeability between vocational training and higher education.

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References

Becker, C., Grebe, T., & Bleikertz, T. (2010). *Berufliche Integration von Studienabbrechern vor dem Hintergrund des Fachkräftebedarfs in Deutschland*. Gesellschaft für Innovationsforschung und Beratung GmbH.

Blossfeld, H.-P., Rossbach, H.-G., & von Maurice, J. (2011a). Education as a Lifelong Process – The German National Educational Panel Study (NEPS). In *Zeitschrift für Erziehungswissenschaft* (Vol. 14, no. 2). Sonderband.

Blossfeld, H.-P., von Maurice, J., & Schneider, T. (2011b). The National Educational Panel Study: Need, main features, and research potential. *Zeitschrift für Erziehungswissenschaft, 14*(2), 5–17.

Blüthmann, I., Lepa, S., & Thiel, F. (2012). Überfordert, Enttäuscht, Verwählt oder Strategisch? Eine Typologie vorzeitig exmatrikulierter Bachelorstudierender. *Zeitschrift für Pädagogik, 58*(1), 89–108.

Daniel, A., Neugebauer, M., & Watermann, R. (2019). Studienabbruch und Einstellungschancen auf dem Ausbildungsmarkt. Ein faktorieller Survey mit Arbeitgeber/innen. *Zeitschrift für Erziehungswissenschaft, 22*(5), 1147–1174.

Dex, S. (1995). The reliability of recall data: A literature review. *Bulletin of Sociological Methodology/Bulletin de Methodologie Sociologique, 49*(1), 58–89.

Dürnberger, A., Drasch, K., & Matthes, B. (2011). Kontextgestützte Abfrage in Retrospektiverhebungen: ein kognitiver Pretest zu Erinnerungsprozessen bei Weiterbildungsereignissen. *Methoden, Daten, Analysen (mda), 5*(1), 3–35.

Ebbinghaus, M., Beicht, U., Gei, J., & Milde, B. (2014). Studienabbrecher für die duale Berufsausbildung gewinnen. In: *Ergebnisse aus dem BIBBExperten monitor Berufliche Bildung*.

Goldrick-Rab, S., & Pfeffer, F. T. (2009). Beyond access: Explaining socioeconomic differences in college transfer. *Sociology of Education, 82*(2), 101–125.

Haas, C., & Hadjar, A. (2020). Students' trajectories through higher education: A review of quantitative research. *Higher Education, 79*(6), 1099–1118.

Heublein, U., Richter, J., Schmelzer, R., and Sommer, D. (2012). Die Entwicklung der Schwund- und Studienabbruchquoten an den deutschen Hochschulen.

Heublein, U., Ebert, J., Hutzsch, C., Isleib, S., König, R., Richter, J., & Woisch, A. (2017). Motive und Ursachen des Studienabbruchs an baden-württembergischen Hochschulen und beruflicher Verbleib der Studienabbrecherinnen und Studienabbrecher. *DZHW Projektbericht, 6*, 2017.

Heublein, U., Hutzsch, C., König, R., Kracke, N., and Schneider, C. (2018). Die Attraktivität der beruflichen Bildung bei Studienabbrecherinnen und Studienabbrechern. In *Reihe Berufsbildungsforschung* (p 18).

Hillmert, S., & Jacob, M. (2003). Social inequality in higher education: Is vocational training a pathway leading to or away from university? *European Sociological Review, 19*(3), 319–334.

Hovdhaugen, E. (2009). Transfer and dropout: Different forms of student departure in Norway. *Studies in Higher Education, 34*(1), 1–17.

Klein, D., & Stocké, V. (2016). Studienabbruchquoten als Evaluationskriterium und Steuerungsinstrument der Qualitätssicherung im Hochschulbereich. *Evaluation von Studium und Lehre* (pp. 323–365). Springer.

Manski, C. F., & Wise, D. A. (1983). *College choice in America*. Harvard Univ. Pr.

Mare, R. D. (1980). Social background and school continuation decisions. *Journal of the American Statistical Association, 75*(370), 295–305.

Müller, W., Pollak, R., Reimer, D., & Schindler, S. (2017). Hochschulbildung und soziale Ungleichheit. In R. Becker (Ed.), *Lehrbuch der Bildungssoziologie* (pp. 309–358). Springer Fachmedien Wiesbaden.

Neugebauer, M., Heublein, U., & Daniel, A. (2019). Studienabbruch in Deutschland: Ausmaß, Ursachen, Folgen, Präventionsmöglichkeiten. *Zeitschrift für Erziehungswissenschaft, 22*(5), 1025–1046.

Reimer, M. (2001). *Die Zuverlässigkeit des autobiographischen Gedächtnisses und die Validität retrospektiv erhobener Lebensverlaufsdaten: Kognitive und erhebungspragmatische Aspekte*.

Schnepf, S. V. (2017). How do tertiary dropouts fare in the labour market? A comparison between EU countries. *Higher Education Quarterly, 71*(1), 75–96.

Scholten, M., & Tieben, N. (2017). Vocational qualification as safety-net? Education-to-work transitions of higher education dropouts in Germany. *Empirical Research in Vocational Education and Training, 9*(7), 1–17.

Schröder-Gronostay, M. (1999). Studienabbruch – Zusammenfassung des Forschungsstandes. In M. Schröder-Gronostay & H. D. Daniel (Eds.), *Studienerfolg und Studienabbruch*. Luchterhand.

Schröder-Gronostay, M. (2000). *Bedingungen des Studienabbruchs. Ergebnisse einer retrospektiven Befragung von Exmatrikulierten*, Dissertation, Universität Kassel.

Shavit, Y., & Müller, W. (2000). Vocational secondary education. Where diversion and where safety net. *European Societies, 2*(1), 29–50.

Shavit, Y., Arum, R., and Gamoran, A. (2007). Stratification in higher education: A comparative study. In *studies in social inequality*. Stanford University Press.

Stegmann, H., & Kraft, H. (1988). Bestimmungsfaktoren für den Studienabbruch und Berufswege von Studienabbrechern. *Mitteilungen aus der Arbeitsmarkt- und Berufsforschung, 21*(4), 498–511.

Tieben, N. (2016a). *Studienverlauf, Verbleib und Berufsstatus von Studienabbrechern. LEAD-Expertise zum Datenreport des Bundesinstituts für Berufsbildung*. Bundesinstitut für Berufsbildung.

Tieben, N. (2016b). Verbleibe und Berufsstatus von Studienabbrechern mit und ohne vor-tertiärer Berufsausbildung. In *Datenreport 2016, Schwerpunkt Studienabbrecher. Bonn: Bundesinstitut für Berufsbildung*.

Tieben, N. (2020a). Non-completion, transfer, and dropout of traditional and non-traditional students in Germany. *Research in Higher Education, 61*(1), 117–141.

Tieben, N. (2020b). Ready to study? Academic readiness of traditional and non-traditional students in Germany. *Studia paedagogica, 25*(4), 11–34.

Tieben, N., & Knauf, A.-K. (2019). Die Studieneingangsphase Studierender mit vor-tertiärer beruflicher Ausbildung: allgemeiner und fach-spezifischer Kenntnisstand und Studienvorbereitung. *Zeitschrift für Erziehungswissenschaft, 22*(2), 347–371.

Trahms, A., Matthes, B., & Ruland, M. (2016). Collecting life-course data in a panel design: Why and how we use proactive dependent interviewing. In H.-P. Blossfeld, J. von Maurice, M. Bayer, & J. Skopek (Eds.), *Methodological issues of longitudinal surveys: The example of the national educational panel study* (pp. 349–366). Springer Fachmedien Wiesbaden.

Ziegele, F. (1997). Grundlagen der Analyse von Studienabbrüchen: Erfassung, Bewertung und Maßnahmen. *Beiträge zur Hochschulforschung, 4*, 435–454.

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Chapter 11
Studying Influences of Socio-economic Contexts and Spatial Effects on Educational Careers



Steffen Hillmert, Andreas Hartung, and Katarina Weßling

Abstract Socio-economic contexts and spatial effects have received increasing attention at the intersection of sociology and education. This research group has laid substantial groundwork in this emerging field of research by developing concepts and methodological techniques for analysing spatial contexts, by collecting and preparing relevant contextual data that can be linked with survey data, and by measuring the impact of socio-structural contextual characteristics on educational aspirations and chances of transition from school to vocational and academic training. For at least this specific stage in educational careers, the end of secondary schooling, we have been able to demonstrate that socio-spatial contextual settings (neighbourhoods and regional contexts) are relevant for educational inequalities. Our research has also demonstrated that the relation between socio-economic contexts and inequalities in education is complex. In particular, little is known about the temporal, spatial, and interpersonal variation in contextual effects. This chapter provides an overview of analytical concepts, measurements, and empirical findings that relate socio-spatial context conditions to educational outcomes, and it outlines promising avenues of future research.

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11.1 Introduction: Socio-spatial Contexts and Educational Outcomes

One of the most important determinants of individual life chances in modern societies is educational attainment. Research has shown repeatedly that the educational attainment process is not just a mere reflection of personal development but is also subject to social influences coming primarily from parents, peers, and the school (class) context (e.g., Breen & Yaish, 2006; Hofferth et al., 1998; Minello & Barban, 2012). However, educational differences between individuals remain even when family background, the proximate social environment, and school-related conditions are comparable. These educational disparities can be traced back partly to social processes in local and regional environments. Such spatial socio-economic contexts have received increasing attention in recent years (Logan, 2012; Sharkey & Faber, 2014). Previous research addressing the effects of spatially related contexts has been concerned predominantly with, on the one hand, aspects of *neighbourhoods* and, on the other hand, socio-economic *regional* conditions.

Studies focusing on *neighbourhood* characteristics have typically considered local levels of socio-economic deprivation or affluence. In that sense, neighbourhood effects do not refer to a single specific indicator but to an information set characterizing the close-range residential area. Neighbourhood effects on educational outcomes can be attributed to several causal mechanisms. In most instances, they are associated with peer influence, collective socialization, social disorder, institutional conditions, neighbourhood discrimination, market incentives, or environmental factors (for an overview, see Brooks-Gunn et al., 1993; Ellen & Turner, 1997; Friedrichs & Nonnenmacher, 2014; Galster, 2012; Jencks & Mayer, 1990; Sampson, 2019; Weßling, 2016).

- *Peer influence*: Such effects are due to interactions among youth through which attitudes, values, behaviour, as well as expectations towards education emerge or change. Such influences are typically transmitted through contagion (Crane, 1991).
- *Collective socialization*: Educational attitudes, values, behaviours, and expectations can be shaped by proximate adults functioning as role models.
- *Social disorder*: Educational outcomes may also be impacted by reactions towards the stress caused by an unstable and problematic environment.
- *Institutional conditions*: The availability and quality of schools (and also other facilities provided within a neighbourhood) affect youth not only through the chances of access to certain institutions but also through shaping the appreciation of institutional resources.
- *Market incentives*: Neighbourhoods may promote economic incentives that turn into a higher appreciation of education. In contrast, youth from areas with poor access to labour market or educational opportunities may undervalue educational attainment because they see little prospective economic value in it.

- *Neighbourhood discrimination*: Employers may hold lower expectations for individuals from particular local areas based on the negative reputation of these areas, and thus be less likely to hire them.
- *Environmental factors*: Exposure to ambient noise, toxins, lead, or other pollutants can affect cognitive and behavioural development and is detrimental for individuals' health. Poor health, in turn, negatively affects students' educational performance.

Neighbourhoods have been studied intensively in the US context (e.g., Sampson, 2019). In particular, negative effects of ethnic and social segregation and unfavourable conditions on various aspects of educational outcomes have been shown repeatedly. For example, neighbourhood effects have been linked to adolescents' mathematics and reading scores as well as final grades (e.g., Ainsworth, 2002; Galster et al., 2016; Garner & Raudenbush, 1991). There is also strong evidence for an influence of deprived neighbourhood conditions on early school dropout (e.g., Rendón, 2014; Wodtke et al., 2011) and lower educational aspirations (e.g., Owens, 2010). In the European context, socio-economically disadvantaged people do not appear to live as segregated as in the US context, and also ethnically concentrated neighbourhoods are more mixed in terms of countries of origin. Existing studies on neighbourhood effects in the European context have found that the impact of living conditions on educational outcomes is lower and less consistent, but there is evidence that residential conditions also affect individuals' opportunities and perspectives in this context (Musterd, 2019). However, most neighbourhood studies in Europe have found positive effects of favourable residential contexts on educational outcomes rather than negative effects of unfavourable contexts (e.g., Helbig, 2010; Kauppinen, 2008). For an overview of studies on the impact of neighbourhoods and academic achievements in which differences in the US and European contexts are discussed explicitly, see Nieuwenhuis & Hooimeijer (2016).

Despite early theoretical approaches that took a holistic perspective on contextuality such as the Chicago School in sociology (Abbott, 1997; Park et al., 1925) or the social ecological approach (Bronfenbrenner, 1979; Vaskovics, 1982) that advocated the integration of multiple spatial contexts such as neighbourhoods, districts, and cities, the neighbourhood effects literature has remained surprisingly unconnected with research on other socio-spatial contexts such as regions or cities. A large number of studies that link *regional* socio-economic and socio-structural conditions with education have dealt with labour market returns to education. Based on the human capital model, it has been argued that the individual risk of being unemployed can be reduced through investments in higher levels of educational qualifications. A positive influence on the chance of enrolling in higher education has been expected particularly in regions with high unemployment; however, those with more education may be less affected by regional variation, and many studies confirm group-specific differences (e.g., Betts & McFarland, 1995; Clark, 2011; Lauer, 2002). A supplementary argument for a positive relation between unemployment and further education is that high unemployment tends to discourage young adults from entering the labour market quickly (*discouraged worker effect*: Raffe & Willms, 1989). However, empirical evidence that combines

individual information on participation in post-compulsory education with macrolevel information has been rather ambiguous. Some studies have failed to find any influence (Micklewright et al., 1990), whereas others have found a weak impact of local labour market conditions on post-compulsory educational participation (Meschi et al., 2011). Beyond that, the regional educational infrastructure has been considered important with respect to individuals' aspirations and transitions to higher education. Regarding infrastructure, the distance to the next college or university has often been referred to, and the larger the distance, the less likely it is that young adults aspire to participate (Finger, 2016) or actually do participate in college or university education (e.g., Reimer, 2013; Spieß & Wrohlich, 2010; Tinto, 1973). Moreover, it has been shown that a long distance to higher education institutions is particularly detrimental for high school graduates from families with lower socio-economic status (e.g., Cullinan et al., 2013; Frenette, 2006). However, the distance approach fails to capture qualitative differences (e.g., fields of study offered, number of universities available, and quality of universities) in the accessibility of university education (Turley, 2009).

In summary, previous research has repeatedly—but often rather unsystematically—uncovered local and regional contextual effects on various aspects of education. It should be noted that these contextual influences have typically been rather small compared to well-known determinants of educational careers such as previous career steps or social background. However, a systematic decomposition and a more precise quantification of different socio-spatial context effects remain important tasks for social science research (cf. Hillmert, 2019). From a methodological point of view, even just an incorrect conceptualization and measurement of spatial contexts alone can lead to an overestimation or underestimation of effects (*modifiable areal unit problem* [MAUP], cf. Kwan, 2012). In this respect, the quantitative analysis of regional or neighbourhood effects may be regarded as still being in its infancy, particularly because the spatial dimension of these effects has often been neglected. Due to increasing data availability and advances in analytical techniques, it is only recently that many sociologists have become interested in spatial analyses and questions about the scale and structure of local and regional context effects and their relevance for individual outcomes such as educational attainment.

11.2 Our Contribution: Conceptualization, Data Preparation, and Flexible Measurement of Context and Spatial Effects

Our research group has contributed to this emerging field of research.[1] First, we have added to the conceptual and methodological literature on spatial contexts in quantitative educational research; second, we have collected and systematized

[1] The two-phase project was part of DFG Priority Programme 1646, funded by the German Research Foundation (DFG), grants HI 767/7-1 and HI 767/7-2. See also http://spaceandplace.de

contextual-level data on socio-economic characteristics of neighbourhoods and regions; and third, we have carried out several substantive studies evaluating the impact of socio-economic context conditions on educational outcomes.

11.2.1 Conceptual Starting Points for Studying Context Effects

Context effects become apparent in various parts of the educational attainment process. On the basis of a general educational decision model (following, e.g., Becker, 2000; Boudon, 1974; Breen & Goldthorpe, 1997; Hillmert & Jacob, 2003), educational attainment can be divided analytically into the *formation of aspirations*, the *development of competencies*, and *educational transitions* along the educational life course. Educational attainment involves the interplay between the development of aspirations and the acquisition of competencies. These two processes result in actually fulfilled educational transitions (see Fig. 11.1). The development of aspirations and competencies follows a successive process of formation and continuous adaptation and becomes visible in stages that mark actual transitions. In that sense, 'secondary effects' (Boudon, 1974) are reflected in the influence of social environments on general aspirations towards education and on the individual demand for a certain educational level to be reached. When a decision situation—a so called turning point (Hodkinson & Sparkes, 1997)—approaches, individuals have to finally evaluate their educational aims in order to make the decision that is (subjectively) most meaningful at that particular time in the life

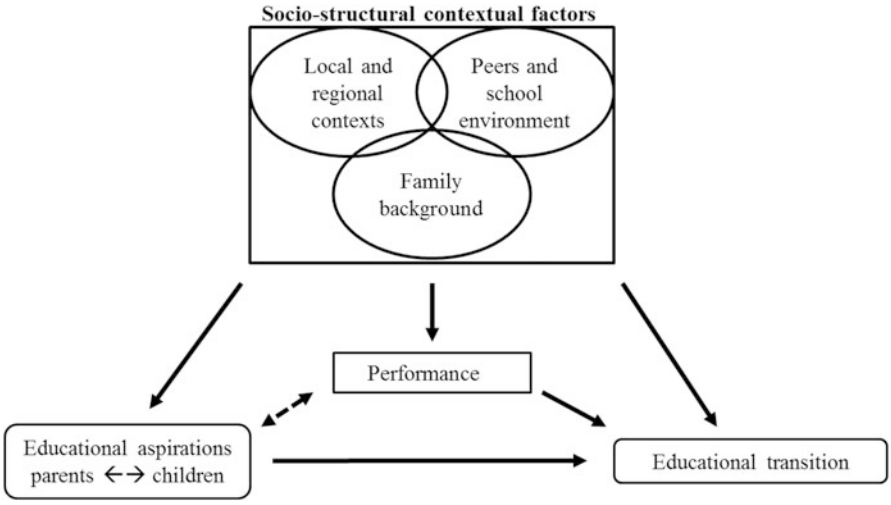


Fig. 11.1 Relationships between relevant contexts and educational attainment (at particular stages in an educational career). (Source: Authors' own illustration)

course. Educational performance can, thereby, have a direct effect on the fulfilled transitions ('primary effects') or it may be mediated through educational aspirations, because individuals adapt their expectations following performance feedback (e.g., by their grades or teachers' recommendations). The reverse relation also exists: educational motivation in the form of aspirations can influence educational performance. All three components of the educational attainment process can be affected by socio-structural contexts. The particular focus of our project has been on the relevance of local and regional contexts.

The socio-spatial context that is relevant for individual attitudes and actions can be assumed to be a space to which the individual is frequently—though not necessarily continuously—exposed (Browning et al., 2016). There are several transmission channels or mechanisms through which local and regional contexts influence the educational attainment process (see Table 11.1). First, an individual's exposition to educational norms and processes of collective socialization in the residential area influences educational preferences and aspirations (Freese, 2009). The development of competencies is assumed to be subject to socio-spatial contexts mediated by differential learning environments that foster or hamper educational progress. Norms concerning learning can also be considered relevant. Moreover, peers in the residential area can be important in the educational attainment process (e.g., Friedrichs & Nonnenmacher, 2014; Sampson et al., 2002; Weßling, 2016). Actual transitions can be assumed to be additionally affected by social interactions with individuals in the local or regional context that provide information on opportunities (e.g., training places or study opportunities). Furthermore, contexts provide such opportunities directly. The majority of the mechanisms listed relate to individual actors such as persons or companies. Most contextual data, however, is organized in the form of aggregated indicators that rather represent the probabilities of having specific interactions or taking relevant opportunities.

Table 11.1 Local and regional context effects on components of educational attainment

Typical mechanisms	Indicator variables	Educational outcomes
Social educational norms	Social and economic living conditions in neighbourhood, average educational/occupational level, housing prices, share of immigrant groups in local population, labour market conditions in region, educational infrastructure in region	→ Aspirations
Collective socialization		
Peer group influences		
Discouraged-worker effect		
Differential learning environments (social composition, social disorder, institutional conditions)	Average educational/occupational level of neighbours, distance to schools, age-specific population in neighbourhood	→ Competencies/ performance
Peer group influences		
Opportunities	Labour market conditions in region, educational infrastructure in region, regional employment structure and average wages	→ Transitions
Social interactions		

Source: Authors' own compilation

In our project, we have selected a specific point in individuals' educational career—the end of general schooling when the transition to vocational and academic training is imminent—to empirically study the relevance of socio-spatial contextual conditions on educational aspirations and transition chances.

11.2.2 Screening and Preparation of Relevant Contextual Data

To analyse the role of socio-spatial contexts for educational careers, local and regional contextual-level information has been linked to individual-level survey data. When doing so, both the contextual-level and the survey data need to fulfil a set of requirements, and specific challenges in linking the different data types have to be addressed.

The *survey data* need, first, to contain comprehensive information about educational careers and should differentiate precisely between the various educational tracks and programmes; second, they need to be longitudinal to capture the educational transitioning processes across the life course; and third, they must contain substantive information about the local residential contexts and geospatial information about these contexts. Even if this is not the case, at least information about the place of residence (e.g., exact addresses or geographical locations, administrative district codes, postal codes, etc.) should be provided to allow the survey data to be combined with geospatial information from external, commercial, and administrative sources. When working with retrospective survey data, residential information is required not just for the time of the interview but for specific stages in the life course. For our purposes, residential information must be specific for the time during which the respondents completed school and made decisions about their further vocational or academic education. We identified two surveys that meet the specified requirements for the German case: the *German Socio-Economic Panel Study* (GSOEP)[2] and the *National Educational Panel Study*, Starting Cohort 6-Adults (NEPS-SC6) and Starting Cohort 4–9th Grade (NEPS-SC4)[3] (Blossfeld et al., 2011).

The *socio-spatial contextual data* need, first, to be available in a time series format with a longer time frame. This allows us to disentangle temporal business-cycle effects from regional effects (cf. Hillmert et al., 2017a). Second, the contextual data need to be available for the point in time at which the educational transition of

[2] Socio-Economic Panel Study (SOEP), 1984–2012, version 29, doi:https://doi.org/10.5684/soep.v34

[3] National Educational Panel Study (NEPS): Starting Cohort Adults, doi:https://doi.org/10.5157/NEPS:SC6:11.1.0, and Starting Cohort 9th Grade, doi:https://doi.org/10.5157/NEPS:SC4:11.0.0. From 2008 to 2013, NEPS data were collected as part of the Framework Program for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, NEPS is being carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in cooperation with a nationwide network.

interest is measured in the survey data. For retrospective data, this point in time might lie up to 20 or 30 years in the past. This situation presents additional difficulties because area codes (e.g., administrative district or municipality codes) tend to change over time. Moreover, area codes in surveys are quite often available only for a particular territorial status. For example, in earlier versions of the NEPS-SC6, these were available for the territorial status in the year 2003. This means that when a respondent provides information about where she or he lived in 1975, then the area code available in the NEPS corresponds to the area's territorial status in 2003. In the newer version of the data, this applies to the status of the year 2013. The districts of residence in GSOEP are currently harmonized according to the territorial status in the year 2014. Moreover, GSOEP is currently the only German panel dataset that allows for an exact localization of participating households (since 2000) for the purpose of linking them to external small-scaled contextual data. Territorial reforms in terms of mergers or dissolutions of municipalities or districts due to population developments and regional restructuring occur quite frequently. This can cause various problems in the preparation of consistent regional time series data (BBSR, 2011, 2013; Weßling, 2016; Weßling & Wicht, 2015). Each contextual unit can be represented spatially on a map by making use of its geometry. Geometries, often represented by the units' centroids, are also necessary for applying techniques of spatial analysis and geographic information system (GIS) applications. Georeferences for administrative territorial units (in particular, municipalities, districts, and federal states) are provided by the Federal Agency for Cartography and Geodesy (*Bundesamt für Kartografie und Geodäsie*: BKG).

In the project, we have linked context information on the level of municipalities and administrative districts to data from both the NEPS and the GSOEP. The context information originated from several sources and represents socio-economic information on the local context (e.g., unemployment), information on the local educational infrastructure (e.g., number of universities), and compositional information on the population (e.g., size of specific age groups). This information on socio-structural and socio-economic contexts has been prepared in time series format and has been aggregated flexibly. Thus, in addition to the substantive conceptual and empirical work, particular effort has been made to collect and prepare socio-spatial contextual data in a time series format. Table 11.2 provides an overview of substantive information and geographic references that have been collected, prepared, and employed in our project.

Table 11.2 Collected and prepared local and regional contextual information

Information	Original data source	Time period	Aggregation levels
Socio-economic conditions: Unemployment (rate) Employment (rate) Percentage of higher educated	Federal Institute for Research on Building, Urban Affairs, and Spatial Development (BBSR) Federal Employment Office (*Bundesagentur für Arbeit*) microm Consumer Marketing	1969–now	Administrative districts (NUTS-3) Harmonized territorial status (West Germany) Market cells (approx. 470 households each)

(continued)

Table 11.2 (continued)

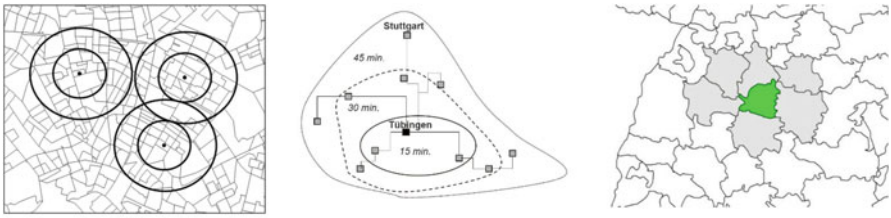
Information	Original data source	Time period	Aggregation levels
Socio-economic conditions: Unemployment (gender-specific, youth, long-term, foreign)	Federal Employment Office	1988–now	Administrative districts (NUTS-3) Harmonized territorial status (West Germany)
Population: Birth cohorts (age-specific population)	Statistical Office (*Statistisches Bundesamt Genesis*) Census 2011	1960–now	Administrative districts (NUTS-3) Harmonized territorial status (West Germany) 1 × 1 km
Educational infrastructure (university): Number of first-year students and students at universities in different fields of study (e.g., engineering, sciences, medical sciences, social/cultural studies) Name, locations, founding years of universities and universities of applied sciences	Higher Education Compass (*Hochschulkompass/ Hochschulrektorenkonferenz*) German Council of Sciences and Humanities (*Wissenschaftsrat*) Statistical Office	1985–now	Municipalities (LAU-2) Harmonized territorial status (West Germany)
Educational infrastructure (school): Number of students and graduates per school type (primary and secondary schools)	Statistical Office *Wegweiser Kommune* (Bertelsmann Foundation)	1993–now	Municipalities (LAU-2) Harmonized territorial status (West Germany)
Territorial/geographic information			
Harmonized table of administrative districts	Statistical Office, BBSR	1960–now	Administrative districts (NUTS-3)
Harmonized table of municipalities	Statistical Office	1985–now	Municipalities (LAU-2) (West Germany)
Travel-time information	BBSR	2009	Municipalities (LAU-2)
Geocodes for administrative units	Federal Agency for Cartography and Geodesy (*Bundesamt für Kartografie und Geodäsie* BKG)	1997–now	Municipalities (LAU-2), Administrative districts (NUTS-3), Governmental districts (NUTS-2), Federal states (NUTS-1)
Geocodes for INSPIRE grids	Census 2011	2011	1 × 1 km
Geocodes for market cells	microm Consumer Marketing	2008	Market cells (approx. 470 households each)

Source: Authors' own compilation

11.2.3 Spatial Methods and Their Application in Substantive Research on Education

By applying several competing and complementary approaches, we have demonstrated the relevance of spatiality in contextual analyses with a focus on educational aspirations and transitions at the end of secondary schooling. Already in the theoretical and conceptual groundwork, the general argument has been that an appropriate definition of the geographical scale of measurement depends upon the assumed theoretical relation between the social processes prevalent within a spatial context and individuals' choices or chances, and these mechanisms vary in terms of their spatial scale. We have been less interested in a summary of all possible effects that are concentrated on a particular geographical level, but rather in the correct geographic representation of the mechanisms of interest. Consequently, instead of measuring an overall 'impact' of a predefined spatial area (e.g., an administrative unit such as a district/*Landkreis*), the aim of empirical applications has been to capture the extension of theoretically relevant mechanisms represented by particular variables. Following this, various conceptualizations of relevant areas have been developed and applied in our research project (see Fig. 11.2).

One approach to assess the spatial reference of regional socio-economic contextual settings has been applied to the impact of regional unemployment on the transition to vocational education and training. For this purpose, data from the GSOEP were linked to administrative time series data on the level of NUTS-3 regions (*Landkreise/Kreisfreie Städte*). This allowed a flexible operationalization of the spatial context to capture the optimal radius in which school graduates search for vocational training places. Results indicate a negative relation between regional unemployment and the chances of entering vocational training in the dual system. Moreover, the effects of unemployment on training chances have a specific spatial structure: the labour market situation in respondents' districts of residence (i.e., their



a) Small-scaled physical distance radii (as in Hartung & Hillmert, 2019), measuring interpersonal contact intensity

b) Travel time radii (as in Weßling & Bechler, 2019), measuring commutable areas

c) District rings (as in Weßling, Hartung, & Hillmert, 2015), measuring personal perception of labour-market conditions

Fig. 11.2 Alternative conceptualizations of spatial referencing

proximate local environment) moderates the relation between the labour market situation in surrounding districts (i.e., their larger local environment) and the school leavers' chances of entering dual vocational training (Weßling et al., 2015). In a subsequent research article, Hillmert et al. (2017a) investigated to what extent individual transitions to vocational training in Germany are affected by local labour market conditions with a special focus on temporal and regional aspects. For this purpose, the authors developed and applied a method of statistical decomposition of time series data. The approach allows for a systematic differentiation between *long-term change*, *business-cycle fluctuations,* and *structural regional* differences in socio-economic conditions (see Fig. 11.3).

Such an approach can be useful for a broad set of empirical applications dealing with context effects. In this example, the decomposed labour market data were merged with longitudinal data from NEPS Starting Cohort 6 (NEPS-SC6). Results indicated that structural differences between regions have significant effects on the transition behaviour of school leavers, whereas temporary fluctuations are of only minor relevance. In Germany, the common focus on East-West differences often

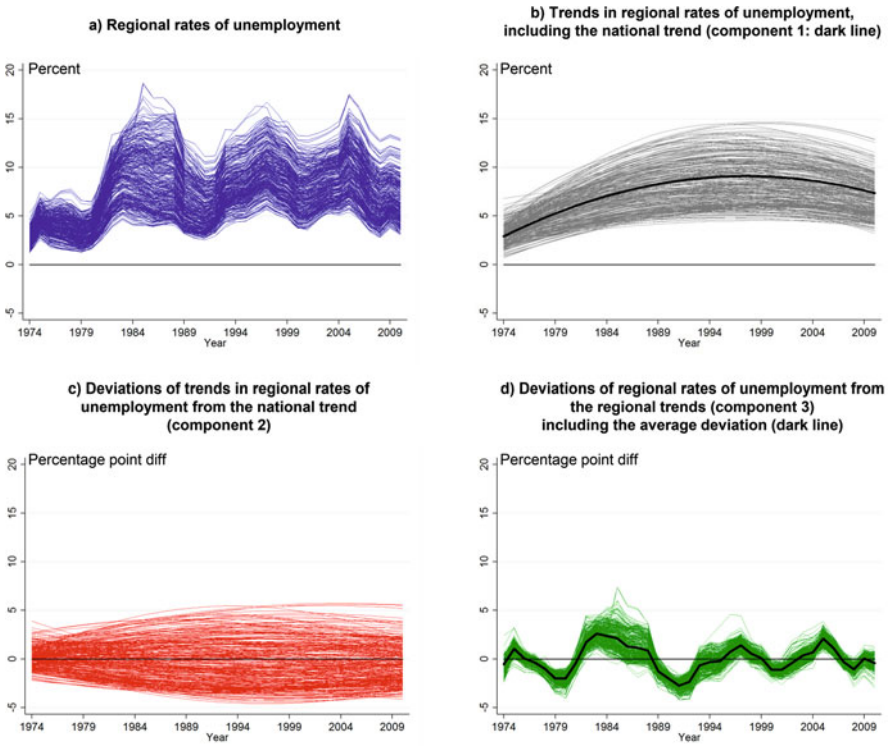


Fig. 11.3 Unemployment rates (percentages/percentage point differences) in West Germany: regional time series (1974–2010) and decomposition (Hillmert et al., 2017a, p. 541)

obscures the considerable regional differences in life chances, manifested by differential access to educational institutions, training opportunities, and employment.

Hartung et al. (2019) have aimed to explain how the regional labour market situation influences the educational and occupational aspirations of 9th and 10th graders. Their article developed a multidimensional concept of aspirations and directly tested the idea of discouragement by linking regional socio-economic conditions to educational and occupational aspirations before transitions take place. So far, only a very limited number of studies have linked regional conditions directly to educational preferences (e.g., Taylor & Rampino, 2014). In Hartung et al. (2019), the contextual data were combined with survey data from NEPS Starting Cohort 4 (NEPS-SC4). Results indicate that regional labour market conditions are relevant with regard to certain aspects of educational and occupational aspirations; in particular, occupational aspirations related to job status and general educational aspirations are influenced positively by the level of regional unemployment. However, the effects vary with respect to the attended school track. In another article, Hartung et al. (2022) also found evidence for an interaction with social background.

We have also used geographic information from the BBSR (*Federal Institute for Research on Building, Urban Affairs and Spatial Development*) on travel times between all German municipalities to flexibly aggregate socio-structural characteristics within travel time radii. Longitudinal microlevel data from the NEPS-SC6 have been linked to the macrolevel data on regional labour market conditions and the local university infrastructure. Results indicate that the chance of entering university and study-related mobility decisions both depend on labour market conditions and university infrastructure in the local context. In general, contextual effects decrease with increasing spatial extent. However, the spatial extent of these contextual effects varies for different socio-spatial characteristics (e.g., unemployment, study opportunities, traditional university town). Moreover, socio-spatial contextual characteristics interact with regard to the chances of entering university (Weßling & Bechler, 2019).

At least in sociology, research concerned with geospatial aspects of neighbourhoods has been rather limited—particularly for the case of Germany. Therefore, we acquired georeferenced information on so called market cells (geographical areas containing approximately 450 households each) from *microm Consumer Marketing* in order to link information on the social composition of neighbourhoods with survey data on individuals' educational aspirations (Hartung & Hillmert, 2019). It was expected that a greater percentage of higher educated in the proximate living environment forms a more favourable educational environment that positively affects individuals' perceptions of given educational alternatives. Corresponding analyses have looked at aspirations to attend higher education. Individual-level data from the GSOEP were merged with the microm data. A flexible 'ego-centered' concept of individuals' local contexts in the form of concentric circles with varying radii (cf. Hillmert, 2018) was applied to assess the geographical range

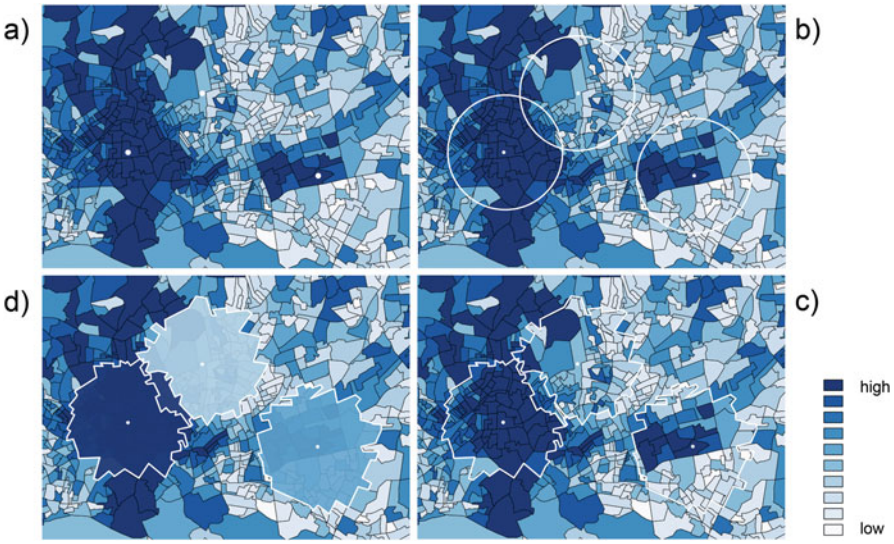


Fig. 11.4 Egocentric spatial neighbourhood contexts as ideal-typical and factual operationalisation (Hartung & Hillmert, 2019, p. 5). (**a**) Proportion of university graduates (light colours: low; dark colours: high) across small neighbourhood units (market cells) in a map section, and three individual residents (dots) as examples. (**b**) Ideal-typical definition of egocentric neighbourhoods (egohoods), illustrated with the same three individuals. (**c**) Factual operationalization of these egohoods. (**d**) Factual operationalization of the egohoods including calculated values for the proportion of university graduates in these egohoods

in which neighbourhood influences on the individuals' aspirations are strongest (see Fig. 11.4). Findings suggest that the share of higher educated in the neighbourhood is indeed important for the formation of aspirations to attend higher education.

Our research group has also contributed to the methodological discussion on the relevance of spatial contexts by demonstrating challenges in dealing with (imperfect) spatial information in survey data and by providing practical solutions (Hillmert et al., 2017b). For this purpose, we made use of the GSOEP and illustrated—by means of popular research examples on returns to education as well as on gender-based and migration-related wage gaps—how sensitive empirical results are to the specification of the regional level of aggregation and to the statistical method applied. In survey data, individuals' locations are often approximated by the geographical units they reside in. We have demonstrated that, in such cases, techniques of spatial analysis often do not provide results that are more precise than those of conventional analyses of survey data, e.g. multilevel analyses. Applying techniques of spatial analysis to limited geographical data is only fruitful if strong assumptions about the location of individuals and the spatial relationships among them can be justified.

11.3 Outlook: Promising Venues of Future Research

We have gained selected evidence on the relation between local and regional context conditions and educational attainment from our project work, and we can draw a number of conclusions. First, we have found evidence for the relevance of the regional socio-economic environment particularly for educational aspirations and transitions at the end of secondary school. Second, we have found that beneficial neighbourhood environments encourage young adults to strive for higher education. Third, we have found that the appropriate spatial scale is highly relevant for the measurement of context effects. Therefore, georeferenced data or at least data on different local or regional levels are required. Fourth, we have found that different contextual characteristics interact with regard to educational transition chances.

Based on both a thorough review of the literature and our own findings and experiences, specific gaps in previous research on socio-economic context effects on education can be identified. These gaps relate to the heterogeneity and the comparative or relative nature of socio-spatial contexts. We find that some effects of spatial contexts on educational outcomes—particularly effects on the relation between socio-economic characteristics of the region and the transition to vocational training or the labour market—are stable over time and place(s). However, some studies reveal positive evidence for a specific spatial contextual effect; others find reversed effects in this regard; and there are even studies that fail to find any influence at all. These ambiguous findings on the relevance of neighbourhoods and regions for educational attainment processes suggest that spatial contexts are not universally relevant but rather heterogeneous in terms of other characteristics. In the following, we sketch a brief outline of promising future research in this area. We envisage, in particular, three major lines of research: first, the impact of socio-spatial contexts along the educational life course; second, the simultaneous impact of multiple contexts (e.g., neighbourhoods, regional environment, and schools); and third, inter-group differences (with regard to cohort, ethnic origin, social origin, and gender) in socio-spatial contextual effects.

11.3.1 Impact of Socio-spatial Contexts Along the Educational Life Course

Following the conceptual framework of the life-course perspective (Elder et al., 2003) makes it possible to understand variations in spatial exposure and influences of local and regional contexts. First, contextual characteristics are not equally important over the life course. Rather, context effects can be expected to have life-course related profiles. Drawing on social ecological ideas about individual development (Bronfenbrenner, 1979), it can be assumed that there is an expansion in the individual space of action from early childhood to adulthood. This reflects the fact that close personal relationships are supplemented increasingly with selective

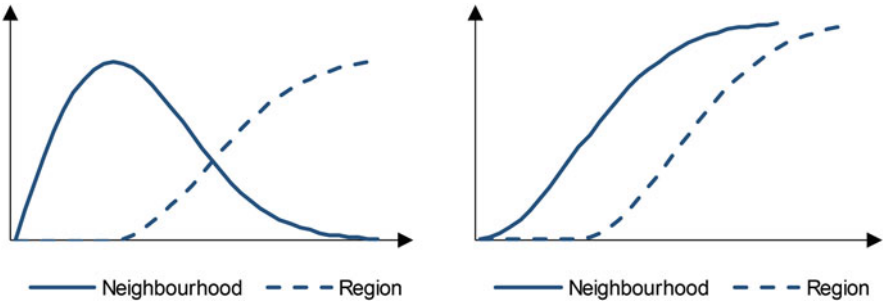


Fig. 11.5 Ideal-typical developments along the life course: spatial context effects (left) and cumulative spatial context effects (right) at different scales. (Smaller (proximate) contexts: neighbourhoods; larger (distal) contexts: regions. Source: Authors' own illustration)

participation in institutional, organizational, and market-based forms of social integration. Hence, when comparing socio-spatial context influences along the educational life course, we can expect a shift in relative relevance from proximate contexts of family and neighbourhood to larger-scale regional contexts that provide relevant opportunities for education, training, and employment (see Fig. 11.5, left). Second, socio-spatial context conditions require certain durations to become salient, so that exposure to specific context conditions can be expected to have cumulative effects along the educational career. Vice versa, particular contextual conditions can become effective only after a certain time of exposure (see Fig. 11.5, right).

So far, most studies have been very limited regarding the length of the observation window. Due to a lack of panel or life-course (residential) data, it has rarely been possible to follow individuals through their entire educational career (South et al., 2016). In contrast, many theoretical arguments call for a longitudinal (life-course) perspective to appropriately analyse spatial contextual effects (cf. Wodtke et al., 2011). It is reasonable to assume that socio-spatial effects—especially when they refer to the developmental aspect of aspirations and competencies—do not materialize immediately, but rather develop continuously in accordance with the relevant exposure of individuals to the context conditions. Furthermore, individuals are exposed to different contexts at different stages in their educational career (Sharkey & Faber, 2014). A life-course perspective on contextual effects is relevant for adequately studying combined consequences (Browning et al., 2016). Research that applies such a life-course perspective is scarce; some studies could show that children are more affected by neighbourhood externalities than adults (Hedman, 2011) because they are in a stage of the life course during which individual attitudes are formed. Crowder & South (2003) found that negative effects of neighbourhood distress on school dropout are stronger for younger than for older adolescents. Positive effects of conditions in advantaged neighbourhoods on high-school graduation were stronger when young people were exposed to the local context over longer periods of time. In turn, it can be argued that residential mobility during childhood can cause some individuals to not experience local contextual effects at all

(Jackson & Mare, 2007). However, so far, there has been only little empirical evidence for these assumptions, particularly with regard to intra-individual developments along the educational life course.

11.3.2 Simultaneous Impact of Multiple Contexts

Individuals live simultaneously in multiple contexts (Cook, 2003; Hillmert, 2019). These contexts are not necessarily, but often, of a spatial nature. For example, an individual is, at the same time, a resident of a neighbourhood, a city, and a region. There are a number of implications of the concept of multiple contexts: first, we know from previous research that neighbourhood conditions as well as regional characteristics impact on processes of educational attainment. However, the underlying theoretical mechanisms of the neighbourhood and the regional context can be assumed to be rather different (see also Table 11.1). A combination of different levels of aggregation makes it possible to observe combined effects of different mechanisms. These effects can be additive; or they may reinforce, compensate, or moderate effects of other socio-spatial contexts. Second, single relevant theoretical mechanisms may be located in complex contexts. In this respect, the interplay between the neighbourhood and the school context has received increased attention in research (Owens, 2010). For example, it has been shown that neighbourhood influences are mediated through the school and school-class context because both tend to overlap (Brännström, 2008; Kauppinen, 2008; Wicht & Ludwig-Mayerhofer, 2014). This suggests considering the influences of specific contexts on educational processes not separately, but simultaneously. Apart from the combination of school and neighbourhood contexts, however, there has been almost no research at all that connects several contextual units (e.g., regions, cities, and neighbourhoods) simultaneously with regard to educational aspirations, competencies, or transition chances. Both Weßling & Meng (2020) and Hedberg & Tammaru (2013) have found that neighbourhood effects are of only little relevance for transitions to employment once the socio-economic conditions of the city or the region have been included in the analytical model. However, there has been almost no research on the relation between other local and regional contexts such as the region, the neighbourhood, and the school. In particular, more emphasis should be given to the relevance of the school context as a mediator of local and regional contextual effects.

11.3.3 Inter-group Differences in Socio-spatial Contextual Effects

A third line of promising future research focuses on inter-group differences in the impact of relevant contextual settings. There is evidence that characteristics of the local and regional contexts are not equally relevant for individuals who have

different characteristics. However, little is known about why impacts differ for different social groups. Heterogeneity in the impact of socio-spatial contexts can be analysed in terms of social origin, ethnic origin, and gender, because these are among the most prominent factors influencing educational attainment. Moreover, analyses for different cohorts make it possible to assess the stability of socio-spatial context effects over time. It is well-studied that social groups are unequal regarding their educational aspirations, competencies, and transition chances. For example, immigrants are known to have relatively high aspirations, often explained by the 'immigrant-optimism thesis' (Kao & Tienda, 1998), while, at the same time, they have lower chances of succeeding in the educational system due to human capital (e.g., language skills) and information deficits (Erikson & Jonsson, 1996). Moreover, girls are known to perform better in school and to be more likely to hold advanced degrees. At the same time, they have lower aspirations or less confidence in their abilities. This is usually explained by gender roles (e.g., DiPrete & Buchmann, 2013). We expect these group-specific patterns to be mediated and moderated by socio-spatial contexts. Socially disadvantaged groups should benefit disproportionally from a favourable local or regional environment, because social interaction with individuals in the local or regional context can provide educationally relevant information that could otherwise not be provided in the familial environment. Socially disadvantaged groups are also more likely to be bound to their local environment due to economic moving costs or familial obligations. Hence, additional educational and occupational opportunities in the local or regional context should increase their educational chances in particular. Finally, social interaction in the local or regional context is more vital in a context with a high share of individuals with similar socio-structural characteristics (e.g., persons from the same ethnic group), so that the influence of socio-spatial contextual characteristics is supposed to be stronger in such a situation.

Disparities between social groups in terms of aspirations, competence development, or transition chances are among the most widely studied relations in research on stratification and inequality, but empirical studies that relate these differences to heterogeneous influences in socio-spatial contexts have been very limited, and the few existing studies have revealed rather ambiguous findings. Some studies have found that favourable regional or neighbourhood conditions are particularly relevant for disadvantageous groups (regarding, e.g., low socio-economic status of the family, see Helbig, 2010; Weßling & Bechler, 2019), whereas other studies have found positive interaction effects between local contexts and social origin only for students from advantageous familial backgrounds (Andersson & Malmberg, 2014); and yet other studies have found that a poor regional environment has a negative impact only on students from a low social origin (Meschi et al., 2011; Sievertsen, 2016). A majority of studies has found contextual effects (both positive and negative) to be stronger for male than for female students (Andersson & Malmberg, 2014), but some studies have failed to find any gender differences in the influence of spatial context characteristics (Frenette, 2006; Hedberg & Tammaru, 2013). For the US context, it has been shown repeatedly that adolescents of Black or Hispanic origin are disproportionately vulnerable to unfavourable local context conditions

(Chetty et al., 2016). However, there has been very little research on the specific relevance of socio-spatial contexts for the educational outcomes of different immigrant groups in the European context. Our own results indicate for the Netherlands that there are immigrant-specific variations in the impact of spatial contexts (Weßling & Meng, 2020). In the German context, young people of immigrant background appear to be less susceptible to positive impacts of favourable conditions in their proximate local environment (Hartung & Hillmert, 2019). We can also expect the scales and spatial profiles of local context effects to be group-specific. Particularly with regard to the various components of the educational attainment process (aspirations, competencies, and transitions), future research can be expected to further disentangle the relation between central dimensions of contexts and educational inequality.

There are also increasing data opportunities. For example, the *Leibniz Institute for Educational Trajectories* (LIfBi) is supplying researchers with a growing number of data waves and cases across the starting cohorts of the NEPS that are sufficient to observe numerous transitions in the educational career and to compare these transitions across cohorts and groups. Beyond that, the availability of several waves per starting cohort enables researchers to keep track of developments in aspirations, performances, and successive transitions along individual educational careers. Therefore, it is becoming increasingly possible to address contextual effects on the processes of educational attainment throughout the course of secondary school and beyond.

References

Abbott, A. (1997). Of time and space: The contemporary relevance of the Chicago School. *Social Forces, 75*(4), 1149–1182.

Ainsworth, J. W. (2002). Why does it take a village? The mediation of neighborhood effects on educational achievement. *Social Forces, 81*(1), 117–152.

Andersson, E. K., & Malmberg, B. (2014). Contextual effects on educational attainment in individualised, scalable neighbourhoods: Differences across gender and social class. *Urban Studies*, 1–17.

BBSR. (2011). *Indikatoren und Karten zur Raum- und Stadtentwicklung – INKAR Ausgabe 2009* [CD-ROM]. Bundesinstitut für Bau-, Stadt- und Raumforschung.

BBSR. (2013). *Indikatoren und Karten zur Raum- und Stadtentwicklung – INKAR Ausgabe 2011* [CD-ROM]. Bundesinstitut für Bau-, Stadt- und Raumforschung.

Becker, R. (2000). Klassenlage und Bildungsentscheidungen: Eine empirische Anwendung der Wert-Erwartungstheorie. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 52*(3), 450–474.

Betts, J. R., & McFarland, L. L. (1995). Safe port in a storm: The impact of labour market conditions on community college enrolment. *Journal of Human Resources, 30*(4), 742–765.

Blossfeld, H.-P., Rossbach, H.-G., & von Maurice, J. (Eds.) (2011). Education as a lifelong process – The German National Educational Panel Study (NEPS). *Zeitschrift für Erziehungswissenschaft*, Special Issue 14.

Boudon, R. (1974). *Education, opportunity, and social inequality: Changing prospects in Western society*. Wiley.

Brännström, L. (2008). Making their mark: The effects of neighbourhood and upper secondary school on educational achievement. *European Sociological Review, 24*(4), 463–478.

