



**Center for
Educational Research**

The Center for Educational Research

The **Center for Educational Research** (Director: Jürgen Baumert) examines learning and development from an institutional point of view. Educational settings such as schools offer a variety of developmental opportunities, but at the same time exclude others. The impact of such settings is investigated from three perspectives: (1) the long-term consequences of schools' opportunity structures on individual development in terms of cognitive competencies as well as motivational and social resources; (2) international comparison of the outcomes of schooling in the fields of reading comprehension, mathematics and science literacy; and (3) improvement of learning and instruction in terms of the cognitive activation of students, mainly in science and mathematics.



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Introductory Overview

The specific concern of the Center for Educational Research (CER) is the study of development and learning from the perspective of institutionalized education. Educational settings such as schools provide a specific structure of opportunities and constraints for learning and development. This structure offers a variety of developmental opportunities, but at the same time excludes others. How do the learning gains of students in different schools or school types differ? How do teachers' pedagogical knowledge, content knowledge, and pedagogical content knowledge differ, and to what extent do these differences influence student learning gains? How do aspects of schooling affect the intra- and interindividual differentiation of personality traits and guide career-forming processes? How strongly do students themselves actively influence their own academic development—for example, by selecting or switching learning environments? What role does family background play in student development, the selection of learning environments, and the optimization of academic outcomes? These and other questions are explored by a multidisciplinary team including educational scientists, psychologists, mathematicians, and sociologists.

Conceptual Orientation: Knowledge Acquisition and Psychosocial Development in the Context of Institutional Learning Settings

Learning in institutional settings is a complex and multidetermined process. It is fundamentally difficult to determine whether a school career and a student's learning outcomes can be described as successful. It is even more difficult to identify the causes of success or failure. Although popular with the public, press, and policy makers, simple explanatory models relying on a single factor to explain successful or unsuccessful learning processes are usually insufficient, if not entirely misleading. Given the complexity of learning in institutional contexts, our Center's research program is guided by multiple perspectives. The interactive nature of individual student characteristics and institutionalized learning settings must be taken into account. In all of our research, learners are perceived as the coproducers of their own development. Special attention is paid to how cognitive activation and self-regulation can be stimulated and supported by instructional environments. Moreover, we assume that individual students proactively select and shape their developmental environments. A comprehensive analysis of institutional opportunities and constraints requires researchers to consider several contextual levels, including countries, schools, classrooms, and the family. Accordingly, our research is

embedded in a multilevel perspective, both conceptually and methodologically, and addresses these different contextual levels. It is important to analyze the effects of various facets of these learning contexts simultaneously. For this reason, our research models incorporate conceptually different facets, such as the curriculum, the quality of instruction, and the composition of the learning group. Because both educational systems and society as a whole change over time, it is crucial that researchers remain attuned to the historical time in which learning takes place. We therefore embed our research in historical analyses and conduct studies to document the effects of changes in institutional settings. The domain specificity of knowledge acquisition is determined by the way in which educational institutions structure content areas into different academic subjects. Our research focuses on domains of knowledge, such as reading, mathematics, English as a foreign language, and sciences. These domains represent basic cultural tools that are critical for individual development in modern societies. Although the acquisition of knowledge in core domains is the central variable in learning settings, it is not the only aspect of interest. We also investigate students' motivation, personality, personal goals, and values as both outcomes of institutional learning and predictors of academic success and choices.

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Schroeder, S., Richter, T., McElvany, N., Hachfeld, A., Baumert, J., Schnotz, W., Horz, H., & Ullrich, M. (2011). Teachers' beliefs, instructional behaviors, and students' engagement in learning from texts with instructional pictures. *Learning and Instruction, 21*, 403–415. doi: 10.1016/j.learninstruc.2010.06.001

Trautwein, U., Köller, O., Lehmann, R., & Lüdtke, O. (Eds.). (2007). *Schulleistungen von Abiturienten: Regionale, schulformbezogene und soziale Disparitäten*. Münster: Waxmann.

Voss, T., Kunter, M., & Baumert, J. (in press). Assessing teacher candidates' general pedagogical and psychological knowledge: Test construction and validation. *Journal of Educational Psychology*.

We use various methodological approaches to identify powerful learning environments, with experiments and intervention studies complementing large-scale longitudinal studies.

Summary Outline

Work at the Center for Educational Research is organized into four Research Areas, which also provide the structure for this Research Report. It should, however, be noted that there is considerable overlap between the Research Areas in terms of researchers, topics, and methods.

Research Area I focuses on the relationship between the opportunity structures of schools and the optimization of individual development in terms of cognitive competencies, motivational and social resources, value commitment, and successful transitions to university education, vocational training, and the labor market.

Research Area II examines how institutional, individual, and familial factors relate to transitions in the educational system. A main focus of the activities in this Research Area is the Center's participation in the Trends in International Mathematics and Science Study (TIMSS), with the development of an additional module to examine the transition from elementary to secondary school. Another emphasis is on the transition from school to university.

The research questions addressed within Research Area III draw on a key finding of PISA 2000, 2003, and 2006. In Germany, at least 25% of the upcoming generation can be identified as potentially at risk in terms of reading literacy. Research Area III uses longitudinal, cross-correlational, and experimental studies to examine how students' reading literacy and language skills develop, and how they can be effectively assessed and promoted.

Research Area IV investigates teacher competence as an important antecedent of educational quality. Drawing on earlier research that identified factors of successful learning environments, the research focus has shifted to the role that teachers play in creating such high-quality instructional settings. Based on a theoretical model of teacher competence, we

investigate how teachers' knowledge, beliefs, and psychological functioning determine their instructional practices. Moreover, we examine how these aspects of teacher competence are shaped and changed within formal learning settings, such as the practical phase of teacher education.

Transformation of the Center for Educational Research to a Virtual Network

From 1996 to 2010, over a period of 14 years, work at the Center for Educational Research has been characterized by continuity and progressive development across successive generations of researchers. The specific concern of the Center has been the study of development and learning from the perspective of institutionalized education. The Center, with its four Research Areas, has profoundly influenced the agenda of educational research in Germany. This applies in equal measure to the study of how institutional opportunities and constraints influence individual developmental trajectories; to the analysis of critical points of transition in childhood, adolescence, and young adulthood; and to the examination of learning and instruction from a domain-specific perspective. What began in 1996 at the Max Planck Institute for Human Development as an integrated and coherent long-term research program has now developed into a dynamic and vibrant network. In an almost natural process, the program has come to its planned conclusion at the Max Planck Institute for Human Development and, at the same time, is being continued, in new and evolved form, in other locations. The large-scale longitudinal studies on institutional influences have moved to the University of Tübingen (Ulrich Trautwein); research on transitions in the educational system is being continued from a lifespan perspective at the University of Potsdam (Kai Maaz); intervention-based reading research has gone to the University of Dortmund (Nele McElvany); and research on teacher competence, instructional quality, and student progress is now based at the University of Frankfurt a. M. (Mareike Kunter). These new centers have developed their own dynamic and innovative research agendas. Finally, the new Berlin

study, which takes advantage of a unique historical opportunity to examine the effects of the reform of Berlin's secondary system to a two-track system in a natural experiment, links Jürgen Baumert's emeritus position at the Max Planck Institute for Human Development in Berlin with the University of Potsdam (Kai Maaz) and the Leibniz Institute for Science and Mathematics Education (IPN) in Kiel (Olaf Köller).

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Research Area I: Opportunity Structures of School and Individual Development in Adolescence and Young Adulthood

The successful development of human beings across the lifespan is dependent both on individual characteristics and on external socializers, such as significant others and social institutions. The social institution of school plays a major role during childhood and adolescence, particularly in the domain of academic learning and, more generally, cognitive development. Furthermore, schools influence the development of motivation, emotions, attitudes, and other personal characteristics. Major research topics addressed in Research Area I include the opportunity structures open to students from different backgrounds, academic achievement trajectories across secondary education, the educational standards attained in German upper secondary schools, the comparability of the school-leaving qualifications awarded across Germany, and determinants and consequences of different academic biographies. Research Area I was one of the cornerstones of the Center for Educational Research from its foundation in 1996 until Jürgen Baumert's retirement in mid-2010, yielding a multitude of theoretically and practically significant findings. In this report, we outline the empirical databases used and several key findings of Research Area I, describe results from one study (TOSCA-Repeat) in more depth, and, finally, give an outlook on how the projects will continue after conclusion of the Center's work.