Breen, R., & Goldthorpe, J. H. (1997). Explaining educational differentials: Towards a formal rational action theory. *Rationality and Society, 9*(3), 275–305.

Breen, R., & Yaish, M. (2006). Testing the Breen–Goldthorpe model of educational decision making. In S. L. Morgan, D. B. Grusky, & G. S. Fields (Eds.), *Mobility and inequality. Frontiers of research from sociology and economics* (pp. 232–258). Stanford University Press.

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by design and nature*. Harvard University Press.

Brooks-Gunn, J., Duncan, G. J., Klebanov, P. K., & Sealand, N. (1993). Do neighborhoods influence child and adolescent development? *American Journal of Sociology, 99*(2), 353–395.

Browning, C. R., Cagney, K. A., & Boettner, B. (2016). Neighborhood, place, and the life course. In M. J. Shanahan, J. T. Mortimer, & M. Kirkpatrick Johnson (Eds.), *Handbook of the life course* (pp. 597–620). Springer.

Chetty, R., Hendren, N., & Katz, L. F. (2016). The effects of exposure to better neighborhoods on children: New evidence from the moving to opportunity experiment. *American Economic Review, 106*(4), 855–902.

Clark, D. (2011). Do recessions keep students in school? The impact of youth unemployment on enrolment in post-compulsory education in England. *Economica, 78*(311), 523–545.

Cook, T. D. (2003). The case for studying multiple contexts simultaneously. *Addiction, 98*, 151–155.

Crane, J. (1991). The epidemic theory of ghettos and neighborhood effects on dropping out and teenage childbearing. *American Journal of Sociology, 96*(5), 1226–1259.

Crowder, K., & South, S. J. (2003). Neighborhood distress and school dropout: The variable significance of community context. *Social Science Research, 32*(4), 659–698.

Cullinan, J., Flannery, D., Walsh, S., & McCoy, S. (2013). Distance effects, social class and the decision to participate in higher education in Ireland. *Economic and Social Review, 44*(1), 19–51.

DiPrete, T. A., & Buchmann, C. (2013). *The rise of women: The growing gender gap in education and what it means for American schools*. Russell Sage Foundation.

Elder, G. H., Johnson, M. K., & Crosnoe, R. (2003). The emergence and development of life course theory. In J. T. Mortimer & M. J. Shanahan (Eds.), *Handbook of the life course* (pp. 3–23). Kluwer Academic.

Ellen, I. G., & Turner, M. A. (1997). Does neighborhood matter? Assessing recent evidence. *Housing Policy Debate, 8*, 833–866.

Erikson, R., & Jonsson, J. O. (Eds.). (1996). *Can education be equalized? The Swedish case in comparative perspective*. Westview Press.

Finger, C. (2016). Institutional constraints and the translation of college aspirations into intentions: Evidence from a factorial survey. *Research in Social Stratification and Mobility, 46B*, 112–128.

Freese, J. (2009). Preferences and the explanation of social behavior. In P. Hedstrom & P. Bearman (Eds.), *Oxford handbook of analytic sociology* (pp. 94–114). Oxford University Press.

Frenette, M. (2006). Too far to go on? Distance to school and university participation. *Education Economics, 14*(1), 31–58.

Friedrichs, J., & Nonnenmacher, A. (2014). Die Analyse sozialer Kontexte. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 66*(Suppl), 1–16.

Galster, G. C. (2012). The mechanism(s) of neighborhood effects: Theory, evidence, and policy implications. In M. van Ham, D. Manley, N. Bailey, L. Simpson, & D. Maclennan (Eds.), *Neighbourhood effects research: New perspectives* (pp. 23–56). Springer.

Galster, G. C., Santiago, A., Lucero, J., & Cutsinger, J. (2016). Adolescent neighborhood context and young adult economic outcomes for low-income African Americans and Latinos. *Journal of Economic Geography, 16*(2), 471–503.

Garner, C. L., & Raudenbush, S. W. (1991). Neighborhood effects on educational attainment: A multilevel analysis. *Sociology of Education, 64*(4), 251–262.

Hartung, A., & Hillmert, S. (2019). Assessing the spatial scale of context effects: The example of neighbourhoods' educational composition and its relevance for individual aspirations. *Social Science Research, 83*. https://doi.org/10.1016/j.ssresearch.2019.05.001

Hartung, A., Weßling, K., & Hillmert, S. (2019). *Educational and occupational aspirations at the end of secondary school: The importance of regional labour-market conditions* (GSBE Research Memoranda No. 019). Research Centre for Education and the Labour Market, Maastricht University.

Hartung, A., Weßling, K., & Hillmert, S. (2022). Interplay between family background and labour-market conditions in shaping students' occupational status expectations. *Journal of Education and Work, 35*(4), 405–421. https://doi.org/10.1080/13639080.2022.2073338

Hedberg, C., & Tammaru, T. (2013). "Neighbourhood effects" and "city effects": The entry of newly arrived immigrants into the labour market. *Urban Studies, 50*(6), 1165–1182.

Hedman, L. (2011). The impact of residential mobility on measurements of neighbourhood effects. *Housing Studies, 26*(04), 501–519.

Helbig, M. (2010). Neighborhood does matter! Soziostrukturelle Nachbarschaftscharakteristika und Bildungserfolg. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 62*(4), 655–679.

Hillmert, S. (2018). Spatial context effects at different scales: A formal model for egocentric contexts in two- and three-dimensional space. *SocArXiv*. https://doi.org/10.31235/osf.io/d4mu7

Hillmert, S. (2019). Multiple social contexts of education: Systematic commonalities, differences and interrelations. In R. Becker (Ed.), *Research handbook on the sociology of education* (pp. 69–87). Edward Elgar.

Hillmert, S., & Jacob, M. (2003). Social inequality in higher education: Is vocational training a pathway leading to or away from university? *European Sociological Review, 19*(3), 319–334.

Hillmert, S., Hartung, A., & Weßling, K. (2017a). A decomposition of local labour-market conditions and their relevance for inequalities in transitions to vocational training. *European Sociological Review, 33*(4), 534–550.

Hillmert, S., Hartung, A., & Weßling, K. (2017b). Dealing with space and place in standard survey data. *Survey Research Methods, 11*(3), 267–287.

Hodkinson, P., & Sparkes, A. C. (1997). Careership: A sociological theory of career decision making. *British Journal of Sociology of Education, 18*(1), 29–44.

Hofferth, S. L., Boisjoly, J., & Duncan, G. J. (1998). Parents' extrafamilial resources and children's school attainment. *Sociology of Education, 71*(3), 246–268.

Jackson, M. I., & Mare, R. D. (2007). Cross-sectional and longitudinal measurements of neighbourhood experience and their effects on children. *Social Science Research, 36*(2), 590–610.

Jencks, C., & Mayer, S. E. (1990). The social consequences of growing up in a poor neighborhood. In L. E. Lynn & M. G. H. McGeary (Eds.), *Inner-city poverty in the United States* (pp. 111–186). National Academy Press.

Kao, G., & Tienda, M. (1998). Educational aspirations of minority youth. *American Journal of Education, 106*(3), 349–384.

Kauppinen, T. M. (2008). Schools as mediators of neighbourhood effects on choice between vocational and academic tracks of secondary education in Helsinki. *European Sociological Review, 24*(3), 379–391.

Kwan, M.-P. (2012). The uncertain geographic context problem. *Annals of the Association of American Geographers, 102*(5), 958–968.

Lauer, C. (2002). Enrolments in higher education: Do economic incentives matter? *Education + Training, 44*(4/5), 179–185.

Logan, J. R. (2012). Making a place for space: Spatial thinking in social science. *Annual Review of Sociology, 38*, 507–524.

Meschi, E., Swaffield, J., & Vignoles, A. (2011). The relative importance of local labour market conditions and pupil attainment on post-compulsory schooling decisions. *International Journal of Manpower, 40*(8), 1482–1509. https://doi.org/10.1108/IJM-11-2017-0303

Micklewright, J., Pearson, M., & Smith, S. (1990). Unemployment and early school leaving. *The Economic Journal, 100*, 163–169.

Minello, A., & Barban, N. (2012). The educational expectations of children of immigrants in Italy. *The Annals of the American Academy of Political and Social Science, 643*(1), 78–103.

Musterd, S. (2019). Neighborhood effects in Europe. In A. M. Orum (Ed.), *The Wiley Blackwell encyclopedia of urban and regional studies*. Wiley Blackwell. https://doi.org/10.1002/9781118568446.eurs0217

Nieuwenhuis, J., & Hooimeijer, P. (2016). The association between neighbourhoods and educational achievement, a systematic review and meta-analysis. *Journal of Housing and the Built Environment, 31*(2), 321–347.

Owens, A. (2010). Neighborhoods and schools as competing and reinforcing contexts for educational attainment. *Sociology of Education, 83*(4), 287–311.

Park, R. E., Burgess, E. W., & MacKenzie, R. D. (1925). *The city*. University of Chicago Press.

Raffe, D., & Willms, D. J. (1989). Schooling the discouraged worker: Local-labour-market effects on educational participation. *Sociology, 23*(4), 559–581.

Reimer, D. (2013). Kontexteffekte und soziale Ungleichheit beim Übergang von der Schule zur Hochschule. In R. Becker & A. Schulze (Eds.), *Bildungskontexte. Strukturelle Voraussetzungen und Ursachen ungleicher Bildungschancen* (pp. 405–429). Springer.

Rendón, M. G. (2014). Drop out and "disconnected" young adults: Examining the impact of neighborhood and school contexts. *The Urban Review, 46*(2), 169–196.

Sampson, R. J. (2019). Neighbourhood effects and beyond: Explaining the paradoxes of inequality in the changing American metropolis. *Urban Studies, 56*(1), 3–32.

Sampson, R. J., Morenoff, J. D., & Gannon-Rowley, T. (2002). Assessing "neighborhood effects": Social processes and new directions in research. *Annual Review of Sociology, 28*(1), 443–478.

Sharkey, P., & Faber, J. W. (2014). Where, when, why, and for whom do residential contexts matter? Moving away from the dichotomous understanding of neighborhood effects. *Annual Review of Sociology, 40*, 559–579.

Sievertsen, H. H. (2016). Local unemployment and the timing of post-secondary schooling. *Economics of Education Review, 50*, 17–28.

South, S. J., Huang, Y., Spring, A., & Crowder, K. (2016). Neighborhood attainment over the adult life course. *American Sociological Review, 81*(6), 1276–1304.

Spieß, C. K., & Wrohlich, K. (2010). Does distance determine who attends a university in Germany? *Economics of Education Review, 29*(3), 470–479.

Taylor, M., & Rampino, T. (2014). Educational aspirations and attitudes over the business cycle. *Economica, 81*(324), 649–673.

Tinto, V. (1973). College proximity and rates of college attendance. *American Educational Research Journal, 10*(4), 277–293.

Turley, R. N. L. (2009). College proximity: Mapping access to opportunity. *Sociology of Education, 82*(2), 126–146.

Vaskovics, L. A. (1982). Sozialökologische Einflussfaktoren familialer Sozialisation. In L. A. Vaskovics (Ed.), *Umweltbedingungen familialer Sozialisation: Beiträge zur sozialökologischen Sozialisationsforschung* (pp. 1–25). Enke.

Weßling, K. (2016). *The influence of socio-spatial contexts on transitions from school to vocational and academic training in Germany*. Doctoral dissertation, Universität Tübingen. https://doi.org/10.15496/publikation-15222

Weßling, K., & Bechler, N. (2019). Where do regional influences matter? The impact of socio-spatial indicators on transitions from secondary school to university. *Review of Regional Research, 39*(2), 163–188.

Weßling, K., & Meng, C. (2020). The mediating and moderating role of neighbourhoods and regions on second generation immigrant youths' school-to-work transitions in the Netherlands. *Population, Space and Place*. https://doi.org/10.1002/psp.2384

Weßling, K., & Wicht, A. (2015). *Möglichkeiten der Nutzung regionaler Daten im Nationalen Bildungspanel (NEPS) – Ein Überblick* (NEPS Working Paper No. 54). https://www.neps-data.de/Portals/0/Working%20Papers/WP_LIV.pdf

Weßling, K., Hartung, A., & Hillmert, S. (2015). Spatial structure counts: The relevance of regional labour-market conditions for educational transitions to vocational training. *Empirical Research in Vocational. Education and Training, 7*(12). https://doi.org/10.1186/s40461-015-0024-6

Wicht, A., & Ludwig-Mayerhofer, W. (2014). The impact of neighborhoods and schools on young people's occupational aspirations. *Journal of Vocational Behavior, 85*(3), 298–308.

Wodtke, G. T., Harding, D. J., & Elwert, F. (2011). Neighborhood effects in temporal perspective. *American Sociological Review, 76*(5), 713–736.

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Part III
Vocational Training and Labour Market

Chapter 12
Low-Achieving School-Leavers in Germany: Who Are They and Where Do They Go?



Anne Christine Holtmann, Laura Menze, and Heike Solga

Abstract In light of educational expansion in Germany, school-leavers with a lower secondary school certificate or less are at risk of being left behind. In this chapter, we first compare their parental resources, cognitive skills, and non-cognitive skills to those of school-leavers with an intermediate school certificate. Second, we investigate whether these low achievers can improve their educational attainment after school by either catching up on school certificates or entering vocational training. We analyse their transitions to vocational education using "With" hier streichen sequence analyses. Using data from the National Educational Panel Study (NEPS), we show that although low-achieving school-leavers are, on average, not as well-endowed with agentic and social resources as other groups, they are otherwise quite heterogeneous. Many have similar cognitive and non-cognitive skills to school-leavers with an intermediate school certificate who usually manage to enter vocational training. However, this potential often remains undiscovered, because considerable proportions of low achievers do not improve their school certificates and do not manage to enter vocational education—even several years after leaving school. We also show that transition patterns vary by school type, with students from special needs schools being especially disadvantaged compared to those from regular schools.

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12.1 Introduction[1]

In light of educational expansion and the increasing skill requirements in labour markets, young people with low levels of education are at risk of being left behind. Education is crucial to succeed on the labour market (and beyond). Leaving school with low levels of education limits further educational opportunities and might be detrimental in both the short and long term. In addition, agentic and social resources that young adults have at their disposal are also known to be important for further learning opportunities and labour market transitions (Schoon & Lyons-Amos, 2016).

Against this background, we focus on low-achieving school-leavers in Germany, asking who they are and how they fare after leaving school. To this end, we first look at the variation among low-achieving school-leavers and shed light on the question whether low school achievement is associated with lower levels of cognitive and non-cognitive skills, poorer vocational orientation, and lower parental resources. Second, we look at the school-to-work transitions of these youths. In this regard, we investigate whether low achievers can improve their educational achievement after leaving general schooling by catching up on school certificates or by entering vocational training. This is because both could help lower their later labour market vulnerability. Furthermore, we explore their training opportunities after school to investigate the consequences of their low educational achievement for their school-to-work transitions. Using sequence analysis, we examine direct and indirect pathways into vocational education, but we also look at the pathways of those who do not manage to enter vocational training or who drop out.

We define low school achievement by the school-leaving certificate obtained at the end of secondary education: low-achieving school-leavers are young people who have obtained *only an (extended) lower secondary certificate* or *no school-leaving certificate* at all (for a justification of this definition see below). We use data from the German National Educational Panel Study (NEPS) following a cohort of young people who attended Grade 9 in 2010 (Blossfeld et al., 2011; Ludwig-Mayerhofer et al., 2019).[2] Its biannual and then annual panel waves provide both a rich set of background information, cognitive and non-cognitive measures, and detailed information on students' life courses since Grade 9.

[1]The research for this chapter was supported by funding from the German Research Foundation (DFG) for the project 'New opportunities or reinforced disadvantages? Variation in returns to low-achieving school leavers' participation in pre-vocational training programmes' (Grant Number: SO 430/8–2).

[2]This chapter uses data from the National Educational Panel Study (NEPS): Starting Cohort Grade 9, https://doi.org/10.5157/NEPS:SC4:9.0.0. NEPS data were collected from 2008 to 2013 as part of the Framework Programme for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). Since 2014, NEPS has been conducted by the Leibniz Institute for Educational Pathways e.V. (LIfBi) at the Otto-Friedrich-Universität Bamberg in cooperation with a Germany-wide network.

12.2 The German Institutional Context

In the highly stratified German school system, students are tracked into different school types as early as age 10–12 and can obtain different school-leaving certificates at the end of secondary education: the (extended) lower secondary certificate, the intermediate certificate, or the university entrance qualification (the *Abitur*). Students may also leave general schooling without a school-leaving certificate.

Over time, the German school system has become less stratified. Some educational reforms and general trends of educational expansion have resulted in distributional changes in terms of both the types of school attended and the school-leaving certificates. In the 1960s, more than 60% of students in lower secondary education attended the *Hauptschule*; by 2012 (the school-leaving year of our cohort), this proportion had fallen to only 18%, and by 2019, it had decreased to only 9% (BMBF Datenportal, own calculations).[3] At the same time, the proportion of students attending intermediate schools (*Realschule*), comprehensive schools, and grammar schools (*Gymnasium)* has increased.[4]

Correspondingly, the proportion of school-leavers who leave school with *an (extended) lower secondary certificate* has fallen from around 60% in the 1960s to less than one-fifth (18%) in 2012 (and 17% in 2019). Likewise, the proportion of young people *without a school-leaving certificate* has decreased from about one-fifth to only 5%. In contrast, the proportion of young people leaving school with *at least* an intermediate school certificate has increased enormously. Thus, today, school-leavers who leave school without any certificate or with only an (extended) lower secondary school certificate constitute a vulnerable group of low-achieving youth.

Young people with no or only a lower secondary certificate have usually attended the lowest school type, the *Hauptschule*, and they used to account for the majority of school-leavers. Today, all school-leaving certificates, except for the university entrance qualification *Abitur*, can be obtained formally at all secondary school types. We therefore use the school-leaving certificate (instead of the school type) as defining criterion for belonging to the group of low-achieving school-leavers.

A special feature of the German school system is that special needs schools continue to exist as an independent school type in all federal states. Germany has established eight different school types in this category depending on the kind of special need. Students from these schools usually leave without a recognized school-leaving certificate (e.g., about 72% in 2018) or only the lowest recognized school certificate (i.e., lower secondary certificate; about 24%) (National Education Report,

[3] BMBF Datenportal: Tab 2.3.3. Schüler/−innen an allgemeinbildenden Schulen nach Bildungsbereichen und Schularten, Zeitreihe: 1960/1961–2020/2021. https://www.datenportal.bmbf.de (Datenlizenz Deutschland Namensnennung 2.0) (retrieved 2-10-2022).

[4] After our observation window (i.e., school-leavers in 2012), the *Hauptschule* disappeared from the map in many states, and has been replaced by secondary schools with multiple tracks or comprehensive schools (leaving the upper-track *Gymnasium* untouched). Dedicated lower-track secondary schools still exist in Bavaria, Baden-Württemberg, Hesse, Lower Saxony, and North Rhine-Westphalia, but declining proportions of students are enrolled in them.

2020: Table D8-4web). Thus, they belong to the vulnerable group of low-achieving youth. Empirically, we limit our analyses to students from special needs schools for learning disabilities, because they constitute the largest group among students attending special needs schools (35.3%; National Education Report, 2018: Table D8-9web) and data on them are available in the German National Educational Panel Study (NEPS).

12.3 Data Source

To examine the agentic and social resources of low-achieving school-leavers and their training opportunities after school, we use data from the NEPS cohort of young people who attended Grade 9 in 2010 when they were about 15 years of age. An oversampling of students from lower school tracks enables us to explore the within-group heterogeneity of low-achieving school-leavers. Moreover, this is one of the very few large-scale data sets that includes a representative sample of students from special needs schools for learning disabilities in Germany.

This data set comprises 16,425 students who have been surveyed once or twice a year since 2010. We use the data up to Wave 9, when students were approximately 19–20 years old (collected between autumn 2015 and spring 2016). The data set provides extensive information on cognitive and non-cognitive characteristics and, because it oversamples students from lower secondary schools and special needs schools for learning disabilities, it allows differentiated evaluations within the group of low-achieving school-leavers.

We are able to observe 12,602 respondents at least up until they left general schooling, meaning that we were able to determine their school-leaving certificate. Seventy per cent of these respondents also participated in Wave 9 and constitute our analytical sample; these include 3513 students (including 813 from special needs schools for learning disabilities) who left school after Grade 9 or 10 with no more than an (extended) lower secondary school certificate. The majority of them are male students (60%). For the descriptive analyses, we use the weights provided by the NEPS to account for the sampling design and panel attrition (Steinhauer & Zinn, 2016).

12.4 The Heterogeneity of Low-Achieving School-Leavers

In this section, we describe the heterogeneity of low-achieving school-leavers in terms of the school types they come from, their agentic resources, and their social resources. We follow Schoon and Lyons-Amos (2016) and distinguish between factors that are more related to individual agency (agentic resources) and structural constraints due to social background (social resources). Agentic resources refer to factors that enable young people to engage in active decision making. We include

both cognitive and noncognitive resources and prior experiences. Social constraints, on the other hand, refer to poorer socioeconomic resources available to young adults and include parental education, employment status, and migration background.

12.4.1 What School Type Do They Come From?

We start by looking at the extent to which the type of school attended still determines the school-leaving certificate obtained. Baumert et al. (2008, p. 59) stated that the decoupling of school types and school-leaving certificates is probably the most important, albeit unplanned, development in the German school system. Yet, does this also apply to low-achieving school-leavers? To answer this question, we compare the school type attended in Grade 9 and the school-leaving certificate achieved. Based on NEPS data, we see that low-achieving school-leavers indeed attended different school types in Grade 9, with some of them even attending the academic track (the *Gymnasium*). However, a complete decoupling has not occurred, because there is still a clear relationship between school type and certificate. The majority of low-achieving school-leavers (64%) come from a lower secondary school (*Hauptschule*), and the majority of those without a school-leaving certificate come from a special needs school for learning disabilities (67%).

This is reflected in the composition of the low-achieving group: 60% of those *without a school-leaving certificate* attended a special needs school for learning disabilities in Grade 9, and 32% attended either a *Hauptschule* or the lower track in a school with multiple tracks. For those leaving school *with a lower secondary certificate*, 88% attended a lower secondary school or a school with multiple tracks. It is also worth noting that the majority of low-achieving school-leavers attended school until 10th grade, like those who left school with an intermediate certificate. Both groups therefore had a similar median school-leaving age (16.5 and 16.9 years, respectively). Thus, despite the aforementioned educational expansion (see Sect. 12.2), the association between low school achievement and school type is still rather strong. Does this strong correlation also apply to the agentic resources of the low-achieving group? In the following two sub-sections, we examine their agentic and social resources.

12.4.2 Agentic Resources

Low-achieving school-leavers are often assumed to be insufficiently mature to enter regular vocational education and training in Germany. The German Federal Employment Agency (Bundesagentur für Arbeit, 2006) defines school-leavers as being insufficiently mature when they lack cognitive skills and basic school knowledge (such as spelling, basic mathematical skills), non-cognitive skills (such as reliability and conscientiousness, social skills, and motivation), and a vocational orientation.

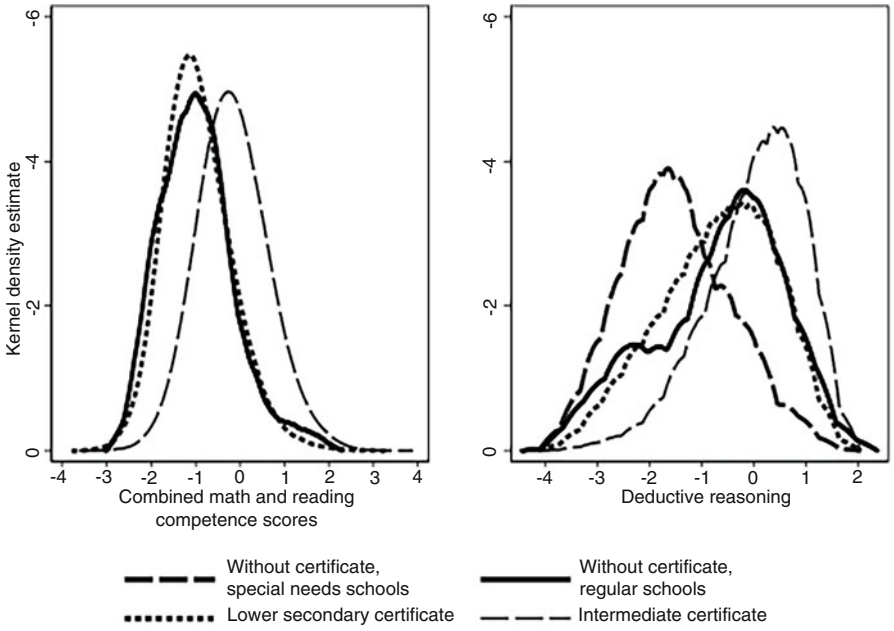


Fig. 12.1 Distribution of competencies and deductive reasoning by school-leaving certificate
Source: NEPS SC4 SUF 9.0.0, including respondents from schools for learning disabilities, weighted, own calculations
Measured in Grade 9, measures for math and reading competencies are not available for school-leavers from special needs schools
z-standardisation with a mean of 0 and a standard deviation of 1 based on total sample

Likewise, the existing literature often refers to low-achieving school-leavers as a rather homogeneous group (Solga, 2002; Solga & Wagner, 2001). In contrast, our analysis with NEPS data suggests that this group is quite heterogeneous, and that a substantial share of it cannot be described as insufficiently mature for training.

Figure 12.1 shows that low-achieving school-leavers are very heterogeneous in terms of their math and reading competencies and basic cognitive abilities (deductive reasoning).[5] On average, they attain lower competence scores than school-leavers who left school with an intermediate school certificate. However, a substantial proportion of them have the same competence scores as school-leavers with an intermediate school-leaving certificate. On deductive reasoning, only school-leavers from special needs schools for learning disabilities show lower average scores than those from regular schools. The school-leaving certificate explains 38% of the variance in competencies and 22% of the variance in deductive reasoning.[6] This means that, in terms of their cognitive potential, quite a few

[5] Separate figures for math and reading are very similar. For reasons of parsimony, we therefore decided to present the figure obtained from the combined scores.

[6] All NEPS respondents are included in this calculation, including the group of school-leavers from the academic track.

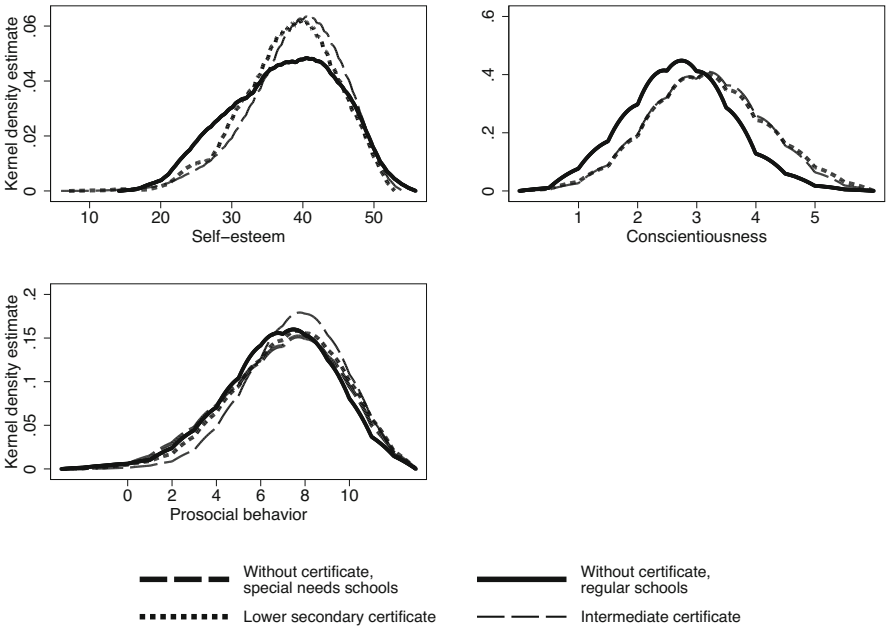


Fig. 12.2 Distribution of self-esteem, conscientiousness, and prosocial behaviour by school-leaving certificate
Source: NEPS SC4 SUF 9.0.0, including respondents from schools for learning disabilities, weighted, own calculations
Measured in Grade 9, measures for self-esteem and conscientiousness are not available for school-leavers from special needs schools
Self-esteem: Scale from 10 to 50, example item: 'All in all, I am satisfied with myself' (von Collani & Herzberg, 2003)
Conscientiousness: Scale of 1–5 based on responses to the questions, 'How much do the following statements apply to you?': 'I am easy-going and tend to be a bit lazy' (responses reversed) and 'I am thorough' (Rammstedt & John, 2007)
Prosocial behaviour: Behaviour aimed at increasing the well-being of others. Scale from 0 to 10, example item: 'I try to be nice to other people, their feelings are important to me' (Goodman et al., 1998)

low-achieving school-leavers could have left school with an intermediate school certificate.

Looking at the distribution of personality traits, the overlap between students with different school-leaving certificates is even greater than the overlap observed for cognitive skills (see Fig. 12.2). Thus, students with different school-leaving certificates are rather similar when it comes to conscientiousness, self-esteem, and self-reported prosocial behaviour. However, none of these non-cognitive characteristics have substantial explanatory power for respondents' school-leaving certificates. For school-leavers without a school-leaving certificate, we find somewhat smaller overlaps, especially in the distribution of conscientiousness.

Having considered the cognitive and non-cognitive dimensions of training (im)maturity, we now turn to vocational aspirations and orientations. We use several indicators (see Table 12.1). As a motivational resource, we look at both the idealistic and realistic occupational aspirations of both school-leavers and their parents (as perceived by respondents). The vast majority of low-achieving school-leavers planned to enter vocational training after school. This matches their parents' aspirations for their children. In addition, the vast majority of students had developed *realistic* occupational aspirations by the start of Grade 9 (i.e., the occupations they expected to be trained in after taking their grades and other limiting factors into account). The average occupational status (ISEI) of realistic occupational aspirations of school-leavers without a school certificate is 32; for those with a lower secondary certificate, it is 38. Both averages are in the lower third of the ISEI scale.[7] In contrast, adolescents with an intermediate school-leaving certificate have career aspirations with a mean ISEI score of 49—that is, in the middle third. The occupational status of students' *idealistic* occupational aspirations (i.e., occupations that they would like to be trained in if there were no restrictions) is higher than their realistic aspirations. Low-achieving school-leavers' idealistic aspirations pertain to occupations ranked in the middle third of the ISEI scale. This discrepancy between realistic and idealistic occupational aspirations indicates that school-leavers have adapted their aspirations in line with their realistic options (see Dombrowski, 2015). Hence, their realistic occupational aspirations and their high level of training orientation do not indicate severe problems in vocational orientation, contrary to the public debate about 'training maturity'.

To identify the possible potential of learning motivation, Table 12.1 additionally shows which school-leaving certificate students aspired to attain when surveyed in Grade 9. These data on educational aspirations show clear differences between the desired, expected, and attained school-leaving certificate. Only 1% of those who left school without a certificate wished to do so (idealistic aspirations), and only 6% expected to do so (realistic aspirations). The discrepancy is also high among those who left school with a lower secondary certificate: only 23% wanted it and 60% expected it. Their parents also had—according to the information provided by their children in the survey—higher educational aspirations for them: the vast majority of parents would have liked their children to achieve at least an intermediate school certificate. As a point of reference, among the school-leavers with an intermediate certificate, the differences between the desired, expected, and attained school-leaving certificate are significantly smaller.

There are two possible ways of interpreting this: on the one hand, this high discrepancy between the expected and attained school-leaving certificate among low-achieving school-leavers can be regarded as problematic, because it indicates that they are often unable to assess their own performance accurately. On the other

[7] ISEI = International Socio-Economic Index of Occupational Status. The ISEI scale ranges from 16 to 90 points. Thus, the lower third is defined from 16 to 40; the middle third, from 41 to 65; and the upper third, from 66 to 90.

Table 12.1 Occupational and educational aspirations by school-leaving certificate (column percentages or arithmetic mean and standard deviation)

	School-leaving certificate when leaving general education school			
	Without certificate	Lower secondary certificate	Low achievers together	Intermediate certificate
I. Occupational aspirations				
Training plan				
Planned to do a regular vocational training programme after school	76%	78%	77%	61%
Idealistic occupational aspiration in Grade 9 (wishes)				
Report a desired occupation	81%	78%	79%	80%
ISEI of idealistic aspiration: Arithmetic mean (standard deviation)	40 (19)	50 (21)	48 (21)	60 (19)
Realistic occupational aspirations in Grade 9 (expectations)				
Report a desired occupation	71%	73%	73%	70%
ISEI of realistic aspiration: Arithmetic mean (standard deviation)	32 (14)	38 (15)	37 (15)	49 (18)
Idealistic educational aspirations of parents[a]				
Study (university)	11%	14%	14%	30%
Vocational training	75%	78%	78%	61%
None of the above	3%	2%	2%	1%
Parents have no opinion about it	11%	6%	6%	8%
II. Educational aspirations				
Idealistic aspirations to graduate from school				
Without a certificate	1%	0%	0%	0%
Lower secondary certificate	23%	23%	23%	1%
Intermediate certificate	60%	61%	61%	52%
Abitur (university entrance qualification)	16%	16%	16%	47%
Realistic aspirations to graduate from school				
Without a certificate	6%	1%	1%	0%
Lower secondary certificate	57%	60%	60%	5%
Intermediate certificate	34%	35%	35%	77%
Abitur (university entrance qualification)	3%	4%	4%	18%
Idealistic school aspirations of parents[a]				
Lower secondary certificate	21%	19%	19%	1%
Intermediate certificate	55%	63%	62%	54%
Abitur (university entrance qualification)	21%	16%	16%	42%
Parents have no opinion about it	3%	2%	3%	3%
Number of cases (unweighted)	616	2897	3513	4971

Source: NEPS SC4 SUF 9.0.0, including respondents from schools for learning disabilities, weighted, own calculations

All measured in Grade 9; exception is the training plan—'Did you want to start a regular vocational training programme right after school?'—was measured in the first wave after leaving school

ISEI International Socio-Economic Index of Occupational Status (scale between 16 and 90)

[a]Information from children (perceived parental aspirations)

hand, the desire to attain a higher school-leaving certificate and to complete vocational training might indicate that these low-achieving school-leavers are still motivated to participate in education (at least in Grade 9). In other words, they have not yet lost their educational and occupational aspirations, despite their setbacks and their being labelled as low achievers (or even disabled) during their school years (see Knigge, 2009; Pfahl, 2011; Solga, 2004).

Overall, the findings on individual agentic resources indicate that—even with a rather narrow interpretation of 'maturity for vocational training'—a notable proportion of low-achieving school-leavers are willing and mature enough to undergo vocational training in terms of their cognitive and non-cognitive skills as well as their vocational orientation. In all dimensions of training maturity, there is a clear overlap between low-achieving school-leavers and those with an intermediate certificate, although the latter are much more successful in entering regular vocational training (see Sect. 12.5 below). Moreover, we observed that some low-achieving school-leavers had the cognitive, non-cognitive, and motivational potential to acquire higher school-leaving certificates, but this remained undiscovered during their school time.

12.4.3 Social Resources

We now turn to social resources such as parents' education, employment status, and immigrant background. Respondents are defined as having an immigrant background if they themselves or both their parents were born outside Germany. Table 12.2 provides information on the social background of the low-achieving school-leavers and of the school-leavers with an intermediate certificate—the latter as the comparison group. Among the low achievers, almost twice as many have an immigrant background compared to those with an intermediate certificate (22% vs 13%). Moreover, their parents' educational attainment is significantly lower: four out of 10 low achievers have parents who also left school with a lower secondary certificate at most; in contrast, among school-leavers with an intermediate certificate, this figure is only around 2 out of 10. These figures are a clear indicator of the intergenerational transmission of educational attainment and inequality. Nevertheless, we also see a notable proportion of low-achieving school-leavers whose parents even obtained a university entrance qualification (17%).

The same applies to parental employment status: almost one half of school-leavers without a school certificate (48%) and almost two thirds of those with a lower secondary certificate (64%) have two employed parents. Thus, they can draw on experience and information from two employed parents in their school-to-work transition period. This proportion is quite high; yet it is significantly lower than that among those with an intermediate school certificate (75%).

Furthermore, the parents of low-achieving school-leavers tend to work in the lower segment of the labour market: the average occupational status is in the lower third of the ISEI scale. In contrast, the mean ISEI score for parents of respondents

Table 12.2 Social background characteristics by school-leaving certificate (column percentages or arithmetic mean and standard deviation)

	School-leaving certificate when leaving general education school			
	Without certificate	Lower secondary certificate	Low achievers together	Intermediate certificate
Immigrant background				
Without	74%	78%	78%	87%
With	26%	22%	22%	13%
Highest school degree of parents				
No or lower secondary certificate	46%	40%	41%	20%
Intermediate certificate	41%	43%	42%	49%
Abitur (university entrance qualification)	13%	17%	17%	31%
Employment status of parents				
No parent employed	12%	6%	7%	2%
One parent employed	40%	30%	31%	23%
Both parents employed	48%	64%	62%	75%
Highest occupational status achieved by parents (ISEI): Arithmetic mean (standard deviation)	37 (18)	39 (18)	39 (18)	47 (19)
Number of cases (unweighted)	616	2897	3513	4971

Source: NEPS SC4 SUF 9.0.0, including respondents from schools for learning disabilities, weighted, own calculations

Immigrant background: respondents themselves or both their parents born outside Germany. *ISEI* International Socio-Economic Index of Occupational Status (scale between 16 and 90). All data on parents generally refer to Grade 9. When possible, data were taken from parent interviews; if not available, from the children

with an intermediate certificate is clearly in the middle third. But even here, we see remarkable variation shown by the standard deviation. Thus, even among parents of low-achieving school-leavers, there is a quite substantial number employed in jobs with a medium and possibly even high occupational status.

Overall, we do see the familiar finding of a strong association between school-leaving certificate and social background: low-achieving school-leavers are, on average, significantly more disadvantaged than those with an intermediate certificate. Thus, on average, low achievers do not have the same social resources at their disposal when looking for a training place. At the same time, the group of low-achieving school-leavers is by no means homogeneous: quite a substantial number of low achievers have good socio-economic resources that they can draw on in their school-to-work transition. In the next section, we examine whether this variation in agentic and social resources translates into variation in their school-to-work transition patterns; or, in other words, whether better individual and social resources indeed increase low achievers' chances to improve their school-leaving certificates and enter vocational education.

12.5 School-to-Work Transitions

To improve their educational attainment, low-achieving school-leavers have two options after leaving general school: they can obtain an intermediate certificate at a vocational school in a so-called prevocational programme that is meant to prepare for vocational education (see Sect. 12.5.1) or they can gain a better qualification by successfully completing a regular vocational training programme (see Sect. 12.5.2). In the following, we look at school-leavers' trajectories after leaving general schooling and explore how well low-achieving school-leavers succeeded in taking advantage of these two options during the observation period until autumn 2013 or autumn 2015/spring 2016 (Wave 9).

12.5.1 Improvement of School-Leaving Certificates

Table 12.3 shows the highest school-leaving certificate achieved in autumn 2015 compared with the school-leaving certificate attained before leaving general school. For those who left school after Grade 9, this is 4 years after leaving school; for those who left school after Grade 10 (the vast majority), this is 3 years after leaving school. The majority of school-leavers who left school without a certificate had not achieved a certificate within the 3 or 4 years after leaving school. Only 30% improved their qualifications by obtaining a lower secondary certificate by 2015. Most school-leavers with a lower secondary certificate remained stuck on the lower secondary certificate level (70%); however, 30% obtained a higher school certificate (23% achieved an intermediate certificate by 2015 and 7% even attained a university entrance qualification). By comparison, 34% of school-leavers with an intermediate certificate obtained an *Abitur* later on.

Overall, 94% of those who left school without a school-leaving certificate and 70% of those with a lower secondary certificate remained in the low-achieving group—even though they very often attended prevocational programmes, most of which offer the opportunity to catch up on school-leaving certificates (see Holtmann et al., 2021). Thus, even several years after leaving school, these young people were unable to pursue their (idealistic and realistic) educational aspirations (see above)—

Table 12.3 School-leaving certificate at the end of general school and in 2015 (row percentages)

School-leaving certificate at the end of general schooling	Improvement of school-leaving certificate			
	Without certificate	Lower secondary certificate	Intermediate certificate	*Abitur*
Without certificate	70%	24%	5%	1%
Secondary school certificate		70%	23%	7%
Intermediate certificate			66%	34%

Source: NEPS SC4 SUF 9.0.0, including respondents from schools for learning disabilities, weighted, own calculations

in stark contrast to those with an intermediate certificate who were often able to exceed their aspirations. Among the latter, 18% considered it realistic to obtain the *Abitur*, but as many as 34% managed to do so by 2015.

12.5.2 Transitions to Vocational Training

We now explore the transitions to vocational training. The German vocational training system is organized like an entry labour market—that is, school-leavers need to apply to and be selected by firms to enter regular (usually firm-based) vocational training programmes (for details, see Protsch & Solga, 2016). Thus, the question is how competitive low-achieving school-leavers are in the race for training places.

As shown above, low-achieving school-leavers want to complete vocational training after school even more than those with an intermediate secondary school-leaving certificate (77% vs 61%, see Table 12.1 above). However, they are much less successful in doing so. Figure 12.3 shows the activity status of the school-leavers in October after leaving general school. We find that 76% of those without a school-leaving certificate ended up in prevocational programmes and only 9% managed to enter regular vocational training programmes immediately after leaving school. The situation is somewhat better for those with a lower secondary certificate: 41% started a prevocational programme after leaving general school and 45% started regular

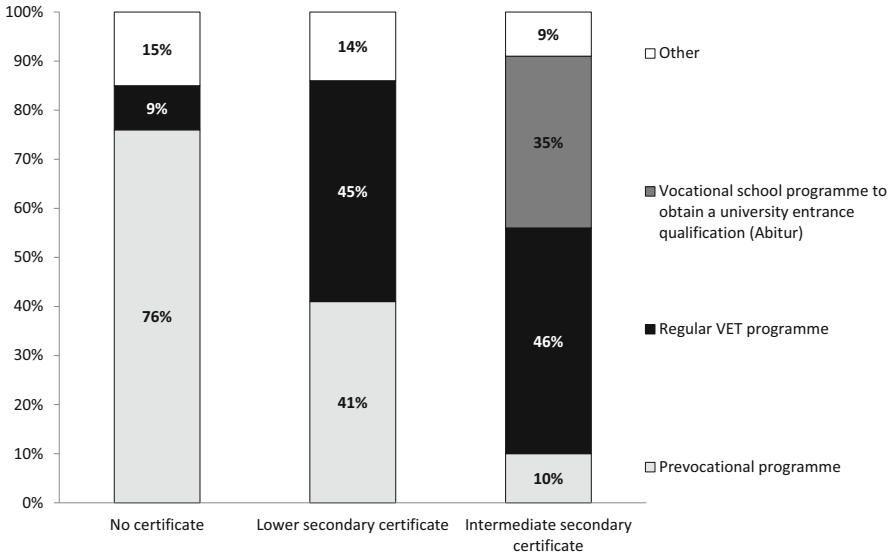


Fig. 12.3 Activity status in October after leaving general school (2011 and 2012, respectively) by school-leaving certificate
Source: NEPS SC4 SUF 9.0.0, including respondents from schools for learning disabilities, weighted, own calculations

vocational training. In comparison, only 10% of those with an intermediate certificate started prevocational programmes; the clear majority of them either successfully entered regular vocational training programmes or attended vocational schools to obtain a higher education entrance qualification.

Our multivariate analyses have shown that both the application behaviour and access to training positions of low-achieving school-leavers were affected significantly by their school-leaving certificate, their attendance of a special needs school, and their final grades (for the analyses, see Holtmann et al., 2017). In contrast, competencies and personality traits did not matter: those with higher maths and reading competencies or more advantageous personality traits (such as conscientiousness and self-esteem) did not differ in terms of whether they applied for or got a training place directly after leaving school. Better social resources in terms of parental education, employment, and occupational position likewise did not improve application behaviour or training chances. This means that the heterogeneity within the group of low-achieving school-leavers remained largely undiscovered—not only in school but also in the transition to vocational training.

However, if we look only at transitions immediately in autumn after leaving school, we may miss differences in the transition patterns of the low-achieving group—for instance, some of this group might have successfully entered regular vocational training programmes after participation in prevocational programmes. We therefore conducted sequence analyses to gain information on typical transition patterns and the frequency of their occurrence. Here, we look at sequences for the period from the beginning of Grade 9 (October 2010) until September 2013—that is, 2–3 years after leaving school after Grade 9 or 10. For the period 2010–2013, we consider activities on a month-by-month basis using retrospective respondent data. We identify five activity types: attending a general school, participating in a prevocational programme, participating in a regular vocational training programme, employment, and other activities (e.g., internships, short training courses, volunteer services, unemployment, inactivity). The sixth category 'not observed' refers to respondents for whom information on their activities was not available until the end of the observation period in September 2013 (panel dropouts). Sequence analysis begins by using optimal matching to compare the individual sequences with each other for similarity (see Brzinsky-Fay et al., 2006; Scherer & Brüderl, 2010). Afterwards, this technique groups similar sequences into common patterns using cluster analysis (Ward's method). We carried out the sequence analysis separately for low-achieving school-leavers from regular schools and low-achieving school-leavers from special needs schools for learning disabilities. This separation allows us to examine a potential double disadvantage experienced by low achievers from special needs schools because of their institutionalized label of having 'learning disabilities'.

Figure 12.4 shows the results of our sequence analyses: there are five transition patterns for those from special needs schools and eight patterns for those from regular schools. Table 12.4 displays the distribution of these patterns and the average number of spells within each pattern. This number depicts how many changes

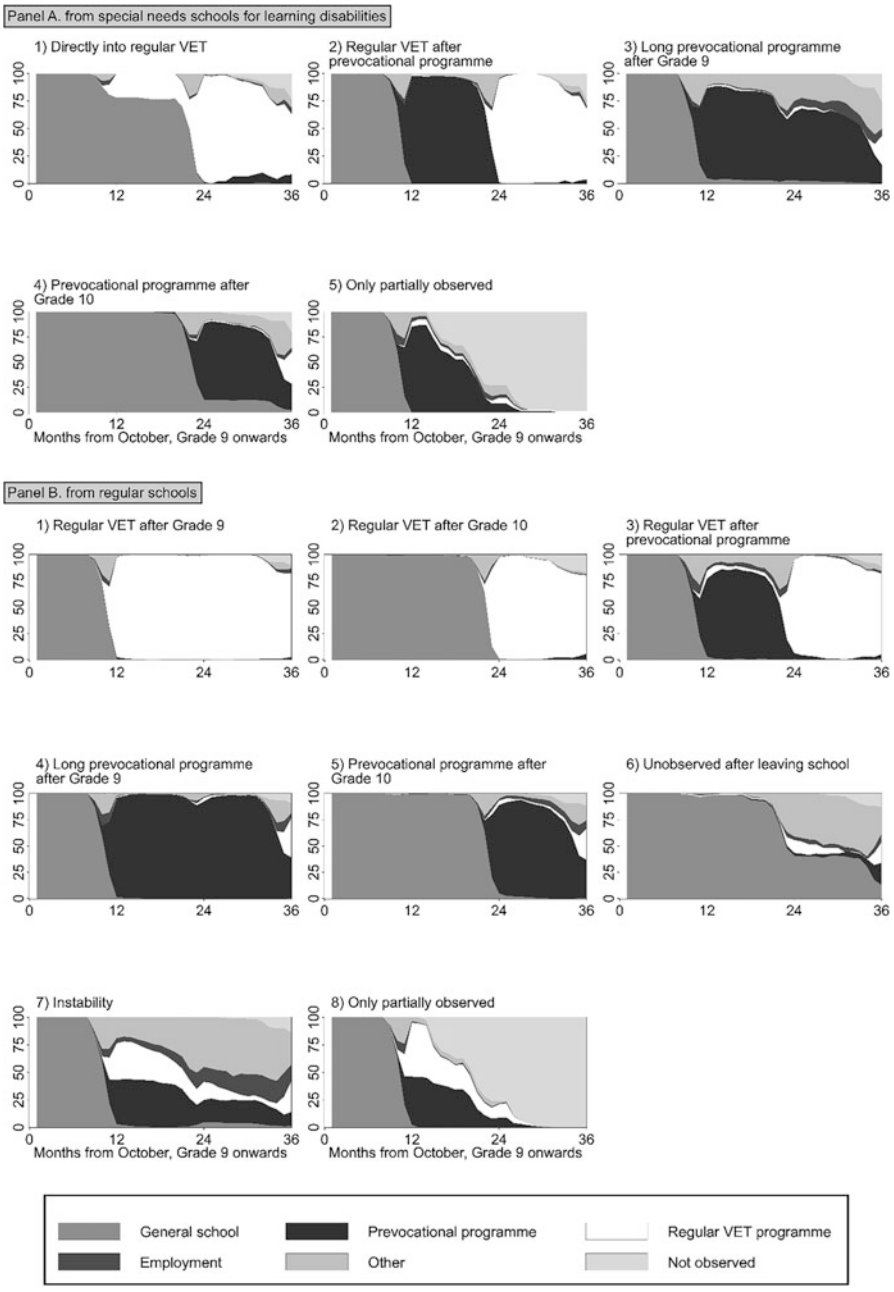


Fig. 12.4 Transition patterns of low-achieving school-leavers between Grade 9 and 3 years later
Source: NEPS SC4 SUF 9.0.0, weighted, own calculations
VET vocational education and training. Status 'other' includes, for example, internship, voluntary service, unemployment, inactivity

Table 12.4 Transition patterns (in column percentages)

	Total	Without certificate	Lower secondary certificate	Average number of spells	Number of cases (unweighted)
From special needs schools					
1. Directly into regular vocational training programme	14%	7%	29%	3,0	119
2. Regular vocational training programme after prevocational programme	12%	13%	9%	4,3	103
3. Long participation in prevocational programmes	28%	34%	14%	4,8	222
4. 10 years of schooling plus prevocational programme	38%	34%	46%	3,5	301
5. Only partially observed	8%	12%	2%	2,8	68
From regular schools					
1. Regular vocational training programme after Grade 9	24%	5%	25%	2,9	610
2. Regular vocational training programme after Grade 10	11%	2%	12%	2,6	323
3. Regular vocational training programme after short prevocational programme	9%	9%	9%	4,5	271
4. Long participation in prevocational programmes after Grade 9	16%	14%	16%	4,0	416
5. Prevocational programme after Grade 10	13%	13%	14%	3,6	389
6. Unobserved after leaving school	5%	14%	5%	3,8	147
7. Instability	12%	22%	11%	5,9	293
8. Only partially observed	9%	21%	8%	3,0	251

Source: NEPS SC4 SUF 9.0.0, including respondents from schools for learning disabilities, weighted, own calculations

respondents experienced during the observation period (i.e., changes between different types of activities as well as between the same type of activities).