The Empirical Database

Given its theoretical focus on institutional influences on human development, the research conducted within Research Area I entails longitudinal multilevel studies that collect data at the country, state, school, class, and individual levels, cover more than one knowledge domain, and allow both intraindividual change across domains and interindividual differences in patterns of intraindividual change to be investigated. The Research Area's flagship studies were designed to investigate how learning contexts in school and college environments affect human development while meeting the requirements of multilevel longitudinal designs. This applies to *Learning Processes, Educational Careers, and Psychosocial Development in Adolescence and Young Adulthood* (BIJU; see Figure 4); *Transformation of the Secondary School System and Academic Careers* (TOSCA; see Figure 5); and *Tradition and Innovation: Development at Hauptschule and Realschule in Baden-Wuerttemberg and at Mittelschule in Saxony* (TRAIN; see Figure 6). The analyses conducted in Research Area I also draw on PISA and TIMSS data as well as on additional data sets collected at our Center. Because the longitudinal modeling of hierarchically structured data is methodologically difficult, data analysis requires specific and complex methods, and our Center is

involved in optimizing research designs and analytical strategies.

Schools as Differential Learning Environments: An Overview of Recent Research

Differential Learning Environments and Academic Achievement

One continued focus of research has been on student performance and learning gains in differential learning environments. Germany is well known for its differentiated secondary system, with the vocational track *Hauptschule*, intermediate track *Realschule*, and academic track *Gymnasium*. However, there is currently much flux in the structure of the school system in many German states, with several states reducing the number of secondary school types to two. A main hypothesis of our Research Center is that the different school types represent differential developmental environments, potentially resulting in differential student learning gains across school types. There are three main explanatory approaches to this "fan-spread effect." The first explanation attributes differential developmental trajectories in German secondary schools to differences in students' performance and learning speed that existed before they entered secondary school. Thus, differing developmental trajectories are an expression of differential learning rates

and a function of entrance selectivity to the three school types. The second approach focuses on the differential effects of school types and school systems relying on differing timetables, curricula, teacher training, and teaching cultures; these effects are "institutional" in nature. The third explanation refers to composition effects arising from differences in the achievement, social and cultural background, and educational biographies of student populations. According to this approach, differences in learning trajectories are not, or are only partially, dependent on attending a certain school type. Rather, they are a consequence of the characteristics of the specific learning group. It is quite possible that all of these influences take effect at the same time.

Baumert, Becker, Neumann, and Nikolova (2009, 2010) examined whether students' learning gains in reading, mathematics, and English depend on the time of their transition from elementary school to the academic track (*Gymnasium*) of secondary schooling (grade 4 vs. grade 6) and on the profile of the academic track attended. In contrast to most German states, students in Berlin generally transfer to the secondary education after grade 6. However, between 7% and 8% of students are allowed to transfer earlier, after grade 4, to one of about 30 *Gymnasium* schools with specific curricular profiles. Baumert et al. (2009, 2010) examined whether high-performing students who took the opportunity to transfer to *Gymnasium* after grade 4 achieved higher learning gains than comparable students who stayed in primary school for grades 5 and 6. Based on data from the Berlin ELEMENT study, the learning gains of grade 5 and 6 students in elementary ($N = 3,169$) and *Gymnasium* ($N = 1,758$) schools were modeled using propensity score matching (PSM) analysis.

When achievement-related differences at the end of grade 4 were controlled, no statistically significant differences in reading comprehension were found between the student groups at the end of grade 6. The results for mathematics were similar, although substantial differences emerged in favor of a single *Gymnasium* that had not yet developed a specific curricular profile at the time of the

assessments. In English, where curricular differences between the different tracks are more pronounced, positive results emerged relative to elementary schools for schools with accelerated profiles, for schools with a bilingual profile, and for the *Gymnasium* without a specific profile; the findings for *Gymnasium* schools focusing on the classics were negative. These findings refute the common assumption that early transition to the academic track of secondary schooling has generally positive effects on the reading and mathematics literacy of high-performing students. The findings for English indicate that differences in learning trajectories may be more pronounced when different educational programs are associated with differences in classroom instruction.

Differential Learning Environments: Impacting Student Self-Concept

The effects of differential learning environments are not restricted to the domain of academic achievement but also apply to student motivation, emotion, and behavior. In a series of studies, we have continued our research program examining frame-of-reference effects on self-related cognitions. An overview of this research agenda can be found in Trautwein and Lüdtke (2010). Herbert Marsh coined the term *Big-Fish-Little-Pond Effect* (BFLPE) to describe reference group effects in self-concept development. Results from a large number of studies indicate that a student's academic self-concept is negatively influenced by the achievement of others in his or her school (a frame of reference effect). Moreover, there is evidence that this negative frame of reference effect is not, or only slightly, reduced by the quality, standing, or prestige of the track or school attended (a "reflected glory" effect). Going beyond prior studies, Trautwein, Lüdtke, Marsh, and Nagy (2009) used both between-school and within-school approaches to investigate frame of reference and reflected glory effects, incorporating students' own perceptions of the standing of their school and class. Multi-level analyses were performed with data from the TOSCA project (three studies with 4,810, 1,502, and 4,247 students, respectively). Find-

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ings from all three studies showed that, given comparable individual achievement, placement in high-achieving learning groups was associated with comparatively low academic self-concepts. However, students' academic self-concept was not merely a reflection of their relative position within the class but also substantively associated with their individual and shared perceptions of the class's standing. Moreover, the negative effects of being placed in high-achieving learning groups were weaker for high-achieving students. Overall, the studies support both educational and social psychology theorizing on social comparison.

Frame-of-reference effects are not restricted to academic self-concepts, however. Milek, Lüdtke, Trautwein, Maaz, and Stubbe (2010) examined the extent to which teachers' recommendations of a secondary track were systematically related to class-mean achievement level and whether there were differences in the strength of this reference group effect across the federal states. Based on a subsample of the German dataset from the 2006 cycle of the *Progress in International Reading Literacy Study* (PIRLS) (4,589 students from 248 grade 4 classes), multi-level logistic regression models were used to compare the relationship between the recommendations made by elementary school teachers and class-mean achievement level in Baden-Wuerttemberg, Bavaria, Hesse, North Rhine-Westphalia, and a reference group (consisting of students from the states of Schleswig-Holstein, Saxony, Saarland, Thuringia, and Rhineland-Palatinate). Findings for the subsample showed a negative association between class-mean achievement and teachers' recommendations that was mediated by school grades. Cross-state differences in the size of reference group effects did not reach the level of statistical significance.

Differential Learning Environments: The Case of Homework Assignments

We have also continued to address differential learning opportunities within the *Homework as Learning Opportunities* (HALO) project. This project, which has strong links to Research Area IV, uses several data sets to explore the

effects of teachers' homework assignments and students' homework completion. Building on our earlier work, we have systematically expanded our research program in the past 2 years. For instance, in two articles (Dettmers, Trautwein, & Lüdtke, 2009b; Trautwein, Schnyder, Niggli, Neumann, & Lüdtke, 2009), we have challenged the widespread assumption that more time spent on homework is generally associated with higher achievement. Furthermore, we have examined in some detail the role of academic emotions in the context of homework (Dettmers, Trautwein, Lüdtke, Goetz, Frenzel, & Pekrun, 2011; Dettmers, Trautwein, Lüdtke, Kunter, & Baumert, 2010). In addition, we have found further evidence for our hypothesis that the quality of homework assignments differs substantially across classrooms and that these differences are related to important outcomes measures, such as homework effort and school grades (Dettmers, Trautwein, & Lüdtke, 2009a). In another study, we examined whether teachers' homework objectives, implementation practices, and attitudes toward parental involvement are associated with the development of students' homework effort, homework emotions, and achievement during grade 8. A total of 63 teachers of French as a second language and their 1,299 grade 8 students participated in the study. In multilevel models, teachers' homework attitudes and behaviors were specified to predict outcomes at the end of grade 8, controlling for covariates at the beginning of grade 8. A low emphasis on drill and practice tasks and a high emphasis on motivation were associated with favorable developments in homework effort and achievement. Controlling homework assignments were associated with less homework effort and more negative homework emotions; the opposite pattern was found for students whose teacher supported student homework autonomy rather than parental homework involvement.

Differential Learning Environments: Methodological Aspects of Assessing Contextual Effects

Methodological aspects of assessing contextual effects are another area that has received

continued attention over the last 2 years at the Center for Educational Research. A key assumption of most educational research is that cognitive, motivational, emotional, and behavioral student outcomes are substantially shaped by features of the social context, such as learning climate, instructional quality, and the social composition of the class or school. In the last two decades, multilevel modeling (MLM) has become the standard approach for assessing contextual effects in the social sciences. A major strength of MLM lies in the possibility of simultaneously exploring relationships among variables located at different levels. In the typical application of MLM in educational research, outcome variables are related to several predictor variables at the individual level (e.g., students) and at the group level (e.g., schools, classes). Despite the progress that has been made in the estimation of multilevel models in recent decades, however, there are still a number of open questions regarding the assessment of contextual effects in educational research. Our Center's work in this area has focused on two issues. First, group characteristics are frequently assessed by aggregating individual student data across groups. We have evaluated different approaches to assessing the psychometric properties of such aggregated data (Lüdtke & Robitzsch, 2009). Second, we have developed statistical methods that can correct for unreliability when multilevel models are used to estimate contextual effects (Lüdtke et al., 2008; Marsh et al., 2009).