For low achievers from special needs schools for learning disabilities (upper panel in Fig. 12.4), we find two patterns with a relatively quick transition to regular vocational training programmes. In Pattern 1, they entered regular vocational training programmes after 10 years of schooling (14%); in Pattern 2, they attended a prevocational programme for 1 year after 9 years of schooling before transitioning to regular vocational training programmes (12%). These two patterns can be considered successful transitions—together, they include one quarter of the low achievers from special needs schools. The transition trajectories displayed by Patterns 3 and 4 had not (yet) ended successfully at the end of the observation period. Pattern 3 is characterized by a longer period of participation in prevocational programmes and

many episodes (numbers of spells). In Pattern 4, only a small proportion of school-leavers had succeeded in starting a regular vocational training programme after 10 years of school attendance and 1 year of prevocational programme attendance by the end of the observation period (September 2013). Patterns 3 and 4 were experienced by two thirds of these low achievers (28% and 38%, respectively). In Pattern 5 (8%), we could observe many respondents for only 24 months after October 2010 before they left the NEPS. The majority of them attended prevocational programmes after Grade 9.

For low achievers from regular schools (lower panel in Fig. 12.4), Patterns 1 and 2 can be regarded as ideal-typical transitions. After attending school for 9 or 10 years, these young people directly started regular vocational training programmes. Around one third of this group experienced these transition patterns (24% and 11%, respectively). In addition, we observe a successful pattern with entry into regular vocational training following a prevocational programme episode after Grade 9 (Pattern 3), which was experienced by 9% of low achievers.

Pattern 4 (16%) is the first of the more problematic transition patterns. Here, young people attended a prevocational programme for 2 years after Grade 9, and a substantial proportion of them also started a third year in a prevocational programme. The situation is similar for Pattern 5 (13%): despite 10 years of schooling, a substantial proportion of them ended up in prevocational programmes for a second year, and only a smaller proportion succeeded in entering regular vocational training programmes afterwards. Young people with Pattern 6 (5%) did not participate in prevocational training programmes or regular vocational training after leaving school; many of them attended school for more than 10 years or started an internship. Pattern 7 is characterized by turbulence and instability after Grade 9—indicated by a higher number of spells within the 3-year observation period. This transition pattern entails shorter episodes in prevocational programmes, started (but not completed) regular vocational training programmes, and employment. About 12% of low-achieving school-leavers from regular schools experienced this pattern. Finally, Pattern 8 (9%) is again a cluster of transitions that we can observe only in part. It predominantly includes young people who left school after Grade 9; some of them started prevocational or regular vocational training programmes, yet the outcome was unclear.

There is a clear association between the transition patterns and school-leaving certificates within both the group of low achievers from special needs schools for learning disabilities and the group from regular schools (see Table 12.4): those with a lower secondary certificate experienced successful transition patterns more often than those who left school without a certificate. Among those who attended special needs schools, the successful Patterns 1 and 2 were experienced by 38% of those with a lower secondary certificate but by only 20% of those without a certificate. Among regular school-leavers, 46% with a lower secondary certificate experienced successful Patterns 1–3, compared to only 16% of those without a certificate. Moreover, there are hardly any differences in this respect between low achievers who did not attain a certificate at either special needs or regular schools (only 20% and 16%, respectively, had successful patterns), but there were clear differences

between those with a lower secondary certificate by school type (38% vs 46%). The latter finding indicates that the lower secondary certificate from a special needs school is associated with lower chances of transitioning to regular vocational training.

We also investigated whether prevocational programmes can aid these young people to enter regular vocational training; and, if so, into which programmes (for the analyses, see Holtmann et al., 2021; Menze & Holtmann, 2019). A crucial question is whether programmes that improve low-achieving young people's formal qualifications (education-focused programmes) or those that give them the opportunity to spend time in firms (firm-based programmes) are more supportive of successful transitions into regular vocational training afterwards. Our study reveals that both programme philosophies are valuable, because participation in them indeed improved low achievers' training chances afterwards. However, 42% of participants did not acquire either higher school certificates or firm contacts during their prevocational programme.

Moreover, programmes in which young people attained a higher school certificate increased not only their training chances in general but also their chances of entering training occupations with a higher status (Holtmann et al., 2021). Thus, certificates, skills, and firm contacts acquired during prevocational programmes are recognized and valued by German employers. It is, however, important to mention that about one half of the prevocational programme participants did not enter regular vocational training programmes afterwards. As indicated by our sequence analyses, the vast majority of them entered a second prevocational programme, a low-skilled job, or unemployment. Nonetheless, even though prevocational programmes do not help everyone, our analyses based on NEPS data suggest that many low-achieving school-leavers benefit from participation in such programmes and are better off than they would have been without the programmes.

12.6 Conclusions

Despite educational expansion and the abolition of the separate lower secondary school type (*Hauptschule*) in many German states, about one fifth of recent school-leavers in Germany still have either a lower secondary certificate or none at all. Moreover, due to educational expansion, leaving school with an intermediate school leaving certificate has become the norm and is accompanied by more demanding educational requirements to obtain training places in firms. As a result, the disadvantages experienced by school-leavers who leave school with no or only a lower secondary certificate continue during their school-to-work transition period (Holtmann et al., 2017; Protsch, 2014; Protsch & Solga, 2016). In this chapter, on the one hand, we examined the agentic resources of low-achieving school-leavers for their transitions after school. On the other hand, we looked at their chances of obtaining a higher school certificate or entering regular vocational training

programmes—that is, their opportunities to escape low educational achievement after leaving school.

We show that school-leavers with a lower secondary certificate or less are a disadvantaged but by no means a homogeneous group. A significant proportion of the members of this group do not differ in their cognitive and non-cognitive potential or social resources from school-leavers with an intermediate school-leaving certificate. These resources could be used to obtain higher school-leaving certificates after leaving school or to successfully enter vocational training. What we found, however, is that this potential remained largely undiscovered—with the devastating consequence that a substantial proportion of this group will remain low achievers in the long term.

While still attending school, the majority of these young people had aspired to attain a better school-leaving certificate than they ultimately achieved. Only a portion of them were able to obtain an intermediate school-leaving certificate in prevocational programmes or start a regular vocational training programme (which is educationally equivalent to attaining a better school-leaving certificate). The labour market opportunities for unsuccessful low achievers in this respect are known to be very poor in terms of access to employment (vs unemployment), occupational status, and wages (Giesecke et al., 2015; Heisig et al., 2019; Solga, 2005).

Overall, the analyses show that low-achieving school-leavers' existing agentic resources are utilized insufficiently. The vast majority of them want to undergo training and many are also 'ready for training' according to the definition of the Federal Employment Agency. However, the transition to vocational training is determined more by their low school-leaving certificates than by their individual and social resources. These findings indicate that the disadvantages experienced by low-achieving young people in their transitions to training have less to do with a lack of individual or social resources than the opportunity structures they encounter—that is, the selection procedures and criteria used by companies and the institutional gatekeepers at the Federal Employment Agency. This disparity between this group's heterogeneity in resources on the one hand and quite homogeneous school-to-work opportunities on the other was already criticized more than 10 years ago in an expert survey by the Federal Institute of Vocational Education and Training (BIBB) in which the overwhelming majority of experts expressed the view that firms should take greater account of young people's development potential and thus also give weaker young people training opportunities more frequently (Ehrenthal et al., 2005, p. 6).

What can be done? First of all, general schools and vocational schools (especially in the context of prevocational programmes) have to do more to promote and discover the educational potential of these young people, and to convert this potential into intermediate school certificates. This would significantly reduce the proportion of young people with low educational attainment and, at the same time, improve their training opportunities. It would also be helpful if the heterogeneity of young people beyond their school-leaving certificates could be better recognized on the training market. To do this, firms would have to use procedures and recruitment

processes that enable them to discover the potential of young people—despite low school-leaving certificates or poorer grades.

The NEPS data are the first representative data set for Germany that allows researchers to study school-to-work transitions of low-achieving youth in depth, including an exceptional sub-sample of respondents who attended special needs schools for learning disabilities. It contains a wealth of information on cognitive and non-cognitive skills as well as on the life course. The upcoming waves will allow researchers to explore their later employment and life outcomes, including their social integration into society, family, and civic engagement. This can provide researchers with the data they need to study the underlying mechanisms of success and failure in these respects.

References

Baumert, J., Cortina, K. S., & Leschinsky, A. (2008). Grundlegende Entwicklungen und Strukturprobleme im allgemeinbildenden Schulwesen. In K. S. Cortina, J. Baumert, A. Leschinsky, K. U. Mayer, & L. Trommer (Eds.), *Das Bildungswesen in der Bundesrepublik Deutschland* (pp. 53–130). Rowohlt.

Blossfeld, H.-P., Rossbach, H.-G., & von Maurice, J. (Eds.). (2011). *Education as a lifelong process* (Sonderband der Zeitschrift für Erziehungswissenschaften 14(2)). Springer VS.

Brzinsky-Fay, C., Kohler, U., & Luniak, M. (2006). Sequence analysis with Stata. *The Stata Journal, 6*(4), 435–460.

Bundesagentur für Arbeit. (2006). *Nationaler Pakt für Ausbildung und Fachkräftenachwuchs—Kriterienkatalog zur Ausbildungsreife.* Retrieved from https://www.bibb.de/dokumente/pdf/a21_PaktfAusb-Kriterienkatalog-AusbReife.pdf

Dombrowski, R. (2015). *Berufswünsche benachteiligter Jugendlicher. Die Konkretisierung der Berufsorientierung gegen Ende der Vollzeitschulpflicht*. W. Bertelsmann Verlag.

Ehrenthal, B., Eberhard, V., & Ulrich, J. G. (2005). *Ausbildungsreife—auch unter den Fachleuten ein heißes Eisen*. Bundesinstitut für Berufsbildung.

Giesecke, J., Heisig, J. P., & Solga, H. (2015). Getting more unequal: Rising labor market inequalities among low-skilled men in West Germany. *Research in Social Stratification and Mobility, 39*, 1–17.

Goodman, R., Meltzer, H., & Bailey, V. (1998). The strengths and difficulties questionnaire: A pilot study on the validity of the self-report version. *European Child & Adolescent Psychiatry, 7*(3), 125–130.

Heisig, J. P., Gesthuizen, M., & Solga, H. (2019). Lack of skills or formal qualifications? New evidence on cross-country differences in the labor market disadvantage of less-educated adults. *Social Science Research, 83*, #102314.

Holtmann, A. C., Menze, L., & Solga, H. (2017). Persistent disadvantages or new opportunities? The role of agency and structural constraints for low-achieving adolescents' school-to-work transitions. *Journal of Youth and Adolescence, 46*(10), 2091–2113.

Holtmann, A. C., Ehlert, M., Menze, L., & Solga, H. (2021). Improving formal qualifications or firm linkages—What supports successful school-to-work transitions among low-achieving school leavers in Germany? *European Sociological Review, 37*(2), 218–237.

Knigge, M. (2009). *Hauptschüler als Bildungsverlierer? Eine Studie zu Stigma und selbstbezogenem Wissen bei einer gesellschaftlichen Problemgruppe*. Waxmann.

Ludwig-Mayerhofer, W., Pollak, R., Solga, H., Menze, L., Leuze, K., Edelstein, R., Künster, R., Ebralidze, E., Fehring, G., & Kühn, S. (2019). Vocational education and training and transitions into the labor market. *Zeitschrift für Erziehungswissenschaft, Edition ZfE, 3*, 277–323.

Menze, L., & Holtmann, A. C. (2019). Was können Schulabgängerinnen und Schulabgänger ohne Mittleren Schulabschluss aus Übergangsmaßnahmen mitnehmen? Entwicklungen und Übergangschancen in Ausbildung. *Zeitschrift für Erziehungswissenschaft, 22*(3), 509–533.

National Education Report (2018) = Autorengruppe Bildungsberichtserstattung. (2018). *Bildung in Deutschland 2018*. wbv.

National Education Report (2020) = Autorengruppe Bildungsberichtserstattung. (2020). *Bildung in Deutschland 2020*. wbv.

Pfahl, L. (2011). *Techniken der Behinderung: Der deutsche Lernbehinderungsdiskurs, die Sonderschule und ihre Auswirkungen auf Bildungsbiografien*. transcript Verlag.

Protsch, P. (2014). *Segmentierte Ausbildungsmärkte: Berufliche Chancen von Hauptschülerinnen und Hauptschülern im Wandel*. Budrich UniPress.

Protsch, P., & Solga, H. (2016). The social stratification of the German VET system. *Journal of Education and Work, 29*(2), 637–661.

Rammstedt, B., & John, O. P. (2007). Measuring personality in one minute or less. *Journal of Research in Personality, 41*, 203–212.

Scherer, S., & Brüderl, J. (2010). Sequenzdatenanalyse. In C. Wolf, & H. Best (Eds.), *Handbuch der sozialwissenschaftlichen Datenanalyse* (pp. 1031–1051). VS Verlag.

Schoon, I., & Lyons-Amos, M. (2016). Diverse pathways in becoming an adult: The role of structure, agency and context. *Research in Social Stratification and Mobility, 46*(Part A), 11–20.

Solga, H. (2002). 'Stigmatization by negative selection': Explaining less-educated persons' decreasing employment opportunities. *European Sociological Review, 18*(2), 159–178.

Solga, H. (2004). Increasing risks of stigmatization. Changes in school-to-work transitions of less-educated West Germans. *Yale Journal of Sociology, 4*, 99–129.

Solga, H. (2005). *Ohne Abschluss in die Bildungsgesellschaft. Die Erwerbschancen gering qualifizierter Personen aus soziologischer und ökonomischer Perspektive*. Verlag Barbara Budrich.

Solga, H., & Wagner, S. (2001). Paradoxie der Bildungsexpansion: Die doppelte Benachteiligung von Hauptschülern. *Zeitschrift für Erziehungswissenschaft, 4*(1), 107–127.

Steinhauer, H. W., & Zinn, S. (2016). *NEPS technical report for weighting: Weighting the sample of Starting Cohort 4 of the National Educational Panel Study (Wave 1 to 6)* (NEPS Survey Paper No. 2). Leibniz Institute for Educational Trajectories.

von Collani, G., & Herzberg, P. Y. (2003). Eine revidierte Fassung der deutschsprachigen Skala zum Selbstwertgefühl von Rosenberg. *Zeitschrift für Differentielle und Diagnostische Psychologie, 24*(1), 3–7.

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Chapter 13
Occupational Sex Segregation and its Consequences for the (Re-)Production of Gender Inequalities in the German Labour Market

Corinna Kleinert, Kathrin Leuze, Ann-Christin Bächmann, Dörthe Gatermann, Anna Erika Hägglund, and Kai Rompczyk

Abstract In Germany, the structuring principle connecting the educational system and the labour market is occupations. In theory, this occupational principle is gender-neutral, because both women and men are channelled into jobs according to the occupations for which they are trained. In practice, however, it means that patterns of occupational sex segregation in the education system are reproduced in the labour market. As a consequence, occupational sex segregation has important consequences for the subsequent employment biographies and life courses of women and men. In this chapter, we study the relevance of occupational sex segregation for the (re-)production of gender inequalities in the German labour

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market. More specifically, we examine long-term trends in occupational sex segregation, how occupational sex segregation is causally linked to other occupational characteristics, how these occupational characteristics translate into gender inequalities regarding non-monetary labour market outcomes, and how these occupational characteristics affect the gender wage gap.

13.1 Introduction

In the German welfare state, occupations are the structuring principle connecting the educational system and the labour market. Because the education system is characterized by not only a pronounced level of standardization and stratification (Allmendinger, 1989) but also an explicit occupational orientation (Kerckhoff, 2003), vocational and academic certificates signal both a specific amount of education and a specific bundle of general and occupation-specific skills (Gangl, 2001; Leuze, 2011). Accordingly, education certificates are necessary prerequisites for finding stable and regular employment in a particular occupation with the associated resources it provides such as prestige and income (Müller et al., 1998). As a result, occupational mobility in Germany is low by international standards, both at labour market entry and during later career development (Gangl, 2001). In sum, the occupational principle is a decisive mechanism of social stratification in the German labour market (Solga & Konietzka, 1999).

In theory, because both women and men are channelled into jobs according to the occupations for which they are trained, the occupational principle is gender-neutral (Solga & Konietzka, 2000). In practice, however, this means that patterns of occupational sex segregation in the education and training system are reproduced in the labour market (Trappe, 2006; Trappe & Rosenfeld, 2001). As a consequence, occupational sex segregation serves to produce and reproduce gender inequalities. Previous research has shown that the uneven distribution of women and men across the occupational structure is particularly important for understanding the gender wage gap (e.g. for Germany, see Aisenbrey & Brückner, 2008; Busch, 2013a; Gartner & Hinz, 2009; Leuze & Strauß, 2009, 2014). Even though a large body of studies has demonstrated that occupations dominated by women pay less, it is far from clear why this is the case—is it the mere share of women, or are the decisive mechanisms other occupational characteristics linked to 'female-typical' occupations? In addition, it remains unclear how these characteristics are linked causally over time and contribute to changing gender inequalities.

Even less is known about the impact of occupational sex segregation on aspects of labour market inequality going beyond wages such as occupational or status mobility. The few existing studies on the effects of occupational segregation on individual occupational mobility show that female-dominated occupations generate 'revolving doors' (Jacobs, 1989) or cumulative disadvantages over the life course (Bygren, 2004; Chan, 1999). Yet even though many studies assume that the share of women in an occupation impacts directly on individual employment prospects

(e.g. Anker, 1997, p. 315), it is often argued that this relationship is not straightforward and should be approached in a systematic way (Jacobs, 1993). Therefore, the project 'Occupational sex segregation and its consequences for the (re-)production of gender inequalities in the German labour market', funded from 2012 until 2018 by the DFG Priority Programme 1646, specified, both theoretically and empirically, the ways in which occupational sex segregation and other occupational characteristics translate into labour market inequalities between women and men in Germany. More specifically, it examined:

- long-term trends in occupational sex segregation
- how occupational sex segregation is causally linked to other occupational characteristics
- how these occupational characteristics translate into gender inequalities regarding non-monetary labour market outcomes
- how these occupational characteristics affect the gender wage gap in Germany.

In the following, we first present the theoretical framework underlying the project; and, second, empirical results on each of these research questions.

13.2 Theoretical Framework

Our theoretical concern was to understand how occupational sex segregation and other occupational characteristics might generate labour market inequalities between women and men and how their influence might change over the life course. In the following, we shall therefore discuss how the sex composition of occupations might be causally linked to other occupational characteristics, and how this relationship might affect gender inequality in the labour market.

The most elaborate body of theory addresses the correlation between occupational sex segregation and wages, a correlation that can be observed universally. There are conflicting theories on the macrolevel processes causing this correlation: it may be caused by either a devaluation of female occupations, active choices, or the channeling of women into low-wage occupations. The central idea behind devaluation is that in the culture of western industrialized countries, women are valued less than men, and this leads to a devaluation or stigmatization of all things associated with women—styles of clothing, names, leisure activities as well as fields of study or occupations (Baron & Newman, 1990; Cohen & Huffman, 2003; Ridgeway, 1997). However, in the literature, whether devaluation is caused merely by a higher share of women working in a particular occupation or whether it is (also) due to particular activities performed in these occupations remains an unsolved issue. In the second perspective, it is argued that the gender-typing of occupations can exist independently of their numerical domination by men or women. Cultural gender-role beliefs involve the idea that household, reproductive and care work, which are provided mainly by women in the private sphere on the basis of affection but not for pay, are considered less valuable than paid work (Ridgeway & Correll, 2006). Other work

contents are labelled 'female' due to feminization processes in such fields as clerical jobs or sales. Results of empirical research on the effect of 'female-typical' activities on wages are rather mixed. Because both dimensions—female-typed job tasks and the sex composition of occupations—are two important aspects of how devaluation might work, it is necessary to differentiate their influence systematically on the occupational level and to complement them with indicators of female- and male-connoted tasks beyond occupations.

Another perspective on the importance of work tasks for wages is offered by the classical human capital approach (Becker, 1962, 1985). This assumes that wage differentials between women and men result from gender-specific investments in human capital. Following this line of argument, researchers claim that female- and male-dominated occupations may differ in the amount of specialized human capital that is needed to perform occupation-specific work tasks. Employers have to compensate for workers' investments in specialized skills and pay a wage premium for them, particularly when demand for these skills is higher than supply (Becker, 1962). Because the usual indicators for human capital in wage models do not capture specialized skills, this effect might be reflected in the proportion of women within an occupation. Only few studies on this issue have been carried out in Germany, and they have found no or only partial evidence in favour of this hypothesis (Heinze, 2009; Leuze & Strauß, 2009; Ochsenfeld, 2014). More strongly justified assumptions on the returns to specific skills, together with new measurement approaches can be found in the literature on skill-biased technological change and its impact on the wage structure in post-industrial countries (Autor, 2013; Autor & Handel, 2013; Autor et al., 2003). However, the assumptions and skills measures used in this research have hardly been applied to analysing the gender pay gap and to linking it with sex segregation structures and their effects on wages.

A slightly different perspective is offered by the theory of compensating differentials. This also addresses the lower wage returns of female-dominated occupations (Rosen, 1986), but additionally considers working time arrangements with female family commitments. In this view, women choose less demanding and less well-paying occupations because they place a higher priority on family obligations and a lower priority on money than men do. The claim is that women's occupations are more 'mother-friendly' in that they feature more flexible hours while, at the same time, paying less. According to preference theory (Hakim, 2000, 2002), the large majority of women today prefer to combine employment and family work without giving a fixed priority to either. Therefore, women try to reduce their working time once they have children, seeking to devote as much time and effort to their family work as to their jobs.

A last theoretical perspective assumes that declining wage levels or other non-pecuniary characteristics lead to a feminization of occupations based on employer preferences. According to the queuing argument of Reskin and Roos (1990), employers have a general preference to hire men. In this perspective, women are located behind men in the labour queue, and even though they also prefer high wages, they will be employed only in occupations that men do not want because they pay less.

In sum, these basic theories make different assumptions about which causal pathways might exist between occupational sex segregation and other occupational

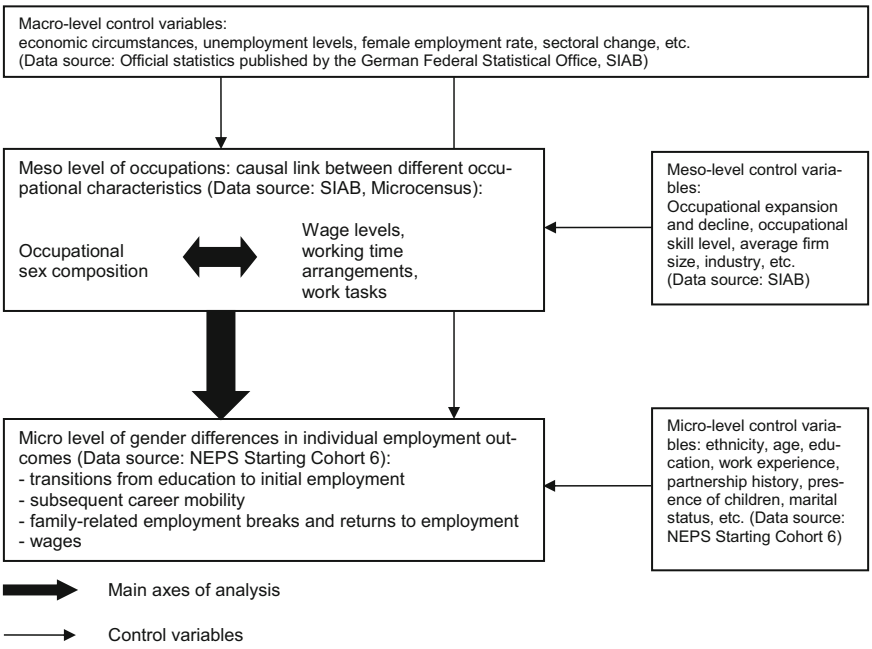


Fig. 13.1 Model for analysing the relationship between occupational structure and gender inequalities in the German labour market

features such as wage levels or working time arrangements. Thereby, they generate distinct structural patterns for the (re-)production of labour market inequalities between women and men over the life course. In our project, we investigated these relationships for the case of Germany on both the mesolevel and between the meso- and microlevels in order to gain a better understanding of the role occupations play in the system of social stratification. Figure 13.1 displays the main axes of analysis that we pursued and the data sources we used. In order to capture the mesolevel of occupations, we used large-scale data on employees (SIAB) and the economically active population (Microcensus), because these data sources are large enough to observe detailed occupational groups in sufficient detail over time. We used NEPS data (Starting Cohort Adults, SC6) to examine how sex segregation and associated occupational characteristics translate into gender inequalities on the individual level.

13.3 Long-Term Trends in Occupational Sex Segregation

Regarding trends in occupational sex segregation, previous studies on Germany have focused mainly on short-term time intervals since the 1990s (Beblo et al., 2008; Busch, 2013b; Falk, 2002). Thus, the first goal of the project was to analyse long-term trends of occupational sex segregation in the West German labour market from

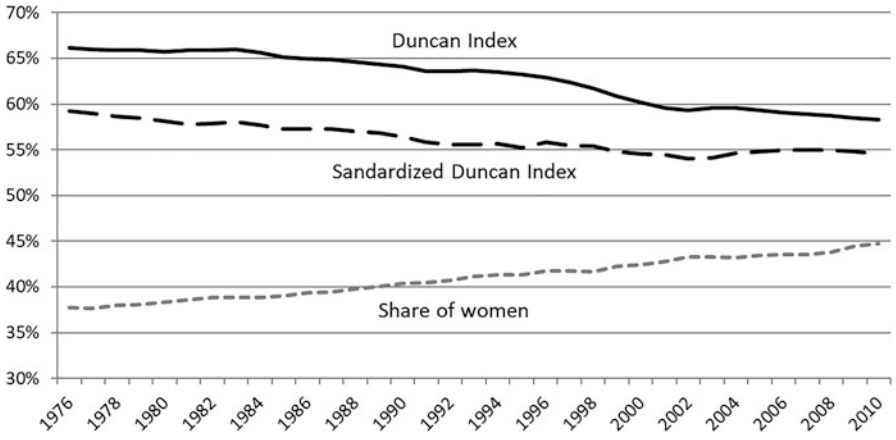


Fig. 13.2 Trends in occupational sex segregation in West Germany, 1976–2010. (Source: SIAB weakly anonymized version 7510, authors' estimations)

1976 until 2010 (Hausmann & Kleinert, 2014). We did this by constructing a unique occupational panel containing yearly information about a high number of occupational groups in West Germany based on a large sample of employee social security data (Sample of Integrated Labour Market Biographies, SIAB (vom Berge et al., 2013)[1]). After data preparation and aggregation of similar occupational categories mainly within the manual sector, we generated information for 254 occupational groups over 35 years (Hausmann et al., 2015b).

To describe trends in occupational sex segregation, we estimated different measures of sex segregation such as the Index of Dissimilarity (Duncan & Duncan, 1955), its size-standardized version, or measures of concentration. Results show that the amount of occupational sex segregation in the West German labour market has been high throughout the observation period (Hausmann & Kleinert, 2014). Segregation has declined only marginally (Fig. 13.2), and the larger part of this trend can be attributed to changes in the occupational structure and not to an increasing mix of women and men within the same occupations. Whereas male-dominated occupations are even more segregated than female-dominated occupations, women are concentrated in a smaller range of occupations. However, women have made some advances since the mid-1970s. Their shares have increased mainly in growing sectors such as service occupations and in fields with academic qualifications. Within these occupational fields, however, segregation structures have hardly changed over time.

[1] The SIAB data is available through the Research Data Centre (FDZ) of the Federal Employment Agency in the Institute for Employment Research. For more information on the data and on data access, see http://fdz.iab.de.

13.4 Causal Links Between Occupational Sex Segregation and Other Occupational Characteristics

The unequal distribution of women and men among different occupations would not pose a problem if working conditions, wages, and promotion and career chances were comparable in male- and female-dominated occupations. However, many studies have found that occupational sex segregation correlates systematically with gender inequalities in the labour market, most pronounced for monetary remunerations. On the occupational level, the relationship between occupational sex composition and wage levels has been analysed mainly for the US labour market (e.g. England et al., 2002; England et al., 2007). However, the results of these studies cannot be transferred directly to the German context, because the institutional conditions of wage negotiations differ strongly, employment chances depend more on vocational certificates, and trends in the occupational structure and wage development vary between both countries.

Thus, in a second step, we looked at the mesolevel of occupations and analysed whether the sex composition of occupations causally affects wage levels in West Germany (Hausmann et al., 2015a). Hence, we tested two competing hypotheses: On the one hand, the devaluation thesis suggests that 'female' occupations are valued less in society and are therefore paid less in the labour market. This causal dynamic should also apply to new occupations and occupations with changing sex composition (England, 1992; Ridgeway, 1997), leading to the assumption that a rising proportion of women in an occupation should result in decreasing wage levels. On the other hand, it can be assumed that the gendering of occupations and their wage levels developed jointly during the emergence of the modern occupational structure (Goldin, 2006). The fact that this relationship did not change fundamentally over time might be explained by institutional inertia (England et al., 2007; Krüger, 1995, 2003). According to this assumption, a direct causal relationship should no longer be found today between the share of women and occupational wage levels.

We tested whether a rising share of women per occupation leads to decreasing wages or whether a causal effect can no longer be found using regression models with fixed occupation effects and lagged independent variables. Using these fixed-effects panel models has the advantage that all unobserved time-constant heterogeneity is controlled by design (Brüderl, 2010). We applied stationary and dynamic fixed-effects panel models to the above-mentioned occupational panel. The models considered short- and long-term effects of the proportion of women on the median wage level within occupations. We found a substantive negative long-term effect, net of occupational working time arrangements and qualification requirements. At first sight, this supported the devaluation hypothesis. However, when estimating separate models for women and men, this negative effect disappeared: a rising share of women in an occupation did not affect women's or men's wage levels in either the short or the long run. Hence, declining total wages at the occupational level are not the result of a rising share of women per se, but are caused rather by the fact that more women are working in these occupations; and that also within occupations,

women generally earn less than men. In our view, this result suggests a social devaluation of all activities performed by women, independent of the predominant gender typing of the occupation they work in.

In a next step, we analysed the causal relations of occupational sex segregation with another important dimension of changing occupational characteristics: part-time work (Bächmann et al., 2022). More specifically, we investigated the reciprocal relationship between sex segregation and part-time work over time within occupational groups in West Germany. Therefore, we asked whether part-time work in occupations increases once more women have entered these occupations, or whether occupations that offer more part-time work attract more women. The first direction of influence suggests that particular groups of women, such as mothers, might choose part-time work to reconcile family and working life. The second direction of influence stresses the importance of occupational choices at the beginning of careers. To test these hypotheses, we enriched our occupational panel data set by further occupational characteristics based on German Microcensus data from 1976 to 2010. The German Microcensus is an obligatory yearly survey conducted by the German Federal Statistical Agency containing a 1-per cent sample of the population living in Germany (Federal Statistical Office and GESIS, 2012). Based on the resulting occupational panel data set covering 254 occupations between 1976 and 2010, we applied linear regression models with fixed occupational effects and lagged covariates. Accordingly, our models consider only within-occupational variance over time and thus control for time-constant unobserved heterogeneity on the occupational level by design (Allison, 2009). Because we anticipated potential mechanisms of reverse causality, we had to overcome the problem that our covariates might not be strictly exogenous—a key assumption for unbiased estimates in static fixed-effects models (Wooldridge, 2010). For this reason, we estimated three different model specifications, namely static (stat FE), dynamic (dyn FE), and Arellano–Bond (A–B) panel models. Jointly, these allow us to assess these problems better and to draw inferences from the results. Moreover, to avoid misspecification of our models, we used different time lags of central independent variables. Results indicate that part-time work in occupations increases, once more women start working in these occupations (Fig. 13.3), especially if they are married and/or have children. In contrast, changing working-time arrangements influence women's inflow into occupations to a much lower extent; instead, the sex composition of previous years strongly affects the current share of women. This points towards strong path dependencies of occupational choices in the German labour market.

Overall, both studies conducted on the mesolevel of occupations indicate that occupational sex segregation is linked to occupational wage levels and part-time ratios in rather complex ways. Thus, whether and how the sex composition of occupations and related occupational characteristics shape individual labour market careers of women and men remains an open question.

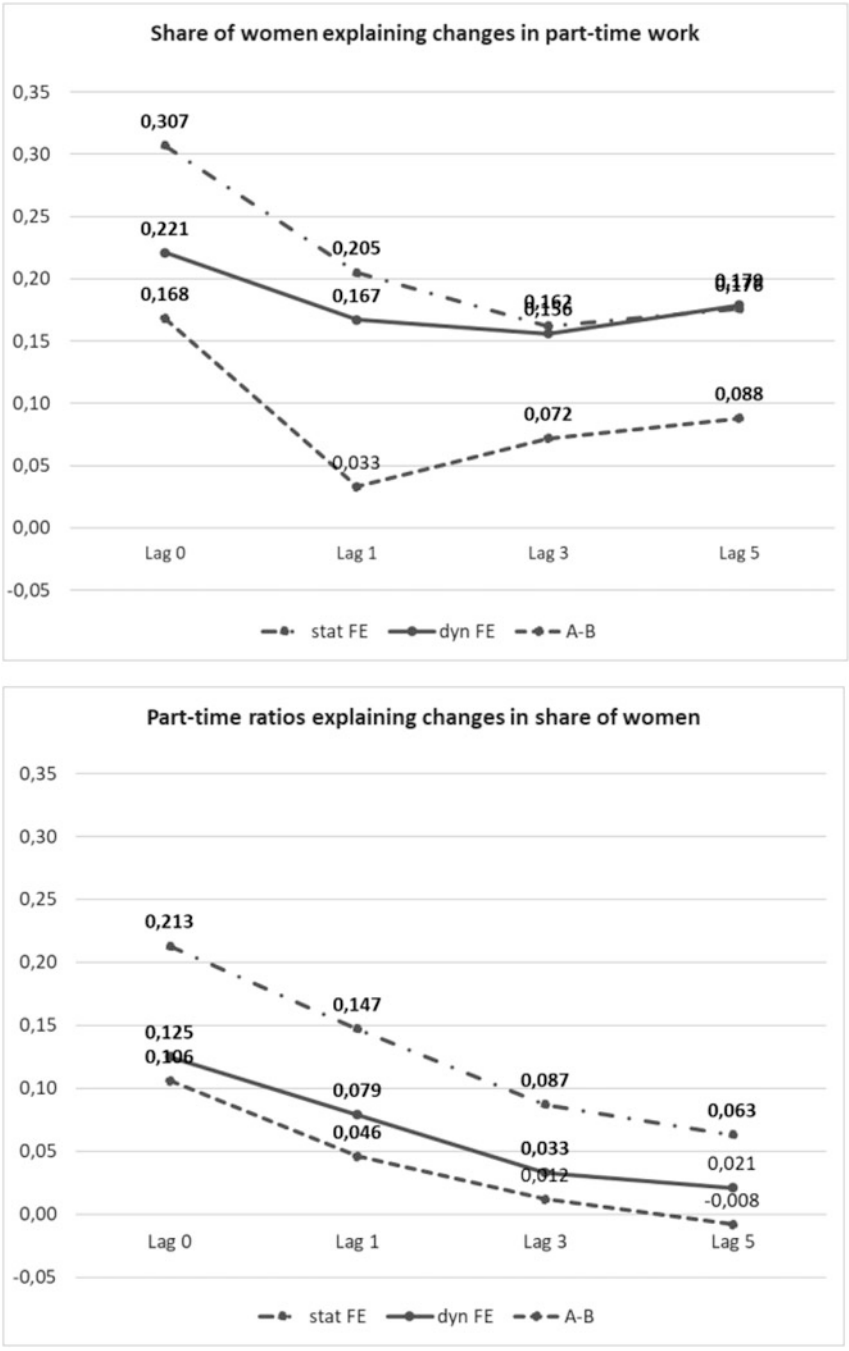


Fig. 13.3 Reciprocal relationships between the share of women and part-time work in occupations. Bold coefficients = $p < 0.05$. (Sources: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Microcensus (SUF) and SIAB weakly anonymized version 7510, authors' estimations)

13.5 How Occupational Characteristics Structure Gender Inequalities in Non-monetary Labour Market Returns

Therefore, in four further papers, we investigated how occupational sex segregation and related occupational characteristics structure gender inequalities in non-monetary labour market returns. We did this by merging the generated occupation-level data with individual data from the National Education Panel Study (NEPS) Starting Cohort 6 based on occupation and year of NEPS respondents' employment spells. For these analyses, the NEPS data were transformed into several longitudinal datasets covering the respective transitions as well as cumulative measures of employment trajectories. NEPS data are particularly well suited for these individual-level analyses, because they contain rich monthly information on the educational and employment histories of more than 16,000 individuals living in Germany (born between 1944 and 1986) as well as on their partners and children. These histories were collected retrospectively in the first survey wave. In subsequent waves, the respondents' life courses are being updated by means of dependent interviewing. This data structure makes it possible to measure individual human capital far more accurately than in other surveys, and it delivers precise information on the exercised occupation over the whole employment history. Finally, NEPS data allow us to measure the gendered nature of employment experience precisely, because family-related employment interruptions, phases of non-employment and unemployment, as well as spells of part-time employment are collected retrospectively.

The first study on the individual level focused on the relevance of occupational characteristics for mothers' family-related employment interruptions (Bächmann & Gatermann, 2017). Leave periods—and particularly longer ones—are well known to have negative consequences for further employment careers, because they contribute to a loss or devaluation of human capital (Aisenbrey et al., 2009). Whereas the determinants and consequences of family-related employment interruptions have been examined in detail, the effects of characteristics related to the occupation held prior to the interruption have been neglected almost completely so far. Hence, this study asked how occupational sex segregation and related occupational characteristics affect the duration of family-related employment interruptions. In particular, we analysed the role of occupational working time arrangements and wage levels and tested two competing hypotheses. First, since female-dominated occupations are associated with a higher share of part-time work, we expected mothers who were employed in such occupations prior to giving birth to have shorter spells of employment interruptions due to a better reconciliation of work and family. Second, because lower wages indicate lower opportunity costs while not working, we anticipated that occupations dominated by women might be accompanied by longer employment interruptions due to their lower wage levels. In addition, we analysed whether the proportion of women in a given occupation per se influences the duration of employment breaks. To test our hypotheses, we concentrated on the duration of employment interruptions of mothers who gave birth to their first child between

1992 and 2010. We employed discrete-time event history models (Allison, 1982) to analyse the impact of occupational sex segregation and associated occupational characteristics on the duration of mothers' employment interruptions. Using event history models enables us to estimate the probability of mothers resuming employment by not only taking into account the time that has already passed since childbirth but also adequately considering right-censored observations—in our case, mothers who had not returned to employment by the end of the observation period. The findings of our models hint towards the second hypothesis: whereas higher occupational wage levels lead to shorter employment breaks, part-time rates and the share of women in an occupation per se have no significant effect on the duration of employment interruptions after childbirth.

We further analysed whether and how sex segregation affects other types of involuntary employment breaks of women and men: namely, unemployment (Hägglund & Bächmann, 2017). For this purpose, we explored transitions from unemployment back to employment from 1993 to 2010, and asked whether gender differences in unemployment trajectories can be explained by the fact that women and men worked in different occupations prior to unemployment. Theoretically, we considered three potential mechanisms that might mediate the influence of occupational sex segregation on re-employment: First, female-dominated occupations might be overcrowded—that is, individuals in these occupations might suffer from increased competition due to an oversupply of labour. Second, they might be characterized by a lower degree of occupational closure indicating that female-dominated occupations are less protected by occupational credentials. Third, shifts in the occupational structure, particularly the decrease in routine manual work, could result in lower re-employment opportunities among incumbents of male-dominated occupations. We also tested this framework by estimating event history models for the same reasons stated above. This time, we used Cox proportional hazards regression models (Blossfeld et al., 2007). To test whether occupational sex segregation and the associated occupational characteristics structure the transitions of women and men back to employment differently, we estimated separate models by gender. Results revealed that working in a male-dominated occupation prior to unemployment influences the transition rate into employment positively—yet, only for men. Moreover, men showed higher transition rates if they worked in occupations with less unemployment in general, higher social closure, and less industrial work. These further occupational characteristics, however, could not explain the effect of occupational sex segregation. Interestingly, none of the occupational characteristics considered affected women's re-employment chances significantly, whereas individual and sectoral aspects were decisive.

In a related study, we explored how sex segregation and associated occupational characteristics influence women's and men's risks of becoming unemployed (Bächmann, 2022). Whereas women in Germany previously faced higher unemployment risks than men, in recent years, the risks facing men have outpaced those facing women. Therefore, we analysed whether this reversal might be due (at least partly) to women and men often working in different occupations. Theoretically, we discussed changes in the labour supply and demand of male- and female-dominated

occupations caused by mechanisms of crowding, and technological and sectoral change. We analysed transitions from employment to unemployment in three decades: the 1980s, 1990s, and 2000s. Using discrete-time event history models (Singer & Willett, 2003), we analysed gender-specific transition patterns from employment into unemployment while controlling for employment experience. Moreover, to analyse whether occupational sex segregation and associated occupational characteristics mediate potential gender differences, we employed the Karlson–Holm–Breen (KHB) decomposition to compare coefficients of nested logit models (Karlson et al., 2012). Our findings show that women faced higher unemployment risks then men in the 1980s, whereas their risk of becoming unemployed was significantly lower than that of men in the 2000s. Additional analyses on occupational closure revealed that women's lower unemployment risk in the 2000s was mediated positively by higher levels of licencing in female-dominated occupations. In contrast, the higher unemployment risks faced by women in the 1980s cannot be traced back to differences in male- and female-dominated occupations. Currently, however, women can benefit from working in occupations with higher occupational closure and thus, ultimately, from occupational sex segregation, at least with respect to employment security.

Finally, we analysed how occupational sex segregation and working-time characteristics affect the transition to part-time work of women and men (Althaber & Leuze, 2020). In Germany, part-time work is considered to be important for reconciling wage work and family responsibilities. Most explanations of part-time work focus on women and discuss factors on the individual, household, and institutional levels, whereas hardly any attention has been paid to men as well as structural factors of the labour market related to occupations. Therefore, in this article, we examined the relevance of occupational characteristics for the transitions from full-time to part-time employment for women and men in Germany between 1992 and 2015. Our theoretical considerations were based on Krüger's institutional approach to gendered life courses (Krüger, 1995, 2003) in combination with Acker's approach to gendered organizations (Acker, 1990). Based on Krüger's approach (1995, 2003) we assumed that transitions to part-time work should be higher in women-dominated occupations, particularly for women. In contrast, the perspective of gendered organizations (Acker, 1990) suggests that transitions to part-time work should be lower in occupations representing strong ideal worker norms such as high shares of fulltime work, overtime, or presence at the workplace, particularly for men. The results of the Cox proportional hazards models (see above) indicate that occupational working-time arrangements rather than sex segregation affect part-time transitions, yet in a differentiated way for women and men. Whereas norms of full-time work and overtime in occupations prevent transitions to part-time work for men, women change more often to part-time under these conditions.

13.6 Occupational Sex Segregation and the Gender Wage Gap

In order to analyse the relevance of occupational sex segregation for the gender wage gap in Germany, we modelled the gender wage gap cross-sectionally and longitudinally. We proceeded in three steps: (a) we analysed the occupational task profiles relevant for understanding the gender wage gap of female- and male-dominated occupations descriptively; (b) we examined the influence of occupational task characteristics on the gender wage gap cross-sectionally by merging occupation-level with individual-level data taken mainly from NEPS SC6; and (c) we analysed the changing influence of occupational characteristics on the gender wage gap longitudinally by merging occupation-level data with data from NEPS-SC6 linked to IAB register data (NEPS-SC6-ADIAB (LIfBi et al., 2022)).

In the first step, we developed measures of occupational tasks in terms of both female- and male-connoted tasks and in terms of specific skills based on the Qualification and Career Surveys of the BIBB[2] (Kleinert et al., 2023). Female-typical tasks were depicted by accounting for caring, cleaning, and accommodating. To measure specific skills, we followed Black and Spitz-Oener (2010) who harmonized the tasks surveyed in the BIBB data sets and computed tasks profiles for different occupations. Transferring the economic tasks literature (Autor et al., 2003) to the German context, we focused on four task dimensions: namely, non-routine analytical tasks, interactive tasks, routine manual tasks, and computer use.

Results of the occupational tasks profiles reveal both continuity and change (Fig. 13.4). Regarding the development of female-typical work tasks, we found rising shares of caring and accommodating tasks, and, to a lower extent, also of cleaning tasks. The usage of female-typical tasks has grown over time with largely similar trends for women and men except for one field: the increase in accommodating tasks has been more pronounced among women. Evidence on skill-biased technological change is less straightforward. There is an increase in non-routine analytical tasks and computer use over time, but hardly any change in interactive and routine manual tasks. Moreover, developments over time are fairly similar for men and women. Thus, consistent with prior studies, our analyses confirm an increase in analytical and interactive tasks profiles over the last decades as well as a rise in female-connoted tasks. Yet, we did not find a decline in routine manual tasks, but rather an increasing complexity in task profiles over time (Rohrbach-Schmidt & Tiemann, 2013).

Our second step was a cross-sectional analysis of how individual task profiles and working-time arrangements contribute to the gender wage gap. A first study on this

[2] In 1979, 1986, 1992, and 1999 data were surveyed by the Federal Institute for Vocational Education and Training (BIBB) in cooperation with the Institute of Employment Research (IAB), and in the years 2006, and 2012 together with the Federal Institute for Occupational Safety and Health (BAuA). For more information on the data and on data access, see http://www.bibb.de/de/62622.htm.

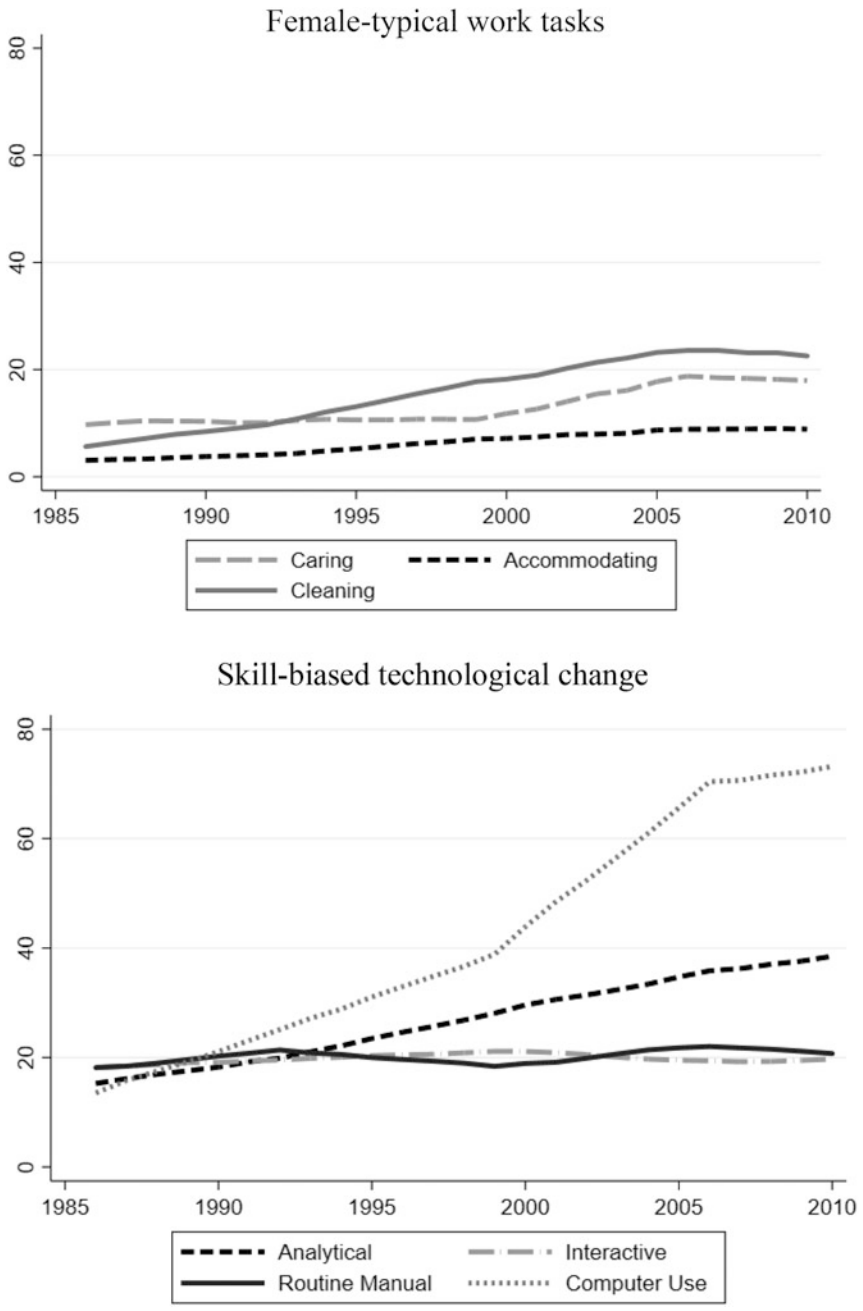


Fig. 13.4 Development of occupational tasks profiles, 1985–2010. (Sources: NEPS-SC6-ADIAB, BIBB/BAuA employment cross-sections, own estimations)

issue examined the gender wage gap among higher education graduates in Germany (Leuze & Strauß, 2016). It examined two mechanisms that might explain why occupations dominated by women pay less: the wage effects of 'gender-typical' work tasks and of 'gender-typical' working time arrangements on the occupational level. Drawing on devaluation theory (England, 1992), we assumed that occupations with 'female-typical' work tasks should pay less, whereas the perspective of gendered organization (Acker, 1990) suggests that occupations with 'male-typical' working time arrangements should pay more. Both of these should contribute to the gender wage gap. We applied linear wage regressions and Blinder–Oaxaca decompositions to a representative survey of higher education graduates who received their degree from a German higher education institution in 2001 (*HIS Absolventenpanel 2001*). These individual-level data were merged with occupation-level tasks data from the BIBB/BAuA Employment Survey of the Working Population on Qualification and Working Conditions in Germany 2006 and occupation-level data on working time from the German Microcensus 2005. Results show that the gender label of occupational work tasks had only limited explanatory relevance. On the one hand, 'male-connoted' tasks such as computing/IT induce wage premiums. On the other hand, occupations with a high share of 'female-typical' tasks (namely teaching/educating) also pay higher wages, which speaks against a general devaluation of 'female-typical' work tasks. Occupational working time arrangements were more important than tasks for our understanding of why occupations dominated by women pay less. Because highly qualified women also work more often in occupations with a high share of part-time employment and less often in occupations with a high share of workers reporting overtime, they earn less than their male counterparts, which supports Acker's (1990) theory of gendered organizations.

A second paper started from these findings and analysed whether differences in demand and supply of men's and women's tasks profiles contribute to our understanding of the gender wage gap (Bächmann et al., 2021). Based on the perspectives of skill-biased technological change (Katz & Murphy, 1992) and the task-based approach (Autor, 2013; Autor & Handel, 2013) combined with sociological considerations of gender essentialism and male primacy, we looked at the systematic variation in the demand and remuneration of job tasks performed mainly by women or by men. We assumed that today's high demand for highly qualified and non-routine activities should lead to a better payment of analytical and interactive activities, whereas physically strenuous and routine activities should pay less. Because women perform more interactive and routine tasks, whereas men perform more analytical and manual tasks (Autor & Handel, 2013), this means that not all job tasks performed primarily by women pay less, but only those that are no longer in high demand. We tested these assumptions using data from a newly developed instrument on tasks performed in respondents' current jobs available in NEPS-SC6, Wave 4 (Matthes et al., 2014). This measures four different dimensions of general job tasks: namely, nonroutine analytical tasks (reading, writing, mathematical), nonroutine and routine interactive tasks, routine manual tasks, and routine analytical tasks. Using these task profiles enabled us to address pay gaps not only

between different occupations but also between women and men working in the same occupation. Hence, we estimated within–between random effects models and Blinder–Oaxaca decompositions to analyse the contribution of gender-specific task profiles to the gender pay gap. Using these hybrid models (Schunck, 2013) enabled us to compare the between-occupation and within-occupation effect of individual task profiles directly within one model. Results showed that men benefit from performing more nonroutine analytical activities than women. In contrast, women benefit from performing fewer manual activities within as well as between occupations and from working in occupations characterized by a higher extent of nonroutine interactive tasks. In sum, our results show that women perform lower paid job tasks more often than men do, which contributes to the gender wage gap. As a main contribution to prior literature, our results demonstrate that this finding is caused not only by differences in the task profiles of male- and female-dominated occupations, but also by the fact that women perform different and less highly rewarded tasks than men within the same occupational groups.

Because skill-biased technological change would suggest changes in tasks over time that then evoke changes in the wage structure, a final paper examined how changing occupational tasks contributed to the gender pay gap over time (Kleinert et al., 2023). In our theoretical framework, we contrasted devaluation theory and skill-biased technological change, which systematically differ in their assumptions on the link between occupational task profiles and the gender wage gap. Based on considerations of devaluation theory, we hypothesized that female-connoted tasks would have a negative effect on wages that persists over time. In contrast, skill-biased technological change would assume that non-routine analytical and interactive tasks would receive increasingly higher wages (Giesecke & Verwiebe, 2009), and this should result in a decline of the gender wage gap. We tested our hypotheses using a data set that links the NEPS-SC6 data with longitudinal administrative wage data on the same persons—the NEPS-SC6-ADIAB—and we merged longitudinal occupational task profiles to the individual trajectories based on the BIBB/BAuA employment surveys (see above). We employed repeated cross-sectional regression analyses and Oaxaca–Blinder decompositions to analyse West German regular employees aged 20–50 who left the educational system in the period 1986–2010. Our results reveal that the impact of tasks over time is more complex than theoretically assumed. Gender differences in the usage of tasks in general do not contribute much to the explanation of the gender wage gap or its trend over time. Only cleaning tasks, which are performed more often by women than men, are associated with wage penalties. However, without the existing sex differences in the usage of particular tasks, namely accommodating, caring, and manual routine tasks, the gender wage gap would have been even larger, particularly in recent years. Furthermore, preliminary results suggest that most tasks have quite different effects on wages for women than for men. Thus, task profiles might influence the gender wage gap not primarily via their uneven distribution among women and men, but by generating different rewards.

13.7 Conclusions

By investigating the relationship between segregation and inequality on the occupational and individual levels, our project produced new theoretical and empirical insights into the extent to which gender inequalities in the German labour market are reproduced systematically by 'contextualized' labour market structures: namely, occupational sex segregation. Our analyses of how occupations affect gender inequalities in the labour market therefore shed further light on the institutional determinants of gender inequalities in Germany. Overall, the empirical findings of our studies conducted in the project point towards five important results.

First, the sex composition within occupations is linked systematically with other characteristics of occupations such as wage levels or working time arrangements. However, these linkages are more complex than theoretically assumed. Even though rising shares of women in an occupation are accompanied by lower wages, this finding is less attributable to the devaluation of female-dominated occupations, but more to the fact that within occupations, women generally earn less than men. With regard to part-time work, we found that rising shares of women in occupations lead to rising shares of part-time work, particularly in the case of mothers and married women, whereas the effect of part-time work on the occupational sex composition is weaker. This points towards the importance of part-time work for reconciling work–family conflicts in the German labour market, whereas supply-side driven processes of part-time provision by employers seem to matter less. Future research will have to establish whether and how further characteristics, such as occupational closure or occupational qualification requirements, are causally linked with the unequal distribution of women and men across occupations.

Second, our findings on the individual consequences of working in sex-segregated occupations indicate that employment trajectories are structured mainly by occupational characteristics that are structurally linked with sex segregation. Whereas occupational wage levels affect the duration of family-related employment interruptions, occupational closure influences men's re-employment chances and women's unemployment risks. Finally, occupational working time arrangements matter for the transition to part-time work of both women and men. With the exception of unemployment risks and re-employment chances after phases of unemployment, the effect of the sex composition of occupations turns out to be insignificant once further occupational characteristics are considered. This indicates that it is occupational attributes related to occupational sex segregation and not the share of women and men per se that reproduce gender inequalities in the German labour market. As a consequence, future research should more thoroughly establish whether gendered labour market outcomes are indeed attributable to the sex composition of occupations or to related characteristics. Moreover, new theoretical considerations have to be developed that are linked not only to the share of women in occupations but also to the additional attributes these occupations hold.

Third, occupational sex segregation and related occupational characteristics affect employment trajectories of women and men in a gender-differentiated way.

Generally, it seems that these factors are more important for shaping the career trajectories of men by influencing, for example, their employment re-entries after unemployment or their transitions to part-time work. For women, these outcomes are influenced more strongly by individual and household level characteristics such as the presence of children or by sectoral factors such as regional unemployment rates. However, when explicitly investigating changes over time, as Bächmann (2022) does, we can see a growing importance of occupational characteristics for the employment trajectories of women as well. In this regard, working in female-dominated occupations is not always detrimental to women's careers, but also might buffer labour market risks. As a consequence, future research should consider not only gender-differentiated influences of occupational characteristics but also their changing importance for women and men over time.

Fourth, besides other well-researched factors that contribute to the gender pay gap such as differences in experience due to employment interruptions and part-time work or the representation of women in management, what women and men actually do in their jobs also matters. We could show that male-dominated, mixed, and female-dominated occupations show a different mix of task profiles. The trend over time in tasks suggests monetary gains for 'female-typical' tasks such as caring or accommodating, but also for tasks that are usually thought to be more 'male' such as computer use or analytical tasks. Consequently, the link between job task profiles and occupational sex segregation is not as persistent or uniform as often assumed. Furthermore, our findings showed that women and men perform different tasks when working in the same occupations. Both aspects of job tasks have consequences regarding their effects on wages. The different tasks that women and men perform explain part of the gender pay gap—between and within occupations.

Finally, the impact of tasks over time is more complex than theoretically assumed. In particular, devaluation theory, which assumes constant wage penalties for activities associated with females, can explain neither the decreasing size of the gender wage gap nor the fact that without sex segregation (or specialization), the gap would have been even bigger. Our analyses suggest that the devaluation of work performed by women depends not only on gender-typical task profiles but also on three further mechanisms. First, we find gender-specific task specialization within occupations that results in wage losses. Second, similar tasks seem to result in different remuneration for women and men. And third, other aspects of 'female' and 'male' work, such as gender-typical working-time arrangements, also contribute to the gender pay gap. In sum, these findings hint at more subtle differences in the type of everyday work and 'unseen' hierarchies between women and men in the same occupation that we cannot measure with the coarse skills and tasks data available in large-scale survey data. It is up to future research to identify these gender differences and their effects on wages in the Germany.

Taken together, our project contributed to several research areas in sociology. Regarding the sociology of occupations and professions, we contributed both theoretically and empirically to a better understanding of how different aspects of occupations have changed over time in the German labour market, and whether or not these changes are causally linked to each other. In the field of gender studies, our

project shed light on how institutional and structural factors of the labour market affect the (re-)production of gender inequalities over the life course in addition to individual-level explanations. Finally, in the field of life-course research, our project systematically linked changes in the macrolevel institutional structure of the labour market and occupations to the development of individual life-course trajectories. Such an endeavour required not only precise theoretical reasoning on the link between institutions and life courses, but also advanced means of data collection and analysis for linking macro- and microlevel data. By aggregating data from the SIAB and the German Microcensus, which can be matched to the life-course data collected by NEPS Starting Cohort 6, we generated novel datasets that can be used in the future by the whole scientific community for analysing occupational influences on life-course outcomes.

To conclude, our theoretical considerations and empirical findings underline the high relevance of occupational sex segregation for the (re-)production of gender inequalities in the German labour market. Sex segregation affects individual life and employment histories via different mechanisms such as wage levels or different levels of closure in male- and female-dominated occupations. As a consequence, a reduction of occupational sex segregation could be one important way to reduce gender inequalities in the labour market. Our research shows that not only women but also men might benefit from a more integrated occupational structure with regard to, for example, the risk of becoming unemployed. A decrease of segregation would also be desirable from a macrosocial welfare perspective: a reduction of occupational sex segregation could help to meet the demand for skilled workers under conditions of demographic ageing (e.g., in health or STEM occupations). Furthermore, a reduction in occupational sex segregation and associated social norms on the occupational choice of women and men would help to create more individual freedom of occupational choice and support the development of talent.

Nonetheless, our research does not give direct hints on how to attain this aim. One possibility would be to directly address occupational gender stereotypes and choice processes starting in early childhood. Another possibility would be to tackle the uneven conditions between and within different occupations, irrespective of their gender distribution, in order to make 'typical female' occupations more attractive for men and 'typical male' occupations more attractive for women. This implies a revaluation of female-dominated occupations—a necessity that has just become apparent again in the course of the COVID-19 pandemic; in particular, as regards the wages paid to care and health occupations. Moreover, to increase the share of women in male-dominated fields, conditions for reconciling family and working life could be improved, particularly in relation to working time norms. Finally, our findings imply that a reduction of occupational sex segregation is no panacea. Our research showed that women and men who perform different tasks are also remunerated differently within the same occupations. As a consequence, it is important to focus not only on gender typing, working conditions, and rewards among broad occupational groups, but also to keep an eye on segregation processes within these groups that might gain in dynamics when overall segregation declines.

References

Acker, J. (1990). Hierarchies, jobs, bodies: A theory of gendered organizations. *Gender & Society, 4*(2), 139–158.

Aisenbrey, S., & Brückner, H. (2008). Occupational aspirations and the gender gap in wages. *European Sociological Review, 24*(5), 633–649. https://doi.org/10.1093/esr/jcn024

Aisenbrey, S., Evertsson, M., & Grunow, D. (2009). Is there a career penalty for mothers' time out? A comparison of Germany, Sweden and the United States. *Social Forces, 88*(2), 573–605. https://doi.org/10.1353/sof.0.0252

Allison, P. D. (1982). Discrete-time methods for the analysis of event histories. *Sociological Methodology, 13*, 61–98. https://doi.org/10.2307/270718

Allison, P. D. (2009). *Fixed effects regression models*. SAGE.

Allmendinger, J. (1989). Educational systems and labor market outcomes. *European Sociological Review, 5*(3), 231–250. https://doi.org/10.1093/oxfordjournals.esr.a036524

Althaber, A., & Leuze, K. (2020). Der Einfluss der beruflichen Geschlechtersegregation und beruflicher Arbeitszeitarrangements auf Teilzeitarbeit. Gleiche Übergangsbedingungen für Frauen und Männer? *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 72*, 317–349. https://doi.org/10.1007/s11577-020-00666-3

Anker, R. (1997). Theories of occupational segregation by sex: An overview. *International Labour Review, 136*(3), 315–339.

Autor, D. H. (2013). The 'tasks' approach to labor markets: An overview. *Journal of Labour Market Research, 46*(2), 185–199. https://doi.org/10.1007/s12651-013-0128-z

Autor, D. H., & Handel, M. T. (2013). Putting tasks to the test: Human capital, job tasks, and wages. *Journal of Labor Economics, 3*(2), 59–96. https://doi.org/10.1086/669332

Autor, D. H., Levy, F., & Murnane, R. J. (2003). The skill content of recent technological change: An empirical exploration. *The Quarterly Journal of Economics, 118*(4), 1279–1333. https://doi.org/10.1162/003355303322552801

Bächmann, A.-C. (2022). Are female-dominated occupations a secure option? Occupational gender segregation, accompanied occupational characteristics, and the risk of becoming unemployed. *European Sociological Review*, online first, https://doi.org/10.1093/esr/jcac068.

Bächmann, A.-C., & Gatermann, D. (2017). The duration of family-related employment interruptions: The role of occupational characteristics. *Journal for Labour Market Research, 50*(1), 143–160. https://doi.org/10.1007/s12651-017-0226-4

Bächmann, A.-C., Kleinert, C., & Leuze, K. (2021, November 6). *Understanding the gender pay gap between and within occupations in Germany: What is the role of individual job tasks*? SocArXiv. Preprint. https://doi.org/10.31235/osf.io/5f4x9

Bächmann, A.-C., Gatermann, D., Kleinert, C., & Leuze, K. (2022). Why do some occupations offer more part-time work than others? Reciprocal dynamics in occupational gender segregation and occupational part-time work in West Germany, 1976–2010. *Social Science Research, 104*, 102685. https://doi.org/10.1016/j.ssresearch.2021.102685

Baron, J. N., & Newman, A. E. (1990). For what it's worth: Organizations, occupations, and the value of work done by women and nonwhites. *American Sociological Review, 55*(2), 155–175. https://doi.org/10.2307/2095624

Beblo, M., Heinze, A., & Wolf, E. (2008). Entwicklung der beruflichen Segregation von Männern und Frauen zwischen 1996 und 2005 – Eine Bestandsaufnahme auf betrieblicher Ebene. *ZAF, 3*(2008), 181–198.

Becker, G. S. (1962). Investment in human capital: A theoretical analysis. *The Journal of Political Economy, 70*(2), 9–49.

Becker, G. S. (1985). Human capital, effort, and the sexual division of labor. *Journal of Labor Economics, 3*(1), 33–58.

Black, S., & Spitz-Oener, A. (2010). Explaining women's success: Technological change and the skill content of women's work. *The Review of Economics and Statistics, 92*(1), 187–194. https://doi.org/10.1162/rest.2009.11761

Blossfeld, H.-P., Golsch, K., & Rohwer, G. (2007). *Techniques of event history modeling using Stata. New approaches to causal analysis*. Erlbaum.

Brüderl, J. (2010). Kausalanalyse mit Paneldaten. In C. Wolf & H. Best (Eds.), *Handbuch der sozialwissenschaftlichen Datenanalyse* (pp. 963–994). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-531-92038-2_36

Busch, A. (2013a). Der Einfluss der beruflichen Geschlechtersegregation auf den "Gender Pay Gap": Zur Bedeutung geschlechtlich konnotierter Arbeitsinhalte. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 65*, 301–338. https://doi.org/10.1007/s11577-013-0201-1

Busch, A. (2013b). *Die berufliche Geschlechtersegregation in Deutschland*. Springer. https://doi.org/10.1007/978-3-658-01707-1_7

Bygren, M. (2004). Being different in the workplace: Job mobility into other workplaces and shifts into unemployment. *European Sociological Review, 20*(3), 199–219. https://doi.org/10.1093/esr/jch018

Chan, T. W. (1999). Revolving doors reexamined: Occupational sex segregation over the life course. *American Sociological Review, 64*(1), 86–96. https://doi.org/10.2307/2657279

Cohen, P. N., & Huffman, M. L. (2003). Individuals, jobs, and labor markets: The devaluation of women's work. *American Sociological Review, 68*(3), 443–463. https://doi.org/10.2307/1519732

Duncan, O. D., & Duncan, B. (1955). A methodological analysis of segregation indexes. *American Sociological Review, 20*(2), 210–217. https://doi.org/10.2307/2088328

England, P. (1992). *Comparable worth: Theories and evidence*. Aldine de Gruyter.

England, P., Budig, M., & Folbre, N. (2002). Wages of virtue: The relative pay of care work. *Social Problems, 49*(4), 455–473. https://doi.org/10.1525/sp.2002.49.4.455

England, P., Allison, P., & Wu, Y. (2007). Does bad pay cause occupations to feminize, does feminization reduce pay, and how can we tell with longitudinal data? *Social Science Research, 36*, 1237–1256. https://doi.org/10.1016/j.ssresearch.2006.08.003

Falk, S. (2002). Geschlechtsspezifische berufliche Segregation in Ostdeutschland zwischen Persistenz, Verdrängung und Angleichung: ein Vergleich mit Westdeutschland für die Jahre 1991–2000. *Mitteilungen aus der Arbeitsmarkt- und Berufsforschung, 1/2002*.

Federal Statistical Office. (Ed.). (2012). *Datenhandbuch Zum Mikrozensus Scientific Use File 2010* (p. 476). Federal Statistical Office & GESIS.

Gangl, M. (2001). European perspectives on labour market entry: A dichotomy of occupationalized versus non-occupationalized systems? *European Societies, 3*(4), 471–494. https://doi.org/10.1080/14616690120112226

Gartner, H., & Hinz, T. (2009). Geschlechtsspezifische Lohnungleichheit in Betrieben, Berufen und Jobzellen (1993–2006). *Berliner Journal für Soziologie, 19*(4), 557–575. https://doi.org/10.1007/s11609-009-0110-3

Giesecke, J., & Verwiebe, R. (2009). Wachsende Lohnungleichheit in Deutschland. *Berliner Journal für Soziologie, 19*(4), 531–555. https://doi.org/10.1007/s11609-009-0108-x

Goldin, C. (2006). The rising (and then declining) significance of gender. In F. D. Blau, M. C. Brinton, & D. B. Grusky (Eds.), *The declining significance of gender?* (pp. 67–101). Russell Sage. https://doi.org/10.3386/w8915

Hägglund, A. E., & Bächmann, A.-C. (2017). Fast lane or down the drain? Does the occupation held prior to unemployment shape the transition back to work? *Research in Social Stratification and Mobility, 49*, 32–46. https://doi.org/10.1016/j.rssm.2017.03.005

Hakim, C. (2000). *Work–lifestyle choices in the 21st century: Preference theory*. Oxford University Press.

Hakim, C. (2002). Lifestyle preferences as determinants of women's differentiated labor market careers. *Work and Occupations, 29*(4), 428–459. https://doi.org/10.1177/0730888402029004003

Hausmann, A.-C., & Kleinert, C. (2014). Berufliche Segregation auf dem Arbeitsmarkt: Männer- und Frauendomänen kaum verändert. *IAB-Kurzbericht, 9/2014*.

Hausmann, A.-C., Kleinert, C., & Leuze, K. (2015a). "Entwertung von Frauenberufen oder Entwertung von Frauen im Beruf?" *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 67*(2), 217–242. https://doi.org/10.1007/s11577-015-0304-y

Hausmann, A.-C., Zucco, A., & Kleinert, C. (2015b). Berufspanel für Westdeutschland 1976–2010 (OccPan). Dokumentation zur Erstellung und Anonymisierung. *FDZ-Methodenreport, 09/2015*.

Heinze, A. (2009). Earnings of men and women in firms with a female dominated workforce: What drives the impact of sex segregation on wages? *ZEW Discussion Paper, No. 09-012*.

Jacobs, J. A. (1989). *Revolving doors: Sex segregation and women's careers*. Stanford University Press.

Jacobs, J. A. (1993). Theoretical and measurement issues in the study of sex segregation in the workplace: Research note. *European Sociological Review, 9*(3), 325–330.

Karlson, K. B., Holm, A., & Breen, R. (2012). Comparing regression coefficients between same-sample nested models using logit and probit: A new method. *Sociological Methodology, 42*(1), 286–313. https://doi.org/10.1177/0081175012444861

Katz, L. F., & Murphy, K. M. (1992). Changes in relative wages, 1963–1987: Supply and demand factors. *The Quarterly Journal of Economics, 107*(1), 35–78. https://doi.org/10.2307/2118323

Kerckhoff, A. C. (2003). From student to worker. In J. T. Mortimer & M. J. Shanahan (Eds.), *Handbook of the life course* (pp. 251–268). Kluwer Academic/Plenum Publishers.

Kleinert, C., Hägglund, A. E., & Bächmann, A.-C. (2023). *Wage inequalities between women and men in Germany: How relevant are gender-typical job tasks and the technological change for understanding the gender pay gap*? [Manuscript in preparation]

Krüger, H. (1995). Dominanzen im Geschlechterverhältnis: Zur Institutionalisierung von Lebensläufen. In R. Becker-Schmidt & G.-A. Knapp (Eds.), *Das Geschlechterverhältnis als Gegenstand der Sozialwissenschaften* (pp. 195–219). Campus.

Krüger, H. (2003). Berufliche Bildung. Der deutsche Sonderweg und die Geschlechterfrage. *Berliner Journal für Soziologie, 13*(4), 497–510. https://doi.org/10.1007/BF03204688

Leuze, K. (2011). Higher education and graduate employment: The importance of occupational specificity in Germany and Britain. In J. Clasen (Ed.), *Converging worlds of welfare? British and German social policy in the 21st century* (pp. 245–265). Oxford University Press.

Leuze, K., & Strauß, S. (2009). Lohnungleichheiten zwischen Akademikerinnen und Akademikern: Der Einfluss von fachlicher Sepezialisierung, frauendominierten Fächern und beruflicher Segregation. *Zeitschrift für Soziologie, 38*(4), 262–281. https://doi.org/10.1515/zfsoz-2009-0401

Leuze, K., & Strauß, S. (2014). Female-typical subjects and their effect on wage inequalities among higher education graduates in Germany. *European Societies, 16*(2), 275–298. https://doi.org/10.1080/14616696.2012.748929

Leuze, K., & Strauß, S. (2016). Why do occupations dominated by women pay less? How 'female-typical' work tasks and working-time arrangements affect the gender wage gap among higher education graduates. *Work, Employment and Society, 30*(5), 802–820. https://doi.org/10.1177/0950017015624402

Matthes, B., Christoph, B., Janik, F., & Ruland, M. (2014). Collecting information on job tasks – An instrument to measure tasks required at the workplace in a multi-topic survey. *Journal for Labour Market Research, 47*, 273–297. https://doi.org/10.1007/s12651-014-0155-4

Müller, W., Steinmann, S., & Ell, R. (1998). Education and labour-market entry in Germany. In W. Müller & Y. Shavit (Eds.), *From school to work. A comparative study of educational qualifications and occupational destinations* (pp. 143–188). Clarendon Press.

NEPS-Netzwerk (LIfBi), Bachbauer, N., Wolf, C., Graf, T., Grießemer, S., Kaimer, S., Köhler, M., Lehnert, C., Oertel, M., & Schneider, A. (2022). *National Educational Panel Study (NEPS), starting cohort 6 (SC6) survey data linked to administrative data of the IAB (NEPS-SC6-ADIAB) - Version 7520 v1*. Research Data Centre of the Federal Employment Agency (BA) at the Institute for Employment Research (IAB). https://doi.org/10.5164/IAB.NEPS-SC6-ADIAB7520.de.en.v1

Ochsenfeld, F. (2014). Why do women's fields of study pay less? A test of devaluation, human capital, and gender role theory. *European Sociological Review, 30*, 536–548. https://doi.org/10.1093/esr/jcu060

Reskin, B. F., & Roos, P. A. (Eds.). (1990). *Job queues, gender queues: Explaining women's inroads into male occupations*. Temple University Press.

Ridgeway, C. L. (1997). Interaction and the conservation of gender inequality: Considering employment. *American Sociological Review, 62*(2), 218–235. https://doi.org/10.2307/2657301

Ridgeway, C. L., & Correll, S. J. (2006). Consensus and the creation of status beliefs. *Social Forces, 85*(1), 431–453. https://doi.org/10.1353/sof.2006.0139

Rohrbach-Schmidt, D., & Tiemann, M. (2013). Changes in workplace tasks in Germany – Evaluating skill and task measures. *Journal for Labour Market Research, 46*(3), 215–237. https://doi.org/10.1007/s12651-013-0140-3

Rosen, S. (1986). The theory of equalizing differences. In O. Ashenfelter & R. Layard (Eds.), *Handbook of labor economics* (Vol. 1, pp. 641–692). North-Holland.

Schunck, R. (2013). Within and between estimates in random-effects models: Advantages and drawbacks of correlated random effects and hybrid models. *The Stata Journal, 13*(1), 65–76.

Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis*. Oxford University Press.

Solga, H., & Konietzka, D. (1999). Occupational matching and social stratification: Theoretical insights and empirical observations taken from a German–German comparison. *European Sociological Review, 15*(1), 25–47. https://doi.org/10.1093/oxfordjournals.esr.a018253

Solga, H., & Konietzka, D. (2000). Das Berufsprinzip des deutschen Arbeitsmarktes. Ein geschlechtsneutraler Allokationsmechnismus? *Schweizerische Zeitschrift für Soziologie, 26*(1), 111–147.

Trappe, H. (2006). Berufliche Segregation im Kontext: Über einige Folgen geschlechtstypischer Berufsentscheidungen in Ost- und Westdeutschland. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 58*(1), 50–78. https://doi.org/10.1007/s11575-006-0003-z

Trappe, H., & Rosenfeld, R. A. (2001). Geschlechtsspezifische Segregation in der DDR und der BRD. Im Verlauf der Zeit und im Lebensverlauf. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, Sonderheft, 41*(2001), 152–181.

vom Berge, P., König, M., & Seth, S. (2013). *Sample of integrated labour market biographies 1975–2010*. FDZ Datenreport 01/2013.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT Press.

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Chapter 14
Employment-Related Further Training in a Dynamic Labour Market



Silke Anger, Pascal Heß, Simon Janssen, and Ute Leber

Abstract In recent decades, accelerating technological progress and increasing international trade have not only made labour markets more dynamic but also steadily changed the demand for skills and knowledge. As a result, workers have had to continuously invest in training to update their skills if they want to avoid long-lasting negative consequences for their careers. This project uses data from the adult cohort of the German National Education Panel Study (NEPS) to investigate how workers' training participation has evolved in dynamic labour markets exposed to technological change and increasing international trade. The study analyses the relationship between workplace automation and employment-related training and shows that the training participation of workers whose jobs were highly exposed to automation was much lower than that of workers whose jobs were less exposed. Moreover, results suggest that employers' financial support explains the lion's share of the training gap. Consistent with the new training literature, firms are the main force behind further training investments.

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14.1 Introduction

Throughout recent decades, technological change, international trade, and economic turbulences have accelerated in the globalized world, making labour markets more and more dynamic. As a result, workers have to handle steadily changing technologies and compete with highly competitive workers in an international labour market. In addition, many workers have to switch jobs more frequently as a consequence of cyclical fluctuations. In such dynamic labour markets, workers continuously have to invest in human capital to maintain and increase their productivity. Otherwise, they are likely to experience long-lasting negative consequences for their careers. Thus, it is not surprising that further training and lifelong learning, such as on-the-job training and retraining, have gained increasing attention in the public media and political debate. However, existing research provides only little evidence about the influence of dynamic labour markets on workers' further training participation.

To understand the importance of employment-related further education in dynamic labour markets, this study concentrates on technological change and further training. A large body of literature documents that computers and industry robots have had a substantial impact on labour markets (e.g., Acemoglu, 2015; Acemoglu & Restrepo, 2017a, b, 2018), because these technologies can perform many routine tasks previously performed by low- and medium-skilled workers.[1] As emerging technologies, such as artificial intelligence (AI), can even perform many non-routine tasks of high-skilled workers,[2] many policymakers and researchers fear that technological change might disrupt labour markets even more substantially in the future.[3] Therefore, many scholars and practitioners emphasize the growing importance of on-the-job training and lifelong learning to prevent disruptive effects of technological change; and governments across the world are investing heavily in training policies.

However, no study has analysed whether and to what extent workers whose jobs are likely to be replaced by new technologies invest in on-the-job training.[4] Obviously, workers have strong individual incentives to update their skills to avoid wage

[1] See Autor (2013), Acemoglu and Autor (2011), Autor et al. (2003), Goos and Manning (2007), Goos et al. (2014), Michaels et al. (2014), and Spitz-Oener (2006) for further evidence on the effects of technological change on labour markets. Akerman et al. (2015), Autor et al. (2002), Bresnahan et al. (2002), Brynjolfsson and Hitt (2003), Caroli and Van Reenen (2001), and Doms et al. (1997) provide evidence on the firm level, and Chin et al. (2006) and Hynninen et al. (2013) provide historical evidence from the introduction of steam engines.

[2] For example, Agrawal et al. (2019) argue that AI has particularly improved the quality of the predictions involved in the decision making of many high-skilled workers. See also Webb (2019) for further evidence about the effect of AI on labour market outcomes for high-skilled workers.

[3] Frey and Osborne (2017) estimate that approximately 47% of total US employment is at risk of automation. Others present more optimistic estimates of approximately 9% (e.g., Arntz et al., 2017).

[4] Sieben et al. (2009) uses survey data on the establishment level to show that firms' training investments increase in response to investments in IT technology.

loss or unemployment in response to technological changes.[5] Yet, firms—not workers—initiate and finance most on-the-job training. According to the results of the Adult Education Survey (AES), 72% of all further training activities in 2018 were financed by firms or took place during working hours (Bundesministerium für Bildung und Forschung, 2019). And firms have different incentives than workers when it comes to training. On one hand, they may invest in training to retain firm-specific human capital, even if new technologies can substitute certain tasks that workers currently perform. On the other hand, they may refrain from investing in training for workers whom they eventually plan to automate. Without understanding whether and how technological change affects workers' training participation, designing efficient training policies that are tailored towards the most affected workers remains difficult.

This study sheds light on the relationship between technological change and training by analysing whether and why workers whose jobs are at a high risk of being changed or automated by technologies invest either more or less in training. Therefore, we use a novel and unique data source: the adult survey of the German National Educational Panel Study NEPS (Allmendinger et al., 2019) combined with administrative register data from the German Federal Employment Agency (BA). Thus, our data combines detailed survey information about workers' training participation with precise register data about individual careers and firms.

Our first goal is to document the training gap between workers in routine jobs who are at a high risk of being substituted by technology and workers in non-routine jobs who are less exposed to the negative consequences of technological change. Results reveal a substantial gap in training participation of approximately 14 percentage points between workers in routine and non-routine jobs. This gap is almost as large as the training gap between high-educated workers (i.e., workers with a university degree) and low educated workers (i.e., workers without a university or apprenticeship degree). The gap persists within educational groups and barely changes after accounting for variables that are strongly related to the workers' unobserved productivity differences, such as information about their health status and results from competence tests. Thus, although we cannot present causal inferences from these results, they do not suggest that unobserved ability differences are able to explain entirely the training gap between routine and non-routine workers.

Our second goal is to exploit the detailed information within our data source to identify the most important factors that are able to account for the training gap between routine and non-routine workers. Detailed decompositions of the training gap reveal that education and other variables strongly related to the employees' unobserved ability account for only a small amount of the training gap (i.e., 6.3%). Similarly, firm characteristics, such as firm size and industry, account for only a small share of the training gap between routine and non-routine workers.

[5] Acemoglu (1997) argues that workers are more willing to invest in training if they expect many firms to innovate, because their returns to training increase with firms' innovation.

Instead, firms' training support accounts for the lion's share of the training gap. In more detail, we find that firms' active human resource activities (e.g., individual offers to train during working time and individual financing offers) account for 29.7% of the gap, and firms' passive human resource strategies (e.g., their general financing strategy) for about 12.1%. Thus, overall, our results suggest that the firms' individual and financial support are the most important determinants of the low training participation of workers in routine jobs. This result is in line with the argument that firms may have low incentives to support and finance the training participation of employees who are likely to be replaced by modern technologies in the near future.

Our results contribute to at least two strands of the literature: first, the literature on routine-biased technological change (Autor et al., 2003). Whereas previous studies have analysed the wage and employment effects of routine-biased technological change, our study shows that routine-biased technological change not only has induced a polarization of the wage and employment structure, but is also related to a polarization of workers' training participation. In this sense, our results provide evidence for a channel through which routine-biased technological change translates into a polarization of wages and employment. Moreover, if routine workers who are most likely to be exposed to the negative consequences of technological change invest less in training and re-training than non-routine workers, the polarization of workers' training participation may reinforce the polarization of the wage and employment structure in the long run.

Second, we contribute to the training literature by showing that routine-biased technological change may have a substantial influence on workers' human capital accumulation. Previous studies have focused on the education level and the enhancement of the training participation rate for low-educated workers (see Fouarge et al., 2013; Hidalgo et al., 2014). We now show that, even within educational groups, workers' training participation is very heterogeneous and depends on their tasks and their firms' support.

14.2 Data

This section describes our data set that combines administrative records of workers and firms from the Integrated Employment Biographies with detailed survey data for workers' training participation from the adult cohort of the National Educational Panel Study (NEPS).

14.2.1 The National Educational Panel Study (NEPS)

This study uses Starting Cohort 6 of NEPS, a longitudinal data set surveying the educational trajectories and labour market careers of about 10,000 adults between

2009 and 2017 (Allmendinger et al., 2019). The data contain detailed information about the individuals' entire labour market careers, education histories, and training activities. Moreover, we can merge the survey data to register information from social security contributions that allow us to obtain precise individual worker and firm characteristics.

The 2011/2012 wave of NEPS is ideally suited for our investigation, because it contains detailed information on workers' training participation and information about their firms' human resources practices, e.g., information about financial and structural company support for on-the-job training. Moreover, the data contain many individual and job characteristics that are likely to influence the workers' training participations but are commonly not observed by researchers. For example, we have information on the workers' health status and their competencies in math and reading. As a result, the lion's share of our analysis relies on the 2011/2012 wave of the NEPS. However, whenever possible, we include information from all waves in our analyses.

14.2.2 Administrative Data from the German Federal Employment Agency

The administrative records from the German Federal Employment Agency (BA) contain individual-level data on labour market activities that are relevant for calculating the amount of social security contributions. The BA uses this information to provide two data sources: first, the Integrated Employment Biographies (Integrierte Erwerbsbiografien, IEB) containing the entire population of German social security records from 1975 to 2018. The data cover all employees subject to social security contributions except civil servants and the self-employed—that is, all dependently employed workers who make up to 80% of the workforce in the German labour market. Unique person and establishment identifiers identify all individuals and establishments such that we can merge the IEB data to the NEPS data. Second, the Establishment History Panel (Betriebs-Historik-Panel, BHP) that contains information about all German firms with at least one worker subject to social security contributions (Schmucker et al., 2018).

Both data sources allow us to rely on precisely measured individual labour market and firm characteristics instead of relying exclusively on survey measures that are commonly prone to substantial measurement error. From the IEB, we obtain precise individual information about each person's occupation, gender, age (in years), exact tenure and labour market experience, and education. From the BHP, we obtain exact information about the firms' size, share of full-time or (marginal) part-time workers, qualification structure, median wage, and location.

14.3 Sample Restrictions and Main Analysis Variables

14.3.1 Sample

Our main analysis sample is composed of individuals who are working at the time of the interview and give consent to link their survey data to the administrative data from social security records (93% consent rate, see Antoni et al., 2018, for more information). We further restrict our sample to individuals who are not undergoing a vocational training and are between 25 and 60 years old. Finally, we delete all observations with missing values in our main analysis variables. These restrictions leave us with 3246 individuals.

14.3.2 Dependent Variables

The purpose of our study is to analyse the training participation of workers whose jobs are likely to be changed or automated. Thus, our dependent variables describe the workers' participation in further training activities. More specifically, we analyse labour-related non-formal training courses that relate to employment spells. However, we exclude training that is not employment-related, informal training that is not organized in courses or seminars, formal training, such as apprenticeship training, and training courses that occur during periods of non-employment.

Our main dependent variable is a dummy variable indicating whether a worker participated in at least one training course throughout the last 12 months before the interview. However, a training dummy measures only the extensive margin of the workers' training participation. Therefore, we also analyse the frequency and duration of training to uncover effects at the intensive margin.

14.3.3 Independent Variables

Our main independent variable measures whether a job is likely to be changed or automated by modern technologies in the near future. To create such as measure, we follow the literature on routine-biased technological change (e.g., Autor et al., 2003). The core idea of this literature is that job tasks are more likely to be replaced by modern technologies if they follow routines that are easy to automate or program. In contrast, tasks that do not follow routines cannot be programmed and automated so easily.[6] Moreover, non-routine tasks often even complement modern technologies.

[6] Advanced technologies such as modern artificial intelligence become ever more likely to even replace non-routine tasks. However, so far, we have ignored this possibility.

More specifically, we rely on a set of six items from the NEPS data to measure the routine-task intensity of an individual's job. Matthes et al. (2014) designed these items explicitly to infer the extent to which a worker performs routine tasks. Table 14.A1 in the appendix reports the content of each item we use. Workers responding to each item indicate the routine intensity of their jobs by rating the frequency of repetitive tasks on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*always or very often*). For the largest part of our analysis, we define a worker as being highly exposed to routine-biased technological changes if the sum score of items lies at or above the 75th percentile. However, in certain robustness checks, we also use a continuous version of this measure.

14.3.4 Control Variables

Because workers do not choose their jobs randomly, the routineness of a worker's job correlates with a large number of observable and unobservable variables that are likely to influence training participation (selection problem). For example, workers' training participation is likely to correlate with firm size, i.e., larger firms tend to invest more in the training of their workers than smaller ones. Because it is very difficult, if not impossible, to find experimental or quasi-experimental variation that assigns workers randomly to their jobs, we have to rely on a huge set of control variables to capture as many confounding factors as possible.

Our data set contains a very rich set of control variables from the administrative register data and the survey data. Whenever possible, we rely on the administrative data to measure our control variables, because register data is less prone to measurement error than the subjective information from survey data. In detail, we obtain information about the workers' gender, part-time work, vocational education, marginal employment, work experience, tenure, and wage from the register data. Moreover, we obtain the following information about the workers' firms from the register data: median wage of full-time workers, firm size, share of full-time workers, and shares of high- and medium-qualified workers.

However, like most register data sources, our register data is limited to a few core labour market and firm characteristics that might not capture all potential confounders. Therefore, we also include important variables from the survey data. Namely, we have information about the workers' migration background, their self-assessed health status, their disability status, and their math and reading competencies. Moreover, the 2010/11 wave of the NEPS provides information about whether a worker's firm implemented human resource practices to support that worker's training participation. For example, we know whether a worker's firm has an official training agreement, an official unit responsible for on-the-job training, or whether the firm generally offers financial training support.

14.4 Descriptive Statistics

Figure 14.1 shows the distribution of our measure for the self-reported routineness of individuals' jobs. The figure reveals that our measure for routineness ranges between 5 and 30 and almost resembles a normal distribution with a mean of approximately 15. The vertical line indicates the 75th percentile of the distribution. Throughout the study, we refer to workers with a routineness below the 75th percentile as non-routine workers and to workers with a value above the 75th percentile as routine workers.

Table 14.1 presents descriptive statistics for the core variables of our analysis. The first column presents the results for routine workers the second for non-routine workers. The third column shows the differences between routine and non-routine workers along with significance levels from *t* tests.

With a training participation of approximately 27% routine workers train substantially less than non-routine workers of whom approximately 41% reported having participated in at least one training throughout the year. The difference in training participation is highly significant on the 1% level. However routine and non-routine workers do not just differ in their training participation, they also differ with respect to many individual characteristics. For example, they are more likely to be female, work part-time, and have a migration background. Moreover, they appear to work in firms with different management and training policies. For example, they

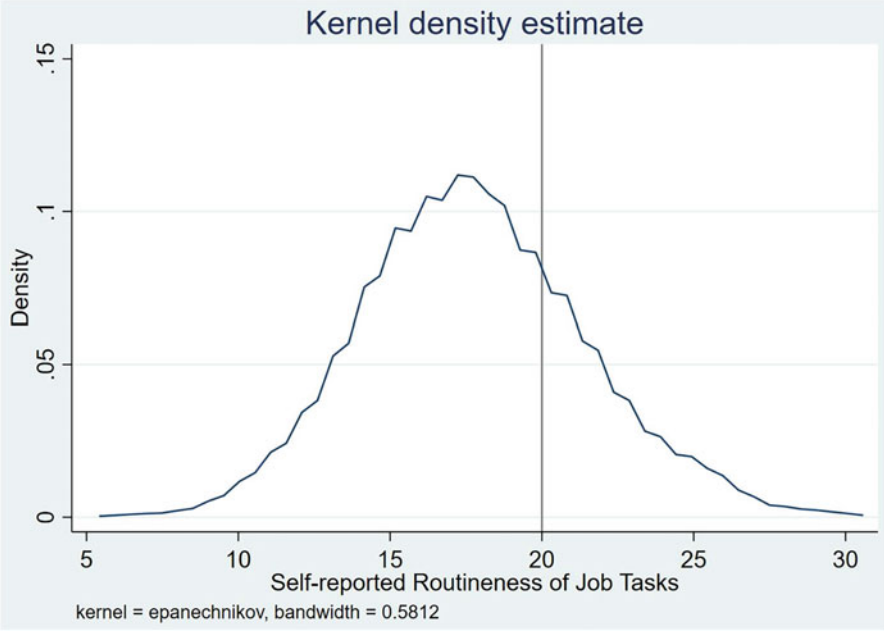


Fig. 14.1 Kernel density estimates of self-reported routineness. (*Source:* 2011/2012 wave of the NEPS Adult Starting Cohort)

Table 14.1 Descriptive statistics of core analysis variables

	Routine workers	Non-routine workers	Difference
Training	0.27	0.41	0.14***
Number of courses	0.70	0.98	0.28***
Individual characteristics			
Gender (1 = female)	0.57	0.42	−0.15***
Migration background	0.23	0.15	−0.07***
Age	45.65	45.24	−0.41
Vocational education	2.10	2.33	0.23***
Experience in years	17.90	17.78	−0.13
Self-assessed health	2.27	2.14	−0.13***
Person is disabled	0.07	0.06	−0.02**
Job characteristics			
Log daily wage	4.29	4.68	0.40***
Tenure in years	8.65	8.74	0.09
Skill requirement	2.18	2.72	0.54***
Part-time (= 1)	0.35	0.23	−0.13***
Firm characteristics			
Company size	2.31	2.41	0.10**
Imputed median daily wage	97.19	112.83	15.64***
Share of full-time workers	0.63	0.68	0.05***
Share of highly qualified workers	0.15	0.24	0.09***
Training agreement	0.48	0.56	0.09***
Planning	0.50	0.62	0.12***
Financing	0.72	0.84	0.12***
Person responsible	0.56	0.64	0.08***
Observations	3246		

Source: 2011/2012 wave of the NEPS Adult Starting Cohort combined with data from the BHP
**$p < .01$; ***$p < .001$

are substantially less likely to work in firms that have a specific training agreement or a designated person who is responsible for on-the-job training. Finally, they are substantially less likely to receive individual training support from their firms, such as opportunities to train during working time and financial training support.

14.5 Empirical Strategy

We apply an Oaxaca–Blinder decomposition to estimate and explain the difference in training participation between routine and non-routine workers. The Oaxaca–Blinder decomposition explains differences in outcomes for individual members of two groups in which random assignment is impossible—for example, gender or race. For the purpose of this study, we use this method to explain training participation differences between routine and non-routine workers—that is, between workers

whose jobs are likely to be changed or automated by modern technologies and all other workers. To decompose the differences in training participation, we estimate the following equation:

$$E(T_{NR}) - E(T_R) = (E(X_{NR}) - E(X_R))'\beta_{NR} + E(X_R)'(\beta_{NR} - \beta_R) \quad (14.1)$$

The left-hand side of Equation 14.1 shows the difference in the expected training participation between non-routine (NR) and routine (R) workers. The right-hand side shows two terms. The first term $(E(X_{NR}) - E(X_R))'\beta_{NR}$ denotes the cumulated mean difference of all explanatory variables between the two groups weighted by the slope of the non-discriminated group. This term is usually referred to as the explained part of the decomposition. Thus, in our case, the first term indicates the part of the difference in the training participation between routine and non-routine workers that is related to observable individual and firm characteristics in our data set. The second term on the right-hand side denotes the cumulated average of the explanatory variables of the reference group of routine workers weighted by the differences of the slopes between non-routine and routine workers. This term is usually referred to as the unexplained part of the decomposition. In our case, this term can be interpreted as the difference in the training participation of routine and non-routine workers that is not related to observable worker and firm characteristics.

14.6 Results

14.6.1 Determinants of the Training Gap Between Routine and Non-routine Workers

Figure 14.2 shows the training gap between routine and non-routine workers for different subgroups of our population. The first bar shows that the raw gap in training participation between routine and non-routine workers amounts to 14 percentage points— i.e., a gap of approximately 40% relative to the average participation rate of 35%. As the second and the third bar reveal, the training gap between routine and non-routine workers remains large within the groups of women and men—although the routine training gap is somewhat larger among men than among women. The training gap also remains large and persistent within the groups of migrants and non-migrants, and within different age groups. Interestingly, the routine training gap is larger among non-migrants than among migrants, and at 22 percentage points, it is particularly large for individuals aged between 30 and 34. In contrast, the routine training gap is smaller for both younger and older workers.

Table 14.2 shows the results of simple ordinary least squares regressions (OLS) of a dummy indicating whether workers have participated in at least one training throughout the year on a dummy variable for a non-routine job and different sets of observable worker characteristics. The first column replicates the raw difference in

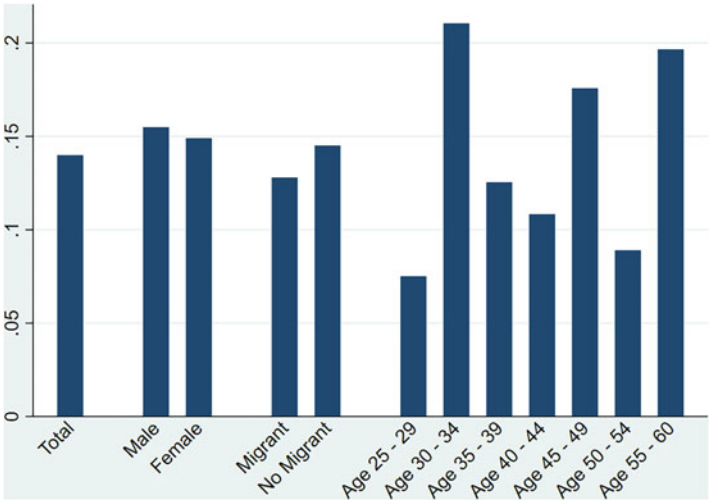


Fig. 14.2 Differences in training participation between routine and non-routine workers. (*Source:* 2011/2012 wave of the NEPS Adult Starting Cohort)

training participation between routine and non-routine workers without further controls. It shows a coefficient estimate of 14 percentage points that is highly significant on the 1% level. The second column adds control variables for the workers' highest level of education. Adding these controls decreases the coefficient estimate only slightly to a value of approximately 12 percentage points. This result suggests that the workers' education and related differences in unobserved ability do not substantially influence the training gap between routine and non-routine workers

The third column adds a dummy indicating the workers' disability status and a dummy indicating whether the worker is of poor health or not. Adding these health variables barely changes the result and suggests that the workers' health is unlikely to explain the training gap. Column four adds further individual controls: migration status, gender, age, and labour market experience. Adding these controls slightly inflates the coefficient estimate to a value of approximately 13 percentage points suggesting that measurement error in our main explanatory variable for routine jobs biases the coefficient estimate towards zero. Column five adds job characteristics, such as tenure or a dummy indicating whether a worker is marginally employed. The results barely change relative to column four. The sixth column adds a substantial amount of firm characteristics: firm size, industry shares of high- and medium-qualified workers, share of full-time employees, share of marginally employed workers, location of the company, and the imputed median wage of full-time workers. Adding all these variables decreases the coefficient to approximately 11 percentage points. Finally, the seventh column adds controls for different training policies of the workers' company, such as dummy variables indicating whether a worker's firm has a training agreement has an official unit responsible for on-the-job training or whether it generally offers financial training support. Adding these

Table 14.2 OLS regression of training participation on different individual characteristics

	I	II	III	IV	V	VI	VII
Routine (dummy)	−0.140***	−0.119***	−0.117***	−0.129***	−0.130***	−0.114***	−0.087***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)
Education	No	Yes	Yes	Yes	Yes	Yes	Yes
Health	No	No	Yes	Yes	Yes	Yes	Yes
Individual char.	No	No	No	Yes	Yes	Yes	Yes
Job char.	No	No	No	No	Yes	Yes	Yes
Firm char.	No	No	No	No	No	Yes	Yes
Company policies	No	No	No	No	No	No	Yes
Observations	3246	3246	3246	3246	3246	3246	3246

Notes: The dependent variable is a dummy taking the value of 1 when the workers reported having participated in at least one training throughout the year and 0 otherwise. Education is measured in three categories: without qualification, apprenticeship degree, and university degree. Health includes variables for a worker's disability status and a dummy indicating whether a worker is of poor health. Individual characteristics include gender, migration background, age, and labour market experience. Job characteristics include tenure and a dummy indicating whether a worker is marginally employed. Firm characteristics include firm size, industry, shares of high- and medium-qualified workers, share of full-time employees, share of marginally employed workers, location of the company, and the imputed median wage of full-time workers. Company policies include dummy variables indicating whether a worker's firm has a training agreement, has an official unit responsible for on-the-job training, or whether the firm generally offers financial training support

***$p < .001$

controls further decreases the estimated training gap between routine and non-routine workers to approximately 9 percentage points

Overall, the results of Table 14.2 reveal that observable individual worker and job characteristics barely influence the estimated training gap between routine and non-routine workers. Moreover, the results suggest that unobserved ability differences that are commonly related to observed factors, such as education, migration status, health, and other individual and job characteristics, are unlikely to explain large parts of the training gap between routine and non-routine workers. However, differences in firm characteristics and, specifically, differences in the firms' training policies have a quite substantial impact on the training gap between routine and non-routine workers.

14.6.2 Decomposition Results

To put our results into perspective, this section presents results from our Oaxaca–Blinder decomposition as described above. Fig. 14.3 presents the results.

The grey bars describe the entire training gap between routine and non-routine workers, the green bars describe the share that can be explained by observable characteristics.