TOSCA-Repeat: Examining the Effects of Institutional Reform at Upper Secondary Level

Major reforms of upper secondary education—the preuniversity track—have been initiated in many of the German states in recent years. German, mathematics, and modern languages have been defined as core subjects, the distinction between basic and advanced *Abitur* courses has been abolished, the number of examination subjects in the *Abitur* has been increased, and opportunities for students to select *Abitur* subjects have been reduced. The primary objective of these reforms is to raise and level the learning bar: to increase overall

performance levels while reducing differences in performance between *Abitur* students. Critics of the reforms have expressed concern at the limitation of students' freedom to choose their subjects; they judge the reforms to be outdated and backward-looking. Our analyses of the student outcomes in the new upper secondary level, which we have presented this year under the title *TOSCA-Repeat*, offer an interim assessment of these reforms. The empirical analyses focus on the state of Baden-Wuerttemberg, which has played a pioneering role in the reform of upper secondary education since the 1990s. In our analyses, we are able to capitalize on the fact that we assessed students in Baden-Wuerttemberg who had studied for the *Abitur* under the "old conditions" in TOSCA-2002, our first survey of *Abitur* students. By repeating the TOSCA assessment in the 2005/06 school year (TOSCA-2006), we were able to take advantage of a unique historical opportunity to examine the effects of major change in the organization of upper secondary education on *Abitur* students' performance levels and readiness for higher education, as well as on their later success in higher education (Trautwein, Neumann, Nagy, Lüdtke, & Maaz, 2010b).

What has Changed in Baden-Wuerttemberg? Since the 2001/02 school year, upper secondary education at *Gymnasium* schools offering general education in Baden-Wuerttemberg has changed in the following ways (Neumann, 2010):

- The distinction between basic and advanced courses in the "core competence subjects" of German, modern languages, and mathematics has been abolished. These three subjects are now taught to the full class for four lessons per week. Moreover, students have to take a written examination in all three subjects.
- In addition to these three core competence subjects, students have four lessons a week in both a "profile subject," which depends on the profile of the general *Gymnasium* they are attending (science profile, language profile, fine arts profile, or physical education profile), and an "elective subject,"

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which can be chosen from the range of compulsory subjects.

- The *Abitur* examination now covers five rather than four subjects.
- All students take two science subjects throughout upper secondary level. Previously, it sufficed to take one science subject as a basic or advanced course.

These reforms of upper secondary education in Baden-Wuerttemberg are intended to raise and level the learning bar in German, mathematics, and modern languages. Annette Schavan, who was at the time Minister of Education and Cultural Affairs in Baden-Wuerttemberg, explained the motivation for abolishing the distinction between basic and advanced courses in these three core competence subjects as follows: "In these subjects, it is more important to achieve acceptable proficiency levels for all students than to give a few the opportunity to specialize."

Changes in Mean Instruction Time

The abolition of the distinction between basic and advanced courses in German, mathematics, and modern languages has meant that *Abitur* students in all schools and types of

Gymnasium now receive the same volume of instruction in these subjects (i.e., four lessons per week). As a result, students now generally receive more English and mathematics instruction—on average, 13.1 minutes more mathematics instruction and 10.8 minutes more English instruction per week. The magnitude of this increase differs slightly depending on the type of *Gymnasium* attended: The higher the proportion of students who had previously been enrolled in the 5-hour advanced course, the lower the increase in mean instruction time.

Achievement Levels in Preuniversity Mathematics

We examined whether the reforms implemented have had the intended effect of raising and leveling the bar in preuniversity mathematics using an assessment based on the mathematics content covered at upper secondary level. The assessment has been shown to have high curricular validity in both of the TOSCA cohorts (Nagy & Neumann, 2010).

Overall, the pattern of results for mathematics was in keeping with the objectives of

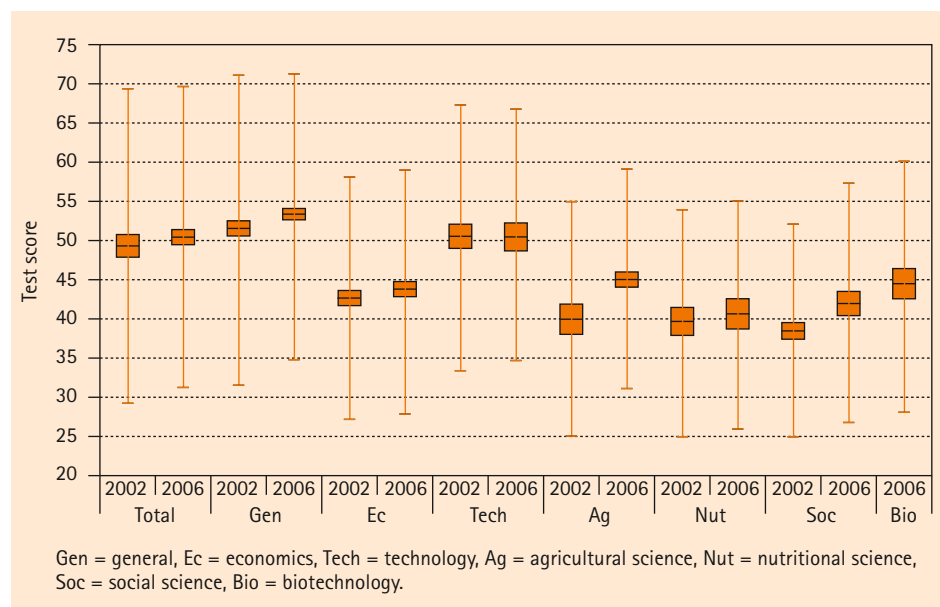


Figure 1. Mean test performance in preuniversity mathematics with 95% confidence intervals (orange rectangles) and distribution of test scores (± 2 standard deviations) in TOSCA-2002 and TOSCA-2006. *Gymnasium* schools specializing in biotechnology did not yet exist in 2002.

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the reforms (Nagy, Neumann, Trautwein, & Lüdtke, 2010). Figure 1 shows the mean test scores (the horizontal lines in the middle of the boxes) and the distributions of test scores in preuniversity mathematics. The distributions indicate the range of performance within which the scores of 95% of the students in the two TOSCA cohorts under investigation fell.

At the level of the total sample of all *Abitur* students, there was a moderate increase in performance and a slight decrease in the distribution of performance of around 4%. The performance gain was somewhat larger in the group of general *Gymnasium* schools than in the total sample; the same applied to the change observed in the distribution of performance, which decreased by about 7%. The strongest performance gains were seen in *Gymnasium* schools specializing in agricultural or social science, where the switch to 4 hours of mathematics per week across the board led to a marked increase in mean weekly instruction time. In contrast, mean performance levels in *Gymnasium* schools specializing in technology remained almost unchanged, as a comparatively high proportion of students in the TOSCA-2002 sample

were enrolled in an advanced level mathematics course.

Was a mean increase in performance seen in all schools? Figure 2 presents change in mean test scores in each individual school. The dots show the mean increase (or decrease) in performance; the vertical lines describe the precision of the measurement (95% confidence intervals). The data show that achievement in many schools improved—but that in others it remained unchanged or worsened. We were able to identify the reasons for these differences between schools in further analyses. The proportion of students in the TOSCA-2002 sample in advanced courses played a key role: The lower the proportion of students in advanced courses, the more positive (or less negative) the change in achievement levels. In terms of the distribution of performance, the reforms were expected to level the bar in students' mathematics achievement both within individual schools and between schools and types of *Gymnasium*. Analyses of the TOSCA-Repeat data revealed a small, but statistically significant, decrease in the distribution of student performance within schools. The data also pointed to reductions in the range of performance between schools

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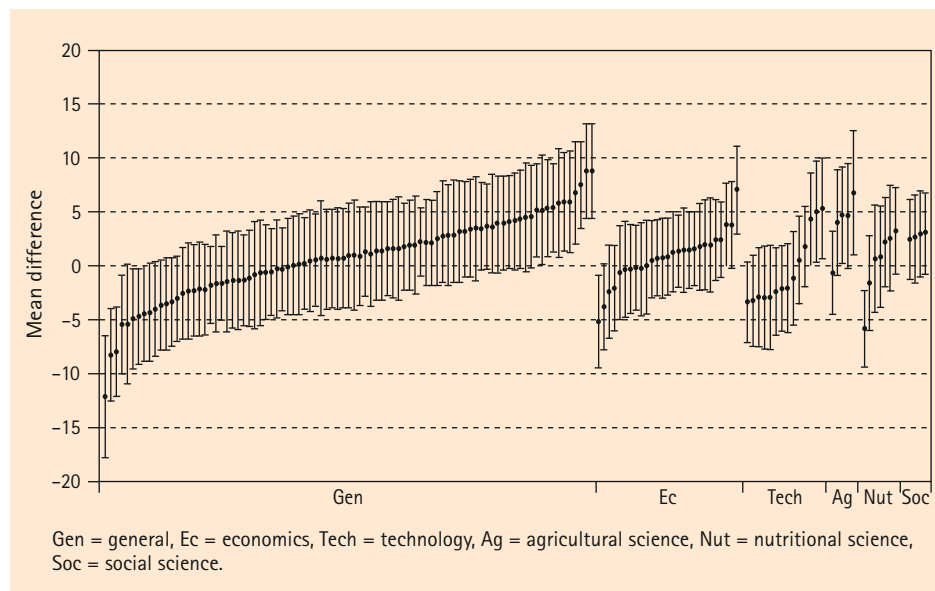


Figure 2. Change in mean performance levels at individual schools between TOSCA-2002 and TOSCA-2006 by type of *Gymnasium*.

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Key Reference

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and types of *Gymnasium*, but these differences were not statistically significant.

Achievement Levels in English

An increase in performance levels combined with a reduction in the differences in student performance was also expected for English. English performance was assessed using a short version of the *Test of English as a Foreign Language* (TOEFL), with items tapping reading comprehension, vocabulary, grammar, spelling, and listening comprehension. TOEFL is used by colleges and universities in the United States and beyond to evaluate the English proficiency of applicants who speak English as a second language. Less prestigious universities require minimum TOEFL scores of 500 on the version of the TOEFL administered in TOSCA, more prestigious universities a score of 550, and top universities, such as Yale or Stanford, a score of 600. Figure 3 shows the means and distributions of English test scores in the two TOSCA cohorts by type of *Gymnasium*.

In contrast to the findings for preuniversity mathematics, there was as good as no change in mean achievement levels in English

(Jonkmann, Trautwein, Nagy, & Köller, 2010) in either the total sample or the individual types of *Gymnasium*. However, the data did point to a decrease in the distribution of performance in English in TOSCA-2006, which was primarily attributable to a reduction in differences in student performance in general *Gymnasium* schools. Overall, however, the level of English achievement was surprisingly stable.

Conclusions and Outlook

To summarize the findings available to date from the TOSCA-Repeat study, we can conclude that the objectives of the reforms have been achieved in certain respects (moderate increase in performance levels and decrease in the range of performance in mathematics, decrease in the range of performance in English), although it is difficult to evaluate the practical relevance of the changes observed. In other respects, however, we found no evidence that the reforms have had the intended effects (e.g., no increase in English performance). However, only part of the data has, as yet, been analyzed. Various other questions (e.g., effects on performance

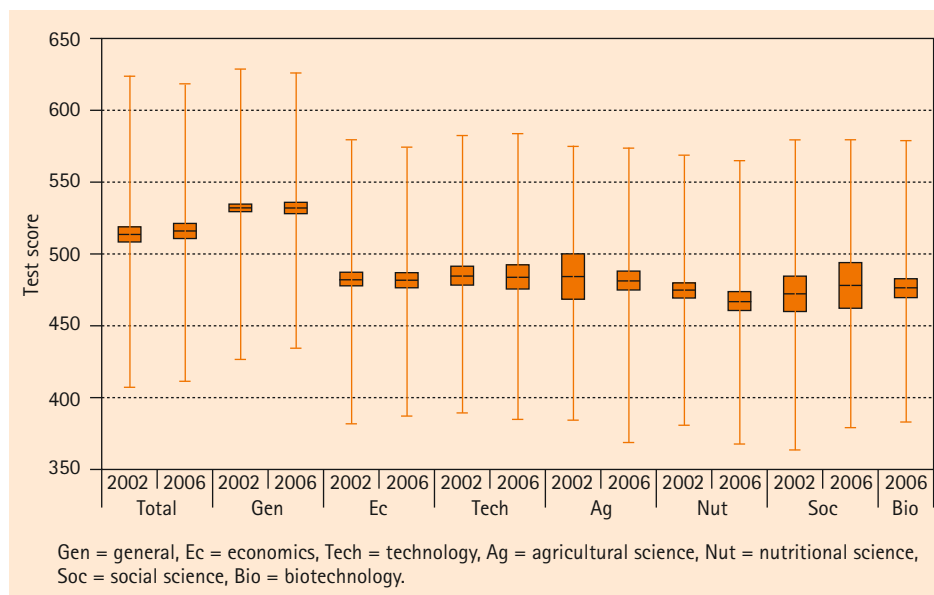


Figure 3. Mean test performance in English (TOEFL) with 95% confidence intervals (orange rectangles) and distribution of test scores (± 2 standard deviations) in TOSCA-2002 and TOSCA-2006. *Gymnasium* schools specializing in biotechnology did not yet exist in 2002.

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in German, history, and other subjects) cannot be addressed on the basis of the TOSCA data, as these subjects were not assessed.

Analysis of the wealth of data generated by the TOSCA study will continue for several years. For example, we plan to examine which student and school characteristics predict *Abitur* students' success in their university and professional careers and whether this success is associated with the reform of upper secondary education. These findings are likely to influence the overall assessment of the reforms—in one direction or the other.

Research Area I: Looking Back and Ahead

The work accomplished in Research Area I has been of central importance within the Center for Educational Research since its foundation in 1996. Much progress has been made in understanding how school systems, schools, and classes become differential learning and developmental contexts that impact important student outcomes, such as achievement, self-concepts, and educational biographies. Although work in this field at the Institute

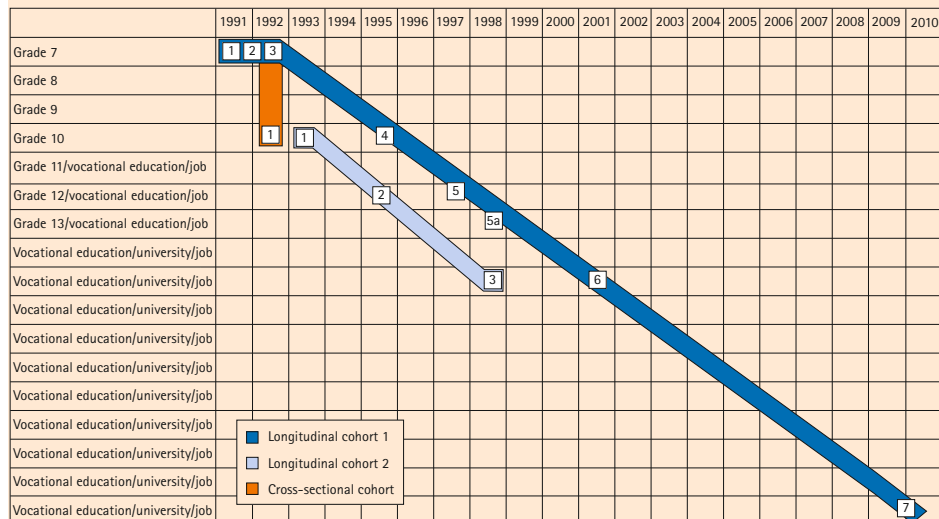
was concluded with the retirement of Jürgen Baumert in mid-2010, the research field is still in flux and far from saturated. Many influential contributions originating in the Center are being followed up by researchers at other institutions. In addition, Jürgen Baumert and his team remain active in this field. The Center's key research projects and large-scale studies have found new homes at different universities across Germany. More specifically, together with Jürgen Baumert, Kai Maaz and his team (including Michael Becker and Marko Neumann) at the University of Potsdam are taking responsibility for the BIJU project. Ulrich Trautwein and his team at the University of Tübingen (including Gabriel Nagy and Kathrin Jonkmann) are in charge of the TOSCA project and the TRAIN study. Ulrich Trautwein will also continue to examine the work on effects of homework assignments and completion. Finally, Oliver Lüdtke, who is now at Humboldt University Berlin, will continue the research program on methodological aspects of assessing contextual effects in student achievement studies.