The figure reveals that individual worker characteristics can explain only approximately 7% of the entire training gap between routine and non-routine workers. Moreover, the workers' job characteristics are also unable to explain a substantial part of the training gap. However, when we add firm characteristics and the measures

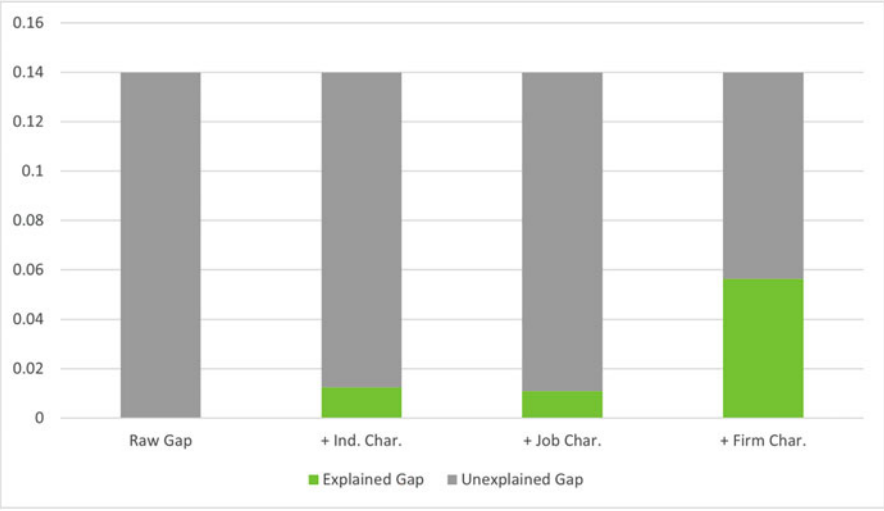


Fig. 14.3 Oaxaca-Blinder decompositions of training gap. (*Source:* 2011/2012 wave of the NEPS Adult Starting Cohort)

for the firms' training policies, the explained share of the gap increases to approximately 40%. Thus, firm characteristics and company policies explain almost one half of the training gap between routine and non-routine workers.

14.7 Conclusion and Outlook

This study investigates whether automation and digitalization of work processes across different occupations have affected workers' training participation. The analyses show that workers whose jobs are likely to be substituted by technology in the near future participate substantially less in on-the-job training than workers whose jobs are not likely to be substituted. In addition, the study explores the mechanisms that explain the training gap between routine and non-routine workers. We find that common observable individual and labour market characteristics, such as education or migration status, cannot explain the training gap, whereas differences in firm characteristics and training policies can explain a large share of the training gap. This result is in line with the argument that firms may have low incentives to support and finance the training participation of employees who are likely to be replaced by modern technologies in the near future. If workers who are potentially exposed to the negative consequences of technological change invest less in training and retraining than workers who are not exposed, the polarization of training participation may reinforce the polarization of the wage and employment structure in the future. Our results strongly support the idea of training subsidies for employees.[7] Against this background, these programmes should have a special focus on the disadvantaged group of routine workers whose jobs are particularly likely to be substituted by technology in the near future.

A relevant question for future research will ask how shocks caused by labour market dynamics—in particular, job displacements following economic turbulences—influence workers' training participation. During economic downturns, many workers lose their jobs, become unemployed, or have to search for new jobs. A great number of prominent studies from the U.S. and Europe have analysed the consequences of job displacement for the careers of workers while focusing on wage profiles. Although evidence is somewhat mixed, most studies found that worker displacement—usually defined as unexpected and involuntary job loss due to firm closures or mass layoffs—has large and long-lasting negative consequences for the careers of individual workers with earnings losses of up to 40% per quarter of a year (e.g., Davis & von Wachter, 2011).[8]

[7] In 2020, the German parliament passed the 'Work of Tomorrow Act'(*Arbeit-von-morgen-Gesetz*), which is designed to support further training in companies with a view to helping individuals and companies to adapt to digitalization and structural change.

[8] Some prominent examples from Germany include Couch (2001) who reported earnings losses of approximately 14%, or Burda and Mertens (2001) who estimated average earnings losses of approximately 4%. Schmieder et al. (2010) found daily earnings losses of approximately 15% per year that persisted for up to 15 years after displacement.

Although researchers widely agree that displaced workers' earning losses are large and long lasting, it remains unclear why displaced workers' large earnings losses persist over the long run. In particular, standard economic theory fails to explain the magnitude and persistence of these long-term displacement losses. To date, existing research has not considered workers' foregone investments in human capital that may help standard theory to explain empirical results of displaced workers' long-term earnings losses. In other words, displaced workers may not only lose specific human capital in response to a job loss (Becker, 1964; Neal, 1995; Topel, 1991), but also forgo access to (employer provided) on-the-job training for long periods after the job loss—because they either remain unemployed, move to lower-paid jobs, or move to firms that provide less training. This would imply that displaced workers experience long periods during which they fail to accumulate human capital through occupation-related further training and, therefore, experience long-lasting negative consequences for their careers. Future work based on NEPS data aims to analyse the relationship between worker displacement and occupation-related further training to fill this research gap.

Another question that should be addressed in the future refers to the returns to employment-related further training in dynamic labour markets. The effects of further training have been analysed for various types of returns, such as income, productivity, career and occupational mobility, prevention of unemployment, and re-integration of non-working individuals into the workforce.[9] As a consequence of technological change, international labour markets, and cyclical fluctuations, workers have to remain flexible and be prepared to switch their jobs and tasks more frequently. Hence, the relevant question is whether job-related further training increases workers' stock of human capital and enables them to conduct different tasks and deal with future changes in job contents. However, to date, it is unclear whether potential effects of further training on labour market outcomes are driven by training-induced skill increases and subsequent changes in job contents or by other mechanisms such as signalling higher productivity (Spence, 1973) or gift exchange (Becker et al., 2013). Future research based on repeated measures of human capital in the NEPS adult cohort aims to explore the returns to further training in the form of worker competencies and job contents to fill this gap.

Findings will complement the new knowledge about the firms' and workers' role in employment-related further training and may help policymakers to target further training investments.

[9] Further training participation has additional benefits beyond labour market returns (see Akerman et al., 2011).

Appendix

Table 14.A1 Task questions

Question	Scale	Note
How often in your daily work do you have to carry out short, repetitive tasks?	1 Routine – 5 Non-routine	Included with reversed scale
How often does it happen that you get tasks at work that you first have to familiarize yourself with?	1 Non-routine – 5 Routine	
How often do you have to react to situations at work that you had not been able to anticipate?	1 Non-routine – 5 Routine	
How often do you change the tasks you have to carry out at work?	1 Non-routine – 5 Routine	
How often do you have to do things at work that you have not done before?	1 Non-routine – 5 Routine	
How often does it happen that every detail of how you carry out your work is specified for you?	1 Routine – 5 Non-routine	Included with reversed scale

Source: 2011/2012 wave of the NEPS Adult Starting Cohort

References

Acemoglu, D. (1997). Training and innovation in an imperfect labour market. *Review of Economic Studies, 64*, 445–464.

Acemoglu, D. (2015). Localised and biased technologies: Atkinson and Stiglitz's new view, induced innovations, and directed technological change. *The Economic Journal, 125*(583), 443–463.

Acemoglu, D., & Autor, D. (2011). Skills, tasks and technologies: Implications for employment and earnings. In D. Card & O. Ashenfelter (Eds.), *Handbook of labor economics* (pp. 1043–1171).

Acemoglu, D. & Restrepo, P. (2017a). *Robots and jobs: Evidence from us labor markets.* NBER Working Paper No. 23285.

Acemoglu, D., & Restrepo, P. (2017b). Secular stagnation? The effect of aging on economic growth in the age of automation. *American Economic Review, 107*(5), 174–179.

Acemoglu, D., & Restrepo, P. (2018). The race between man and machine: Implications of technology for growth, factor shares, and employment. *American Economic Review, 108*(6), 1488–1542.

Agrawal, A., Gans, J. S., & Goldfarb, A. (2019). Artificial intelligence: The ambiguous labor market impact of automating prediction. *Journal of Economic Perspectives, 33*(2), 31–50.

Akerman, A., Gaarder, I., & Mogstad, M. (2015). The skill complementarity of broadband internet. *Quarterly Journal of Economics, 130*(4), 1781–1824.

Akerman, R., Vorhaus, J., & Brown, J. (2011). *The wider benefits of learning*. Gütersloh.

Allmendinger, J., Kleinert, C., Pollak, R., Vicari, B., Wölfel, O., Althaber, A., Antoni, M., Christoph, B., Drasch, K., Janik, F., Künster, R., Laible, M.-C., Leuze, K., Matthes, B., Ruland, M., Schulz, B., & Trahms, A. (2019). Adult education and lifelong learning. In H.-P. Blossfeld & H.-G. Rossbach (Eds.), *Education as a lifelong process. The German National Educational Panel Study (NEPS)* (Zeitschrift für Erziehungswissenschaft. Sonderheft, 03) (pp. 325–346). Springer VS.

Antoni, M., Bachbauer, N., Eberle, J., & Vicari, B. (2018). NEPS-SC6-Erhebungsdaten verknüpft mit administrativen Daten des IAB (NEPS-SC6-ADIAB 7515). *FDZ-Datenreport*, 02/2018.

Arntz, M., Gregory, T., & Zierahn, U. (2017). Revisiting the risk of automation. *Economics Letters, 159*, 157–160.

Autor, D. H. (2013). The 'task approach' to labor markets: An overview. *Journal for Labour Market Research, 46*(3), 185–199.

Autor, H. D., Levy, F., & Murnane, R. J. (2002). Upstairs, downstairs, and skills on two floors of a large bank. *Industrial and Labor Relations Review, 55*(3), 432–447.

Autor, H. D., Levy, F., & Murnane, R. J. (2003). The skill content of recent technological change: An empirical exploration. *The Quarterly Journal of Economics, 118*(4), 1279–1333.

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. Columbia University Press.

Becker, S. O., Messer, D., & Wolter, S. C. (2013). A gift is not always a gift: Heterogeneity and long-term effects in a gift exchange experiment. *Economica, 80*, 345–371.

Bresnahan, T. F., Brynjolfsson, E., & Hitt, L. M. (2002). Information technology, workplace organization, and the demand for skilled labor: Firm-level evidence. *Quarterly Journal of Economics, 117*(1), 339–376.

Brynjolfsson, E., & Hitt, L. M. (2003). Computing productivity: Firm-level evidence. *Review of Economics and Statistics, 85*(4), 793–808.

Bundesministerium für Bildung und Forschung. (2019). *Weiterbildungsverhalten in Deutschland 2018*. Ergebnisse des Adult Education Survey – AES Trendbericht.

Burda, M. C., & Mertens, A. (2001). Estimating wage losses of displaced workers in Germany. *Labour Economics, 8*, 15–41.

Caroli, E., & Van Reenen, J. (2001). Skill-biased organizational change? Evidence from a Panel of British and French Establishments. *The Quarterly Journal of Economics, 116*(4), 1449–1492.

Chin, A., Juhn, C., & Thompson, P. (2006). Technical change and the demand for skills during the second industrial revolution: Evidence from the merchant marine, 1891–1912. *The Review of Economics and Statistics, 88*(3), 572–578.

Couch, K. (2001). Earnings losses and unemployment of displaced workers in Germany. *ILR Review, 54*(3), 559–572.

Davis, S. J. & von Wachter, T. (2011). Recessions and the cost of job loss. NBER Working Paper No. w17638.

Doms, M., Dunne, T., & Troske, K. R. (1997). Workers, wages, and technology. *The Quarterly Journal of Economics, 112*(1), 253–290.

Fouarge, D., Schils, T., & de Grip, A. (2013). Why do low educated invest less in further training? *Applied Economics, 45*, 2587–2601.

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change, 114*, 254–280.

Goos, M., & Manning, A. (2007). Lousy and lovely jobs: The rising polarization of work in Britain. *The Review of Economics and Statistics, 89*(1), 118–133.

Goos, M., Manning, A., & Salomons, A. (2014). Explaining job polarization: Routine-biased technological change and offshoring. *American Economic Review, 104*(8), 2509–2526.

Hidalgo, D., Oosterbeek, H., & Webbink, D. (2014). The impact of training vouchers on low-skilled workers. *Labour Economics, 31*, 117–128.

Hynninen, S.-M., Ojala, J., & Pehkonen, J. (2013). Technological change and wage premiums: Historical evidence from linked employer–employee data. *Labour Economics, 24*, 1–11.

Matthes, B., Christoph, B., Janik, F., & Ruland, M. (2014). Collecting information on job tasks—An instrument to measure tasks required at the workplace in a multi-topic survey. *Journal for Labour Market Research, 47*(4), 273–297.

Michaels, G., Natraj, A., & Van Reenen, J. (2014). Has ICT polarized skill demand? Evidence from eleven countries over twenty-five years. *Review of Economics and Statistics, 96*(1), 60–77.

Neal, D. (1995). Industry-specific human capital: Evidence from displaced workers. *Journal of Labor Economics, 13*(4), 653–677.

Schmieder, J., von Wachter, T.; Bender, S. (2010). The long-term impact of job displacement in Germany during the 1982 recession on earnings, income, and employment. IAB Discussion Paper, No. 1/2010.
Schmucker, A., Eberle, J., Ganzer, A.Stegmaier, J. & Umkehrer, M. (2018). Establishment history panel 1975–2016. FDZ-Datenreport, 01/2018.
Sieben, I., De Grip, A., Longen, J., & Sørensen, O. (2009). Technology, selection, and training in call centers. *Industrial and Labor Relations Review, 62*(4), 553–572.
Spence, M. (1973). Job market signaling. *Quarterly Journal of Economics, 87*(3), 355–374.
Spitz-Oener, A. (2006). Technical change, job tasks, and rising educational demands: Looking outside the wage structure. *Journal of Labor Economics, 24*(2), 235–270.
Topel, R. (1991). Specific capital, mobility, and wages: Wages rise with job seniority. *Journal of Political Economy, 99*(1), 145–176.
Webb, M. (2019). The impact of artificial intelligence on the labor market. *SSRN 3482150*.

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Chapter 15
Regional Factors as Determinants of Employees' Training Participation



Katja Görlitz, Sylvi Rzepka, and Marcus Tamm

Abstract Although the literature on the determinants of training has considered individual and firm-related characteristics, it has generally neglected regional factors. This is surprising, given the fact that labour markets differ by regions. Regional factors are often ignored because (both in Germany and abroad) many data sets covering training information do not include detailed geographical identifiers that would allow a merging of information on the regional level. The regional identifiers of the National Educational Panel Study (Starting Cohort 6) offer opportunities to advance research on several regional factors. This article summarizes the results from two studies that exploit these unique opportunities to investigate the relationship between training participation and (a) the local level of firm competition for workers within specific sectors of the economy and (b) the regional supply of training measured as the number of firms offering courses or seminars for potential training participants.

15.1 Introduction

The knowledge and skills that individuals acquire are a major source of economic growth (Hanushek & Kimko, 2000). Faced with the need to adapt to new technological or organizational change, further training has gained in importance in the last

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decades and will likely continue to do so. Indeed, in terms of the number of participants, the training sector is already the largest education sector in Germany. Whereas there is a large literature analysing the characteristics of training participants (e.g. Fitzenberger & Muehler, 2015; Kaufmann & Widany, 2013; Kruppe & Baumann, 2019; Pischke, 2001) and the determinants of firms that provide training to their workforce (e.g. Gerlach & Jirjahn, 2001; Görlitz, 2010; Käpplinger, 2007; Zwick, 2004), there are few studies investigating regional determinants of training. Bellmann et al. (2011) and Martin et al. (2015), for example, have performed comprehensive analyses showing how a variety of regional economic factors predict regional training activities, and there are two studies investigating whether a firm's provision of training depends on the regional population density (Brunello & de Paola, 2008; Brunello & Gambarotto, 2007). In addition, Martin et al. (2016) analyse the effect on continuous training participation of variations in community administrative practices on the local level.

This lack of evidence is surprising given that both Rzepka and Tamm (2016) and Görlitz and Rzepka (2017) show that there is a large extent of variation in the share of individual training participants on the regional level in Germany. While there are some regions with a share of training participants fewer than 25 percent, others have almost twice as many participants. The probable reason why regional factors have been largely neglected so far is that many data sets that include training information do not additionally include detailed geographical identifiers that would allow a merging of regional factors. One exception is the data from the National Educational Panel Study (NEPS): Starting Cohort 6—Adults (Adult Education and Lifelong Learning) that contain detailed training information on the individual level and offers the opportunity to assess geographical identifiers of these individuals on the regional level. As part of SPP 1646 funded by the DFG, two studies were published by Rzepka and Tamm (2016) and Görlitz and Rzepka (2017) that exploit this unique opportunity to shed light on regional determinants of training participation. This article summarizes the results of these studies. Rzepka and Tamm (2016) analyse the industry-specific local employer density as a predictor of individuals' training incidence and training intensity. Local employer competition might affect training, because firms often finance the training of their employees. However, if they have to fear that the employee trained by them will be hired by a competing firm just after completing training, their willingness to finance it will be reduced. Thus, for firms, the higher the level of competition, the lower the incentives to finance training. Görlitz and Rzepka (2017) investigate whether training supply—that is, the number of firms providing courses and seminars to the public—affects individuals' training participation. Both studies focus on training of employed individuals, which comprises any formal and non-formal training with a professional interest.

The remainder of this article is set out as follows. The next section describes the data and shows how regional factors can be merged to the NEPS data. Sections 15.3 and 15.4 summarize the analyses investigating either local employer competition (Rzepka & Tamm, 2016) or training supply (Görlitz & Rzepka, 2017) as determinants of training. The last section concludes the article and emphasizes the research potential of the NEPS data.

15.2 Data and Opportunities to Merge Regional Characteristics

Rzepka and Tamm (2016) and Görlitz and Rzepka (2017) use data from NEPS: Starting Cohort 6—Adults (Adult Education and Lifelong Learning), doi:10.5157/NEPS:SC 6:1.0.0.[1] NEPS data collection is part of the Framework Programme for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research and supported by the federal states.

In the first wave in 2009/10, the data contain survey information on, for example, educational and training biographies, social demographics, and labour market outcomes from more than 11,000 individuals who were born between 1944 and 1986 (Blossfeld et al., 2011). Data include the county in which each survey participant works. This information can be used to merge regional information to the data. When analysing labour market processes, one can merge data on the county level or any higher level. Both Rzepka and Tamm (2016) and Görlitz and Rzepka (2017) aggregate the more than 400 counties to 140 local labour markets following Kosfeld and Werner (2012). The local labour markets aggregate counties that are characterized by commuter links. Counties with strong commuter flows are combined to belong to one local labour market. This regional unit represents the relevant labour market for an individual, because the decision which employer to choose and when to switch employers is often determined by the travel time to work. Of course, travel time is influenced by the distance of counties, but also by infrastructure and public transport. The definition of local labour markets based on commuter links captures both aspects.

NEPS data are well suited to analyse training processes because they cover a variety of survey questions addressing an individual's training participation. Rzepka and Tamm (2016) and Görlitz and Rzepka (2017) define training incidence as employees' participation in any formal and non-formal training with a professional interest (e.g. seminars and courses) within 12 months prior to the survey interview. Additionally, Rzepka and Tamm (2016) also analyse total training in hours. This aggregates the number of hours spent in training seminars or courses in the last 12 months. NEPS data also allow controlling for the 'usual' determinants of training on the individual level: gender, migration background, age, education, and occupation. Job-related characteristics such as tenure, temporary contract, or part-time contract and factors of the firm such as firm size and industry are available as well.

[1] For a more detailed description of Starting Cohort 6 and the research potential of the data, see Allmendinger et al. (2019).

15.3 The Impact of Local Employer Competition on Training Incidence

According to the human capital theory (Becker, 1964), training is an investment that is made when training returns exceed the corresponding costs. Becker distinguishes between two types of training that determine whether firms or workers bear the training costs: firms will bear the costs of training that is specific to the firm, whereas employees have incentives to invest in general training that is transferable when changing jobs. The empirical literature has provided evidence conflicting with these predictions, because it shows that employers contribute substantially to general training (Loewenstein & Spletzer, 1999). Based on these findings, a new strand of training literature emerged in economics—the 'new training literature'—in which it is assumed that labour markets are imperfect (Acemoglu & Pischke, 1998). These theories predict that employers will invest in general training if they have monopsony power to compress wages so that they can recoup their training investments by paying wages that are lower than workers' labour productivity.

One source of monopsony power that induces firms to invest in training could be mobility constraints. If mobility costs for individuals are low—for instance, in regions with high industry-specific firm density—the risk that employees will quit after receiving employer-sponsored training and be re-employed by another firm ('poaching risk') will be higher. The poaching risk lowers firms' incentives to invest in training (Gersbach & Schmutzler, 2012). Mühlemann and Wolter (2007) test this hypothesis for Switzerland and provide evidence that having a greater number of firms in a region that are in the same industry reduces the likelihood of a firm financing apprenticeship training. Similarly, Brunello and de Paola (2008) and Brunello and Gambarotto (2007) report that the population density (measured as the number of employees per square kilometre) is an important determinant of firms' training decisions in Italy and the UK, respectively. Also, Picchio and van Ours (2011) find that a decrease in labour market frictions significantly reduces firms' training expenditures.

Rzepka and Tamm (2016) investigate the effect of local employer competition on individual training participation in Germany. Their analysis uses data from Wave 2009/2010 of NEPS Starting Cohort 6 and defines individual training incidence and training duration as their dependent variables. Data on labour market competition come from the Establishment-History-Panel (BHP) provided by the Institute of Employment Research (IAB) and these are merged to the NEPS survey on the regional level of local labour markets. The authors used two measures of local labour market competition: (a) the density and (b) the concentration of firms in a particular NACE industry[2] per region. Density was measured by the number of firms per industry and region divided by the size of the region in square kilometres; and the concentration was calculated using the Herfindahl index. For both outcomes, they

[2]NACE is the statistical classification for industries used in the European Union and stands for the French 'Nomenclature statistique des Activités économiques dans la Communauté Européenne'.

estimate separate regressions using each of the two measures of local labour market competition. Their model controls for sector- and region-specific fixed effects that absorb many sources of endogeneity and selection into local labour markets.

The analysis shows that employees are significantly less likely to participate in training, and their training duration decreases in response to an increase in local labour market competition. This supports the new training literature. In sum, it means that there may be negative externalities on training participation due to sectoral agglomeration. The authors also discuss potential remedies. For instance, firms could increasingly use payback clauses when financing further training. In practice, this means that employees would need to reimburse training costs if they move to another company before the investment is paid off.

15.4 Regional Training Supply as a Predictor of Individuals' Training Participation

Görlitz and Rzepka (2017) explore the correlation between regional training supply and employees' training participation. They measure training supply as the number of firms that offer training in the local labour market. The reason why training supply could affect participation is that training demand can be met only by training supply. If there is no training supply, individuals are constrained in their training decisions. Another reason is that training often takes place in classroom-type settings at locations distant from the workplace of employees, so that workers have to travel to the training supplier in order to participate in training. Even though this seems to be more important for self-financed training, it also matters for training financed by employers. Whereas large firms also provide training inhouse, many smaller firms co-finance training for courses that are given by an external provider. In general, travel costs have been shown to influence educational decisions. For example, the study by Card (1995) exploits differences in the proximity to college as instruments for educational attainment. With regard to training, Tuor and Backes-Gellner (2009) have shown that giving up free time for training plays a much more important role for non-participation in training than having to spend money for training.

The authors merge the survey data of Wave 2009/2010 of NEPS Starting Cohort 6 with information on training supply that comes from two distinct sources. First, they calculate the number of training suppliers based on their industry affiliation 'Adult and other education n.e.c.' (NACE Rev. 2, code 85.59) from the universe of all German establishments provided by the German federal employment agency (Statistik der Bundesagentur für Arbeit, 2013). This measure is referred to as 'BA data' in the following. Second, they use information on the number of firms supplying training in 2007 that is available in the wbmonitor data (Bundesinstitut für Berufsbildung und Deutsches Institut für Erwachsenenbildung, 2007). This information is called henceforth the 'wbmonitor data'. Because the establishments are defined by having at least one employee who is covered by the social security

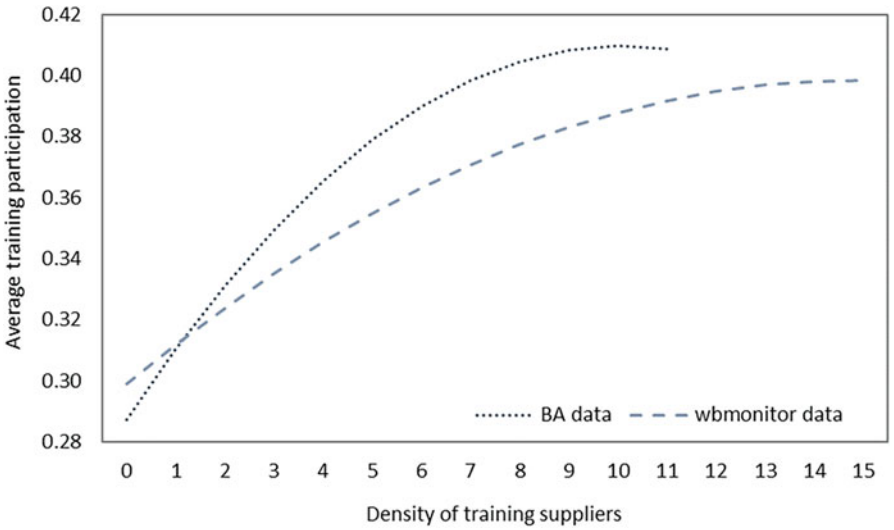


Fig. 15.1 OLS prediction of the relationship between training participation and the density of training suppliers. Notes: The graph illustrates the predictions of the OLS regression results of Table 2 from Görlitz and Rzepka (2017). The constant of the regression is 0.29 in the BA data and 0.30 in the wbmonitor data

system, and because many employees of training suppliers are not covered by social security, the number of training suppliers is smaller in the BA data compared to the wbmonitor data.

Görlitz and Rzepka (2017) regress training incidence on each of the two measures of training supply in separate regressions. To account for differences in the size of the local labour market, they do not analyse the number of training suppliers as an independent variable, but rather define the density of training suppliers by dividing the absolute number of training suppliers by the size of the respective local labour market in square kilometres. Results indicate that training participation is significantly higher in regions with many suppliers in the training market. Furthermore, they show that the density of training suppliers is not related linearly to training incidence. Instead, there is a statistically significant, concave relationship between the density and the incidence of training. Figure 15.1 illustrates this relationship.[3] An increasing number of training suppliers per square kilometre is initially associated with higher training levels. However, if the density of training suppliers is above average compared to other regions, a further increase in density is no longer associated with higher levels of training participation. The authors conclude that policymakers who follow the political aim of increasing training participation

[3] The reason why the prediction using the BA data and the wbmonitor data differ in the density of training suppliers is that the maximum number of training suppliers is lower in the BA data than in the wbmonitor data.

through subsidizing training supply should focus on regions with below-average training supply, because this is more likely to be effective than providing subsidies to all regions equally. However, they also note that a final policy conclusion requires a causal analysis of the relationship, and this remains a topic for future research.

15.5 Conclusion

This article presents the research potential of NEPS Starting Cohort 6 given by merging aggregate regional information on the county level. It also emphasizes the research potential of NEPS data by summarizing the analyses and the findings of two research studies that exploit it: Rzepka and Tamm (2016) and Görlitz and Rzepka (2017).

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References

Acemoglu, D., & Pischke, S. (1998). Why do firms train? Theory and evidence. *Quarterly Journal of Economics, 113*(1), 79–119.

Allmendinger, J., Kleinert, C., Pollak, R., Vicari, B., Wölfel, O., Althaber, A., Antoni, M., Christoph, B., Drasch, K., Janik, F., Künster, R., Liable, M.-C., Leuze, K., Matthes, B., Ruland, M., Schulz, B., & Trahms, A. (2019). Adult education and lifelong learning. In H.-P. Blossfeld & H.-G. Rossbach (Eds.), *Education as a lifelong process: The German National Educational Panel Study (NEPS)* (3rd ed., pp. 325–346) Springer VS.

Becker, G. (1964). *Human capital*. University of Chicago Press.

Bellmann, L., Hohendanner, C., & Hujer, R. (2011). Regional determinants of employer-provided further training. *Schmollers Jahrbuch, 131*(4), 581–598.

Blossfeld, H.-P., Rossbach, H.-G., & von Maurice, J. (2011). Education as a lifelong process. The German National Educational Panel Study (NEPS) [Special issue]. *Zeitschrift für Erziehungswissenschaft, 14*.

Brunello, G., & de Paola, M. (2008). Training and economic density: Some evidence from Italian provinces. *Labour Economics, 15*(1), 118–140.

Brunello, G., & Gambarotto, F. (2007). Do spatial agglomeration and local labor market competition affect employer-provided training? Evidence from the UK. *Regional Science & Urban Economics, 37*(1), 1–21.

Bundesinstitut für Berufsbildung und Deutsches Institut für Erwachsenenbildung. (2007). *wbmonitor Anbieterkataster, Stand 2007*.

Card, D. (1995). Using geographic variation in college proximity to estimate the return to schooling. In L. Christofides, E. Grant, & R. Swidinsky (Eds.), *Aspects of labour market behaviour: Essays in honour of John Vanderkamp*. University of Toronto Press.

Fitzenberger, B., & Muehler, G. (2015). Dips and floors in workplace training: Gender differences and supervisors. *Scottish Journal of Political Economy, 62*(4), 400–429.

Gerlach, K., & Jirjahn, U. (2001). Employer provided further training: Evidence from German establishment data. *Schmollers Jahrbuch, 121*, 139–164.

Gersbach, H., & Schmutzler, A. (2012). Product markets and industry-specific training. *The RAND Journal of Economics, 43*(3), 475–491.

Görlitz, K. (2010). The development of employers' training investments over time: A decomposition analysis using German establishment data. *Journal of Economics and Statistics, 230*(2), 186–207.

Görlitz, K., & Rzepka, S. (2017). Does regional training supply determine employees' training participation? *Annals of Regional Science, 59*(1), 281–296.

Hanushek, E., & Kimko, D. (2000). Schooling, labor-force quality, and the growth of nations. *American Economic Review, 90*(5), 1184–1208.

Käpplinger, B. (2007). Welche Betriebe in Deutschland sind weiterbildungsaktiv? Nutzung des CVTS2-Datensatzes zur Analyse der betrieblichen Weiterbildung. *Zeitschrift für Berufs- und Wirtschaftspädagogik, 103*(3), 382–396.

Kaufmann, K., & Widany, S. (2013). Berufliche Weiterbildung – Gelegenheits- und Teilnahmestrukturen. *Zeitschrift für Erziehungswissenschaft, 16*(1), 29–54.

Kosfeld, R., & Werner, A. (2012). Deutsche Arbeitsmarktregionen – Neuabgrenzung nach den Kreisgebietsreformen 2007–2011. *Raumforschung und Raumordnung, 70*(1), 49–64.

Kruppe, T., & Baumann, M. (2019). Weiterbildungsbeteiligung, formale Qualifikation, Kompetenzausstattung und Persönlichkeitsmerkmale. *IAB-Forschungsbericht 01/2019*.

Loewenstein, M., & Spletzer, J. (1999). General and specific training. *Journal of Human Resource, 34*(4), 710–733.

Martin, A., Schömann, K., Schrader, J., & Kuper, H. (2015). Ausgewählte Ergebnisse: Die Wiederentdeckung der Bedeutung der Region. In A. Martin, K. Schömann, J. Schrader, & H. Kuper (Eds.), *Deutscher Weiterbildungsatlas* (pp. 26–130). W. Bertelsmann.

Martin, A., Schömann, K., & Schrader, J. (2016). Der Einfluss der kommunalen Steuerung auf die Weiterbildungsbeteiligung: Ein Mehrebenen Modell mit Daten des Mikrozensus in Deutschland. *Zeitschrift für Erziehungswissenschaft, 19*(1), 55–82.

Mühlemann, S., & Wolter, S. (2007). Regional effects on employer provided training: Evidence from apprenticeship training in Switzerland. *Zeitschrift für Arbeitsmarktforschung, 40*(2/3), 135–147.

Picchio, M., & van Ours, J. (2011). Market imperfections and firm-sponsored training. *Labour Economics, 18*, 712–722.

Pischke, S. (2001). Continuous training in Germany. *Journal of Population Economics, 14*, 523–548.

Rzepka, S., & Tamm, M. (2016). Local employer competition and training of workers. *Applied Economics, 48*(35), 3307–3321.

Statistik der Bundesagentur für Arbeit. (2013). *Arbeitsmarkt in Zahlen, Betriebe nach Kreisen und Wirtschaftszweigen (WZ 2008)*.

Tuor, S., & Backes-Gellner, U. (2009). Time – Even more costly than money: Training costs of workers and firms. *SwissLeading house working paper 46*, University of Zurich.

Zwick, T. (2004). Training – A strategic enterprise decision? In G. Fandel, U. Backes-Gellner, M. Schlüter, & J. Staufenbiel (Eds.), *Modern concepts of the theory of the firm: Managing enterprises of the new economy* (pp. 355–366). Springer.

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Part IV
Individuals with Migration Background

Chapter 16
Is the First Language a Resource, an Obstacle, or Irrelevant for Language Minority Students' Education?



Aileen Edele, Julian Seuring, Kristin Schotte, Cornelia Kristen, and Petra Stanat

Abstract Successful integration into the education system is of major importance for the future prospects of immigrants and their children as well as for the social cohesion and viability of the receiving societies. Language is generally viewed as an important aspect of this integration. Whereas there is widespread agreement that the language of the residence country (L2) is crucial for students' educational success, the relevance of the language of the country of origin (L1) is disputed. Adopting an interdisciplinary perspective and drawing on NEPS data, this contribution focuses on the role of L1 in the educational success of immigrants and their children and examines whether L1 serves as a resource, is an obstacle, or is mostly irrelevant. We describe key arguments and theoretical positions related to this issue and present findings from the project 'The role of immigrants' first and second language proficiency for social integration, particularly in education: Analyses of NEPS data'. We conclude by discussing these results and suggesting future avenues for research.

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16.1 Introduction

One in three learners in the German education system comes from an immigrant family, and Germany currently is the country with the largest number of new recent immigrants in Europe. In many other countries around the globe, considerable proportions of the respective populations are also immigrants and their descendants, and there is little reason to assume that migration movements will decline in the near future. The successful integration of immigrants and their children into the education systems is of major importance for these individuals' future prospects and for the social cohesion and viability of the receiving societies. Identifying factors and processes that foster (or hinder) educational performance is therefore pivotal. Adopting an interdisciplinary perspective and drawing on NEPS data, the project 'The role of immigrants' first and second language proficiency for social integration, particularly in education: Analyses of NEPS data' aimed to clarify the role of immigrants' language proficiency and language use in their educational success.

The education of immigrants and their children is an important socio-political issue and a thriving area of research in a number of disciplines including education, sociology, and psychology. This research consistently indicates that in most contexts including Germany, immigrants and their offspring tend to be less successful in the education system than native-born ethnic majority students (for an overview, see Edele & Stanat, 2022). On average, they attain lower levels of school-related competencies (e.g., Henschel et al., 2019; Rjosk et al., 2017), with particularly large disparities in the first generation and even more pronounced disparities among recently arrived refugee students (Schipolowski et al., 2021). Students of immigrant descent are also at a disadvantage with respect to their educational participation and the degrees they eventually complete. For instance, they participate less frequently in early education (Autorengruppe Bildungsberichterstattung, 2018), and attend the academic school track (*Gymnasium*) less often than students from the native-born ethnic majority (Kristen & Granato, 2007; Weis et al., 2018). They also have lower chances of attaining university entrance qualifications and higher chances of leaving school without a certificate (Statistisches Bundesamt, 2019).

These findings raise the question regarding which factors and processes account for the described inequalities. One well-established and key result of previous research is that the difficulties immigrants and their children face in their educational careers are due largely to differences in their parents' educational and social background (Gresch & Kristen, 2011; Heath et al., 2008; Henschel et al., 2019; Kristen & Granato, 2007; Müller & Stanat, 2006; Rjosk et al., 2017). They are a result of social rather than of migration-related inequalities (Kalter, 2005). However, even when students' social background is taken into account, educational disparities remain—at least for some groups of origin and on some indicators of educational success. The remaining differences point to additional factors that are specific to the post-migration situation. One of these factors is language.

From the point of view of a general resource framework (Becker, 1962, 1993), immigrants often lack resources that are important for their children's educational success and for their labour market integration. One prominent example for such a

resource is proficiency in the language of the residence country or immigrants' second language (L2). L2 proficiency is generally viewed as a key to integration (Chiswick & Miller, 1995; Esser, 2006; Kalter, 2011). Immigrant families frequently speak the language used in their country of origin (often labelled as first language or L1) at home—either exclusively or in addition to L2. Children growing up in immigrant families thus often have fewer opportunities to acquire their L2 in their families, and, on average, attain lower L2 competence levels than their peers from native families (for an overview, see Kempert et al., 2016).

At the same time, they have a special resource at their disposal: namely, proficiency in L1. Whereas theory, empirical findings, and practitioners agree on the crucial role of access to and knowledge of L2 for students' educational success, the relevance of their L1 for their education is controversial (see Edele et al., 2020; Kempert et al., 2016). Although the role of L1 for the acquisition of L2 and for school success has been discussed for decades, available evidence on the consequences of being competent in L1 and using it in everyday interactions is inconclusive. One major problem is that language proficiency, especially L1 proficiency, is often measured with self-reports, even though the validity of the resulting findings is limited (see Edele et al., 2015). Indeed, studies using objective measures of language proficiency are scarce, particularly in data sets with large samples.

The data gathered in the *National Educational Panel Study* (NEPS; see Blossfeld et al., 2011) offer a unique opportunity to examine the role of L1 (and L2) in language-minority students' educational success, because they include language tests that objectively assess language-minority students' proficiency in L1. More specifically, NEPS assesses proficiency in the two most commonly used L1s in the German immigrant population—Turkish and Russian—in several starting cohorts. In addition, it includes a range of key indicators of educational outcomes, including objective tests of L2 reading comprehension, English skills, and mathematics and science proficiency. NEPS data are also rich in important background characteristics and potential confounding variables such as students' socio-economic background or their general cognitive abilities.

The present contribution focuses on one of the project's key research questions: the role of L1 in language-minority students' educational success. In the following section, we describe main theoretical positions addressing this relationship. We then present key findings from our project, and conclude with a discussion of these results and of future research directions in this area.

16.2 The Role of L1 in Language-Minority Students' Educational Success: Theoretical Background

Different theoretical positions suggest beneficial, absent, or detrimental consequences of L1 proficiency and use on language-minority students' educational outcomes. In the following, we present key arguments and positions that characterize these views. We start with arguments that characterize L1 as a resource for education.

16.2.1 L1 as a Resource for Educational Success

Two major positions suggest that language-minority students benefit from their L1. These are the *cognitive perspective* and the *cultural perspective* (Mouw & Xie, 1999). The cognitive perspective assumes that L1 proficiency or use—either on its own or in combination with L2—fosters learners' cognitive abilities and competence development in school-related domains. The *linguistic interdependence hypothesis* (Cummins, 1979, 1981, 2000) provides a key argument for this perspective. It states that language-minority learners with a high level of proficiency in their L1 have advantages in acquiring L2. Specifically, it posits that the linguistic level that learners achieve in L2 is a function of the linguistic level they have previously achieved in L1. This proposition is based on the idea that command of any language relies on a so-called *common underlying proficiency* (CUP) through which linguistic, metalinguistic, and conceptual knowledge is transferred across languages. The assumed positive effect of L1 proficiency on acquiring L2 should promote language-minority students' educational success across domains.

In addition, it has been suggested that bilingualism—that is, L1 proficiency and use in combination with L2 proficiency and use—has beneficial cognitive effects (see Kempert et al., 2016). According to one prominent argument, the alternate use of different languages and the constant demand to control two language systems enhances executive functioning (Bialystok, 2017). Executive functioning is needed to play with ideas, to take time to think before acting, to master novel challenges, to stay focused, and to resist temptations (Diamond, 2013). These abilities are relevant for learning processes, and executive functioning has been shown to be an important predictor of academic success (e.g., Huizinga et al., 2018). If multilingualism does, in fact, enhance executive functioning, it should facilitate the school learning of multilinguals across learning domains.

It has also been proposed that bilingualism entails advantages for the acquisition of additional languages (L3). A core argument for this proposition is that multilinguals possess an enhanced metalinguistic awareness that should facilitate the acquisition of other languages (e.g., Thomas, 1988). Metalinguistic awareness is the ability to view language as an object and to reflect on language in abstract terms (Jessner, 2006). Multilinguals may also benefit from their enhanced executive functioning in their L3 learning, and be able to transfer knowledge and skills from the languages they already know to new languages (Hirosh & Degani, 2018). Language-minority learners are therefore often assumed to outperform their monolingual peers in acquiring third languages.

The cultural perspective also proposes positive effects of L1 on language-minority students' educational success, but it introduces a different mechanism. It assumes that L1 use can provide access to important resources of L1-speaking family members and close contacts in the co-ethnic community. Proponents of the *theory of segmented assimilation* argue that, under certain circumstances, close ties to family members and to individuals in the co-ethnic community can protect children and adolescents from adverse influences (Bankston & Zhou, 1995; Mouw & Xie, 1999;

Portes & Hao, 2002; Zhou, 1997). Family members and co-ethnics can provide social support and may also exert social control and promote educational success as an important goal. In this way, close-knit networks can prevent students from socializing in subcultures that counteract their educational progress. Note that this position suggests positive effects of L1 only under certain conditions—namely, when learners grow up in contexts in which they are at risk of entering deviant subcultures, and when family members and other close co-ethnic ties provide the necessary resources and orientations (see Kroneberg, 2008). Moreover, scholars have pointed out the transitional character of these influences: being able to communicate in L1 should be helpful only as long as immigrant students' close contacts have limited command of L2. With better knowledge of L2 in students' co-ethnic environments, these advantages should disappear (Mouw & Xie, 1999; Portes & Hao, 2002).

The outlined perspectives concurrently suggest beneficial effects of L1 for language-minority students' educational success, yet, they differ in essential aspects. The cognitive perspective suggests benefits of high levels of L1 proficiency and of alternating use of L1 and L2 for individuals' competence development in different educational domains. According to the cultural perspective, the use of L1 in everyday communication is the key to accessing important resources that family members and co-ethnics have at their disposal. Although the use of L1 requires at least a basic level of proficiency, the crucial factor here is the communication rather than the achieved skill level or the switching between languages. The positive consequences of using L1 are expected to extend to a range of outcomes including competence development as well as educational decisions. The cognitive perspective, in contrast, focuses exclusively on the consequences of L1 on competence development.

16.2.2 L1 as Irrelevant or Detrimental for Educational Success

Other scholars argue that L1 is irrelevant for immigrants' educational success. According to their reasoning, integration in the receiving society relies primarily on resources that are immediately relevant and can be used directly in this context such as the respective majority language(s) (Esser 2004, 2006, 2009; Kalter, 2007). Ethnic resources, such as L1, are considered to be of little usefulness in a receiving context in which they can rarely be employed. Accordingly, this position suggests that most L1s are of neglectable relevance in educational institutions, unless they are taught as foreign languages or used as a language of instruction, which is generally not the case—at least in the German context. For this reason, language-minority children should not benefit from their L1 and should not have advantages in their educational outcomes compared to their monolingual peers. L1 is thus seen as largely irrelevant for language-minority learners' education.

The so-called *time-on-task hypothesis* assumes a competing relationship between the use of L1 and L2 (e.g., Gathercole, 2002; Leseman et al., 2009; Scheele et al.,

2010). Time on task refers to the time that learners actively spend on what they need to learn (Hopf, 2005). The idea that time on task matters for learning outcomes goes back to Carroll's (1963, 1973) learning theory according to which learning success is a function of the time that learners actively invest and the time they need to acquire a certain learning content. This position emphasizes that learners have only a limited amount of learning time at their disposal, and that the time spent on acquiring their L1 takes away from the time that could be allocated to acquiring L2 and other school-relevant competencies. Accordingly, the time spent on using L1 at home should have negative effects on the acquisition of L2 and, ultimately, on educational success. Table 16.1 provides an overview of the theoretical perspectives suggesting various effects of L1 on educational success.

Table 16.1 Overview on theoretical perspectives suggesting effects of L1 on educational success and project findings

Theoretical perspective	Aspect of L1	Affected outcome(s)	Expected effect, general finding	Project finding
Cognitive perspective				
Interdependence hypothesis	L1 proficiency	L2 proficiency, L3 proficiency (mediated effects on educational achievement more generally)	Positive effect, supported	Students with higher L1 listening proficiency attain higher levels of L2 reading proficiency (Edele & Stanat, 2016)
Enhanced executive functioning	L1 proficiency/ L1 use in combination with L2 proficiency/ L2 use	Executive functioning (mediated effects on educational achievement more generally)	Positive effect, not examined	
Enhanced metalinguistic awareness	L1 proficiency in combination with L2 proficiency	L3 proficiency (mediated by enhanced metalinguistic awareness)	Positive effect, not unequivocally supported	Immigrant bilinguals with above-average proficiency in L1 and L2 outperform monolingual students with average L2 proficiency; in bilingual students, only L2 proficiency but not L1 proficiency relates to L3 performance (Edele et al., 2018)

(continued)

Table 16.1 (continued)

Theoretical perspective	Aspect of L1	Affected outcome(s)	Expected effect, general finding	Project finding
Cultural perspective	L1 use	Educational outcomes more generally	Positive effect, not supported	L1 use is not associated with advantages for mathematics achievement (Strobel, 2016)
Limited usefulness of ethnic resources (due to restricted transferability)	L1 use/L1 proficiency	Educational achievement	No effect; not specifically examined	
Time-on-task/ language competition	L1 use	L2 proficiency (mediated effects on educational achievement more generally)	Negative effect, supported	Use of L1/L2 is negatively related to proficiency in the respective other language (Edele & Stanat, 2016; Kristen et al., 2019; Miyamoto et al., 2020; Seuring et al., 2020; Strobel & Seuring, 2016)

16.3 The Role of L1 in Language-Minority Students' Educational Success: Key Findings

The various empirical studies conducted within the project 'The role of immigrants' first and second language proficiency for social integration, particularly in education: Analyses of NEPS data' provide multifaceted insights into the role of L1 in language-minority students' educational success. Analyses were based on cross-sectional data, carefully controlling for relevant potentially confounding factors such as the socio-economic and sociocultural background of the family, general cognitive abilities, or type of school attended. First, we present findings pertaining to the theoretical perspectives that view L1 as a resource, starting with the cognitive perspective followed by the cultural perspective. Then, we report results on language competition and thus on arguments that characterize L1 as an obstacle to immigrant students' educational success.

16.3.1 Interdependence Between L1 Listening Comprehension and L2 Reading Comprehension

To elucidate the role of L1 in L2 reading—a key indicator of educational success and a crucial prerequisite for succeeding in school and later in life—we determined how

language-minority students' listening comprehension in L1 relates to their reading comprehension in L2 (Edele & Stanat, 2016). Reading models, including the prominent *simple view of reading* (Gough & Tunmer, 1986; Hoover & Gough, 1990), regard listening comprehension as a major determinant of reading comprehension. Previous research has confirmed the importance of listening comprehension for reading comprehension, particularly in older students (Carver, 1998; Kendeou et al., 2009; Tilstra et al., 2009). At the same time, research on the *linguistic interdependence hypothesis* (Cummins, 1979, 2000) has focused mainly on the effect of L1 literacy skills and its precursors on L2 reading abilities (e.g., Lindsey et al., 2003; Prevoo et al., 2016; Proctor et al., 2006). Examinations of the transfer of L1 oral language skills such as listening comprehension to reading in L2, in contrast, are scarce (see Geva & Genesee, 2006).

To address this gap, we used data from NEPS Starting Cohort 4[1] that assessed language-minority students' listening comprehension in Russian and Turkish as well as their L2 reading comprehension (for details on test construction and validation, see Edele et al., 2016; Gehrer et al., 2013). We tested the assumption that L1 listening comprehension is related to language-minority students' reading comprehension in L2, and that this linguistic interdependence is more pronounced at higher levels of L1 proficiency. The sample included 502 ninth-grade students with Russian as L1 and 662 ninth-grade students with Turkish as L1 from the first, second, and third immigrant generation. Russian and Turkish differ in their similarity to students' L2, with Russian being more similar to German than Turkish. Nevertheless, in both language groups, L1 listening comprehension significantly predicted L2 reading comprehension in linear regression models. This was also true after important control variables were taken into account, including students' socio-economic background, L2 vocabulary knowledge, L2 reading fluency, and their general cognitive abilities. Polynomial regression models further indicated that the relationship between L1 proficiency and L2 proficiency was linear in the Russian sample, yet stronger at higher levels of L1 proficiency in the Turkish sample. Overall, these findings support the assumption of linguistic transfer and indicate that oral language skills transfer as well. They also partly confirm the idea that transfer is more pronounced at higher levels of L1 proficiency. A possible explanation for the differential findings across the two language groups is the different degree of similarity to German of either Turkish or Russian. In distant languages, such as Turkish and German, only language-independent skills such as metacognitive strategies have the potential to transfer. The transfer of such skills, however, may be restricted to advanced levels of L1 listening comprehension. More similar languages such as Russian and German, in contrast, allow for the transfer of language-specific skills such as vocabulary knowledge. This should also be possible at lower proficiency levels.

In demonstrating that L1 listening comprehension relates positively to L2 reading comprehension, the study extends the range of L1 skills previously known to transfer

[1] https://doi.org/10.5157/NEPS:SC4:1.1.0

to L2 reading. It indicates that cross-linguistic transfer is not restricted to literacy skills, but extends to oral language abilities. This finding is highly relevant from a practical perspective. Language-minority students typically acquire their L1 in their families. They may therefore speak their L1 fluently but not necessarily be literate in this language. Our findings suggest that immigrant students do not necessarily need literacy skills to benefit from proficiency in their family language. Rather, L1 oral language skills seem to have the potential to improve L2 reading comprehension. Our findings are also important from a theoretical perspective, because the linguistic interdependence hypothesis posits the transfer of literacy skills (Cummins, 2000, p. 173), and previous research on cross-linguistic transfer has focused on reading skills. Our findings suggest that theoretical accounts addressing linguistic transfer should also include the oral domain. However, L1 was associated only weakly with L2 in our study. Presumably, we would have detected a closer link between L1 and L2 if we were to have assessed reading comprehension in both languages.

16.3.2 Immigrant Bilingualism and Third Language Learning

The cognitive perspective also posits that bilingualism—that is, combined proficiency in L1 and L2—entails cognitive advantages. In particular, bilingualism is often assumed to benefit the acquisition of an L3. Previous research does, in fact, indicate that bilingualism is helpful for L3 learning in bilingual school contexts (for overviews, see Cenoz, 2003; Hirosh & Degani, 2018). However, only a few studies have investigated the role of bilingualism in the L3 learning of immigrant students in monolingual contexts in which only L2 is used in instruction at school and L1 is acquired in the family context (e.g., Hesse et al., 2008; Maluch et al., 2015; van Gelderen et al., 2003). Findings from these studies are inconclusive. One possible explanation for these inconsistent results is that L3 advantages depend on immigrant students' proficiency levels in L1 and L2—something that previous studies have rarely considered.