The BIJU Study—Aims and Data Collection

BIJU has four guiding components:

- (1) providing institutional and individual baseline data on the integration of the East and West German educational systems since 1991;
- (2) analyzing domain-specific learning as a function of personal resources and institutional opportunity structures;
- (3) analyzing long-term trajectories of psychosocial development in adolescence and young adulthood;
- (4) analyzing ways of coping with the transition from school to vocational training or university.

Data collection began with a survey of the main cohort (longitudinal cohort 1) in the 1991/92 school year (see Figure 4). Data were gathered from grade 7 students at three measurement points. The first point of measurement coincided with the transformation of the unitary school system of the former East Germany to the tracked system adopted from West Germany. The fourth wave of data collection was conducted in spring 1995, when the main cohort students were in the final grade of lower secondary school. The fifth wave took place in spring 1997, when participants were either in vocational or upper secondary education. The sixth wave of data collection, conducted in 2001, focused on how students had mastered the transition from school to university or from vocational education to the labor market. A seventh wave of data collection took place in 2009/10. The sample of school classes comprises some 8,000 students from 212 secondary schools of all types in the states of Berlin, Mecklenburg-West Pomerania, North Rhine-Westphalia, and Saxony-Anhalt. A second longitudinal cohort and a cross-sectional add-on study complement the BIJU data set.



www.biju.mpg.de

Figure 4. Study design of the BIJU project.

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The TOSCA Project—Aims and Data Collection

At Time 1 of the TOSCA 2002 cohort, a representative sample of 4,730 students in their last year of upper secondary education (aged about 17 to 19 years) was sampled between March and May 2002. All students were attending either traditional *Gymnasium* schools or one of the five (now six) forms of vocational *Gymnasium* schools that have been established in Baden-Wuerttemberg. More than 60% of these students consented to be recontacted for follow-up studies. The second wave of data collection took place from February to May 2004 with 2,315 students. The third wave took place from February to May 2006 with 1,912 students. In early 2007, a subsample of participants was administered a set of mathematics and cognitive ability tests. Additional waves of data collection took place in 2008 and 2010, with about 1,500 participants each.

A second TOSCA cohort ("TOSCA-2006") was recruited in 2006, comprising almost 5,000 students in their last year of upper secondary education at more than 150 schools in Baden-Wuerttemberg. More than 2,500 of the TOSCA 2006 participants were recontacted and surveyed again in 2008 and 2010.

A third cohort ("TOSCA-10") comprises *Realschule* and *Gymnasium* students who were in grade 10—that is, approaching the end of lower secondary education—in 2007. Again, achievement tests and questionnaires were administered. One focus of our analyses is on which student characteristics are particularly powerful predictors of whether or not a student enters the preuniversity track (*gymnasiale Oberstufe*).

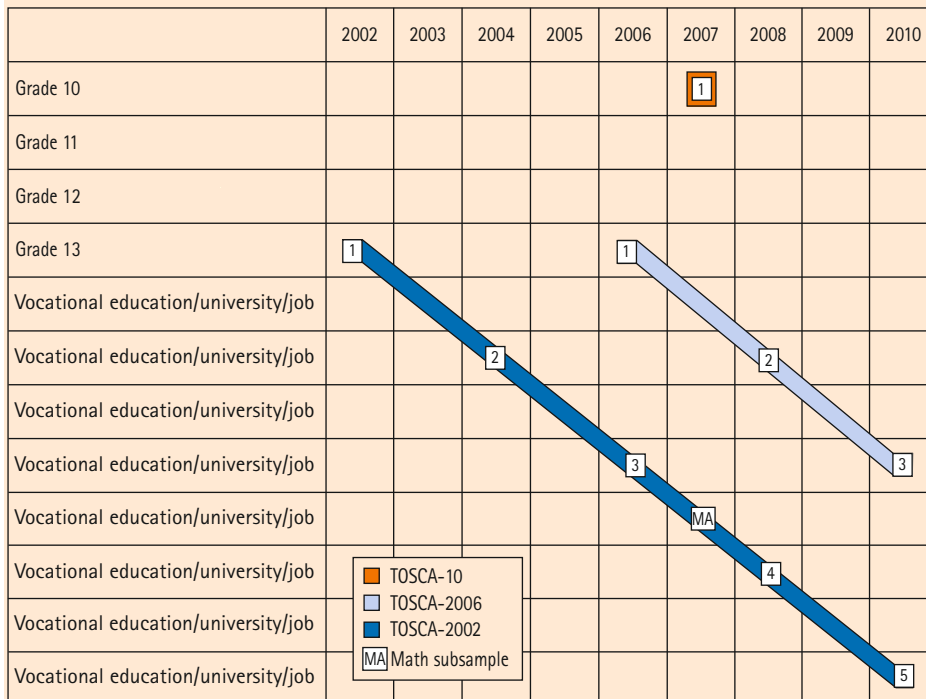


Figure 5. Study design of the TOSCA project.

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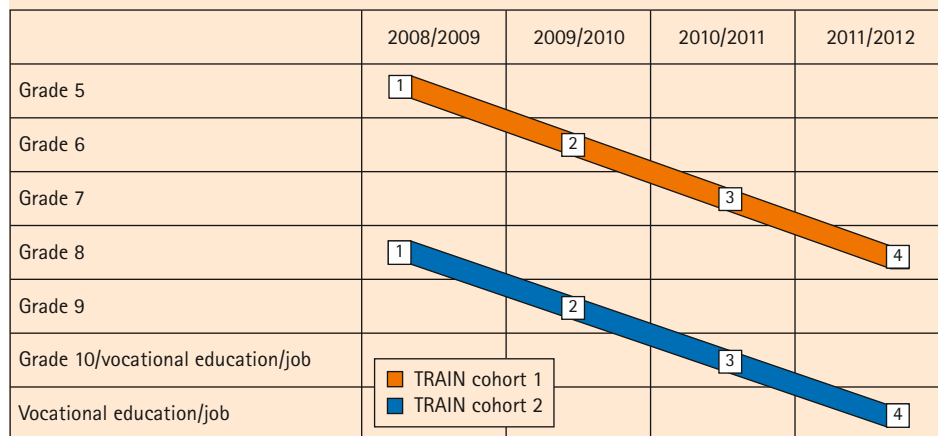
The TRAIN Study—Aims and Data Collection

The TRAIN (Tradition and Innovation) study investigates students' developmental trajectories and learning gains in the differently structured educational systems of Baden-Wuerttemberg and Saxony. The focus of our analyses is on the lower and intermediate tracks (*Hauptschule* and *Realschule*), which are separate in Baden-Wuerttemberg, but implemented in a combined *Mittelschule* in Saxony.

TRAIN addresses important research questions that prior studies were not able to examine in sufficient detail. Most important, the study investigates the consequences of different forms of ability grouping and the impact of class composition. Moreover, intervention modules are implemented with the aim of identifying effective means of improving the motivation and achievement of at-risk students. In addition, the study analyzes the educational careers of students with specific learning difficulties or behavioral or psychological problems and their influence on the learning and development of their classmates.

Data collection began in November of the 2008/09 school year. Participants were some 6,000 grade 5 and grade 8 students in 60 *Hauptschulen* and 24 *Realschulen* in Baden-Wuerttemberg and 22 *Mittelschulen* in Saxony (see Figure 6). Data were also obtained from the students' teachers and parents. The students were administered a comprehensive battery of tests and questionnaires over a 2-day period. The achievement tests covered the academic domains of mathematics, English as a foreign language, and German. Basic cognitive ability, concentration, and career knowledge were also assessed. The questionnaires focused on student motivation, interests, family background, self-concept, psychological problems, learning difficulties, and uptake of additional and remedial instruction. In Saxony, social network data were also obtained. Form tutors were asked about various aspects of their work, and teacher ratings of each student's behavioral problems, participation, and motivation were also obtained in both states.

Data are to be collected annually over a 4-year period (for the grade 5 cohort). We intend to continue monitoring the students of the grade 8 cohort after they have left school.



www.train-studie.de

Figure 6. Study design of the TRAIN project.

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Research Area II: Transitions in the Educational System

The biographies of young people are characterized by a host of transitions. Beyond the biological changes and psychological transitions from childhood to adolescence and adulthood that each individual needs to negotiate, young people have to make several transitions within the educational system, each governed by specific institutional, legal, and societal regulations. These transitions require complex decisions that, in differentiated educational systems, have far-reaching effects on students' educational and vocational biographies. The analysis of transitions has a long tradition within the Center for Educational Research. Research Area II integrates all of the Center's projects and subprojects that deal explicitly with the analysis of transitions at various stages of educational careers, placing a particular focus on family background.

The specific importance of educational transitions in the German school system results from the structure of the educational system. Students in Germany are selected to different secondary tracks at the end of grade 4 or grade 6, when they are about 10 or 12 years of age (Figure 7). There is considerable variation across the German states in terms of the number and quality of these tracks. Although between-school tracking is the major form of achievement differentiation, within-school and between-school differentiation are used concurrently in some states. In addition, some major reforms have been implemented in many German states in the last few years,

with a clear shift toward a two-track system. Nevertheless, the "tripartite" system of *Hauptschule*, *Realschule*, and *Gymnasium* remains the best known in Germany, and most of our data sets were collected when there were still three or more secondary tracks in most German states.

Figure 7 shows a simplified version of the German school system. *Hauptschule* is the academically least demanding track; *Realschule*, the intermediate track; and *Gymnasium*, the college-bound track. *Hauptschule* students, who graduate after grade 9 or grade 10, typically enter the dual system, which combines part-time education at vocational school

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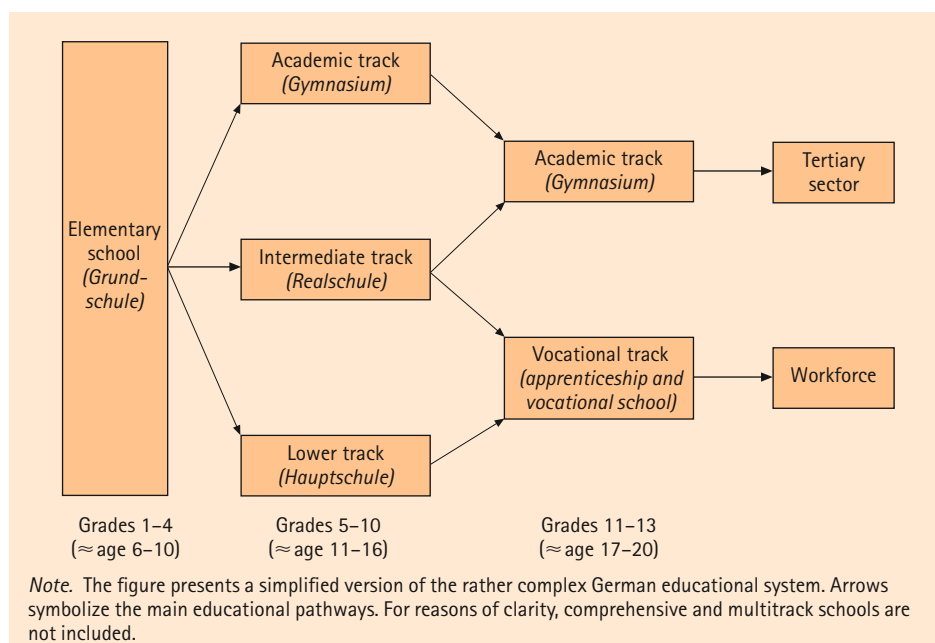


Figure 7. The German educational system.

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with on-the-job training. *Realschule* students graduate after grade 10; most of them also enter the dual system, usually aspiring to more skilled occupations. *Gymnasium* students graduate after grade 12 or grade 13; the final *Gymnasium* examination (*Abitur*) is a requirement for university entrance (Maaz, Neumann, & Trautwein, 2009). Although the educational pathways illustrated are the most common, it is also possible for students to transfer to a higher or lower track at various points in their school careers.

The principle guiding the tracked secondary system is to provide all students with an education commensurate with their aptitudes and needs that allows them to reach their fullest potential. To what extent this strategy succeeds is a recurring question that has been examined widely (e. g., in Research Area I). The findings of this research indicate that the school types of the tracked secondary system represent differential learning and developmental environments and that students in the different school types learn different amounts. The secondary school type attended can thus critically influence the learning trajectories observed.

Academic achievement is the main determinant of the secondary school type attended in all German states. Parents can also influence the transition decision, however, and various systematic (e. g., regional structures) and unsystematic factors (e. g., "measurement errors") may play an additional role. Whether and how students are able to transfer from one track to another during their lower secondary education also depends on various factors (Baumert, Maaz, & Trautwein, 2010a; Maaz, Baumert, Gresch, & McElvany, 2010).

In view of the significance of the transition to the tracked secondary system, the theoretical and practical questions addressed in Research Area II include the following:

- How close is the association between family background and the transition decision? What are the mechanisms underlying this association?
- How permeable is the school system? Which students take advantage of this permeability?

- What role do teachers play at decisive points of transition? How do they approach the difficult diagnostic task of recommending a secondary track?
- Are there undesired reference group effects at points of transition, similar to those known to exist for grading, for example?
- Do students from immigrant families face specific challenges at the transition to secondary education?

The Transition Study: From Elementary to Lower Secondary Education

The Transition study on *The Transition From Elementary to Secondary School: Regional, Social, and Ethnic/Cultural Disparities in Educational Equity* is the first to present nationally representative data on the transition to secondary education, one of the most critical transitions in the educational biography. The Transition study was linked to the *Trends in International Mathematics and Science Study* (TIMSS 2007, Principle Investigator: Wilfried Bos) and the BiSta study, which was conducted to standardize test items for the assessment of educational standards in German and mathematics at elementary level (Principle Investigator: Olaf Köller). The Transition study extended the design of TIMSS 2007 and BiSta to include a parent survey assessing aspects of social background and parental support behavior as well as a survey of elementary teachers. This collaborative approach allowed us to draw on the results of standardized tests in mathematics, science, and German without additional financial costs and to considerably extend the scientific knowledge of how parental intentions, cultural, social, and economic backgrounds, teachers' recommendations, and institutional regulations interact at the transition from primary to secondary school. The study was conducted in 13 German states in the 2006/07 school year. A total of 4,768 students from 227 classes participated, along with their parents and class teachers.

The Transition study takes an interdisciplinary approach that connects questions addressed by educational science, psychology, and sociology. The main objective of the Transition study was to analyze the

formation of parental decisions concerning the transition from elementary to secondary school against the background of the following factors:

- students' achievement and attitudes at elementary school;
- the parental decision-making process as a function of the social, ethnic, and cultural background;
- the secondary track recommended by the elementary school teacher;
- the process of parent-teacher consultation;
- institutional regulations; and
- regional differences in the structure of the secondary system, the cultural environment, and the economic and labor market structure.

The second objective of the study was to analyze how the students and their parents coped with the process of transition.

Primary and Secondary Background Effects at the Transition to Secondary Education

Drawing on Boudon's theoretical model originally developed in the 1970s, Maaz and Nagy (2010) analyzed the effects of social background at the transition to lower secondary education. For the Transition study, Boudon's model was adapted to the German educational system and extended to include factors with particular relevance for the transition from elementary to lower secondary education (grades and teacher recommendations). Maaz and Nagy specified Boudon's definition of primary background effects as social background influences that impact the development of students' competence and consequently affect their grades, the secondary track their teachers recommend, and the track in which they enroll. Secondary background effects, in contrast, are social background

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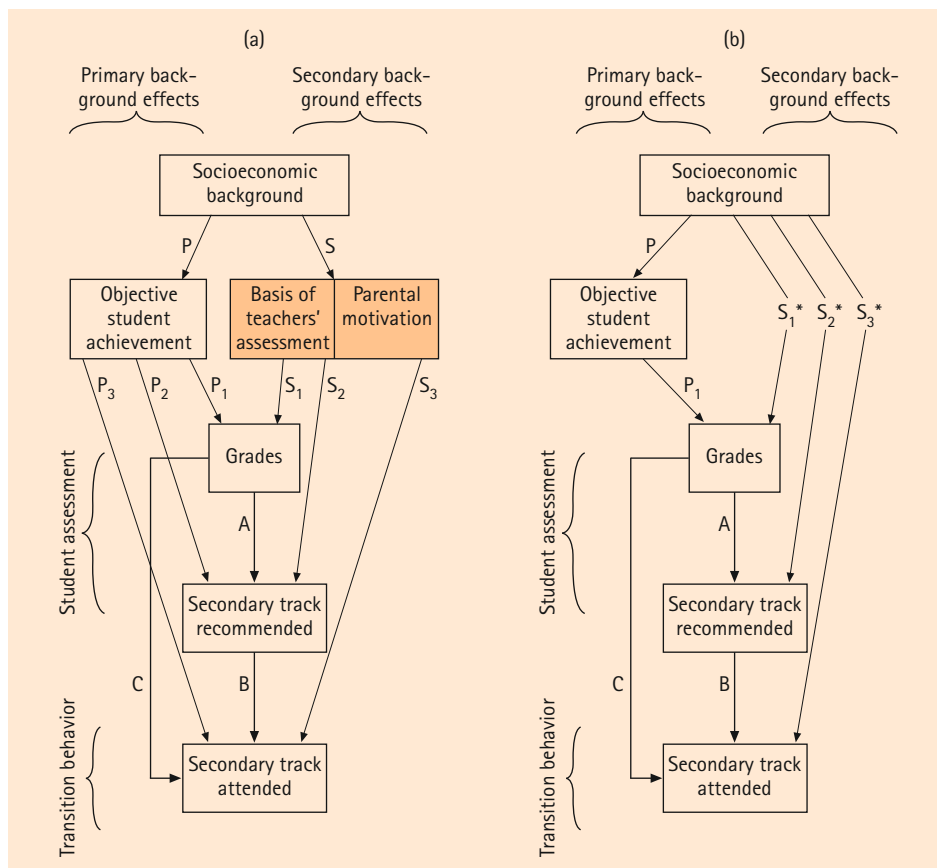


Figure 8. Schematic illustration of the structural model of background effects: (a) full theoretical model and (b) reduced model used by Maaz and Nagy (2010).