We addressed this issue by analysing data from NEPS Starting Cohort 4[2] (see Edele et al., 2018). Assessments in this starting cohort include psychometrically sound proficiency tests of L1 (Russian/Turkish), L2 (German), and L3 (English), and allow us to determine the role of different proficiency levels in L1 and L2 in the third-language learning of language-minority students in a monolingual school context. Specifically, we compared the L3 proficiency of language-minority students with varying proficiency levels in L1 and L2 and resulting profiles of bilingualism to monolingual students' L3 proficiency. Based on the literature, we expected only students with high proficiency levels in L1 and L2 (balanced bilinguals at a high level) to outperform their monolingual peers. To ensure that potential L3 advantages

[2] https://doi.org/10.5157/NEPS:SC4:6.0.0

of bilinguals are not merely the result of high proficiency in the language of instruction, we compared bilinguals with different profiles not only to the entire sample of monolinguals with, by definition, average skills in German, but also to a subsample with above-average German proficiency levels. To determine the respective relevance of L1 and L2 in L3 learning for bilingual students, we carried out additional analyses focusing on this group and including L1 and L2 proficiency as continuous variables.

We analysed data from 8752 tenth graders and distinguished Russian–German ($N = 352$) and Turkish–German ($N = 436$) bilingual students from German monolingual students ($N = 7964$). Students' listening comprehension test scores in Russian and Turkish served as measures of their L1 proficiency; reading comprehension test scores in German as measures of their L2 proficiency; and reading comprehension test scores in English as measures of their L3 proficiency. Multiple linear regression analyses that controlled for sociodemographic and socio-economic background characteristics, general cognitive abilities, and the type of school attended revealed that Russian–German and Turkish–German high-level balanced bilinguals outperformed their German monolingual peers with average German proficiency in the English reading test. Comparisons of high-level balanced bilingual students to their monolingual peers with similarly high levels of L2 proficiency, however, did not reveal L3 advantages of bilingual students. Additional analyses focusing exclusively on bilinguals showed that only L2 proficiency but not L1 proficiency was positively related to students' L3 proficiency. Overall, our findings indicate that bilingualism is not necessarily beneficial for L3 learning. In a context such as Germany in which L2 is the dominant language of instruction, advantages in L3 learning seem to be limited to bilinguals with above-average proficiency levels in their L1 and L2, and occur only in comparison to monolingual students with average proficiency in L2 but not to monolingual students with above-average L2 proficiency. Moreover, only bilingual students' proficiency in L2, but not in L1, was related to their L3 achievement. Hence, the most relevant linguistic resource for L3 learning of bilingual immigrant students in monolingual contexts seems to be their proficiency in the language of instruction (L2).

16.3.3 L1 Use and Mathematics Achievement

In addition to analyses of potential cognitive mechanisms associated with L1 proficiency, we investigated whether speaking L1 might entail advantages for language-minority students' educational success due to a communicative mechanism, as suggested by the cultural perspective. According to the theory of segmented assimilation, language-minority students can gain access to favourable resources provided within the family or ethnic community by using their L1 in everyday communication (see Section 'L1 as a resource for educational success'). Previous research examining this communicative mechanism has been inconclusive (Kristen & Olczyk, 2013). One major limitation of most empirical investigations is that they

examined effects of L1 proficiency—more precisely, of self-reported proficiency in L1—rather than the use of L1 (e.g., Bankston & Zhou, 1995; Lutz & Crist, 2009; Waters et al., 2010), and were therefore unable to disentangle communicative from cognitive mechanisms. The few studies that explicitly examined L1 use did not yield conclusive evidence (Abada & Tenkorang, 2009; Dollmann & Kristen, 2010; Mouw & Xie, 1999; Xie & Greenman, 2011).

Using data from 1662 ninth-grade language-minority students of different origins (Turkey, Poland, Former Soviet Union) participating in NEPS Starting Cohort 4,[3] we investigated the association between language-minority students' L1 use with parents and their mathematics achievement (Strobel, 2016). Adopting a conditional perspective, we expected positive effects of using L1 within the family on educational achievement only if parents hold attitudes and resources in favour of educational success. The findings from linear regression analyses revealed a negative relationship between L1 use with parents and students' mathematics achievement. Students who spoke exclusively German at home outperformed those who also use the L1 with parents. Interestingly, this negative association was reduced to non-significant levels when considering students' L2 reading proficiency. Thus, for students with similar proficiency levels in German, L1 use with parents does not seem to entail advantages or disadvantages. To test the assumption of a conditional effect, we further examined whether the relationships between L1 use and mathematics achievement varied with parents' educational aspirations, their highest educational level, and ethnic origin. However, the results did not change in any of these specifications, indicating that L1 use with parents is equally (un)important.

These findings challenge the notion that using L1 within the family facilitates language-minority students' educational achievement due to a communicative mechanism. However, we cannot rule out the possibility that using L1 might be more important under conditions and for outcomes other than the ones examined in our research. For instance, the communicative mechanism could primarily foster the transmission and reinforcement of shared values and aspirations in favour of education (e.g., Feliciano & Lanuza, 2016; Friberg, 2019) that should be particularly relevant for students' education choices, but may be less so for their achievement.

16.3.4 L1 Exposure and L1/L2 Proficiency

As described above, other theoretical notions view L1 as detrimental or, at best, irrelevant for educational success (see Section 'L1 as irrelevant or detrimental for educational success'). In line with the time-on-task hypothesis, prior studies (e.g., Azzolini et al., 2012; Duursma et al., 2007; Leseman et al., 2009; Müller & Stanat, 2006; Scheele et al., 2010), including those using data from large-scale school assessments (e.g., Haag et al., 2016; OECD, 2020), have consistently identified a

[3] https://doi.org/10.5157/NEPS:SC4:4.0.0

negative relationship between L1 use in the family and language-minority students' proficiency in L2 and other competence domains. These findings are in line with the proposition that using a language is one of the most powerful determinants of second-language acquisition (Chiswick & Miller, 2001; Kristen, 2019). Language-minority students who speak mainly their L1 at home rather than L2 are less exposed to the language of instruction, and this might impede L2 learning and ultimately their educational achievement.

Several analyses conducted within the framework of our project provide insights into how language exposure relates to language proficiency. In line with prior research, we found that the language used within the family related strongly to L2 proficiency. Frequently using L2 in the family context seems to increase language-minority students' chances of achieving high levels of L2 reading abilities (Miyamoto et al., 2020; Strobel & Seuring, 2016). At the same time, we found that regularly speaking L1 at home related positively to students' proficiency in this language (Kristen et al., 2019; Seuring et al., 2020), negatively to their proficiency in L2, and vice versa (Edele & Stanat, 2016). Moreover, we found a similar—although less pronounced and less consistent—pattern for the use of L1 with classmates and language proficiency in L1 and L2. Regularly speaking L1 with classmates related negatively to language-minority students' L2 proficiency and positively to Turkish–German speaking students' proficiency in L1. In the Russian–German language group, the use of L1 with classmates was unrelated to students' L1 proficiency (Seuring et al., 2020). Taken together, these findings indicate a positive association between the use of L1/L2 and students' proficiency in the respective language, and a negative association between L1 use and L2 proficiency. These findings are generally in line with the notion of time on task. Table 16.1 summarizes the project findings.

16.4 Conclusions

Our research conducted within the project 'The role of immigrants' first and second language proficiency for social integration, particularly in education: Analyses of NEPS data' provides multifaceted insights into the role of L1 proficiency and L1 use in language-minority students' educational attainment. A key finding is that students with good L1 oral skills have greater chances of attaining high levels of L2 reading skills. This finding is in line with the linguistic interdependence hypothesis and complements previous research that has focused mainly on the cross-linguistic transfer of reading abilities. Relating to the consequences of bilingualism for third-language learning in the monolingual school context of Germany, our analyses do not support the notion that immigrant bilinguals are generally at an advantage. Only bilinguals with above-average proficiency levels in both L1 and L2 outperform monolingual students with average proficiency in L2. Moreover, only bilingual students' L2 proficiency, but not their L1 proficiency, relates positively to their L3 proficiency. This suggests that the language of instruction, rather than bilingualism,

is the main linguistic resource for acquiring a third language in the monolingual school context of Germany. Taken together, these findings partly support the cognitive perspective. At the same time, they demonstrate that positive effects of L1 are neither very strong nor consistent.

The notion that using the L1 opens access to parental resources that support language-minority children's educational success was not supported in our analyses. Specifically, we did not find evidence supporting the cultural perspective according to which speaking the L1 facilitates educational success because of a communicative advantage, as suggested by the theory of segmented assimilation. This is in line with previous studies in the German context (e.g., Dollmann & Kristen, 2010) that did not find benefits of using L1 at home for language-minority students' educational success. Overall, the pattern of our findings implies that the L1 can be a potential resource for language-minority students' educational success due to cognitive processes, but not because of an enhanced communication with other speakers of L1.

Our findings also provide insights into the role of language exposure in language-minority students' L1 and L2 acquisition. The frequent use of a language, particularly in the family context and to a lesser extent with classmates, relates positively to proficiency in this language and negatively to proficiency in the respective other language. These findings support the time-on-task hypothesis and are also in line with theoretical models of second language acquisition (e.g., Chiswick & Miller, 2001) according to which language exposure is of key relevance for language learning. At the same time, it is still unclear to what extent and under what conditions negative effects of using L1 on L2 learning due to time on task are exacerbated or even outweighed by positive effects of bilingualism due to enhanced cognitive functioning and transfer.

Despite the negative net influence of L1 use on L2 proficiency, we would like to emphasize that we do not support the call for language minority families to use L2 instead of L1 at home in order to support their children's educational success. This would not just ignore their individual rights and deprive them of the opportunity to transmit their L1 to their children. It might also jeopardize their children's educational integration, especially if parents have only limited proficiency in L2 and cannot provide high-quality input in this language. At the same time, findings suggest that it is important to provide language-minority children with sufficient and high-quality exposure to L2 in the education system, and to start this already in preschool. This includes L2 input from different sources, including native speakers, that is adequately challenging in its complexity (Unsworth, 2016).

One important limitation of our analyses is their cross-sectional design. Although we carefully controlled for potentially confounded variables, it is not possible to draw causal conclusions or to identify changes over time. Future research should and will exploit the potential of the NEPS for longitudinal analyses, keeping in mind that it could take longer periods of time for potential effects of L1 and bilingualism to unfold. Another promising venue for future research is to examine the role of immigrant bilingualism on school adjustment more generally and ask whether bilingualism entails advantages for competence development in additional domains such as mathematics and science as well as in cross-domain skills such as

metacognition. The interrelations of L1 proficiency and L1 usage with other resources—for instance, the identification of students of immigrant descent with their ethnic group and the ethnic majority group, and their psychological adaptation (Schotte et al., 2018)—are also promising venues for future work in this field.

Overall, there is no simple answer to the question which role L1 plays in language-minority children's educational success. The question is complex and needs to be answered in a differentiated fashion. First, it is necessary to specify whether the question relates to L1 use or L1 proficiency. Second, it is necessary to take proficiency levels in L1 and L2 into account. Third, effects vary for different educational outcomes.

To conclude, we would like to stress that speaking their L1 is an important resource for students from immigrant families, regardless of potential effects on their educational outcomes. Speaking another language, and particularly the language of one's ethnic origin, is valuable in its own right. It allows one to communicate with speakers of this language, to connect to the cultural heritage of one's ethnic group and participate in its cultural life, and, generally speaking, to gain experiences one would have missed without these skills. It is important to keep this in mind when interpreting findings on effects of L1 and, most importantly, when drawing conclusions about potential implications for policy and practice.

References

Abada, T., & Tenkorang, E. Y. (2009). Pursuit of university education among the children of immigrants in Canada: The roles of parental human capital and social capital. *Journal of Youth Studies, 12*(2), 185–207. https://doi.org/10.1080/13676260802558870

Autorengruppe Bildungsberichterstattung. (2018). *Bildung in Deutschland 2018: ein indikatorengestützter Bericht mit einer Analyse zu Wirkungen und Erträgen von Bildung*. wbv Publikation. https://doi.org/10.3278/6001820fw

Azzolini, D., Schnell, P., & Palmer, J. R. (2012). Educational achievement gaps between immigrant and native students in two 'new' immigration countries: Italy and Spain in comparison. *The Annals of the American Academy of Political and Social Science, 643*(1), 46–77. https://doi.org/10.1177/0002716212441590

Bankston, C. L., III, & Zhou, M. (1995). Effects of minority-language literacy on the academic achievement of Vietnamese youths in New Orleans. *Sociology of Education, 68*(1), 1–17. https://doi.org/10.2307/2112760

Becker, G. S. (1962). Investment in human capital: A theoretical analysis. *Journal of Political Economy, 70*(5), 9–49.

Becker, G. S. (1993). *Human capital: A theoretical and empirical analysis, with special reference to education*. University of Chicago Press.

Bialystok, E. (2017). The bilingual adaptation: How minds accommodate experience. *Psychological Bulletin, 143*(3), 233–262. https://doi.org/10.1037/bul0000099

Blossfeld, H. P., von Maurice, J., & Schneider, T. (2011). 1 The National Educational Panel Study: Need, main features, and research potential. *Zeitschrift für Erziehungswissenschaft, 14*(2), 5–17. https://doi.org/10.1007/s11618-011-0178-3

Carroll, J. B. (1963). A model of school learning. *Teachers College Record, 64*(8), 723–733.

Carroll, J. B. (1973). Ein Modell schulischen Lernens. In W. Edelstein & D. Hopf (Eds.), *Bedingungen des Bildungsprozesses: Psychologische und pädagogische Forschungen zum Lehren und Lernen in der Schule* (pp. 234–250). Klett.

Carver, R. P. (1998). Predicting reading levels in grades 1 to 6 from listening level and decoding level: Testing theory relevant to the simple view of reading. *Reading and Writing, 10*, 121–154. https://doi.org/10.1023/A:1007923124312

Cenoz, J. (2003). The additive effect of bilingualism on third language acquisition: A review. *International Journal of Bilingualism, 7*(1), 71–87. https://doi.org/10.1177/13670069030070010501

Chiswick, B. R., & Miller, P. W. (1995). The endogeneity between language and earnings: International analyses. *Journal of Labor Economics, 13*(2), 246–288.

Chiswick, B. R., & Miller, P. W. (2001). A model of destination-language acquisition: Application to male immigrants in Canada. *Demography, 38*(3), 391–409. https://doi.org/10.1353/dem.2001.0025

Cummins, J. (1979). Linguistic interdependence and the educational development of bilingual children. *Review of Educational Research, 49*(2), 222–251. https://doi.org/10.3102/00346543049002222

Cummins, J. (1981). The role of primary language development in promoting educational success for language minority students. In California State Department of Education (Ed.), *Schooling and language minority students* (A theoretical framework) (pp. 3–49). California State Department of Education. https://doi.org/10.13140/2.1.1334.9449

Cummins, J. (2000). *Language, power, and pedagogy: Bilingual children in the crossfire*. Multilingual Matters.

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*, 135–168. https://doi.org/10.1146/annurev-psych-113011-143750

Dollmann, J., & Kristen, C. (2010). Herkunftssprache als Ressource für den Schulerfolg? Das Beispiel türkischer Grundschulkinder. In C. Allemann-Ghionda, P. Stanat, K. Göbel, & C. Röhner (Eds.), *Migration, Identität, Sprache und Bildungserfolg* (pp. 123–146). Beltz.

Duursma, E., Romero-Contreras, S., Szuber, A., Proctor, P., Snow, C., August, D., & Calderón, M. (2007). The role of home literacy and language environment on bilinguals' English and Spanish vocabulary development. *Applied Psycholinguistics, 28*(1), 171–190. https://doi.org/10.1017/S0142716406070093

Edele, A., & Stanat, P. (2016). The role of first-language listening comprehension in second-language reading comprehension. *Journal of Educational Psychology, 108*(2), 163–180. https://doi.org/10.1037/edu0000060

Edele, A. & Stanat, P. (2022). Zuwanderung und soziale Ungleichheit. In H. Reinders, D. Bergs-Winkels, A. Prochnow, & I. Post. (Eds.), *Lehrbuch Empirische Bildungsforschung: Eine elementare Einführung* (pp. 1105–1126). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-658-27277-7_58

Edele, A., Seuring, J., Kristen, C., & Stanat, P. (2015). Why bother with testing? The validity of immigrants' self-assessed language proficiency. *Social Science Research, 52*, 99–123. https://doi.org/10.1016/j.ssresearch.2014.12.017

Edele, A., Schotte, K., & Stanat, P. (2016). Assessment of immigrant students' listening comprehension in their first languages (L1) Russian and Turkish in grade 9: Test construction and validation. In H.-P. Blossfeld, J. von Maurice, M. Bayer, & J. Skopek (Eds.), *Methodological issues of longitudinal surveys* (pp. 441–463). Springer. https://doi.org/10.1007/978-3-658-11994-2_25

Edele, A., Kempert, S., & Schotte, K. (2018). Does competent bilingualism entail advantages for the third language learning of immigrant students? *Learning and Instruction, 58*, 232–244. https://doi.org/10.1016/j.learninstruc.2018.07.002

Edele, A., Kempert, S., & Stanat, P. (2020). Mehrsprachigkeit und Bildungserfolg. In I. Gogolin, A. Hansen, S. McMonagle, & D. Rauch (Eds.), *Handbuch Mehrsprachigkeit und Bildung* (pp. 151–155). Springer. https://doi.org/10.1007/978-3-658-20285-9_22

Esser, H. (2004). Does the "new" immigration require a "new" theory of intergenerational integration? *International Migration Review, 38*(3), 1126–1159.

Esser, H. (2006). *Sprache und Integration: die sozialen Bedingungen und Folgen des Spracherwerbs von Migranten*. Campus.

Esser, H. (2009). Pluralisierung oder Assimilation: Effekte der multiplen Inklusion auf die Integration von Migranten. *Zeitschrift für Soziologie, 38*(5), 358–378.

Feliciano, C., & Lanuza, Y. R. (2016). The immigrant advantage in adolescent educational expectations. *International Migration Review, 50*(3), 758–792. https://doi.org/10.1111/imre.12183

Friberg, J. H. (2019). Does selective acculturation work? Cultural orientations, educational aspirations and school effort among children of immigrants in Norway. *Journal of Ethnic and Migration Studies, 45*(15), 2844–2863. https://doi.org/10.1080/1369183X.2019.1602471

Gathercole, V. C. M. (2002). Monolingual and bilingual acquisition: Learning different treatments of that-trace phenomena in English and Spanish. In K. Oller & R. Eilers (Eds.), *Language and literacy in bilingual children* (pp. 220–252). Multilingual Matters. https://doi.org/10.21832/9781853595721-011

Gehrer, K., Zimmermann, S., Artelt, C., & Weinert, S. (2013). NEPS framework for assessing reading competence and results from an adult pilot study. *Journal for Educational Research Online, 5*(2), 50–79.

Geva, E., & Genesee, F. (2006). First-language oral proficiency and second-language literacy. In D. August & T. Shanahan (Eds.), *Developing literacy in second-language learners: Report of the National Literacy Panel on a language-minority children and youth* (pp. 185–196). Erlbaum.

Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education, 7*(1), 6–10. https://doi.org/10.1177/074193258600700104

Gresch, C., & Kristen, C. (2011). Staatsbürgerschaft oder Migrationshintergrund? Ein Vergleich unterschiedlicher Operationalisierungsweisen am Beispiel der Bildungsbeteiligung. *Zeitschrift für Soziologie, 40*(3), 208–227. https://doi.org/10.1515/zfsoz-2011-0303

Haag, N., Böhme, K., Rjosk, C., & Stanat, P. (2016). Zuwanderungsbezogene Disparitäten. In P. Stanat, K. Böhme, S. Schipolowski, & N. Haag (Eds.), *IQB-Bildungstrend 2015: Sprachliche Kompetenzen am Ende der 9. Jahrgangsstufe im zweiten Ländervergleich* (pp. 431–480). Waxmann.

Heath, A. F., Rothon, C., & Kilpi, E. (2008). The second generation in Western Europe: Education, unemployment, and occupational attainment. *Annual Review of Sociology, 34*, 211–235. https://doi.org/10.1146/annurev.soc.34.040507.134728

Henschel, S., Heppt, B., Weirich, S., Edele, A., Schipolowski, S., & Stanat, P. (2019). Zuwanderungsbezogene Disparitäten. In P. Stanar, S. Schipolowski, N. Mahler, S. Weirich, & S. Henschel (Eds.), *IQB-Bildungstrend 2018* (pp. 295–336). Waxmann.

Hesse, H.-G., Göbel, K., & Hartig, J. (2008). Sprachliche Kompetenzen von mehrsprachigen Jugendlichen und Jugendlichen nicht-deutscher Erstsprache. In DESI-Konsortium (Ed.), *Unterricht und Kompetenzerwerb in Deutsch und Englisch: Ergebnisse der DESI-Studie* (pp. 208–231).

Hirosh, Z., & Degani, T. (2018). Direct and indirect effects of multilingualism on novel language learning: An integrative review. *Psychonomic Bulletin & Review, 25*(2), 892–916. https://doi.org/10.3758/s13423-017-1315-7

Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing, 2*(2), 127–160. https://doi.org/10.1007/BF00401799

Hopf, D. (2005). Zweisprachigkeit und Schulleistung bei Migrantenkindern. *Zeitschrift für Pädagogik, 51*(2), 236–251.

Huizinga, M., Baeyens, D., & Burack, J. A. (2018). Executive function and education. *Frontiers in Psychology, 9*, 1357. https://doi.org/10.3389/fpsyg.2018.01357

Jessner, U. (2006). *Linguistic awareness in multilinguals: English as a third language*. Edinburgh University Press.

Kalter, F. (2005). Ethnische Ungleichheit auf dem Arbeitsmarkt. In M. Abraham & T. Hinz (Eds.), *Arbeitsmarktsoziologie* (pp. 303–332). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-322-93529-8_10

Kalter, F. (2007). Ethnische Kapitalien und der Arbeitsmarkterfolg Jugendlicher türkischer Herkunft. In M. Wohlrab-Sahr & L. Tezcan (Eds.), *Konfliktfeld Islam in Europa* (pp. 391–418). https://doi.org/10.5771/9783845203263-391

Kalter, F. (2011). The second generation in the German labor market: Explaining the Turkish exception. In R. Alba & M. C. Waters (Eds.), *The next generation – Immigrant youth in a comparative perspective* (pp. 166–184). New York University Press.

Kempert, S., Edele, A., Rauch, D., Wolf, K. M., Paetsch, J., Darsow, A., Maluch, J., & Stanat, P. (2016). Die Rolle der Sprache für zuwanderungsbezogene Ungleichheiten im Bildungserfolg. In C. Diehl, C. Hunkler, & C. Kristen (Eds.), *Ethnische Ungleichheiten im Bildungsverlauf: Mechanismen, Befunde, Debatten* (pp. 157–241). VS Verlag. https://doi.org/10.1007/978-3-658-04322-3_5

Kendeou, P., Van den Broek, P., White, M. J., & Lynch, J. S. (2009). Predicting reading comprehension in early elementary school: The independent contributions of oral language and decoding skills. *Journal of Educational Psychology, 101*(4), 765–778. https://doi.org/10.1037/a0015956

Kristen, C. (2019). Language assimilation and the education of immigrant students. In R. Becker (Ed.), *Research handbook on the sociology of education*. Edward Elgar Publishing. https://doi.org/10.4337/9781788110426.00039

Kristen, C., & Granato, N. (2007). The educational attainment of the second generation in Germany: Social origins and ethnic inequality. *Ethnicities, 7*(3), 343–366. https://doi.org/10.1177/1468796807080233

Kristen, C., & Olczyk, M. (2013). Ethnische Einbettung und Bildungserfolg. In R. Becker & A. Schulze (Eds.), *Bildungskontexte* (pp. 353–403). Springer. https://doi.org/10.1007/978-3-531-18985-7_13

Kristen, C., Seuring, J., & Stanat, P. (2019). Muster und Bedingungen des Erwerbs und Erhalts herkunftssprachlicher Kompetenzen. *Zeitschrift für Erziehungswissenschaft, 22*(1), 143–167. https://doi.org/10.1007/s11618-019-00883-3

Kroneberg, C. (2008). Ethnic communities and school performance among the new second generation in the United States: Testing the theory of segmented assimilation. *The Annals of the American Academy of Political and Social Science, 620*(1), 138–160. https://doi.org/10.1177/0002716208322714

Leseman, P. P., Scheel, A. F., Mayo, A. Y., & Messer, M. H. (2009). Bilingual development in early childhood and the languages used at home: Competition for scarce resources? In I. Gogolin & U. Neumann (Eds.), *Streitfall Zweisprachigkeit–the bilingualism controversy* (pp. 289–316). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-531-91596-8_17

Lindsey, K. A., Manis, F. R., & Bailey, C. E. (2003). Prediction of first-grade reading in Spanish-speaking English-language learners. *Journal of Educational Psychology, 95*(3), 482–494. https://doi.org/10.1037/0022-0663.95.3.482

Lutz, A., & Crist, S. (2009). Why do bilingual boys get better grades in English-only America? The impacts of gender, language and family interaction on academic achievement of Latino/a children of immigrants. *Ethnic and Racial Studies, 32*(2), 346–368. https://doi.org/10.1080/01419870801943647

Maluch, J. T., Kempert, S., Neumann, M., & Stanat, P. (2015). The effect of speaking a minority language at home on foreign language learning. *Learning and Instruction, 36*, 76–85. https://doi.org/10.1016/j.learninstruc.2014.12.001

Miyamoto, A., Seuring, J., & Kristen, C. (2020). Immigrant students' achievements in light of their educational aspirations and academic motivation. *Journal of Ethnic and Migration Studies, 46*(7), 1348–1370. https://doi.org/10.1080/1369183X.2018.1538772

Mouw, T., & Xie, Y. (1999). Bilingualism and the academic achievement of first- and second-generation Asian Americans: Accommodation with or without assimilation? *American Sociological Review, 64*(2), 232–252. https://doi.org/10.2307/2657529

Müller, A. G., & Stanat, P. (2006). Schulischer Erfolg von Schülerinnen und Schülern mit Migrationshintergrund: Analysen zur Situation von Zuwanderern aus der ehemaligen Sowjetunion und aus der Türkei. In J. Baumert, A. Baader, K. Barkawi, J. Baumert, P. Stanat, & R. Watermann (Eds.), *Herkunftsbedingte Disparitäten im Bildungswesen: Differenzielle Bildungsprozesse und Probleme der Verteilungsgerechtigkeit* (pp. 221–255). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-531-90082-7_6

OECD. (2020). Performance and academic resilience amongst students with an immigrant background. In PISA (Ed.), *2018 results (Vol. 2): Where all students can succeed*. OECD Publishing.

Portes, A., & Hao, L. (2002). The price of uniformity: Language, family and personality adjustment in the immigrant second generation. *Ethnic and Racial Studies, 25*(6), 889–912. https://doi.org/10.1080/0141987022000009368

Prevoo, M. J. L., Malda, M., Mesman, J., & Van IJzendoorn, M. H. (2016). Within- and cross-language relations between oral language proficiency and school outcomes in bilingual children with an immigrant background: A meta-analytical study. *Review of Educational Research, 86*(1), 237–267. https://doi.org/10.3102/0034654315584685

Proctor, C. P., August, D., Carlo, M. S., & Snow, C. (2006). The intriguing role of Spanish language vocabulary knowledge in predicting English reading comprehension. *Journal of Educational Psychology, 98*(1), 159–169. https://doi.org/10.1037/0022-0663.98.1.159

Rjosk, C., Haag, N., Heppt, B., & Stanat, P. (2017). Zuwanderungsbezogene Disparitäten. In P. Stanat, S. Schipolowski, C. Rjosk, S. Weirich, & N. Haag (Eds.), *IQB-Bildungstrend 2016. Kompetenzen in den Fächern Deutsch und Mathematik am Ende der 4. Jahrgangsstufe im zweiten Ländervergleich* (pp. 237–275). Waxmann.

Scheele, A. F., Leseman, P. P., & Mayo, A. Y. (2010). The home language environment of monolingual and bilingual children and their language proficiency. *Applied Psycholinguistics, 31*(1), 117–140. https://doi.org/10.1017/S0142716409990191

Schipolowski, S., Edele, A., Mahler, N., & Stanat, P. (2021). Mathematics and science proficiency of young refugees in secondary schools in Germany. *Journal for Educational Research Online, 13*(1), 78–104. https://doi.org/10.31244/jero.2021.01.03

Schotte, K., Stanat, P., & Edele, A. (2018). Is integration always most adaptive? The role of cultural identity in academic achievement and in psychological adaptation of immigrant students in Germany. *Journal of Youth and Adolescence, 47*(1), 16–37. https://doi.org/10.1007/s10964-017-0737-x

Seuring, J., Rjosk, C., & Stanat, P. (2020). Ethnic classroom composition and minority language use among classmates: Do peers matter for students' language achievement? *European Sociological Review, 36*(6), 920–936. https://doi.org/10.1093/esr/jcaa022

Statistisches Bundesamt. (2019). *Bevölkerung mit Migrationshintergrund. Ergebnisse des Mikrozensus 2018: Bevölkerung und Erwerbstätigkeit*. Statistisches Bundesamt.

Strobel, B. (2016). Does family language matter? The role of foreign language use and family social capital in the educational achievement of immigrant students in Germany. *Ethnic and Racial Studies, 39*(14), 2641–2663. https://doi.org/10.1080/01419870.2016.1145712

Strobel, B., & Seuring, J. (2016). Spracherhalt oder Sprachverlagerung? *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 68*(2), 309–339. https://doi.org/10.1007/s11577-016-0360-y

Thomas, J. (1988). The role played by metalinguistic awareness in second and third language learning. *Journal of Multilingual and Multicultural Development, 9*(3), 235–246. https://doi.org/10.1080/01434632.1988.9994334

Tilstra, J., McMaster, K., Van den Broek, P., Kendeou, P., & Rapp, D. (2009). Simple but complex: Components of the simple view of reading across grade levels. *Journal of Research in Reading, 32*(4), 383–401. https://doi.org/10.1111/j.1467-9817.2009.01401.x

Unsworth, S. (2016). Quantity and quality of language input in bilingual language development. In E. Nicoladis & S. Montanari (Eds.), *Bilingualism across the lifespan: Factors moderating language proficiency* (pp. 103–122). De Gruyter Mouton. https://doi.org/10.1515/9783110341249-008

van Gelderen, A., Schoonen, R., De Glopper, K., Hulstijn, J., Snellings, P., Simis, A., & Stevenson, M. (2003). Roles of linguistic knowledge, metacognitive knowledge and processing speed in L3, L2 and L1 reading comprehension: A structural equation modeling approach. *International Journal of Bilingualism, 7*(1), 7–25. https://doi.org/10.1177/13670069030070010201

Waters, M. C., Tran, V. C., Kasinitz, P., & Mollenkopf, J. H. (2010). Segmented assimilation revisited: Types of acculturation and socioeconomic mobility in young adulthood. *Ethnic and Racial Studies, 33*(7), 1168–1193. https://doi.org/10.1080/01419871003624076

Weis, M., Müller, K., Mang, J., Heine, J. H., Mahler, N., & Reiss, K. (2018). Soziale Herkunft, Zuwanderungshintergrund und Lesekompetenz. In K. Reiss, M. Weis, E. Klieme, & O. Köller (Eds.), *PISA 2018. Grundbildung im internationalen Vergleich* (pp. 129–162). Waxmann.

Xie, Y., & Greenman, E. (2011). The social context of assimilation: Testing implications of segmented assimilation theory. *Social Science Research, 40*(3), 965–984. https://doi.org/10.1016/j.ssresearch.2011.01.004

Zhou, M. (1997). Segmented assimilation: Issues, controversies, and recent research on the new second generation. *International Migration Review, 31*(4), 975–1008. https://doi.org/10.1177/019791839703100408

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Chapter 17
Ethnic Differences in Social Capital Mobilization at the Transition to Vocational Training in Germany



Tobias Roth and Markus Weißmann

Abstract In this chapter, we provide an in-depth analysis of the differences between students with and without a migration background in Germany in mobilising social capital during the transition to vocational education and training (VET) after lower secondary education. Besides retrospective information, we analyse (hypothetical) prospective information. Furthermore, we distinguish between different kinds of social contacts and different types of support. Using data from the first five waves of starting cohort 4 (9th graders) of the National Educational Panel Study (NEPS) we find that students rely heavily on their social contacts, with parents playing the most important role. Regarding general information and support, we find only small ethnic differences in the mobilization of non-institutional social contacts. In contrast, adolescents with a migration background tend to receive specific assistance less often from relatives outside the nuclear family and substantively less often from parents. Our results suggest that the general motivation of non-institutional social contacts to provide support at the transition to VET does not differ between natives and migrants, but that the ability of these ties to provide more specific, instrumental assistance depends on their receiving-country-specific resources and thus on their migration history.

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17.1 Introduction

Many people mobilize their social networks during the job search and application process, because social contacts can provide useful information and support on the labour market (Kramarz & Skans, 2014). Whereas several studies have investigated differences in network mobilization between natives and migrants, few studies have examined these differences at the transition from school to work. In particular, there is a lack of empirical research based on data that provide detailed prospective and retrospective information on the mobilization of several kinds of social contacts for various purposes.

Against this background, we provide an in-depth analysis of differences between students with and without a migration background in Germany when it comes to their mobilization of social capital during the transition to vocational education and training (VET) after lower secondary education. In Germany, the school-to-work transition for most youths without a general university entrance qualification (*Abitur*) is characterized by entry into the strongly company-based VET system. At the end of general schooling, adolescents usually do not yet have sufficient labour market experience and information, and are thus likely to depend heavily on support from their social contacts when searching for an apprenticeship (Roth, 2014a, 2018). Among these ties, parents play a key role in providing support and information during their children's vocational orientation and apprenticeship search (e.g. Beicht & Granato, 2010; Hoenig, 2019; Roth, 2014a). However, parents with a migration background are likely to lack knowledge about the vocational training system and about open VET positions (e.g. Kretschmer, 2019; Roth, 2014a). Hence, they might not be able to provide help in the same way as native parents. Due to their important role, we will pay special attention to ethnic differences in the mobilization of information and support from parents.

Using data from the first five waves of Starting Cohort 4 (Grade 9) of the National Educational Panel Study (NEPS), we can overcome several shortcomings of previous research and add to the existing literature in several ways: in contrast to most other data used in previous studies, NEPS data provide nationwide, longitudinal information on a large sample of 9th graders attending regular schools. Students were subsequently interviewed annually or bi-annually, covering the transition period from lower secondary to upper secondary general education or vocational training. Hence, NEPS data allow us to analyse not only retrospective information from adolescents after having left general schooling but also (hypothetical) prospective information from students at the end of general lower secondary education. This is an important improvement, because the problem with retrospective information is that the actual mobilization of social contacts depends not only on social capital resources but also on the need for support—for instance, due to unsuccessful experiences in searching formally for an apprenticeship. Moreover, NEPS data provide not only longitudinal but also uniquely detailed social capital information, and this allows us to investigate commonalities and differences in network mobilization between adolescents with and without a migration background in more detail

depending on the type of social contact and the kind of support considered. Finally, whereas previous results on network mobilization have been mainly descriptive, we additionally run multivariate analyses in order to investigate whether differences in the mobilization of parents between adolescents with and without a migration background are in fact caused by ethnicity or rather by socio-economic background. In our multivariate analyses, we also divide adolescents with a migration background into those who were foreign born themselves or whose parents were both foreign born and those with at least one German-born parent.

This chapter is structured as follows: we first give a brief overview of the German education and vocational training system followed by a discussion of the theoretical considerations and previous research. After describing the data and analytical strategy, we present our empirical results. The chapter concludes by summarizing and discussing our findings.

17.2 The German Education and Vocational Training System

In the highly stratified German education system (Müller, 2005), students who attend the most demanding track (*Gymnasium*) in lower secondary education usually continue in the same school to general upper secondary education, whereas those attending the less demanding tracks mostly start VET after lower secondary education. Those who neither continue with general education nor start VET participate in pre-vocational measures in order to increase their chances of finding a training position later on. Most vocational training programmes take place in the form of dual training (Bundesministerium für Bildung und Forschung, 2016) that combines practical training in a company with theoretical education at a vocational school. In order to obtain a dual apprenticeship, adolescents have to apply directly to companies offering such positions. Hence, the search and application processes are similar to those for regular jobs (Glauser & Becker, 2016; Roth, 2014b), and almost 70% of the dual VET trainees are hired by companies after training (Bundesministerium für Bildung und Forschung, 2018). A smaller number of VET programmes are pursued as school-based training in which practical phases are often also part of the training (Solga et al., 2014). For adolescents without a university entrance qualification, formal vocational qualifications are of key importance for a smooth school-to-work transition and a stable professional career. Because most adolescents with a migration background do not succeed in obtaining a higher education entrance qualification, VET qualifications are particularly important for the successful integration of ethnic minorities into the German labour market (Granato & Kalter, 2001; Hunkler, 2010). At the same time, however, adolescents with a migration background make the transition to vocational training less often than native adolescents (Bundesministerium für Bildung und Forschung, 2018).

17.3 Theoretical Background

Social networks are an important source of information and support during the transition to VET, because school leavers themselves usually lack labour market experience and thus have to rely on others to receive assistance. Social networks can provide general support or counselling during the adolescents' job-choice and career planning. They can also offer more specific, instrumental assistance during the VET search—for example, by providing information on apprenticeship vacancies or about potential training companies and their hiring practices. Social contacts can also support apprenticeship seekers—for instance, by helping to write applications or prepare for interviews. Lastly, they can act as referrals and put in a good word for the applicant with potential employers (Burt, 1992; Granovetter, 1995; Kogan, 2011; Roth, 2014b).

Young school leavers usually start from scratch when it comes to establishing labour-market-relevant social ties themselves. Because their friends usually go to school as well, we can assume that they likewise mostly lack substantive work experience and knowledge about the labour market. This also applies to their siblings, who are often of similar age. Consequently, adolescents at the end of lower secondary education are likely to rely mainly on the support of 'older' social contacts who already have labour market and/or VET experience such as parents or other older relatives and acquaintances. It can be assumed that parents are particularly important in this respect, because teenagers usually still live with them in the same household, and they are therefore easily available to them. In addition to this spatial proximity, their emotional proximity makes parents highly motivated to assist their children during the transition from school to work (Moerbeek & Flap, 2008; Roth, 2018).

The contacts mentioned above are usually acquired via birth or by private means in everyday interaction. However, ties acquired through institutional channels might also help school leavers find an apprenticeship. Obviously, schools are the most significant institutions in this respect, and, consequently, teachers are expected to be the most important institutional social contacts for the provision of information and support. Teachers might, for example, initiate partnerships and joint projects with companies, act as referrals, visit vocational guidance events with their students, or practice how to write job applications with them.

Overall, we assume that young people often draw on their institutional and non-institutional social contacts during their search for a training place, with parents being of major importance. Based on these general theoretical observations about the mobilization of social ties during the apprenticeship search, we shall now take a closer look at potential differences in the mobilization of different categories of social ties between adolescents with and without a migration background.

Concerning non-institutional social contacts, there are no obvious theoretical reasons to assume that the motivation of these contacts to provide support differs between ethnic groups. Consequently, the extent of involvement and general information on vocational orientation and career planning available from

non-institutional social contacts should be similar for adolescents with and without a migration background. In contrast, providing more specific, instrumental assistance during the apprenticeship search such as giving information about attractive vacancies or helping with an application depends not only on the willingness of the social ties to support but also on their actual ability to do so. This again depends on their language skills, knowledge about the German education and vocational training system, and their information about and connections into the labour market. Because these resources are receiving-country-specific, there are good reasons to assume that native contacts are more competent in providing instrumental information and support than migrant contacts (Alba, 2008; Alba & Nee, 2003; Esser, 2004; Kalter & Kogan, 2014; Lancee, 2012; Lancee & Hartung, 2012). This should apply especially to first-generation migrant contacts who were not fully socialized and educated in the receiving country, whereas, in contrast, the differences between native contacts and migrant contacts born in the receiving country (second generation) should be less pronounced. Consequently, adolescents with a migration background whose parents are both foreign born should substantially less often receive instrumental information and support from their parents in their transition to vocational training than native adolescents.

Adolescents with a migration background with at least one native-born parent are expected to be less disadvantaged because, on average, their parents should have more receiving-country-specific information and resources needed at the transition from general schooling to vocational training than parents who were both foreign born. Given the disadvantages of ethnic minority youths at the transition from school to work in Germany and the tendency towards ethnic homophily in friendship networks (Leszczensky & Pink, 2015), we expect that the siblings and friends of children with a migration background are less able to provide specific information and support compared to those of native youths. However, we do not expect these ethnic differences to be exceptionally large for two reasons: first, both siblings and friends normally are of similar age as the respondents, and most of them should thus also have attended German schools. Consequently, their individual knowledge about the education and VET system should not differ much from that of natives. Second, the utility of siblings and friends of native adolescents should also be limited, because many of them have not yet gained experience in the VET system. Additionally, negative ethnic effects regarding siblings might be counteracted by the fact that migrant families have, on average, more children (Bundesministerium für Familie, Senioren, Frauen und Jugend, 2013), leading to a larger pool of contacts who can provide information and support. We also expect ethnic differences in the support from relatives outside the nuclear family. Because these relatives are more likely to be older and foreign born than siblings and friends among adolescents with a migration background, the extent of ethnic differences in support from relatives outside the nuclear family should be more similar to that of parental support.

Institutional social contacts, such as teachers, should usually provide both general and specific, instrumental information and support equally to native adolescents and adolescents with a migration background. However, if migrant children expect their parents or other non-institutional social contacts to be less helpful, they might turn

more often to institutional social contacts for information and assistance than natives. In addition, teachers might systematically give more support to students who need special assistance during the apprenticeship search, such as socially disadvantaged or low-performing students among whom migrants are over-represented. On the other hand, if ethnic discrimination on behalf of teachers exists, native adolescents might receive more assistance from teachers than adolescents with a migration background.

In summary, our expectations for ethnic differences in the amount of information and support received from institutional social contacts are not clear. For non-institutional social contacts, we expect that there are no differences concerning general involvement and obtaining unspecific information from social network contacts between adolescents with and without a migration background. In contrast, we expect that friends and siblings of ethnic minority youths less often provide specific, instrumental information and support compared to friends and siblings of native youths, although differences should be comparatively small. Furthermore, we expect adolescents with a migration background to less often receive specific, instrumental information and assistance from other relatives, and particularly from parents, than native adolescents. The latter should be true especially for adolescents whose parents were both born abroad, whereas differences to natives should be less pronounced when at least one of the parents was born in Germany.

17.4 Previous Empirical Findings

Previous research has shown that the majority of apprenticeship seekers in Germany receive information and help from relatives, friends, or acquaintances during their job search, with parents clearly being the most important source (e.g. Beicht & Granato, 2010; Bundesinstitut für Berufsbildung, 2017; Eberhard, 2012; Eberhard et al., 2018; Hoenig, 2019; Roth, 2014a, 2018; Ulrich et al., 2018). In addition, parents' involvement and transmission of information during the transition to VET seem to increase the likelihood of obtaining an apprenticeship (Beicht, 2011; Hoenig, 2019; Lindemann & Gangl, 2019; Ulrich, 2013).

Quantitative empirical findings on ethnic differences in network mobilization in Germany are based mainly on data from the BA/BIBB Applicant Survey which includes adolescents who registered in the Federal Employment Agency (BA) as training applicants (Beicht, 2011; Bundesinstitut für Berufsbildung, 2014; Eberhard et al., 2018). Retrospective accounts from VET applicants indicate that, in general, adolescents with and without a migration background tried to mobilize their social contacts during their career choice and apprenticeship search to a similar extent. Concerning actual mobilization, results show that native adolescents have more often talked to their parents during their career orientation and apprenticeship search than adolescents with a migration background, whereas no differences are found with respect to friends and acquaintances. With data from the BIBB-Transitional

Study, Beicht and Granato (2010) showed that adolescents with a migration background less often received help from their social network in making contact with companies. However, the authors did not distinguish between different kinds of social ties. The most differentiated information on ethnic differences in the network mobilization can be found in Roth (2014a). Based on a small, regionally limited sample, he showed that natives more often received information relevant for planning their VET and assistance in finding an apprenticeship from their social contacts. Ethnic differences were most pronounced with respect to instrumental support received from parents and from parents' friends and acquaintances, whereas there were no clear differences with respect to information and help received from adolescents' friends and acquaintances.

Whereas the overall results to date are consistent with our theoretical expectations, previous studies have several, already described shortcomings that limit their explanatory power and generalizability.

17.5 Data and Analytical Strategy

We base our empirical analyses on data from Starting Cohort 4 (SC4) of the National Educational Panel Study (NEPS). This starting cohort provides longitudinal information on the educational and occupational career of ninth graders selected via a Germany-wide school-based sampling approach who have been interviewed annually or bi-annually since then. We use the first five waves that cover a period of about 2 years in which most of the students make their transition from lower secondary education to upper secondary general education or to vocational education and training. We do not consider students attending the *Gymnasium* in Grade 9 in our analyses, because nearly all of them continue to general upper secondary education. This would make it impossible to compare their answers to questions about entering VET to those of students attending the less demanding tracks. We also exclude students from special needs schools, because they did not receive the same questions as students from general schools.

Indicators of Network Mobilization We derive our indicators of network mobilization from seven different questions: two referring to general and five to specific goal-oriented information and support from social contacts. The two general and three of the specific goal-oriented indicators comprise prospective information from students still attending lower secondary education (Waves 1 to 3). In addition, two of the specific goal-oriented indicators comprise retrospective information from adolescents after having left general schooling (Waves 3 and 5). For each question, students were presented with a list containing several groups of persons who might be helpful for certain challenges. In the analyses, we consider teachers (institutional social contacts) as well as parents, siblings, other relatives, and friends (non-institutional social contacts). This rich source of information on social capital mobilization is clearly an advantage of the NEPS SC4 data over other sources. The

downside, however, is that we are faced with differing samples of analyses for the different indicators, with each sample representing a selection of the student population. Furthermore, the response categories and the social contacts considered differ slightly between the questions (a full overview of the wording of all questions can be found in Tables 17.A4, 17.A5 and 17.A6 in the appendix). Consequently, findings for the different indicators are only partially comparable.

Two prospective questions capture the importance of different social contacts in providing general information for job choice and during the apprenticeship search. Respondents were asked to rate their importance on a 4-point scale that we recoded to dummy variables (1: 'rather important' or 'very important' versus 0: 'very unimportant' or 'rather unimportant'). The first question was given to students at the beginning of Grade 9 (Wave 1) who planned to enter an apprenticeship the following year (Sample 1). The second question was given to students at the end of Grade 9 (Wave 2) or Grade 10 (Wave 3) who planned to apply for an apprenticeship during the respective school year (Sample 2). For this question, we considered the last information available before respondents leave general education.

In contrast to this information on general involvement and assistance, the remaining three prospective questions measure specific goal-oriented assistance during the apprenticeship search. All students in general education in Wave 2 or 3 were asked to indicate on a 4-point scale ranging from 1 (*very unlikely*) to 4 (*very likely*) how likely it was that their social contacts would inform them about interesting apprenticeships, make an effort towards getting an apprenticeship for them, or help them write an application. In a second step, students who answered *rather likely* or *very likely* were asked to name all relevant sources for the respective type of support from a list of possible sources of information.[1] As above, we use information at the time of students' last year of general lower secondary schooling (Sample 3). Information on help with writing an application is available only for Wave 3 (i.e. at the end of Grade 10; Sample 4).

In addition to this prospective information, students who left the general education system provided information about which social contacts actually told them about interesting open training positions or helped them to find an apprenticeship. For these retrospective questions, we consider the first information available after respondents left general education (either Wave 3 or Wave 5; Sample 5). Most of these respondents pursue VET, whereas a smaller share attends a transition programme of vocational preparation and very few do something else (e.g. working without a vocational qualification or being unemployed).

[1] Respondents who answered *very unlikely* or *rather unlikely* were coded as not having named any of the sources provided. Because there were no filter questions that excluded respondents who do not possess the social contacts asked (e.g. respondents without siblings), they are expected to simply not have ticked the relevant source.

Migration Background We define adolescents as having a migration background if they themselves, at least one of their parents, or at least two of their grandparents were not born in Germany. All other respondents are considered natives. In the multivariate analyses, we further divide adolescents with a migration background into those whose parents were both foreign born and those with at least one German-born parent.

Analytical Strategy In a first step, we provide a comprehensive descriptive overview on the extent of social capital mobilization of natives and migrants with respect to different groups of social contacts and types of support. To test for statistically significant differences between natives and migrants, we apply bivariate linear probability models. Because Starting Cohort 4 of the NEPS survey applied a stratified sampling approach by which certain school types were oversampled (*Hauptschule*, *Integrierte Gesamtschule*, *Freie Waldorfschule*, and *Förderschule*; Steinhauer & Zinn, 2016), we use design weights that account for the different inclusion probabilities of the students.[2] We apply cluster-robust standard errors that take into consideration the correlation of observations on the school level.

In a second step, we run multivariate linear probability models to check whether differences between adolescents with and without a migration background in the mobilization of their parents are in fact due to ethnic rather than socio-economic differences. In these models, we control for students' socio-economic background by considering the highest educational attainment (lower secondary degree or less, intermediate secondary degree, at least *Abitur*) and the highest occupational status (ISEI-08) of their parents[3] as well as the number of books in the household. In addition, our models include the adolescents' gender, year of birth (before 1995, 1995, after 1995), and whether they live in a single-parent household. Lastly, we also include Grade 9 school dummies. We thus estimate school fixed-effects regression models by which we control for all school characteristics such as school type or social or ethnic composition of the student population as well as for regional variation of VET demand and supply. In our analyses, we allow the number of cases to vary across the different measures of social capital mobilization to obtain the most informative sample possible for each of the measures. In additional analyses, we hold the number of cases constant across several measures to make results comparable. Table 17.1 gives an overview of the number of cases and the

[2] Due to the varying sample definitions in our analyses along with the combination of information from various waves for some social capital variables (cf. above), none of the longitudinal weights provided by the NEPS are suitable for our analyses. Hence, we are unable to account for the different risk of panel dropout between students with and without a migration background. However, when we reran our models using various longitudinal and cross-sectional weights, our results remained robust (available upon request).

[3] If no information from the parent questionnaire is available, we use information from the adolescents. If neither of the parents is currently employed, we set their ISEI to the lowest empirical value of our variable (11.56) and simultaneously include a dummy variable to account for missing information due to current non-employment. If there is information about only one parent, this information is used.