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Table 1
Detailed Path Diagram of the Path Model Investigated (Standardized Solution): Estimates of Primary and Secondary Background Effects and Total Background Effects (Sum of Primary and Secondary Effects)—Figures in Parentheses Show the Relative Proportions of Primary/Secondary Background Effects to Total Background Effects

	<i>Primary background effects</i>		<i>Secondary background effects</i>		<i>Total background effects</i>
<i>Student assessment (PBE-A/SBE-A)</i>					
German	.22	(0.60)	.15	(0.40)	.37
Mathematics	.23	(0.67)	.11	(0.33)	.35
General studies	.19	(0.53)	.17	(0.47)	.36
<i>Student assessment (PBE-TR/SBE-TR)</i>					
Carried over PBE-A/SBE-A	.24	(0.63)	.14	(0.37)	.37
Incremental	–	(–)	.11	(–)	.11
Total	.24	(0.49)	.25	(0.51)	.48
<i>Transition behavior (PBE-TB/SBE-TB)</i>					
Carried over PBE-A/SBE-A	.12	(0.65)	.07	(0.35)	.19
Carried over PBE-TR/SBE-TR	.09	(0.49)	.09	(0.51)	.18
Incremental	–	(–)	.14	(–)	.14
Total	.21	(0.41)	.30	(0.59)	.51

Note. PBE-A: primary background effect of assessment; SBE-A: secondary background effect of assessment; PBE-TR: primary background effect of track recommendation; SBE-TR: secondary background effect of track recommendation; PBE-TB: primary background effect of transition behavior; SBE-TB: secondary background effect of transition behavior.

influences resulting from factors other than students' academic achievement—for example, from social differences in educational expectations or behaviors at the transition to secondary education. In contrast to primary effects, these secondary effects are incompatible with meritocratic beliefs about students' educational outcomes and prospects. Maaz and Nagy (2010) sought to gauge the influences of social background on grading, the secondary track recommended, and the track in which students actually enrolled. Moreover, they sought to disentangle primary and secondary effects of social background and thus to identify potential points of intervention for reducing inequalities of opportunity in the German educational system (see Figure 8). In line with previous findings, the data showed that socioeconomic background affected student grades, the secondary track recommended, and the secondary track attended, having the lowest absolute effect on grades and the highest on secondary track

attended. Both primary and secondary effects of social background were found for all three outcomes under consideration. For grades, the relative proportion of primary effects was larger than that of secondary effects. For secondary track recommended, both effects were of approximately the same size. For secondary track attended, however, secondary effects outweighed primary effects. Moreover, about half of this secondary effect on transition behavior was attributable to a carry-over of the preceding effects on grades and secondary track recommended (see Table 1). The other half of the effect resulted from the parents' final decision on a secondary track. In other words, even if the secondary effects involved in teachers' assessments of their students were fully eliminated, students from socially privileged families would still have higher chances of attending an academic-track school than children from less privileged families, even if their achievement was identical (see also Baumert & Maaz, 2010a).

Immigration

The results of the PISA study confirmed that students from immigrant families do less well at school and leave education with lower qualifications than their German peers. Whereas PISA examined student achievement and educational opportunities toward the end of compulsory education, Gresch and Becker (2010) investigated the relationship between immigration background and access to the academic track at the end of elementary schooling.

Like Maaz and Nagy (2010), Gresch and Becker (2010) drew on Boudon's theoretical model that distinguishes between primary and secondary effects of social background. Immigration-specific primary effects may result, for example, from language difficulties that make it harder for children from immigrant families to follow instruction, leading to lower achievement levels. In contrast, secondary—that is, achievement-independent—effects of immigration background are in operation when, for example, immigrant students move to a lower secondary school track than their German peers despite comparable achievement levels.

Because previous research has shown that the educational behavior of immigrant groups

may differ depending on their specific social and cultural background, the Transition study focused on the two largest groups of immigrants in Germany: students from Turkish families and the children of ethnic German repatriates. Very few previous studies in Germany have allowed immigrant groups to be differentiated, and barely any empirical findings were previously available on the children of ethnic German repatriates.

The results (see Figure 9) showed that children from immigrant families were, in general, less likely to attend an academic-track *Gymnasium*, but that this difference was primarily attributable to the lower socioeconomic status of their families. When achievement levels were comparable, this negative background effect was reversed, with students from immigrant families having greater chances of attending *Gymnasium* than their German peers. This pattern of results was particularly pronounced for students with a Turkish background. This finding can be interpreted as a *positive* secondary effect of immigration background. It is explained by the fact that immigrant families are often particularly keen for their children to attend the academic track. However, few immigrant children live up to these expecta-

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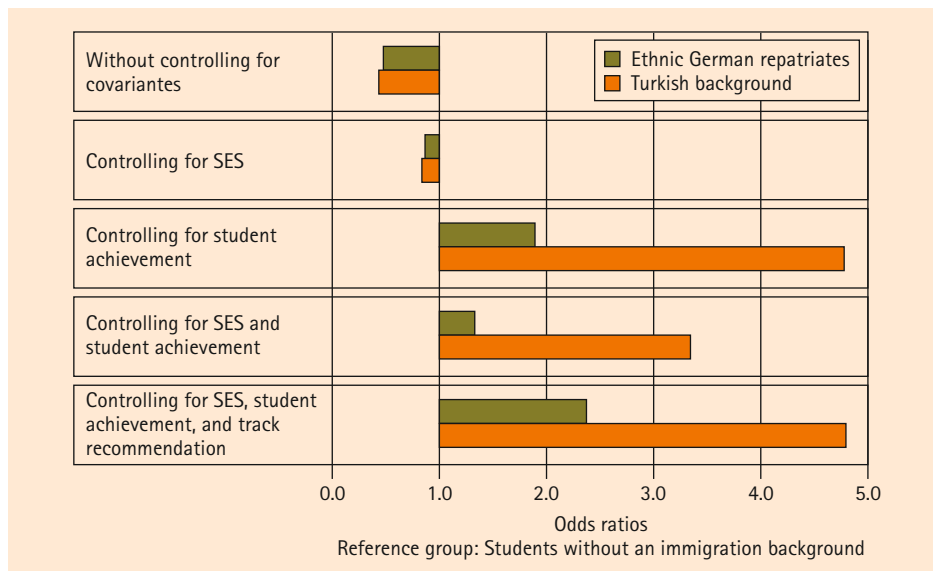


Figure 9. Logistical regression of transition behavior on immigration background, socioeconomic status (SES), standardized test scores, grades, and track recommendation.

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tions, as their achievement levels are typically not high enough.

In summary, student achievement is a key factor in the lower participation of immigrant children in the academic track of the German secondary school system. Our findings indicate that the causes of differential participation are not located in the transition process itself, but take effect prior to this transition. Measures such as language development programs in preschool and elementary school are therefore needed to better equip children from immigrant families for school learning. Only then will immigrants and their children have a realistic chance of achieving their high educational goals.

Institutional Effects

Gresch, Baumert, and Maaz (2010) investigated how institutional regulations governing the transition process influenced parental decision making. One key factor in the transition process is the secondary track recommended by the elementary school on the basis of individual student aptitude. The degree to which this recommendation is binding varies considerably across states. In some states, parents are able to enroll their child in the secondary track of their choice, even if a less challenging track was recommended. In other states, students whose parents wish to enroll them in a higher track than that recommended are required to pass a formal examination as evidence of their suitability for that track. In the former case, the degree of bindingness is low; in the latter, it is high and linked to an examination (Füssel, Gresch, Baumert, & Maaz, 2010; Kropf, Gresch, & Maaz, 2010). Whether or not these differences in the degree of bindingness of the tracking recommendation have differential effects on parents' decisions is a contentious issue in the literature. Gresch et al. (2010) were the first to systematically address the relationship between the bindingness of the recommendation and social selectivity at the transition to secondary education, drawing on data from all states in which students transfer to secondary education at the end of grade 4. The first finding to emerge from the analyses is also apparent from the official statistics.