Table 17.1 Descriptive overview over the variables used in the multivariate analyses and school types in grade 9 (differentiated by sample of analyses)

Variable	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	All
Sex						
Male	52.7	52.1	52.2	50.9	54.3	52.7
Female	47.3	47.9	47.8	49.1	45.7	47.3
Year of birth						
Before 1995	17.6	17.3	14.4	11.8	16.3	15.2
1995	49.3	49.9	48.8	48.7	50.3	48.8
After 1995	33.2	32.8	36.8	39.6	33.4	36.0
Migrant generation						
Both parents and respondent German born (native)	75.1	73.9	72.3	73.9	73.5	71.8
Both parents or respondent foreign born	12.5	13.9	14.9	13.8	14.4	15.4
One parent foreign born, one parent German born	12.5	12.2	12.8	12.3	12.2	12.8
Parents' highest education degree						
Lower secondary or below	27.4	24.9	22.7	19.6	25.0	23.4
Intermediate secondary	48.2	50.5	46.1	46.7	47.8	46.2
Upper secondary or above	24.4	24.6	31.1	33.7	27.1	30.4
Parents' highest ISEI	42.7	42.5	44.6	46.1	43.4	44.2
Parents currently not employed						
No	93.2	92.8	93.3	94.1	93.3	93.1
Yes	6.8	7.2	6.7	5.9	6.7	6.9

Two parents in household						
No	18.5	17.9	18.2	16.7	17.7	18.6
Yes	81.5	82.1	81.8	83.3	82.3	81.4
Number of books at home (1–6)	3.4	3.4	3.6	3.7	3.5	3.5
School type in grade 9						
Lower secondary school	29.7	24.6	26.1	17.0	31.8	27.6
School with several courses of education	14.1	14.7	12.4	11.9	12.5	12.3
Intermediate secondary school	47.3	49.3	45.0	53.1	45.5	43.8
Comprehensive school	8.8	11.4	16.6	18.1	10.2	16.3
Number of observations	3333	2954	6468	4775	4593	6793

Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations. Design-weighted mean values, unweighted number of observations

distribution of all control variables and school types in Grade 9 after listwise deletion for the five different samples and for all cases that are part of any of these samples (last column).

17.6 Empirical Results

17.6.1 Descriptive Results

We start the empirical analyses with a descriptive overview of our prospective measures of general support from social network contacts. Figure 17.1 shows that both institutional and non-institutional social contacts are important sources of general information for the job choice. Each of the four kinds of social contacts is considered important by at least 70 per cent of adolescents who indicated at the beginning of Grade 9 that they wanted to search for an apprenticeship during the school year (Sample 1). At about 85 per cent, parents are mentioned most often by

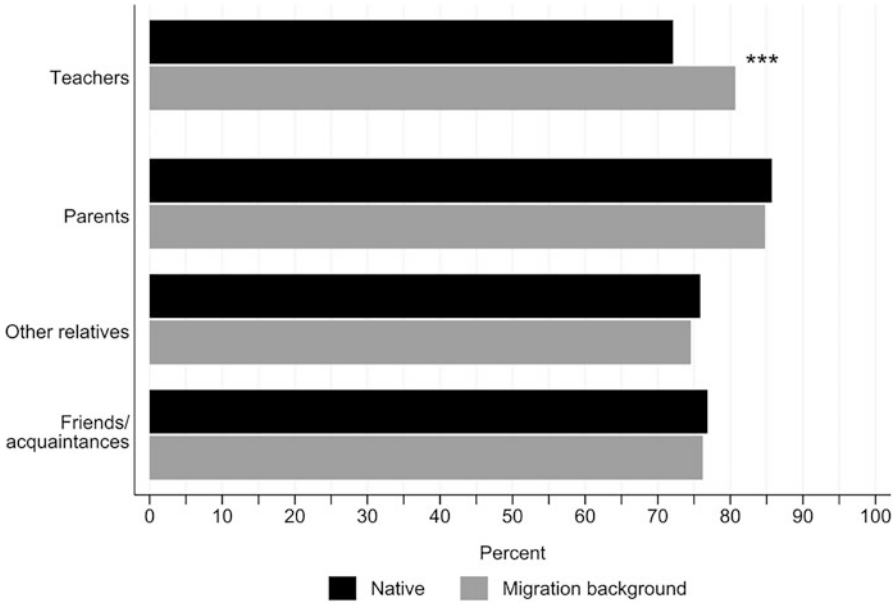


Fig. 17.1 Prospective support: information regarding job choice (Sample 1)
Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; $N = 3333$; cluster-robust standard errors, design-weighted
Bars indicate per cent of adolescents who answered that the respective source is 'rather important' or 'very important'

both adolescents with and without a migration background. There are also no ethnic differences in the importance of relatives and friends. In contrast, significantly more adolescents with a migration background (difference of around 9 percentage points) regard teachers as important sources of information.

Concerning the importance of receiving general information from social contacts during the apprenticeship search shown in Fig. 17.2 (Sample 2), we find similar patterns to those for the first indicator. All four kinds of social contacts are considered important; however, on a lower level than for general information regarding the job choice. Again, parents are most often rated as important. Ethnic differences are small (around 5 percentage points) yet significant on the 5% level. We again do not find any substantive ethnic differences for other relatives and friends, whereas teachers are significantly more often rated important by adolescents with a migration background (difference of around 10 percentage points).

Thus far, we conclude that the majority of apprenticeship seekers regard social contacts as an important source of general information during their transition to vocational training. In this regard, parents are most often considered important by both adolescents with and without a migration background, and ethnic differences

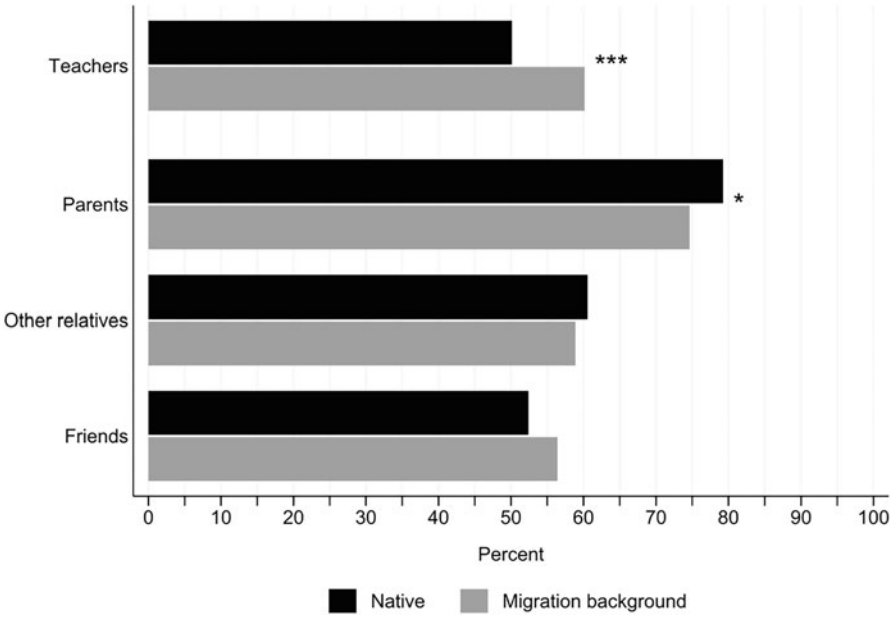


Fig. 17.2 Prospective support: information during apprenticeship search (Sample 2)
Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; $N = 2954$; cluster-robust standard errors, design-weighted
Bars indicate per cent of adolescents who answered that the respective source is 'rather important' or 'very important'

are rather small. This supports our notion that, when it comes to general support during this transition phase, parents born in Germany and parents born abroad are equally involved in their children's job choice and apprenticeship search. However, teachers seem to be important as well, particularly for adolescents with a migration background. This could be due to the fact that ethnic minorities more often need guidance in their job choice and encounter problems when entering the apprenticeship system.

In the next step, we show descriptive results for our prospective measures on specific, instrumental information and support. These refer to students at the end of lower secondary schooling (Figs. 17.3, 17.4 and 17.5; Samples 3 and 4). Overall, we find that many adolescents consider it likely to receive specific information and support from their social contacts. At the same time however, the various types of contacts are named by considerably fewer respondents than was the case for general information and support. Thus, it seems that the amount of possible support embedded in young adolescents' social networks is lower in the form of specific assistance compared to that regarding general assistance. Again, and in line with results on general information, we find that parents are seen as the most helpful source

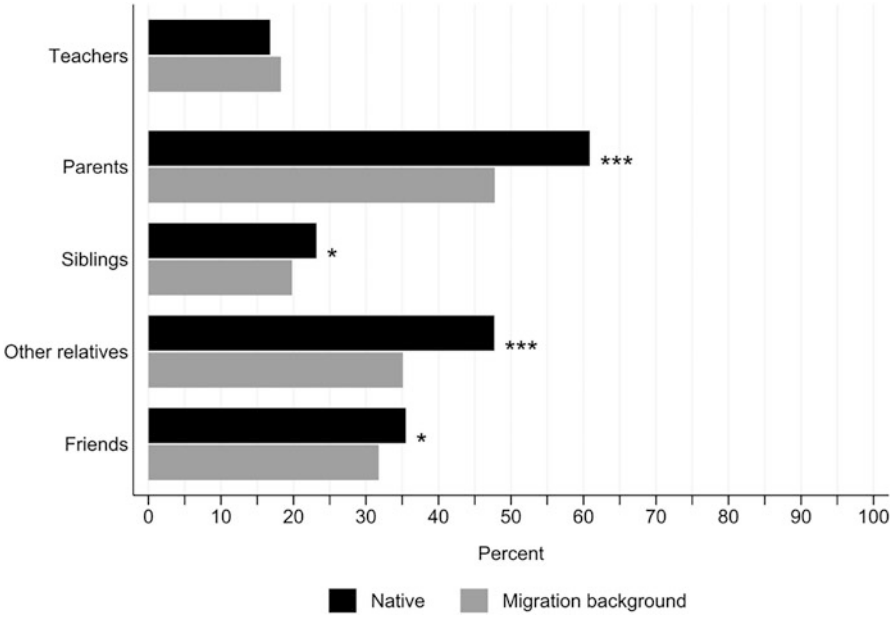


Fig. 17.3 Prospective support: information about interesting open apprenticeship positions (Sample 3)
Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; N = 6468; cluster-robust standard errors, design-weighted
Bars indicate per cent of adolescents who answered that information or support from the respective source is 'rather likely' or 'very likely'

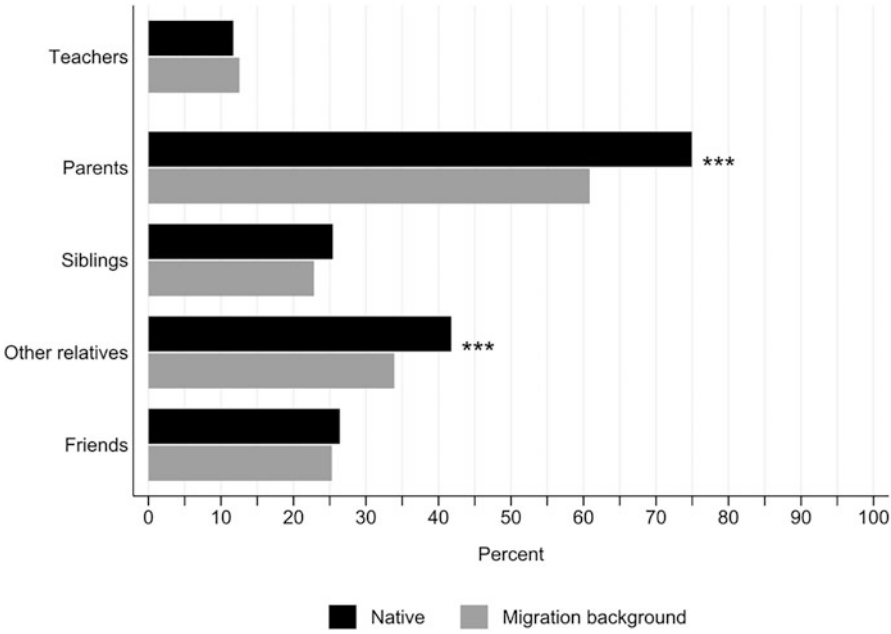


Fig. 17.4 Prospective support: efforts towards getting an apprenticeship (Sample 3)
Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; N = 6468; cluster-robust standard errors, design-weighted
Bars indicate per cent of adolescents who answered that information or support from the respective source is 'rather likely' or 'very likely'

followed by relatives, friends, and siblings. The distance between parents and the other kinds of social ties is much more pronounced for specific, instrumental assistance than for general assistance. Moreover, in contrast to the results on general information, teachers do not seem to play an important role when it comes to specific assistance.

Concerning differences between adolescents with and without a migration background, we do not find any significant ethnic differences regarding teachers for any of the three measures of specific, instrumental assistance. Ethnic minority youth report less often than natives that their siblings and friends are likely to provide specific information and support. However, as expected, these ethnic differences are rather small and statistically significant for only one (friends) or two (siblings) of the measures.[4] In contrast, substantively more native adolescents than adolescents with a

[4] A higher number of siblings increases the expected probability of receiving support from them. Because migrants have, on average, more siblings than natives, controlling for the number of siblings somewhat increases the ethnic differences in prospective sibling support (results available upon request). However, this does not change the interpretation of our results.

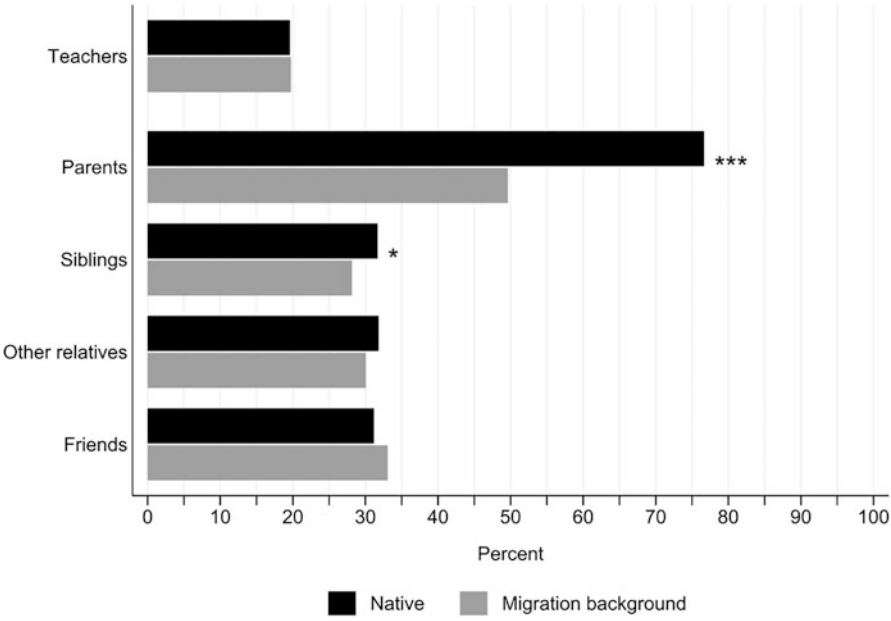


Fig. 17.5 Prospective support: help with writing an application (Sample 4)
Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; N = 4771; cluster-robust standard errors, design-weighted
Bars indicate per cent of adolescents who answered that information or support from the respective source is 'rather likely' or 'very likely'

migration background expect their parents to provide information about interesting apprenticeship vacancies (difference of around 13 percentage points) or to help them obtain such a position (difference of around 14 percentage points). Ethnic differences are even more pronounced with regard to the expected support from parents when writing an application for an apprenticeship (difference of around 27 percentage points). This underlines the importance of receiving-country-specific resources, especially for parents who want to provide specific instrumental information and support to their children: whereas parents need knowledge about the German vocational training system as well as information about and connections into the labour market in order to inform their children about interesting vacancies and help them find an apprenticeship, assistance in writing an application requires language proficiency that can be expected to be considerably lower among migrants compared to natives.

Concerning the first two prospective measures on specific, instrumental information and support, we also find clear ethnic differences with respect to assistance from relatives. However, this is less pronounced than for parents (difference of around 12 percentage points for information and around 8 percentage points for efforts

towards getting an apprenticeship). This further supports the notion that contacts who were socialized and educated abroad might lack receiving-country-specific resources and are thus less helpful in providing specific support on the labour market. Contrary to our expectations, however, we find no differences between adolescents with and without a migration background when looking at their expectation concerning received help from relatives with writing an application for an apprenticeship (Figs. 17.3, 17.4 and 17.5).

In sum, our prospective results show that adolescents see especially their parents as a key source of information and support during their transition from general education to vocational training. Whereas this is equally true for adolescents with and without a migration background with regard to general information, the possibilities that migrant parents have to provide specific, instrumental assistance seem to be clearly limited. Although less pronounced, this also seems to be the case for relatives outside the nuclear family. A contrasting picture emerges for the role of teachers in this transition process. Whereas students with and without a migration background do not differ in how they perceive the potential of teachers to provide specific support, students with a migration background more often expect to need assistance from teachers during job choice and general information during apprenticeship search. In order to exclude the possibility that comparisons of the results on general and specific prospective information are biased by different analysis samples, we run additional analyses in which we restrict the sample to cases with information on all five measures. General results remain unchanged (cf. Table 17.A1 in the appendix).

In a last step of our descriptive analyses, we investigate the two retrospective measures of specific, instrumental information and support from adolescents who left the general education system (see Figs. 17.6 and 17.7). As in the prospective measures, parents are the source most often considered important by both adolescents with and without a migration background. Whereas adolescents with a migration background substantively less often state that their parents told them about interesting apprenticeship or training vacancies (ethnic gap of around 12 percentage points), differences with regard to help in finding an apprenticeship are only small and not significant (difference of around 3 percentage points). Unexpectedly, adolescents with a migration background received information about VET vacancies from teachers significantly more often than native adolescents (difference of around 10 percentage points) and more often experienced that teachers helped them obtain an apprenticeship (difference of around 8 percentage points). This indicates that they try to compensate their lack of support from their parents by mobilizing institutional social contacts. Teachers might either assist them in their search efforts by actively connecting them with training companies or vocational schools or by informing them about other institutional opportunities such as employment agencies. Ethnic differences with regard to other kinds of social ties are comparatively small. Compared to natives, ethnic minority youths somewhat more often report having received information about interesting VET vacancies from siblings and friends. Lastly, in

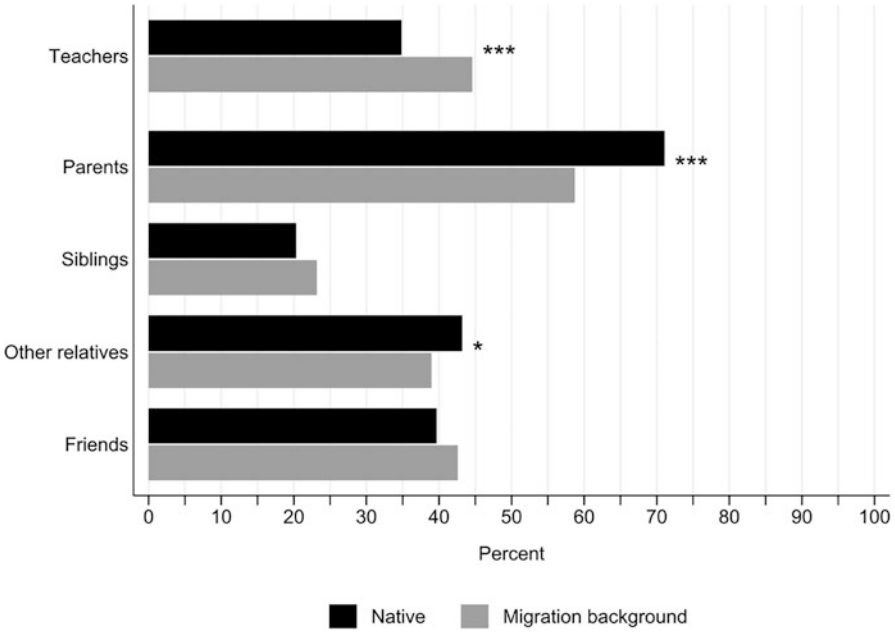


Fig. 17.6 Retrospective support: information about interesting open apprenticeship positions (Sample 5)
Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; $N = 4593$; cluster-robust standard errors, design-weighted
Bars indicate per cent of adolescents who answered that they received information/support from the respective source

line with our theoretical arguments, native youths more often receive information about open positions from their relatives compared to ethnic minority youths (difference of around 4 percentage points).

Interestingly, whereas adolescents more often mention their parents as an important source of information about interesting VET vacancies retrospectively rather than prospectively, the opposite is true in the case of providing actual help to find an apprenticeship. Figure 17.8 shows that this pattern also holds when we restrict our analysis sample to those adolescents with information on all four measures—that is, to those who left general education after Grade 9 or 10.

Our descriptive analyses show that all social ties considered are important sources of information and support for adolescents in their school-to-work transition, with parents being by far most important. The results for non-institutional social contacts are mostly in line with our expectations. Adolescents with a migration background less often receive specific help and information from their parents than native adolescents, and they also anticipate this. In contrast, this is not the case with regard

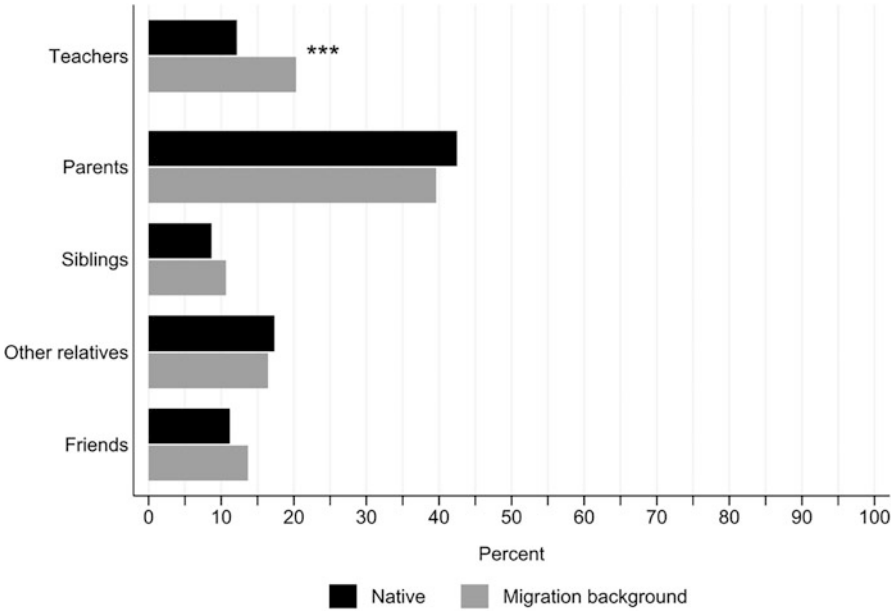


Fig. 17.7 Retrospective support: efforts towards getting a VET positions (Sample 5)
Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; $N = 4593$; cluster-robust standard errors, design-weighted
Bars indicate per cent of adolescents who answered that they received information/support from the respective source

to obtaining general information, for which receiving-country-specific resources should not be decisive. Whereas results for relatives outside the nuclear family are not completely conclusive, they tend to take the same direction as those for parents. In contrast, we find no clear ethnic differences with respect to friends; and whereas natives somewhat more often expect their siblings to be helpful, ethnic differences do not emerge retrospectively. Concerning institutional social contacts, results indicate that adolescents with a migration background more often rely on the assistance of teachers than native adolescents. This rather speaks against ethnic discrimination by teachers and supports the argument that adolescents with a migration background are more dependent on support from teachers, who, in turn, are willing to provide it. In addition to general job application training in class or referring students to career counselling, this support can also include individual assistance with writing applications, finding suitable apprenticeship vacancies, and even organizing partnerships with regional companies and arranging internships.

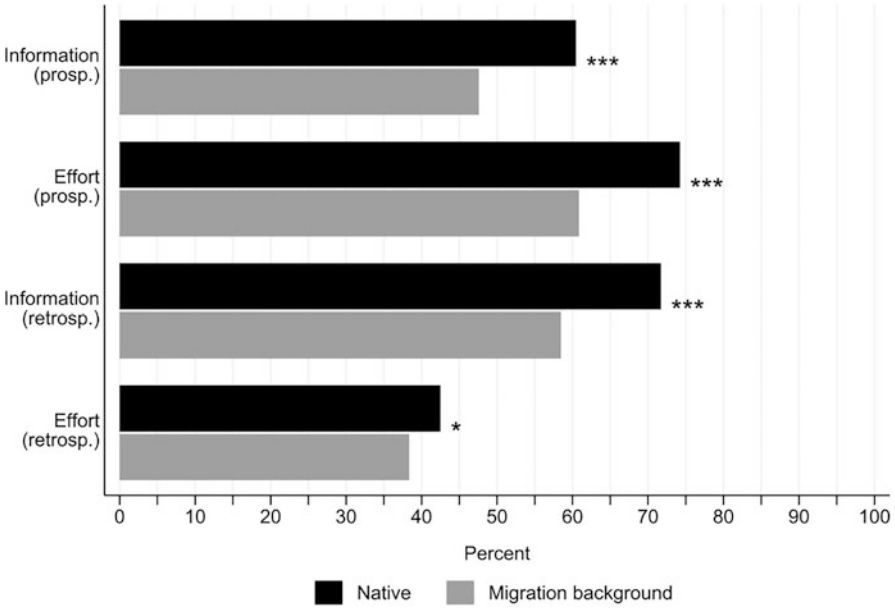


Fig. 17.8 Comparison of prospective and retrospective measures on information and support from parents
Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; $N = 4343$; cluster-robust standard errors, design-weighted
Prospective information: Bars indicate per cent of adolescents who answered that information or support from the respective source is 'rather likely' or 'very likely'
Retrospective information: Bars indicate per cent of adolescents who answered that they received information/support from the respective source

17.6.2 Multivariate Results

As shown above, parents play a key role in providing information and support to young school leavers during the transition from school to work. This is in line with results from previous studies on the role of social capital during the apprenticeship search. However, parents of adolescents with a migration background seem to be substantively less helpful during this transition than parents of native adolescents. This might be due to a lack of migrant parents' receiving-country-specific capital such as language resources and knowledge about the VET market or to a lack of native contacts in the social network. However, it is also possible that lower socio-economic status or contextual factors, such as regional availability of training opportunities, are responsible for this ethnic gap. Therefore, in the following, we shall further investigate the role of adolescents' parents by running multivariate analyses in which we control for parents' socio-economic status. In order to also control for regional variations and context characteristics on the school level, we run

school fixed-effects regressions. Moreover, we differentiate between adolescents with a migration background whose parents are both first-generation migrants and adolescents with a migration background of whom at least one parent was born in the receiving country. In the first set of models, we simply replicate the descriptive findings for each indicator with migration background differentiated by migrant generation. The second set of models presents ethnic differences in multivariate analyses including all control variables and school fixed effects as described above (coefficients for the control variables can be found in Tables 17.A2 and 17.A3 in the appendix).

Table 17.2 shows multivariate analyses for the two indicators referring to rather general information and support. Model 1a and Model 1b overall replicate the descriptive results from Figs. 17.1 and 17.2. Ethnic differences are statistically significant only for the first and second generation regarding general information received during the apprenticeship search (Model 1b). However, these differences are reduced and become non-significant once we control for socio-economic background and school characteristics in Model 2b. This further corroborates our assumption that migrant and native parents are very similar with respect to providing general support.

Table 17.3 shows multivariate results referring to indicators of instrumental support—both prospectively for students at the end of lower secondary schooling and retrospectively for those who have left general education after Grade 9 or Grade 10. Regarding prospective information and support, Model 1a, Model 1b, and Model 1c show substantive ethnic differences, as already seen in Figs. 17.3, 17.4 and 17.5. In addition, the models show that ethnic disadvantages are especially pronounced for adolescents with a migration background whose parents are both born abroad, whereas they are far smaller (and in case of Model 1a not significant) for those with at least one German-born parent. The inclusion of our control variables reduces ethnic penalties, but the results remain substantively the same as in the bivariate models. Regarding retrospective information and support, results are similar.

Table 17.2 Coefficients from linear probability regressions: general information

	Sample 1: Information regarding job choice		Sample 2: Information during apprenticeship search	
	Model 1a	Model 2a	Model 1b	Model 2b
Migrant generation (ref.: native)				
Both parents foreign born	−0.021	−0.001	−0.084**	−0.056
	(0.020)	(0.025)	(0.026)	(0.036)
At least one parent German born	0.003	0.010	−0.003	0.012
	(0.020)	(0.022)	(0.024)	(0.029)
Number of cases	3333	3333	2954	2954

Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Models 2 include all control variables and school dummies, cluster-robust standard errors (in parentheses), design-weighted

Table 17.3 Coefficients from linear probability regressions: specific, instrumental information and support

	Prospective information						Retrospective information			
	Sample 3: Information about open positions		Sample 3: Effort towards getting position		Sample 4: Help with writing an application		Sample 5: Information about open positions		Sample 5: Effort towards getting position	
	M1a	M2a	M1b	M2b	M1c	M2c	M1d	M2d	M1e	M2e
Migrant generation (ref.: native)										
Both parents foreign born	−0.221***	−0.173***	−0.230***	−0.175***	−0.414***	−0.353***	−0.187***	−0.165***	−0.072**	−0.083**
	(0.020)	(0.022)	(0.018)	(0.021)	(0.026)	(0.031)	(0.025)	(0.029)	(0.026)	(0.029)
At least one parent German born	−0.026	−0.011	−0.037*	−0.028	−0.108***	−0.091***	−0.048*	−0.035	0.022	0.023
	(0.023)	(0.023)	(0.018)	(0.018)	(0.024)	(0.023)	(0.024)	(0.026)	(0.025)	(0.026)
Number of cases	6468	6468	6468	6468	4771	4771	4593	4593	4593	4593

Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Models 2 include all control variables and school dummies, cluster-robust standard errors (in parentheses), design-weighted

Although somewhat less pronounced than for the prospective measures, we again find statistically and substantively significant differences in bivariate and in multivariate models between native adolescents and adolescents whose parents were both born abroad. For school leavers with one German-born parent, differences to natives are small and statistically significant only with regard to information about open positions when socio-economic background is not taken into account (Model 1d).

We can conclude that, whereas ethnic differences regarding the provision of specific, instrumental information and support from parents are particularly pronounced between native adolescents and adolescents who themselves or whose parents were both born abroad, differences to natives are weak or even non-existent when at least one parent of the adolescents with a migration background was born in Germany. In addition, substantive results remain largely unchanged when we control for socio-economic background and context characteristics in our multivariate analyses. This is in line with our theoretical assumption that ethnic differences are mostly not due to differences in socio-economic status or structural factors. Instead, they are likely to result from migrant parents' insufficient receiving-country-specific knowledge, resources, and contacts due to their shorter length of stay in the receiving country and their lack of own experience with the German education and vocational training system.

17.7 Summary and Conclusion

Based on refined information from NEPS Starting Cohort 4, we gave a comprehensive overview of (potential) social capital mobilization among adolescents with and without a migration background during the transition to vocational training at the end of lower secondary education. In addition, we provided in-depth insights into the role parents play in this process. In line with previous research, we find that students rely heavily on information and support from their social network, with parents playing the most important role. Besides this replication of earlier results on the basis of a nationwide sample of ninth graders in regular schools, our analyses provide new information concerning ethnic differences in the mobilization of social ties at the transition to VET that enhance current knowledge in several ways. Our main results can be summarized as follows: first, concerning institutional social contacts, there are indications that adolescents with a migration background more often rely on information and support from teachers than native adolescents do. Second, for non-institutional social contacts, we see hardly any ethnic differences in the expected network mobilization with regard to general information and support. Third, we also find no strong ethnic differences in the expected specific, instrumental assistance from siblings and friends, whereas adolescents with a migration background tend to less often receive specific assistance from relatives outside the nuclear family and substantively less often specific assistance from parents. Fourth, ethnic differences in actually received specific, instrumental assistance widely mirror the findings of our prospective measures for parents, but this is not the case for other sources of information. Fifth, our multivariate analyses show that ethnic differences in the

provision of specific assistance from parents are especially pronounced for adolescents who themselves or whose parents were both born abroad, and that these differences cannot be traced back to socio-economic background or context factors.

Overall and in line with our theoretical expectations, results suggest that the general motivation of non-institutional social contacts to provide support at the transition to VET does not differ between natives and migrants, but that the ability of these ties to provide more specific, instrumental assistance depends on their receiving-country-specific resources and thus on their migration history. Consequently, adolescents whose parents were born abroad are clearly disadvantaged, because they are likely to less often receive specific, instrumental assistance from their parents. The finding that adolescents with a migration background are more likely to rely on information and help from teachers suggests that institutional social contacts might be used to counteract these disadvantages. This may, however, not be enough to fully compensate for the disadvantages caused by the lack of assistance from parents. These findings are relevant in the German context, because, as we have seen, parents are by far the most important source of information and support at the transition to VET. Moreover, previous research indicates that parental assistance actually increases the likelihood of obtaining an apprenticeship (Beicht, 2011; Hoenig, 2019; Lindemann & Gangl, 2019; Ulrich, 2013). Finding an apprenticeship is an important first step in acquiring a vocational qualification; and for adolescents who do not enter tertiary education, such a qualification is indispensable to establish a successful career in the German labour market in which occupation-specific credentials are highly valued (Bills et al., 2017; Müller, 2005). Because comparatively few young adults with a migration background possess a vocational degree and about one third of them have neither a university degree nor a VET qualification (Autorengruppe Bildungsberichterstattung, 2018), a successful transition into the VET system plays a key role in the structural integration of adolescents with a migration background in Germany. Thus, our results suggest that it is important to assist adolescents with a migration background at the transition to VET in order to foster a smooth school-to-work transition, for example through the organization of internships or information campaigns, thereby compensating for the limited possibilities of their parents to support them.

On a more general level, we have shown that differentiated analyses are important to better understand ethnic differences in network mobilization in the school-to-work transition. In this respect, it seems especially important for future research to distinguish between different kinds of institutional and non-institutional social contacts as well as between general and specific assistance. Furthermore, future research should investigate more closely why it is specifically migrant parents who are less likely to provide specific assistance during this transition. Our theoretical argumentation and empirical findings suggest that the reason lies in a lack of receiving-country-specific resources, but an explicit empirical investigation of the exact mechanisms is beyond the scope of this chapter and is therefore left to future research. Finally, future research should further explore how social capital mobilization and apprenticeship search success are related. The refined information in the NEPS offers opportunities for a differentiated analysis that can further enhance existing knowledge from previous research.

Appendix

Table 17.A1 Listwise deletion of applicants to information on all five measures regarding prospective information

	Information regarding job choice[a]			Information during apprenticeship search[a]			Information about open positions[b]			Effort towards getting position[b]			Help with writing an application[b]		
	N	MB	DS	N	MB	DS	N	MB	DS	N	MB	DS	N	MB	DS
Teachers	74.2	80.4	*	51.0	61.6	*	17.3	17.9		12.1	11.5		21.6	15.5	
Parents	86.7	85.7		80.9	76.5		65.2	51.3	***	77.3	63.8	***	74.6	48.7	***
Siblings							27.0	18.7	*	30.7	21.8	*	33.3	26.4	
Relatives	76.4	71.4		62.0	57.4		51.1	35.8	***	45.0	34.6	***	34.2	30.6	
Friends/acquaintances	77.7	74.9		53.3	54.4		39.7	32.1	*	29.4	26.1		35.0	29.6	

Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; N = 1492; cluster-robust standard errors, design-weighted.
Notes: *N* native, *MB* migration background, *DS* difference significant
[a]Values indicate per cent of adolescents who answered that the respective source is 'rather important' or 'very important'
[b]Values indicate per cent of adolescents who answered that information or support from the respective source is 'rather likely' or 'very likely'

Table 17.A2 Coefficients from linear probability regressions: general information (full models)

	Sample 1: Information regarding job choice		Sample 2: Information during apprenticeship search	
	Model 1a	Model 2a	Model 1b	Mode2b
Migrant generation (ref.: native)				
Both parents foreign born	−0.021	−0.001	−0.084**	−0.056
	(0.020)	(0.025)	(0.026)	(0.036)
At least one parent German born	0.003	0.010	−0.003	0.012
	(0.020)	(0.022)	(0.024)	(0.029)
Female		0.006		−0.005
		(0.016)		(0.021)
Year of birth (ref.: 1995)				
Before 1995		−0.019		0.006
		(0.025)		(0.038)
After 1995		0.019		0.014
		(0.017)		(0.021)
Books in household		0.003		−0.001
		(0.006)		(0.009)
Parents' highest general education (ref.: Lower secondary or below)				
Intermediate secondary		0.048*		0.016
		(0.023)		(0.027)
Upper secondary or above		0.026		−0.033
		(0.025)		(0.031)
Highest ISEI (parents)		0.001		0.001
		(0.000)		(0.001)
Parents currently not employed		0.031		−0.038
		(0.037)		(0.046)
Two parents in household		0.033		0.015
		(0.022)		(0.027)
Number of cases	3333	3333	2954	2954

Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Models 2 additionally include school dummies, cluster-robust standard errors (in parentheses), design-weighted.

Table 17.A3 Coefficients from linear probability regressions: specific, instrumental information and support (full models)

	Prospective information						Retrospective information			
	Sample 3: Information about open positions		Sample 3: Effort towards getting position		Sample 4: Help with writing an application		Sample 5: Information about open positions		Sample 5: Effort towards getting position	
	M1a	M2a	M1b	M2b	M1c	M2c	M1d	M2d	M1e	M2e
Migrant generation (ref.: native)										
Both parents foreign born	−0.221***	−0.173***	−0.230***	−0.175***	−0.414***	−0.353***	−0.187***	−0.165***	−0.072**	−0.083**
	(0.020)	(0.022)	(0.018)	(0.021)	(0.026)	(0.031)	(0.025)	(0.029)	(0.026)	(0.029)
At least one parent German born	−0.026	−0.011	−0.037*	−0.028	−0.108***	−0.091***	−0.048*	−0.035	0.022	0.023
	(0.023)	(0.023)	(0.018)	(0.018)	(0.024)	(0.023)	(0.024)	(0.026)	(0.025)	(0.026)
Female		0.052***		0.033*		0.060***		−0.021		−0.061***
		(0.014)		(0.013)		(0.016)		(0.017)		(0.017)
Year of birth (ref.: 1995)										
Before 1995		−0.022		−0.031		−0.004		−0.014		−0.040
		(0.022)		(0.022)		(0.024)		(0.028)		(0.028)
After 1995		0.025		0.021		0.025		−0.022		−0.008
		(0.017)		(0.014)		(0.015)		(0.017)		(0.019)
Books in household		0.021***		0.015**		0.018**		0.016*		0.010
		(0.006)		(0.005)		(0.006)		(0.007)		(0.007)
Parents' highest general education (ref.: lower secondary or below)										
Intermediate secondary		0.023		0.033		0.110***		0.011		0.050*
		(0.021)		(0.018)		(0.023)		(0.022)		(0.023)
Upper secondary or above		0.026		0.003		0.113***		−0.026		0.039
		(0.023)		(0.021)		(0.025)		(0.028)		(0.027)

(continued)

Table 17.A3 (continued)

	Prospective information						Retrospective information			
	Sample 3: Information about open positions		Sample 3: Effort towards getting position		Sample 4: Help with writing an application		Sample 5: Information about open positions		Sample 5: Effort towards getting position	
	M1a	M2a	M1b	M2b	M1c	M2c	M1d	M2d	M1e	M2e
Highest ISEI (parents)		0.001		0.001*		0.002***		0.000		−0.001
		(0.000)		(0.000)		(0.000)		(0.001)		(0.001)
Parents currently not employed		−0.023		−0.038		−0.019		−0.076*		−0.089**
		(0.030)		(0.029)		(0.037)		(0.038)		(0.035)
Two parents in household		0.043*		0.027		0.050**		0.081***		0.048*
		(0.018)		(0.019)		(0.018)		(0.024)		(0.022)
Number of cases	6468	6468	6468	6468	4771	4771	4593	4593	4593	4593

Source: National Educational Panel Study (NEPS): Starting Cohort 4, authors' own calculations
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Models 2 additionally include school dummies, cluster-robust standard errors (in parentheses), design-weighted.

Question Wording: Prospective Information from Students

Table 17.A4 General information and support

Information regarding job choice (sample 1)	
Source	Student questionnaire wave 1 (beginning of grade nine)
Filter question	"Do you intend to apply for an apprenticeship during the 9th grade?"
Response categories	Yes No
Follow-up question	"How important are the following sources of information for your job choice? Please check one box in each line."
Sources (selected)	Tips from parents Tips from other relatives (siblings, aunt, uncle...) Tips from friends and acquaintances Tips from teachers
Response categories	Very unimportant Rather unimportant Rather important Very important
Information during apprenticeship search (sample 2)	
Source	Student questionnaire wave 2 and wave 3
Filter question	"Do you intend to apply for an apprenticeship during the 9th grade?" "Do you plan to apply for a vocational training position during the school year?"
Response categories	Yes No
Follow-up question	"When you look for an apprenticeship, how important do you consider the following information? Please check one box in each line."
Sources (selected)	Parents Other relatives (siblings, aunt, uncle) Friends Teachers
Response categories	Very unimportant Rather unimportant Rather important Very important

Table 17.A5 Specific information and support

Information about interesting open apprenticeship positions (sample 3)	
Source	Student questionnaire wave 2 and wave 3
Filter question	"The following questions refer to people from your private life, whether or not you know them well. Imagine you are looking for an apprenticeship. How likely is someone from your private life going to inform you about interesting apprenticeships? Please check only one answer."
Response categories	Very unlikely Rather unlikely Rather likely Very likely

(continued)

Table 17.A5 (continued)

Follow-up question	"Who did you have in mind when you heard the last question? Please check all applicable answers."
Sources (selected)	Your parents Your siblings Other people from your family or relatives A teacher at your school Your friends
Response categories	Not specified Specified
Efforts towards getting an apprenticeship (sample 3)	
Source	Student questionnaire wave 2 and wave 3
Filter question	"How likely is someone from your private life going to make an effort towards getting an apprenticeship for you? Please check only one answer."
Response categories	Very unlikely Rather unlikely Rather likely Very likely
Follow-up question	"Who did you have in mind when you heard the last question? Please check all applicable answers."
Sources (selected)	Your parents Your siblings Other people from your family or relatives A teacher from your school Your friends
Response categories	Not specified Specified
Help with writing an application (sample 4)	
Source	Student questionnaire wave 3
Filter question	"Imagine you're looking for a vocational training position. How likely is it that someone in your life would help you write an application for that vocational training position? Please choose one answer only."
Response categories	Very unlikely Rather unlikely Rather likely Very likely
Follow-up question	"Who do you think would provide that help? Please mark all answers that apply."
Sources (selected)	Your parents Your siblings Other people in your family A teacher at your school Your friends
Response categories	Not specified Specified

Question Wording: Retrospective Information from Students

Table 17.A6 Specific information and support

Information about interesting open apprenticeship positions (sample 5)	
Source	School leaver questionnaire wave 3 and wave 5
Question	"Did someone from the following groups tell you about interesting apprenticeship or training positions that were open? Read out the options, multiple answers allowed."
Sources (selected)	Your parents Your siblings Other people in your family/relatives A teacher at your former school Friends None of the above
Response categories	Not specified Specified
Efforts towards getting an apprenticeship position (sample 5)	
Source	School leaver questionnaire wave 3 and wave 5
Question	"Did someone from the following groups of people help you get your current apprenticeship position/an apprenticeship position? Read out the options, multiple answers allowed."
Sources (selected)	Your parents Your siblings Other people in your family/relatives A teacher at your former school Friends None of the above
Response categories	Not specified Specified

References

Alba, R. (2008). Why we still need a theory of mainstream assimilation. In F. Kalter (Ed.), *Migration und integration* (pp. 37–56). VS Verlag für Sozialwissenschaften.

Alba, R., & Nee, V. (2003). *Remaking the American mainstream: Assimilation and contemporary immigration*. Harvard University Press.

Autorengruppe Bildungsberichterstattung. (2018). *Bildung in Deutschland. Ein indikatorengestützter Bericht mit einer Analyse zu Wirkungen und Erträgen von Bildung*. wbv Publikation.

Beicht, U. (2011). *Junge Menschen mit Migrationshintergrund: Trotz intensiver Ausbildungsstellensuche geringere Erfolgsaussichten BIBB-Analyse der Einmündungschancen von Bewerberinnen und Bewerbern differenziert nach Herkunftsregionen*. Forschungs- und Arbeitsergebnisse aus dem Bundesinstitut für Berufsbildung. Bundesinstitut für Berufsbildung.

Beicht, U., & Granato, M. (2010). *Ausbildungsplatzsuche: Geringere Chancen für junge Frauen und Männer mit Migrationshintergrund* (BIBB REPORT 15/10). Bundesinstitut für Berufsbildung.

Bills, D. B., Di Stasio, V., & Gërxhani, K. (2017). The demand side of hiring: Employers in the labor market. *Annual Review of Sociology, 43*, 291–310. https://doi.org/10.1146/annurev-soc-081715-074255

Bundesinstitut für Berufsbildung. (2014). *Datenreport zum Berufsbildungsbericht 2014: Informationen und Analysen zur Entwicklung der beruflichen Bildung*. Bundesinstitut für Berufsbildung.

Bundesinstitut für Berufsbildung. (2017). *Datenreport zum Berufsbildungsbericht 2017: Informationen und Analysen zur Entwicklung der beruflichen Bildung*. Bundesinstitut für Berufsbildung.

Bundesministerium für Bildung und Forschung. (2016). *Berufsbildungsbericht 2016*. BMBF.

Bundesministerium für Bildung und Forschung. (2018). *Berufsbildungsbericht 2018*. BMBF.

Bundesministerium für Familie, Senioren, Frauen und Jugend. (2013). *Mütter mit Migrationshintergrund – Familienleben und Erwerbstätigkeit*. Monitor Familienforschung Ausgabe 32. BMFSFJ.

Burt, R. S. (1992). *Structural holes: The social structure of competition*. Harvard University Press.

Eberhard, V. (2012). Der Übergang von der Schule in die Berufsausbildung. *Ein ressourcentheoretisches Modell zur Erklärung der Übergangschancen von Ausbildungsstellenbewerbern*. W. Bertelsmann Verlag.

Eberhard, V., Gei, J., Borchardt, D., Engelmann, D., & Pencke, A. (2018). *Zur Situation von Ausbildungsstellenbewerbern und -bewerberinnen: Ergebnisse der BA/BIBB-Bewerberbefragung 2016*. Verlag Barbara Budrich.

Esser, H. (2004). Does the "new" immigration require a "new" theory of intergenerational integration? *International Migration Review, 38*, 1126–1159. https://doi.org/10.1111/j.1747-7379.2004.tb00231.x

Glauser, D., & Becker, R. (2016). VET or general education? Effects of regional opportunity structures on educational attainment in German-speaking Switzerland. *Empirical Research in Vocational Education and Training, 8*, 1–25. https://doi.org/10.1186/s40461-016-0033-0

Granato, N., & Kalter, F. (2001). Die Persistenz ethnischer Ungleichheit auf dem deutschen Arbeitsmarkt – Diskriminierung oder Unterinvestition in Humankapital? *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 53*, 497–520. https://doi.org/10.1007/s11577-001-0076-4

Granovetter, M. (1995). *Getting a job: A study of contacts and careers*. University of Chicago Press.

Hoenig, K. (2019). *Soziales Kapital und Bildungserfolg: Differentielle Renditen im Bildungsverflauf*. Springer VS. https://doi.org/10.1007/978-3-658-24234-3

Hunkler, C. (2010). Ethnische Unterschiede beim Zugang zu Ausbildung und Erwerb von Ausbildungsabschlüssen. In B. Becker & D. Reimer (Eds.), *Vom Kindergarten bis zur Hochschule - Die Generierung von ethnischen und sozialen Disparitäten in der Bildungsbiographie* (pp. 213–250). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-531-92105-1_8

Kalter, F., & Kogan, I. (2014). Migrant networks and labor market integration of immigrants from the Former Soviet Union in Germany. *Social Forces, 92*, 1435–1456.

Kogan, I. (2011). When informal is normal … On the role of credentials and contacts for the job entry in Serbia. *Research in Social Stratification and Mobility, 29*, 445–458. https://doi.org/10.1016/j.rssm.2011.03.001

Kramarz, F., & Skans, O. N. (2014). When strong ties are strong: Networks and youth labour market entry. *Review of Economic Studies, 81*, 1164–1200. https://doi.org/10.1093/restud/rdt049

Kretschmer, D. (2019). Explaining native-migrant differences in parental knowledge about the German educational system. *International Migration, 57*, 281–297. https://doi.org/10.1111/imig.12535

Lancee, B. (2012). The economic returns of bonding and bridging social capital for immigrant men in Germany. *Ethnic and Racial Studies, 35*, 664–683. https://doi.org/10.1080/01419870.2011.591405

Lancee, B., & Hartung, A. (2012). Turkish migrants and native Germans compared: The effects of inter-ethnic and intra-ethnic friendships on the transition from unemployment to work. *International Migration, 5*, 39–54. https://doi.org/10.1111/j.1468-2435.2011.00736.x

Leszczensky, L., & Pink, S. (2015). Ethnic segregation of friendship networks in school: Testing a rational-choice argument of differences in ethnic homophily between classroom- and grade-level networks. *Social Networks, 42*, 18–26. https://doi.org/10.1016/j.socnet.2015.02.002

Lindemann, K., & Gangl, M. (2019). Parental unemployment and the transition to vocational training in Germany: Interaction of household and regional sources of disadvantage. *European Sociological Review, 35*, 684–700. https://doi.org/10.1093/esr/jcz027

Moerbeek, H. H. S., & Flap, H. D. (2008). Social resources and their effect on occupational attainment through the life course. In N. Lin & B. H. Erickson (Eds.), *Social capital: An international research program* (pp. 133–157). Oxford University Press.

Müller, W. (2005). Education and youth integration into European labour markets. *International Journal of Comparative Sociology, 46*, 461–485. https://doi.org/10.1177/2F0020715205060048

Roth, T. (2014a). Die Rolle sozialer Netzwerke für den Erfolg von Einheimischen und Migranten im deutschen *(Aus-)Bildungssystem*. Shaker.

Roth, T. (2014b). Effects of social networks on finding an apprenticeship in the German vocational training system. *European Societies, 16*, 233–254. https://doi.org/10.1080/14616696.2013.821622

Roth, T. (2018). The influence of parents' social capital on their children's transition to vocational training in Germany. *Social Networks, 55*, 74–85. https://doi.org/10.1016/j.socnet.2018.05.006

Solga, H., Protsch, P., Ebner, C., & Brzinsky-Fay, C. (2014). *The German vocational education and training system: Its institutional configuration, strengths, and challenges*. WZB Discussion Paper, 2014-502.

Steinhauer, H. W., & Zinn, S. (2016). *NEPS technical report for weighting: Weighting the sample of starting cohort 4 of the National Educational Panel Study (wave 1 to 6)* (NEPS survey paper No. 2). Leibniz Institute for Educational Trajectories, National Educational Panel Study.

Ulrich, A., Frey, A., & Ruppert, J.-J. (2018). The role of parents in young people's career choices in Germany. *Psychology, 9*, 2194–2206. https://doi.org/10.4236/psych.2018.98125

Ulrich, J. G. (2013). Regionale Unterschiede in der Integrationsfähigkeit des dualen Berufsausbildungssystems. *WSI Mitteilungen, 1*, 23–32.

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Chapter 18
Gendered Occupational Aspirations: A Comparison of Young Native-Born and Turkish Minority Women



Manuel Siegert, Tobias Roth, and Irena Kogan

Abstract Declining birth rates, an ageing population and the goal to remain globally competitive and prosperous puts pressure on the German labour market and increases the demands for greater labour force participation of women. Women with a migration background constitute a growing share of the German population, but a disproportionally lower share of the total labour force. We focused on the gender-specific occupational preferences of female adolescents with a Turkish migration background compared to those without any migration background and related these preferences to the young women's interests, family orientations, normative gender role perceptions, and the socioeconomic status of the aspired profession in our analyses. Contrary to our expectations, our results indicate that Turkish girls less often aspire to female-dominated occupations than majority native-born girls. Instead, they prefer integrated occupations, which tend to be more prestigious and better paid. This might be mostly due to their ambitious occupational aspirations, because the gap between native-born and Turkish girls is reduced substantively after controlling for aspirations.

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18.1 Introduction

Declining birth rates, an ageing population, and the goal to remain globally competitive and prosperous is putting pressure on the German labour market and increasing the demand for a greater labour force participation of women. Women with a migration background constitute a growing share of the German population, but a disproportionally lower share of the total labour force. Compared to other women with or without a migration background, women with a Turkish migration background are even more likely to be either unemployed or employed in low-paid, low-status jobs (e.g., Salikutluk et al., 2020; Schührer, 2018, pp. 32–33; Stichs, 2008, p. 48). This weak labour market position of women with a Turkish migration background has been shown to result largely from a lack of human capital (e.g., Hunkler, 2014, pp. 11–12; Salikutluk et al., 2020). In particular, their lack of vocational qualifications brings considerable disadvantages in the German job market (Schührer, 2018, p. 30) that is well known for its strong credentialism (Konietzka, 1999; Müller & Kogan, 2010). Although the link between an individual's vocational training and future job has been weakening, it is still not easy to change a once-chosen career path (Dütsch et al., 2013).

Young women and men tend to choose different training occupations (Statistisches Bundesamt/Wissenschaftszentrum Berlin für Sozialforschung, 2016), and this perpetuates educational and occupational gender segregation. Particularly female adolescents with a Turkish migration background seem to be concentrated in a small number of female-dominated occupations such as medical/dental assistants or hairdressers (BMBF, 2019, p. 67; Siegert, 2009, p. 35). Such jobs are more likely to be low paid and offer limited career mobility compared to more gender-balanced occupations (e.g., journalists or customer service managers) (Cotter et al., 2004; Hakim, 1998; Magnusson, 2009, 2013). Young women with a Turkish migration background are also more likely to be employed in female-dominated jobs than young women with or without a migration background: whereas 67.1% of 30- to 34-year-old women with a Turkish migration background work in an occupation in which women make up 70% or more of the workforce (a so called female-dominated occupation), this applies to only 59.6% of women of the same age with another migration background and 51.6% of women of the same age without a migration background (own calculations based on the Scientific Use File of the German Microcensus 2011; data provided by Federal and State Statistical Offices, Research Data Centres).

Why would young women in general and women of Turkish descent in particular end up more often in female-dominated occupations? One possible explanation is that women *prefer* female-dominated occupations because these enable them to reconcile family obligations and career relatively easily, because they offer tasks and a professional environment that coincide with so called female interests and skills, and because they are considered appropriate for a woman (Achatz, 2008, p. 267; Becker, 1975, 1985; Busch, 2013, pp. 40–46; Polachek, 1981).

This explanation might apply particularly to women with origins in more traditional societies, including Turkey, because they tend to be oriented more towards family and motherhood than women from other migration backgrounds. On average, they marry and have children earlier, and they adhere more to the traditional gender roles than women without a migration background (e.g., Becher & El-Menouar, 2014, pp. 67–69, 101; Nauck, 1999, p. 52; Weiss & Wittmann-Roumi Rassouli, 2007, p. 160). However, research has also shown that students with a Turkish migration background tend to have quite ambitious educational (Salikutluk, 2016) and vocational aspirations (e.g., Diehl et al., 2009, p. 57; Wicht, 2016). The fact that female-dominated occupations are not very prestigious (Magnusson, 2009) may well be a decisive reason why young Turkish women do *not* strive for typical female professions.

This study focuses on preferences for female-dominated occupations as a possible reason for the over-representation of women with a Turkish migration background in female-dominated jobs. To this end, we compare the occupational aspirations of female majority native-born and Turkish 9th graders in general schooling using data from Starting Cohort 4 of the National Educational Panel Study (NEPS). We focus on occupational aspirations *before* entry into the labour market, because studying individuals who have already entered the labour market would increase the risk of hindsight biases and the likelihood that respondents have adapted their preferences and beliefs to their current labour market situation. The decision to focus on young women of Turkish descent is driven by their particular position in the German labour market together with their traditional gender-role perceptions and occupational aspirations. Furthermore, persons with a Turkish migration background represent the largest minority group in Germany (Statistisches Bundesamt, 2020, p. 68), and this enables us to draw meaningful comparisons with majority native-born German women. We seek to explain the differences in occupational aspirations between Turkish and majority native-born women in terms of their interest orientation, family orientation, normative gender roles, and the socio-economic status of their aspired profession.

Contrary to our expectations, we do not find any consistently pronounced differences in interests, family orientation, or normative gender-role perceptions between majority native-born and Turkish girls. Our results suggest that Turkish girls are *not* more interested in female-dominated occupations than majority native-born girls, but rather in the better-paid and more prestigious integrated occupations. However, results also show that they expect to face difficulties in realizing their aspirations and to end up in a female-dominated occupation.

The chapter is structured as follows. First, we describe the occupational and vocational situation of (young) women with a Turkish migration background in Germany. In the second section, we provide the theoretical basis, discussing why school-leavers choose gendered occupations. After having formulated our expectations, we introduce the data and variables used. We then present the analyses and results. The chapter closes with a summary and discussion of the findings.

18.2 The Occupational and Vocational Training Situation of (Young) Women in Germany: State of Research

In Germany, fewer young women than young men start vocational education, and young women with a migration background do so less often than their majority native-born counterparts (BMBF, 2019, p. 46). Young women with a Turkish migration background are even less likely to complete vocational education than young women from other immigrant groups or those without a migration background (Siegert, 2009, p. 31). In Germany in 2018, 86% of majority native-born women, 73% of women with a migration background, and only 56% of women with a Turkish migration background had a vocational qualification (Statistisches Bundesamt, 2019, pp. 201–202). Even 35% of women with a Turkish migration background who were born and raised in Germany lack vocational qualifications (Schührer, 2018, p. 30).

Both female apprentices with and without a migration background are concentrated in a few—largely female-dominated—occupations (BMBF, 2019, p. 67; Siegert, 2009, p. 35) such as medical assistants (proportion of women ca. 99%), dental assistants (ca. 100%), hairdressers (ca. 90%), and office clerks (ca. 72%) (Siegert, 2009, p. 35). Additionally, our findings from the Microcensus 2011 presented above show that young women with a Turkish migration background are *more likely* to be concentrated in female-dominated occupations than young women with or without a migration background. Because vocational qualifications are of crucial importance for a successful labour market career in Germany, this contributes to the lower labour market status of women with a Turkish migration background. Thus, in 2009, about 68% of women without and 53% of women with a migration background aged 15–65 were economically active, whereas the employment rate among women with a Turkish migration background was approximately 38% (Seebaß & Siegert, 2011, pp. 25, 27). The share of the economically active was markedly higher among women with a Turkish background who possessed a vocational qualification (Schührer, 2018, p. 34). When employed, women with a Turkish background were found more often in marginal or part-time employment, and they earned less than women without or with another migration background (Statistisches Bundesamt, 2019, pp. 443, 475–476).

One key reason for the lower uptake of apprenticeships and less smooth transitions from school to work among adolescents with a migration background is their poorer educational performance compared to adolescents without a migration background (Hunkler, 2014, p. 100). However, their grades, school-leaving qualifications, and social backgrounds cannot be the only reasons for their disadvantages in the transition to vocational education and training or to the labour market (Beicht, 2015, p. 60; Hunkler, 2014, pp. 99–100). One possible explanation for the remaining differences is that employers discriminate against the children of immigrants in their hiring decisions. Hunkler (2014, p. 253) showed that young women with a migration background—many of Turkish descent—had a much lower chance of entering more prestigious office jobs than young women without a migration background even

after controlling for a series of relevant background characteristics. Hunkler (2014, p. 254) assumes that this is due to statistical discrimination on the part of employers who probably expect young women with a migration background to start a family much earlier and take a longer career break than women without a migration background. Hunkler argues that employers might rationally prefer female adolescents without a migration background in order to maximize the returns on their investment in employee training.

To sum up, generally fewer young women than young men start an apprenticeship in Germany, and the young women who do so are concentrated mostly in a few, mainly female-dominated occupations. Female adolescents with a Turkish migration background are less successful in Germany's vocational education and training system than female adolescents with another or no migration background. Difficulties in finding apprenticeship positions translate into weak labour market outcomes. There is also evidence that young Turkish women are more concentrated in a small number of female-dominated occupations than majority native-born young women. Although previous research suggests that external constraints might play a key role in this regard (Diehl et al., 2009, p. 64; Hunkler, 2014, p. 254), the extent to which this concentration is related to young women's own occupational aspirations is unknown.

18.3 Theoretical Background and Expectations

Educational and occupational aspirations have gained prominence in social mobility and inequality research particularly through the Wisconsin model developed by Sewell et al. (1969). In this model, occupational aspirations play a key role in occupational attainment alongside parental socio-economic status and an individual's mental abilities. According to the authors (Sewell & Hauser, 1972), a large part of parental influences occurs via parental aspirations that are subsequently transmitted to their offspring. Scholars tend to differentiate between idealistic and realistic aspirations—a distinction that will also be relevant in our analyses. Whereas idealistic aspirations refer to desired future occupational attainment, realistic aspirations refer to the actually expected future occupational attainment—that is, they take existing constraints into account (Becker, 2010; Haller, 1968).

Based on the idea of the Wisconsin model that aspirations play a paramount role in occupational attainment, we argue that the phenomenon of occupational gender typing could be caused by gender-specific idealistic occupational aspirations. Because women of Turkish migration background are over-represented in female-dominated jobs in Germany, we expect that they also strive for these occupations in early adulthood.

We further argue that gender typing of occupational preferences can be explained by the extent to which young women differ with respect to (1) their orientations towards either family or labour market, (2) gender-role perceptions, (3) the importance they attach to the specific aspects of certain occupations, (4) parental—and

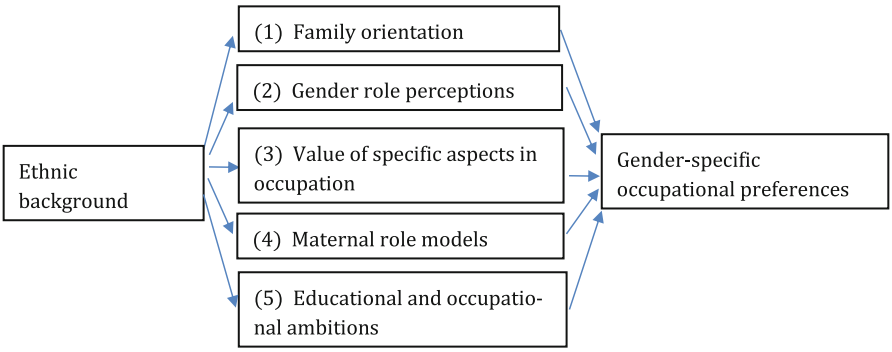


Fig. 18.1 Model to explain differences in gender-specific occupational aspirations between ethnic groups

particularly maternal—role models, and (5) the level of their occupational ambitions in general. We expect differences between young women with a Turkish migration background and those without a migration background in all these aspects. These differences should account for the variation in group-specific occupational aspirations (Fig. 18.1).

One of the most common explanations for why females and males are interested in different occupations is the gender-specific division of household tasks within families. It is argued that, because they do most of the household chores, women look for jobs that allow them to harmonize their employment with their family obligations (Becker, 1975, 1985; Polachek, 1981). This is why part-time jobs with flexible working hours are especially attractive to them (Busch, 2013, p. 38). Yet, although in Germany, employees in female-dominated occupations work on average fewer hours than employees in male-dominated or gender-integrated ones, employees in more male-dominated jobs have more flexible working schedules (Busch, 2013, p. 340).

What remains open in this approach, however, is, why women do most of the household chores. One explanation that takes this question into account is provided by gender-specific socialization theory (Eccles, 1987). Accordingly, normative gender-role perceptions are learned and internalized in the course of socialization, and these include, among other things, beliefs about gender-appropriate behaviour, the appropriate division of household duties between females and males, as well as appropriate occupations for women and men (Busch, 2013, pp. 44–46; Dunne, 1980).

Related to this are personal interest orientations. Socializing girls to be oriented towards family and household tasks generates specific values, orientations, and interests that are reflected in gender-specific occupational aspirations (see Achatz, 2008, p. 267; Busch, 2013, pp. 40–44). Indeed, especially occupational values that have a strong link to social aspects are considerably more pronounced among women than among men (e.g., Busch, 2013, p. 48), and this helps to explain genderspecific occupational aspirations (e.g., Busch, 2013, p. 338).

Furthermore, Eccles and Hoffman (1984) proposed that parents often serve as role models for their children who tend to align their occupational aspirations with their parents' occupations: boys look to their fathers and girls to their mothers. Whereas previous research has shown that parents' occupational positions, gender-role attitudes, and division of household roles influence their children's gender-role attitudes and occupational aspirations, this is less pronounced for girls than for boys (Busch, 2011, 2013, pp. 48–49; Helbig & Leuze, 2012; Moen et al., 1997).

The level of occupational aspirations is another factor to consider. Becker and Glauser (2015) argue that the motive of status maintenance influences not only school-related educational aspirations and decisions but also vocational aspirations and choices. The authors show empirically that the motive of status maintenance is important for gendered aspirations and decisions (Becker & Glauser, 2015). Because gender-integrated occupations are generally better paid (Cotter et al., 2004; Hakim, 1998; Magnusson, 2013) and more prestigious (Magnusson, 2009) than female- and male-dominated occupations, students from higher social classes can be expected to aspire primarily to integrated occupations. Indeed, Helbig and Leuze (2012) found that especially girls from upper social strata aspire less often than girls from lower social strata to female-dominated occupations.

With regard to young women with a Turkish migration background, previous research indicates that they are more family oriented than young women without a migration background (Weiss & Wittmann-Roumi Rassouli, 2007, p. 160) and that they do most of the family's household tasks (Becher & El-Menouar, 2014, p. 101). Furthermore, traditional gender-role perceptions are more prominent among adolescents with a Turkish migration background than among adolescents without a migration background (e.g., Becher & El-Menouar, 2014, pp. 67–69; Nauck, 1999, p. 52; Weiss & Wittmann-Roumi Rassouli, 2007, p. 160). With regard to role models, it has been shown that women with a Turkish migration background are less economically active than majority native-born women (Schührer, 2018, pp. 32–33; Stichs, 2008, p. 48); and, as already discussed, women with a Turkish migration background are also more likely to work in female-dominated occupations than women with another ethnic background. Consequently, it seems plausible to assume that female adolescents with a Turkish migration background are more likely to aspire to female-dominated occupations than their counterparts without a migration background, and that controlling for the above-discussed factors contributes to diminishing the gap between the two groups in the gender typing of their occupational preferences.

However, we must also take into account that students with a Turkish migration background have more ambitious educational (Salikutluk, 2016) as well as vocational and occupational aspirations than students without a migration background (e.g., Diehl et al., 2009, p. 57; Wicht, 2016). Because female- and even male-dominated occupations are generally less well paid (Cotter et al., 2004; Hakim, 1998; Magnusson, 2013) and less prestigious (Magnusson, 2009) than gender-integrated occupations, it is thus possible that young Turkish women in fact do not strive more for female-dominated occupations than young women without a migration background but rather for gender-integrated professions.

In sum, all aspects assumed to increase the likelihood that young women will aim for female-dominated occupations—family orientation, social occupational values, traditional gender-role attitudes, and the mother's labour market position—are more prevalent among women with a Turkish migration background than among those without a migration background. Only the fact that female adolescents with a Turkish migration background have more ambitious career aspirations could reduce the probability that they will gravitate to female-dominated occupations. We therefore expect that:

1. On average, female adolescents with a Turkish migration background aspire more often to female-dominated occupations and less often to integrated or male-dominated occupations than female adolescents without a migration background.
2. After accounting for family orientation, social occupational values, traditional gender-role perceptions, and the mother's labour market position, female adolescents with a Turkish migration background no longer aspire more to female-dominated occupations than female adolescents without a migration background. Instead, Turkish women prefer gender-integrated occupations due to the higher occupational status of their aspired professions.
3. After also controlling for the occupational status of the aspired professions, we no longer find any differences between female adolescents with a Turkish migration background and those without a migration background with regard to the gender specificity of the aspired occupation.

18.4 Data and Variables

For the empirical analyses, we use the first three waves from Starting Cohort 4 of the German NEPS (Blossfeld et al., 2014).[1] In this starting cohort, a representative sample of 9th graders in regular schools[2] (mostly 15 years old) was selected via stratified cluster sampling (Skopek et al., 2013). Wave 1 was collected at the beginning of Grade 9 (autumn 2010); Wave 2, at the end of Grade 9 (spring 2011); and Wave 3, in spring 2012. The large number of cases in the NEPS data allows us to focus on two specific subgroups: majority native-born girls and girls with a Turkish migration background (i.e., who themselves or of whom at least one parent was born in Turkey). The data also provide refined information on the girls' occupational aspirations as well as their normative gender-role perceptions, family orientation, and interest orientation.

[1] NEPS data were collected from 2008 to 2013 as part of the Framework Programme for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). Since 2014, the NEPS survey has been carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in cooperation with a nationwide network. See https://doi.org/10.5157/NEPS:SC4:6.0.0

[2] We excluded students attending special needs schools.

To measure the gender specificity of the aspired occupation, we use information from a question about the students' idealistic occupational aspirations: in Wave 2 students were asked to indicate their favoured profession (coded using ISCO-08) if they could choose any profession they wished. Because we are interested in the young women's occupational preferences that are influenced as little as possible by perceived or anticipated constraints, we focus on idealistic rather than realistic aspirations. If we were to use realistic instead of idealistic aspirations, we would run the risk of capturing not young women's original and unconstrained preferences but their expectations instead, and these are likely to differ from their actual preferences.

We calculate the level of gender specificity of each occupation based on the share of women in the profession as recorded in the Microcensus 2011. This is an annual, official, mandatory, and representative survey of 1% of German households.[3] To gain a sufficient number of cases to calculate the female share in an occupation, we use a 3-digit code of the ISCO-08 that combines similar professions (e.g., hotel managers and restaurant managers) into one category. We use this information to categorize professions into male-dominated (share of females ≤30%), integrated (share of females 30–70%), and female-dominated (share of females ≥70%) (Buchmann & Kriesi, 2012; Charles & Buchmann, 1994; Trappe, 2006). Although researchers often use this classification, it is not uncontested (Achatz, 2008; Becker & Glauser, 2015, p. 29). Therefore, we also test an alternative operationalization of the dependent variable in the form of a continuous variable indicating the overall share of women in the aspired occupations. The key results are similar.

To measure family orientation, we use information on how important it is for the respondents to have children sometime in the future measured on a scale from 1 (*very unimportant*) to 5 (*very important*) and the age at which they imagine having their first child (1 = *16–19 years old*, 6 = *never*).

Interest orientation is measured with six variables indicating practical/technical, intellectual/researching, artistic/literary, social, entrepreneurial, and conventional interests. Each variable is a mean score of three single items that were measured on a scale from 1 (*very little interest*) to 5 (*very interested*).

Normative gender-role perceptions are assessed by the extent of respondents' agreement with three statements: 'The proportion of women in politics should be equal to that of men', 'It's the man's job to earn money and the woman's job to take care of the household and family', and 'Men are better suited for certain professions than women'. Answer categories range from 1 (*completely disagree*) to 4 (*completely agree*).

We use information on the employment status of mothers and the gender specificity of their occupations as a proxy for the maternal role model. We differentiate between mothers who are not employed at all, those who are employed at least part time in a female-dominated occupation (share of females ≥70%), and those who are

[3] We used the Scientific Use File of the Microcensus 2011 that consists of a 70% subsample of the original survey (data provided by Federal and State Statistical Offices, Research Data Centres).

employed at least part time in an occupation that is not female dominated (share of females <70%).

The mothers' employment status was measured in Wave 1, and information on interest orientation and family orientation was gathered in Wave 2. Questions on normative gender-role perceptions were asked only in Wave 3, which means that they follow the dependent variable chronologically. Consequently, we run the multivariate analyses with and without the information on normative gender-role perceptions to check the robustness of our results. The key results remain unaltered independently of including the information from Wave 3.

The occupational status of the aspired professions is operationalized through applying the ISEI-08 to students' aspired occupations.

The multivariate analyses account for variables that could potentially affect students' occupational aspirations. We control for school achievement and attainment in two steps. In the first step, we differentiate between *Hauptschule* (lowest type of secondary school), *Realschule* (intermediate type of secondary school), and *Gymnasium* (highest type of secondary school). All students attending a comprehensive school or a school with more than one educational track are combined into a single fourth category. In the second step, we use the grades for mathematics and German from the previous school report card to measure school achievement (grades are rescaled so that higher values signify better school grades). Furthermore, we use detailed information about students' social background including the number of books in the household as well as the parents' highest educational attainment and highest occupational status (ISEI-08).[4] The information for all control variables was collected in Wave 1.

We handle missing information in the data by means of multiple imputations in STATA (mi command) (StataCorp, 2013), creating 20 data sets in which missing information was multiply imputed. For this purpose, we first include all dependent and independent variables as well as panel weights for the imputations and then exclude cases with missing information on the dependent variables from our analyses (MID method; von Hippel, 2007). This procedure usually increases efficiency and produces the most accurate estimates. Our sample consists of 3758 majority native-born girls and 315 girls with a Turkish migration background. All results are based on multiply imputed data sets considering panel weights for Waves 1 and 2. In the multivariate analyses we run multinomial logistic regressions and report average marginal effects. Due to the stratified cluster sampling, we use clustered standard errors that allow for intragroup correlations within schools in the regression models.

[4]To measure parents' education and occupation, we use information from the parent questionnaire. If no information from the parents is available, information from the adolescents is used instead. If information on only one parent is available, this information is used.

18.5 Analyses and Results

18.5.1 Descriptive Evidence

We find that about two thirds of the girls—regardless of their migration background—aspire to an integrated occupation; about one quarter, to a female-dominated occupation; and only 11%, to a male-dominated one (see Table 18.1). Contrary to our expectations, Turkish girls are slightly less likely to aspire to female-dominated occupations and more likely to aspire to integrated ones than majority native-born girls. We find no differences between the two ethnic groups regarding aspirations for male-dominated occupations. This finding suggests that considerations of occupational status might have a stronger impact than socialization and gender-role attitudes on the gender specificity of the aspired occupation.

With regard to our key independent variables (Table 18.2), we find the expected large differences in mothers' employment status: more than 80% of majority native-born mothers are employed at least part time compared to only about one half of the Turkish mothers. Furthermore, among those mothers who are employed, the proportion of Turkish mothers working in female-dominated occupations is much higher. In line with expectations derived from socialization theory, we also find that Turkish girls have a stronger interest in occupational values related to social aspects than majority native-born girls. Whereas the differences in practical/technical and entrepreneurial interests are more pronounced between majority native-born and Turkish girls, ethnic differences are rather small overall. The results for family orientation are also less clear-cut than expected. Although Turkish girls wish to have children earlier than majority native-born girls, both groups attach the same level of importance to having children in general. Finally, even though we find that Turkish girls tend to have more traditional views than majority native-born girls, the two groups have similar views regarding whether men are better suited to certain professions than women. If traditional gender-role attitudes do indeed shape beliefs about appropriate occupations for females and males, which then influence occupational aspirations, we should have found differences between the groups here.

In sum, the differences between majority native-born and Turkish girls in terms of interest orientation, family orientation, and normative gender-role perceptions point

Table 18.1 Gender specificity of aspired occupation

Occupation	No migration background	Turkish migration background	Overall
Male-dominated	11.2%	11.2%	11.2%
Integrated	62.4%	67.4%$^{+}$	62.8%
Female-dominated	26.4%	21.4%$^{+}$	26.0%
N	3758	315	4073

Sources: NEPS-SC4_R_6-0-0; own calculations and illustration
Missing data are handled using multiple imputation (MID method). Significance of the difference between majority native-born German girls and girls with a Turkish migration background: $^{+}p < 0.10$, $*p < 0.05$, $**p < 0.01$. Data weighted

Table 18.2 Key independent and control variables

	No migration background	Turkish migration background
Family orientation (1 = very unimportant, 5 = very important)		
Importance of having children	MV: 3.93	MV: 3.94
Aspired age to have first child (1 = 16–19 years old, 6 never)	MV: 2.98	MV: 2.79**
Interest orientation (1 = very little interest, 5 = very interested)		
Practical/technical	MV: 2.34	MV: 2.45^{+}
Intellectual/research-related interests	MV: 2.49	MV: 2.61
Artistic/linguistic interests	MV: 2.91	MV: 2.80
Social	MV: 3.48	MV: 3.60*
Entrepreneurial	MV: 2.99	MV: 3.22**
Conventional	MV: 2.44	MV: 2.78**
Normative gender role perceptions (1 = completely disagree, 4 = completely agree)		
Equal proportion of men and women in politics	MV: 3.59	MV: 3.44*
Men should earn money, women should take care of household	MV: 1.53	MV: 1.80**
Men better suited to certain professions	MV: 2.70	MV: 2.73
Mother's employment status		
Not employed or only part time	17.3%	45.5%**
Employed in female-dominated job	47.5%	36.1%**
Employed in not female-dominated job	35.2%	18.4%**
Socioeconomic status (ISEI-08) of aspired profession	MV: 64.51	MV: 69.21**
N	3758	315

Sources: NEPS-SC4_R_6-0-0; own calculations and illustration
Missing data are handled using multiple imputation (MID method). Significance of the difference between native-born German girls and girls with a Turkish migration background: $^{+}p < 0.10$, $*p < 0.05$, $**p < 0.01$; data weighted

in the expected direction, but they are less pronounced than expected. On the contrary, results confirm that Turkish girls have substantively higher idealistic occupational aspirations than majority native-born girls. These results may explain why we did not find the expected pattern of gender specificity of students' aspired occupations. The differences in interest orientation, family orientation, and normative gender-role attitudes between majority native-born and Turkish girls are possibly too weak to yield meaningful differences in the gender specificity of the aspired occupation. At the same time, the differences in the level of occupational aspirations might be strong enough to cancel the possible cumulative effects of the above-mentioned factors.

18.5.2 Multivariate Analyses

Figure 18.2 reports the average marginal effects from the multinomial regression models of the gender specificity of the aspired occupation on the ethnicity of the female students.[5] In a first step, we run a model without control variables that replicates the bivariate findings: whereas majority native-born and Turkish girls are equally likely to aspire to a male-dominated job, the probability of aspiring to an integrated profession is about 5 percentage points higher for Turkish than for majority native-born girls, and the probability of aspiring to a female-dominated job is roughly 5 percentage points lower (Model 1). After controlling for school achievement and attainment and for family background, these initially unexpected differences substantially increase to about 15 and 14 percentage points respectively (Model 2).

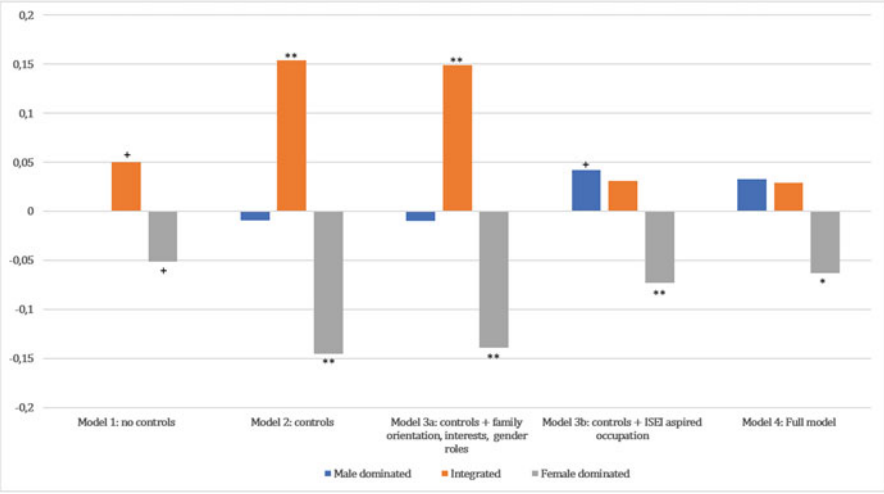


Fig. 18.2 Average marginal effects from multinomial regression models of the gender specificity of the aspired occupation on the ethnicity of the female students (Turkish vs. majority native-born girls)
Sources: NEPS-SC4_R_6-0-0; own calculation and illustration. *Note:* Results based on multinomial logit regressions. Average marginal effects shown. *Significance:* $^{+}p < 0.10$, $*p < 0.05$, $**p < 0.01$; data weighted. Missing data are handled using multiple imputation (MID method)

[5] Because we have no clear theoretical assumptions about differences in the effects of the independent variables between majority native-born and Turkish girls, we do not include interaction effects with ethnicity in our main models in order to keep them parsimonious. To check whether our results are not influenced substantially by this decision, we additionally run models in which we interact all control variables with ethnicity. The main results concerning differences between majority native-born and Turkish girls in the gender specificity of the aspired occupation (average marginal effects) are similar to our main specification (see Fig. 18.A1 in the appendix).

The effect sizes remain largely unchanged when adding our indicators of family orientation, interest orientation, normative gender-role perceptions, and mothers' employment status (Model 3).[6] This does not mean that these variables themselves do not affect the gender specificity of the aspired professions. Indeed, only family orientation is largely irrelevant; most other indicators show significant coefficients in the expected direction. Yet, these indicators do not substantially alter the between-group differences in gender-specific occupational preferences (Table 18.A1 in the Appendix).

Finally, taking the socio-economic status of the aspired professions into account explains most of the ethnic differences in gender specificity between native-born and Turkish girls (Models 3b and 4). As a result, the sizes of the differences are again similar to the bivariate findings, but now the difference in the probability of aspiring to a female-dominated occupation is statistically significant on the 5% level, whereas no statistically significant differences in aspiring to an integrated occupation are found between the two groups. Differences in the probability of aspiring to male-dominated occupations between majority native-born and Turkish girls are substantially and statistically non-significant in all model specifications.

We can therefore conclude that, contrary to our expectations, Turkish girls do *not* aspire to female-dominated jobs more than majority native-born girls do, even though native-born girls are more likely to have employed mothers, better school achievement, and a higher-status family background. Our results suggest that this finding can be explained largely by the high career aspirations of young women of Turkish origin and the fact that gender-mixed occupations generally have a higher socio-economic status than female-dominated occupations.

18.6 Conclusions and Discussion

Women with a Turkish migration background are less likely to be economically active, more likely to be unemployed, and more likely to be employed in low-paid, low-status jobs than other women with or without a migration background (e.g., Schührer, 2018, pp. 32–33; Stichs, 2008, p. 48). Improving their labour market situation would require considerable efforts to enhance their human capital and particularly their vocational skills.

It seems problematic in this regard that comparatively few Turkish girls start apprenticeships, and that those who do tend to pursue apprenticeships in female-dominated occupations (BMBF, 2019, p. 67; Siegert, 2009, p. 35). The concentration in female-dominated occupations reinforces the relatively weak labour market position of women with a Turkish migration background in Germany, because

[6] Additional analyses show that the main results do not change when we do not consider normative gender-role perceptions in our multivariate models.

female-dominated occupations are, on average, less well paid and offer limited career mobility (Cotter et al., 2004; Hakim, 1998; Magnusson, 2009, 2013).

Against this background, we investigated whether young women of Turkish descent tend to self-select into female-dominated occupations more than women without a migration background, because these occupations are more reconcilable with family obligations, offer tasks and a professional environment that coincide with so called female interests and skills, and are commonly considered appropriate for women.

We focused our analyses on comparing the gender-specific occupational preferences of female adolescents with a Turkish migration background to those of female adolescents without any migration background, and we related these preferences to the young women's interests, family orientations, normative gender-role perceptions, and the socio-economic status of the aspired profession.

Contrary to our expectations, results indicate that Turkish girls less often aspire to female-dominated occupations than majority native-born girls. Instead, they prefer integrated occupations that tend to be more prestigious and better paid. This might be due mostly to their ambitious occupational aspirations, because the gap between native-born and Turkish girls is reduced substantively after controlling for aspirations.

In contrast, ethnic differences in the gender typicality of occupational aspirations are largely unaffected once the gender specificity of interests, family orientation, and normative gender-role perceptions are accounted for in the multivariate analyses. This indicates that the motive to maintain or improve one's status is indeed very important for gender-specific occupational aspirations and decisions (see Becker & Glauser, 2015). However, we must also consider that the gender typicality of the gender-specific socialization factors did not differ substantially between the groups.

The question remains, however, why female adolescents with a Turkish migration background are so often in disadvantaged labour market positions, even though they start out with high aspirations and generally do *not* aspire more to work in female-dominated occupations. The most obvious explanation is that external constraints prevent Turkish girls from obtaining their desired professions. Diehl et al. (2009, p. 58) show that adolescents with a migration background have much lower chances of securing their desired apprenticeship than those without a migration background. Hunkler (2014, p. 253) likewise finds that young women with a migration background have lower chances of obtaining a more prestigious office job than young women without this background.

Because integrated occupations normally require better school-leaving qualifications than female-dominated jobs do, it seems obvious that the discrepancy between aspirations and reality is due largely to the rather weak educational performance of Turkish girls that fails to match their career aspirations. Our finding that the ethnic gap is explained strongly by the high career aspirations of young women of Turkish origin also points in this direction.

Because NEPS data provide information on both idealistic and realistic occupational aspirations of 9th graders (both measured in Wave 2), we can investigate this

Table 18.3 Gender specificity of aspired vs. expected occupation

	No migration background		Turkish migration background	
Occupation	Desired occupation	Expected occupation	Desired occupation	Expected occupation
Male-dominated	11.2%	10.4%	11.2%	7.1%
Integrated	62.4%	48.2%	67.4%	47.4%
Female-dominated	26.4%	41.4%	21.4%	45.5%
N	3758		315	

Sources: NEPS-SC4_R_6-0-0; own calculations and illustration
Note: Missing data are handled using multiple imputation (MID method)

question further by contrasting *desired*—that is, idealistic aspirations—with *expected* reality—that is, realistic aspirations.[7]

Both native-born German and Turkish young women clearly tend to expect that they will end up in a female-dominated occupation, although this is not what they want (Table 18.3). This is in line with Kleinert and Schels (2020), who find that occupational aspirations and the final occupational placement become increasingly gendered in the course of the transition from school to work, especially for young women. Yet, this discrepancy between idealistic and realistic aspirations is substantively larger for Turkish girls (about 24 percentage points) than for majority native-born girls (about 15 percentage points). Thus, already at this young age, a substantive share of girls with a Turkish migration background seem to anticipate that they will not attain their goals.

It also becomes clear that, whereas majority native-born girls are more likely to aspire to female-dominated occupations than Turkish girls, the opposite is true when it comes to expected occupations. This underlines the importance of focusing on the idealistic aspirations to answer our main research question: had we used the realistic aspirations, we would have come to the conclusion that young women with a Turkish migration background not only end up more often in female-dominated occupations than young women without a migration background but also more often aspire to do so.

With regard to the question why young women of Turkish descent are more likely to end up in female-dominated occupations than women without a migration background, we have shown that this cannot be attributed to their original preferences. Our results rather suggest that the actual labour market placement of young Turkish women is strongly affected by external conditions pushing them into female-dominated occupations. In light of this, there is a need for more research that takes a life-course perspective and identifies critical transitions and events that push (Turkish) women into female-dominated occupations.

[7] The question measuring realistic occupational aspirations was: 'Based on everything you currently know, what profession will you most likely have later on?'

Appendix

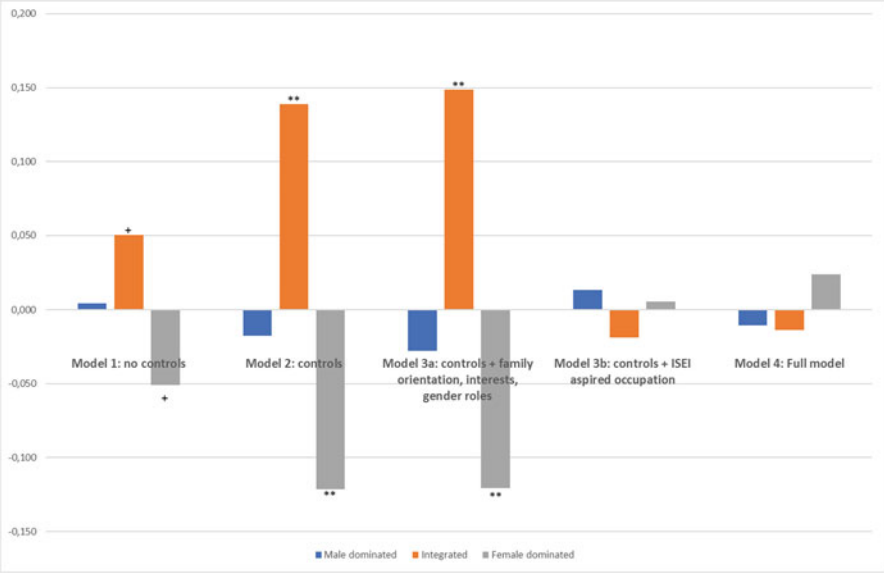


Fig. 18.A1 Average marginal effects from multinomial regression models of the gender specificity of the aspired occupation on the ethnicity of the female students (Turkish vs. majority native-born girls)—full interaction model
Sources: NEPS-SC4_R_6-0-0; own calculation and illustration. *Note:* Results based on multinomial logit regressions. Average marginal effects shown. *Significance:* +p < 0.10, *p < 0.05, **p < 0.01; data weighted. Missing data are handled using multiple imputation (MID method)

Table 18.A1 multinomial regression model of the gender specificity of the aspired occupation on the ethnicity of the female students (Turkish vs. majority native-born girls)

	Male-dominated	Integrated	Female-dominated
Turkish (*Ref: Native*)	0.033	0.029	−0.063*
Type of school (*Ref: Gymnasium*)			
Hauptschule	−0.005	−0.104**	0.109**
Comprehensive school	−0.008	−0.098**	0.106**
Realschule	−0.019	−0.059**	0.078**
Grade German	−0.004	0.010	−0.006
Grade mathematics	0.004	0.007	−0.011
Highest occupational status parents (ISEI-08)	0.000	−0.000	0.000
Highest qualification parents (*Ref: Lower sec. degree with apprenticeship or less*)			
Intermediate sec. degree (with apprenticeship)	0.035*	−0.021	−0.014
At least Abitur	0.040*	−0.013	−0.027

(continued)

Table 18.A1 (continued)

	Male-dominated	Integrated	Female-dominated
Books in household	0.001	0.010	−0.011*
Practical/technical interests	0.043**	−0.019*	−0.024**
Intellectual/research related interests	0.010	−0.016*	0.005
Artistical/linguistical interests	−0.021**	0.044**	−0.023**
Social interests	−0.028**	−0.052**	0.081**
Entrepreneurial interests	0.032**	0.023*	−0.055**
Conventional interests	−0.018*	0.011	0.008
Importance to have children	−0.000	0.001	−0.000
Aspired age first child	0.003	0.006	−0.010
Equal proportion men and women in politics	−0.009	0.011	−0.002
Men should earn money, women should take care of household	−0.021*	−0.002	0.023*
Men better suited for certain professions	0.008	0.008	−0.016*
Mother's employment status (*Ref: Not employed at least part time*)			
Employed in female-dominated job	−0.006	0.027	−0.021
Employed in not female-dominated job	0.002	0.036+	−0.038*
Socioeconomic status (ISEI-08) of aspired profession	−0.003**	0.010**	−0.007**
N		4073	

Sources: NEPS-SC4_R_6-0-0; own calculations and illustration
Note: Results based on multinomial logit regressions. Average marginal effects shown
Significance: +p < 0.10, *p < 0.05, **p < 0.01; data weighted. Missing data are handled using multiple imputation (MID method)

References

Achatz, J. (2008). Geschlechtersegregation im Arbeitsmarkt. In M. Abraham & T. Hinz (Eds.), *Arbeitsmarktsoziologie. Probleme, Theorien, empirische Befunde* (pp. 263–302). VS Verlag für Sozialwissenschaften.

Becher, I., & El-Menouar, Y. (2014). *Geschlechterrollen bei Deutschen und Zuwanderern christlicher und muslimischer Religionszugehörigkeit* (Forschungsbericht des Bundesamtes für Migration und Flüchtlinge No. 21). Bundesamt für Migration und Flüchtlinge.

Becker, G. S. (1975). *Human capital: A theoretical and empirical analysis with special reference to education*. Columbia University Press.

Becker, G. S. (1985). Human capital, effort, and the sexual division of labor. *Journal of Labor Economics, 3*, 33–58.

Becker, B. (2010). *Bildungsaspirationen von Migranten—Determinanten und Umsetzung in Bildungsergebnisse* (Working Paper No. 137, 210). Mannheimer Zentrum für Europäische Sozialforschung.

Becker, R., & Glauser, D. (2015). Geschlechtsspezifische Berufswünsche und Ausbildungsentscheidungen. In K. Häfeli, M. P. Neuenschwander, & S. Schumann (Eds.), *Berufliche Passagen im Lebenslauf* (pp. 21–47). Springer VS.

Beicht, U. (2015). *Berufliche Orientierung junger Menschen mit Migrationshintergrund und ihre Erfolgschancen beim Übergang in betriebliche Berufsausbildung. Überblick über Ergebnisse quantitativer Forschung der letzten zehn Jahre in Deutschland sowie vergleichende Analysen auf Basis der BIBB-Übergangsstudien und der BA/BIBB-Bewerberbefragungen* (Wissenschaftliches Diskussionspapier des Bundesinstituts für Berufsbildung No. 163). Bundesinstituts für Berufsbildung.

Blossfeld, H.-P., Rossbach, H.-G., & von Maurice, J. (2014). *Education as a lifelong process: The German National Educational Panel Study (NEPS)* (Second revised edition). Springer VS.

Buchmann, M., & Kriesi, I. (2012). Geschlechtstypische Berufswahl: Begabungszuschreibungen, Aspirationen und Institutionen. In R. Becker & H. Solga (Eds.), *Soziologische Bildungsforschung. Sonderheft 52 der Kölner Zeitschrift für Soziologie und Sozialpsychologie* (pp. 256–280). Verlag für Sozialwissenschaften.

Bundesministerium für Bildung und Forschung (Ed.). (2019). *Berufsbildungsbericht 2019*. BMBF.

Busch, A. (2011). *Determinants of occupational gender segregation: Work values and gender (A) typical occupational preferences of adolescents* (SFB 882 Working Paper Series No. 2).

Busch, A. (2013). *Die berufliche Geschlechtersegregation in Deutschland. Ursachen, Reproduktion, Folgen*. Springer VS.

Charles, M., & Buchmann, M. (1994). Assessing micro-level explanations of occupational sex segregation: Human-capital development and labour market opportunities in Switzerland. *Schweizerische Zeitschrift für Soziologie, 20*, 595–620.

Cotter, D. A., Hermsen, J. M., & Vanneman, R. (2004). *Gender inequality at work*. Russell Sage Foundation.

Diehl, C., Friedrich, M., & Hall, A. (2009). Jugendliche ausländischer Herkunft beim Übergang in die Berufsausbildung: Vom Wollen, Können und Dürfen. *Zeitschrift für Soziologie, 38*(1), 48–67.

Dunne, F. (1980). Occupational sex-stereotyping among rural young women and men. *Rural Sociology, 45*, 396–415.

Dütsch, M., Liebig, V., & Struck, O. (2013). Erosion oder Stabilität der Beruflichkeit? Eine Analyse der Entwicklung und Determinanten beruflicher Mobilität. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 65*, 505–531.

Eccles, J. (1987). Gender roles and women's achievement-related decisions. *Psychology of Women Quarterly, 11*, 135–172.

Eccles, J. S., & Hoffman, L. W. (1984). Sex roles, socialization, and occupational behavior. In H. W. Stevenson & A. E. Siegel (Eds.), *Child development research and social policy* (Vol. 1, pp. 367–420). University of Chicago Press.

Hakim, C. (1998). *Social change and innovation in the labour market: Evidence from the census SARs on occupational segregation and labour mobility, part-time working and student jobs*. Oxford University Press.

Haller, A. O. (1968). On the concept of aspiration. *Rural Sociology, 33*, 484–487.

Helbig, M., & Leuze, K. (2012). Ich will Feuerwehrmann werden! Wie Eltern, individuelle Leistungen und schulische Fördermaßnahmen geschlechts(un-)typische Berufsaspirationen prägen. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 69*, 91–122.

Hunkler, C. (2014). *Ethnische Ungleichheit beim Zugang zu Ausbildungsplätzen im dualen System*. Springer VS.

Kleinert, C., & Schels, B. (2020). Zurück zur Norm? Kompromissbildung zwischen geschlechtstypischen und –untypischen Berufsaspirationen, Bewerbungs- und Ausbildungsberufen. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 72*(Suppl 1), 229–260.

Konietzka, D. (1999). *Ausbildung und Beruf. Die Geburtsjahrgänge 1919–1961 auf dem Weg von der Schule in das Erwerbsleben*. VS Verlag für Sozialwissenschaften.

Magnusson, C. (2009). Gender, occupational prestige, and wages: A test of devaluation theory. *European Sociological Review, 25*(1), 87–101.

Magnusson, C. (2013). More women, lower pay? Occupational sex composition, wages and wage growth. *Acta Sociologica, 56*(3), 227–245.

Moen, P., Erickson, M. A., & Dempster-McClain, D. (1997). Their mother's daughters? The intergenerational transmission of gender attitudes in a world of changing roles. *Journal of Marriage and Family, 59*(2), 281–293.

Müller, W., & Kogan, I. (2010). Education. In S. Immerfall & T. Göran (Eds.), *Handbook of European societies. Social transformations in the 21st century* (pp. 217–290). Springer.

Nauck, B. (1999). Sozialer und intergenerativer Wandel in Migrantenfamilien in Deutschland. In R. Buchegger (Ed.), *Migranten und Flüchtlinge: Eine familienwissenschaftliche Annäherung* (pp. 13–69). Österreichisches Institut für Familienforschung.

Polachek, S. W. (1981). Occupational self-selection: A human capital approach to sex differences in occupational structure. *Review of Economics and Statistics, 63*, 60–69.

Salikutluk, Z. (2016). Why do immigrant students aim high? Explaining the aspiration-achievement paradox of immigrants in Germany. *European Sociological Review, 32*(5), 581–592.

Salikutluk, Z., Giesecke, J., & Kroh, M. (2020). *The situation of female immigrants on the German labour market: A multi-perspective approach* (SOEP papers on Multidisciplinary Panel Data Research No. 1072).

Schührer, S. (2018). *Türkeistämmige Personen in Deutschland. Erkenntnisse aus der Repräsentativuntersuchung „Ausgewählte Migrantengruppen in Deutschland 2015" (RAM)* (Working Paper des Forschungszentrums des Bundesamtes für Migration und Flüchtlinge No. 81). Bundesamt für Migration und Flüchtlinge.

Seebaß, K., & Siegert, M. (2011). *Migranten am Arbeitsmarkt in Deutschland* (Working Paper 36 der Forschungsgruppe des Bundesamtes, aus der Reihe „Integrationsreport", No. 9). Bundesamt für Migration und Flüchtlinge.

Sewell, W., & Hauser, R. (1972). Causes and consequences of higher education: Models of the status attainment process. *American Journal of Agricultural Economics, 54*(5), 851–861.

Sewell, W. H., Archibald, O. H., & Portes, A. (1969). The educational and early occupational attainment process. *American Sociological Review, 34*, 82–92.

Siegert, M. (2009). *Berufliche und akademische Ausbildung von Migranten in Deutschland* (Working Paper 22 der Forschungsgruppe des Bundesamtes, aus der Reihe „Integrationsreport", No. 5). Bundesamt für Migration und Flüchtlinge.

Skopek, J., Pink, S., & Bela, D. (2013). *Starting cohort 4: 9th grade (SC4) SUF version 1.1.0 data manual—National Educational Panel Study (NEPS)*. University of Bamberg.

StataCorp. (2013). *Stata multiple-imputation reference manual—Release 13*. Stata Press.

Statistisches Bundesamt. (2019). *Bevölkerung und Erwerbstätigkeit. Bevölkerung mit Migrationshintergrund—Ergebnisse des Mikrozensus 2018* (Fachserie 1 Reihe 2.2).

Statistisches Bundesamt. (2020). *Bevölkerung und Erwerbstätigkeit. Bevölkerung mit Migrationshintergrund—Ergebnisse des Mikrozensus 2019* (Fachserie 1 Reihe 2.2).

Statistisches Bundesamt/Wissenschaftszentrum Berlin für Sozialforschung. (2016). Datenreport 2016. *Ein Sozialbericht für die Bundesrepublik Deutschland*. In *Zusammenarbeit mit: Das Sozio-oekonomische Panel (SOEP) am Deutschen Institut für Wirtschaftsforschung* (DIW Berlin). Bundeszentrale für politische Bildung (bpb).

Stichs, A. (2008). *Arbeitsmarktintegration von Frauen ausländischer Nationalität in Deutschland. Eine vergleichende Analyse über türkische, italienische, griechische und polnische Frauen sowie Frauen aus den Nachfolgestaaten des ehemaligen Jugoslawiens* (Working Paper der Forschungsgruppe des Bundesamtes für Migration und Flüchtlinge No. 20). Bundesamt für Migration und Flüchtlinge.

Trappe, H. (2006). Berufliche Segregation im Kontext. Über einige Folgen geschlechtstypischer Berufsentscheidungen in Ost- und Westdeutschland. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 58*(1), 50–78.

von Hippel, P. T. (2007). Regression with missing Ys: An improved strategy for analyzing multiply imputed data. *Sociological Methodology, 37*, 83–117.

Weiss, H., & Wittmann-Roumi Rassouli, M. (2007). Ethnische Traditionen, religiöse Bindungen und „civic identity". In H. Weiss (Ed.), *Leben in zwei Welten. Zur sozialen Integration ausländischer Jugendlicher der zweiten Generation* (pp. 155–188). VS Verlag für Sozialwissenschaften.

Wicht, A. (2016). Occupational aspirations and ethnic school segregation: Social contagion effects among native German and immigrant youths. *Journal of Ethnic and Migration Studies, 42*, 1825–1845.

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