In those states in which the elementary school's recommendation is binding, mean rates of transfer to the academic track are considerably lower than in the other states. However, this effect is not attributable—as one might be tempted to infer from the official statistics—to fewer students being recommended for the *Gymnasium* track in those states. In fact, the opposite seems to be the case: Our data indicate that elementary teachers in states in which recommendations are binding are more liberal in giving recommendations for the *Gymnasium* track. Neither is the effect attributable to differences in the social structure of parents with school-aged children in the two groups of states. The difference in transition behavior persisted even when socioeconomic background and track recommendation were controlled. A second finding adds to this picture: The bindingness of the recommendation does not regulate transitions to the *Gymnasium* track that are not in line with teachers' recommendations either. In other words, the threat of an additional examination does not have a generally deterrent effect on parents who want to send their children to a *Gymnasium* even without a recommendation.

Thus, the observable differences between the two groups of states in educational participation at *Gymnasium* are not attributable to differences in elementary school teachers' recommendation practices, in the social structure of the student population, or even in the institutional regulations governing the transition to secondary education. A second set of analyses examined the relationship between the bindingness of the tracking recommendation and socially determined differences in parental decision making. Consistent with the results of Maaz and Nagy (2010), the data showed that social background has a substantial influence on the decision-making process—even when the track recommendation is controlled. The chances of a student from a highly privileged background attending a *Gymnasium* were more than 60% higher than those of a student from a middle-class family, even if both students had been recommended for the same track. This finding is not surprising.

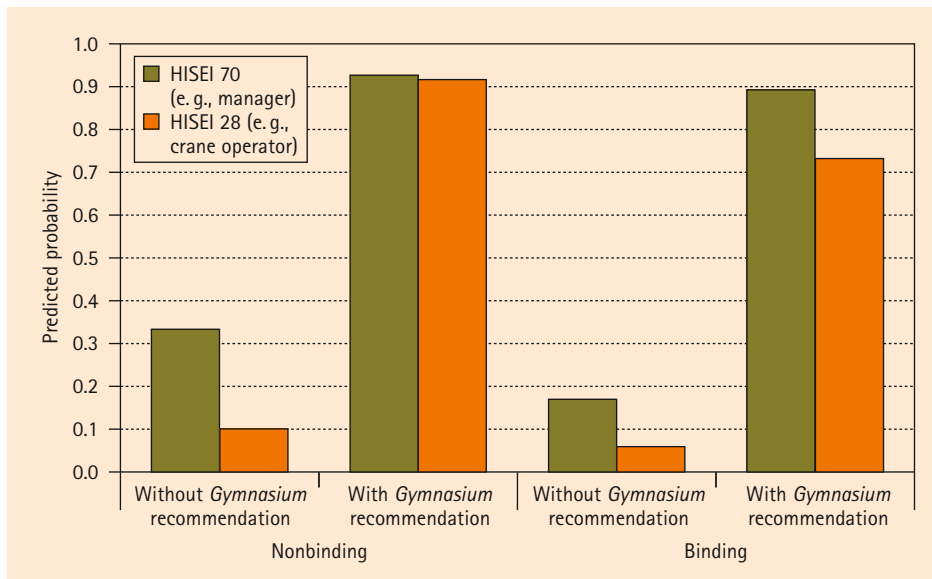


Figure 10. Probability of transferring to a *Gymnasium* depending on the track recommendation received, whether or not it is binding, and social background.

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What is notable, however, is that the effect of social background is particularly marked for students who were not recommended for *Gymnasium*—but only in states where parents are free to choose a secondary track (see Figure 10). This pattern of results suggests that increasing the bindingness of elementary school recommendation, while stipulating that students wishing to attend a secondary track higher than that recommended must first pass an objective examination, can diminish social disparities in educational behavior.

Parental Decisions: Testing the Extended Expectancy–Value Model

Almost every sixth *Gymnasium* student was not recommended for *Gymnasium* by his or her elementary school, and almost every tenth student at other school types was in fact recommended for *Gymnasium*. Which factors cause parents to decide for or against a certain school type? In various theoretical approaches from psychology and sociology, values and expectancies of success have been identified as playing a decisive role in the formation of educational decisions. However, it remains unclear how exactly parents arrive at

these decisions. Using data from the Transition study, Jonkmann, Maaz, McElvany, and Baumert (2010) for the first time investigated all factors theoretically predicted to impact parental decisions in a single empirical study. The study drew on the extended expectancy–value model of Eccles and colleagues, which has already been used to predict educational decisions, such as the choice of major. The model predicts that parents will decide on a *Gymnasium* if they are confident that their child will be able to cope with the demands of this track. The value that parents attribute to a *Gymnasium* education makes an equally important contribution to their decision (see Figure 11).

Four aspects of the value component are distinguished. The status maintenance motive reflects the importance of the *Abitur* qualification in fulfilling parents' expectations that their child will do at least as well as they have in the world of work. Further, the value accorded to a broad general education, the perceived utility of the *Abitur* qualification for the child's future career, and the costs of staying in education for longer all feed into the value that parents place on their children attending *Gymnasium*.

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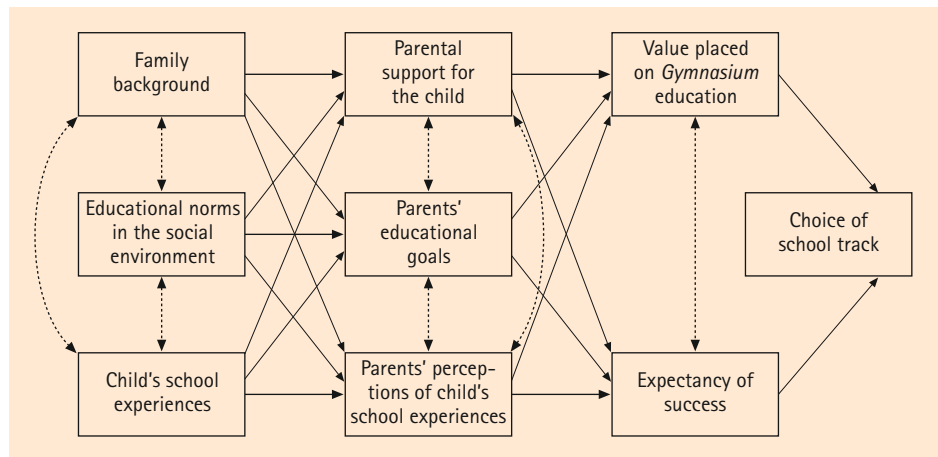


Figure 11. The extended expectancy-value model for parental decisions on the choice of secondary school track.

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According to the Eccles model, parents' expectancies and values are determined by their evaluations of their child's academic achievement, the mid- and long-term educational goals they have for their child, and their confidence in being able to support their child. These more psychological characteristics in turn mediate the effects of the more sociological characteristics of the family's socioeconomic and cultural background, the social environment, and the child's educational experiences to date.

Jonkmann, Maaz, McElvany, & Baumert (2010) compared parents who had enrolled their child in a *Gymnasium* without a recommendation with parents who had followed the recommendation of the elementary school, and with parents who had chosen a different school type although their children were recommended for *Gymnasium*. The results were largely in line with the predictions of the model. If *Gymnasium* was "the norm" in the family's social environment, parents were more likely to send their child to a *Gymnasium* even without a recommendation. These children reported somewhat more pressure to perform and psychosomatic complaints in elementary school than their future classmates who were recommended for *Gymnasium*. Even without a *Gymnasium* recommendation, the likelihood of a child attending *Gymnasium* increased if the parents considered the child to be underchal-

lenged at elementary school or regarded the *Abitur* qualification as important for status maintenance. For parents who opted for *Gymnasium* without a recommendation, the perceived utility of the *Abitur* qualification for their child's future career was particularly high. However, all parent groups attributed high importance to a broad general education; this characteristic did not differentiate between the study groups. Likewise, financial considerations did not impact school choice. As predicted by the model, parents' expectancies of success also played an important role in the choice of the secondary school track. Parents who enrolled their child in a *Gymnasium* were more confident in their children's success than other parents—even if the elementary school had advised against a *Gymnasium*. Family socioeconomic background, in contrast, was almost irrelevant to the transition decision when differences in parents' expectancies, values, and beliefs were controlled.

In sum, the results of this study showed that parents differ in the way they respond to the tracking recommendation made by the elementary school and that these differences can be effectively predicted by the extended expectancy-value model. The model can thus help to further the understanding of how parental deliberations and decisions contribute to the emergence of social inequality at the transition to secondary education.

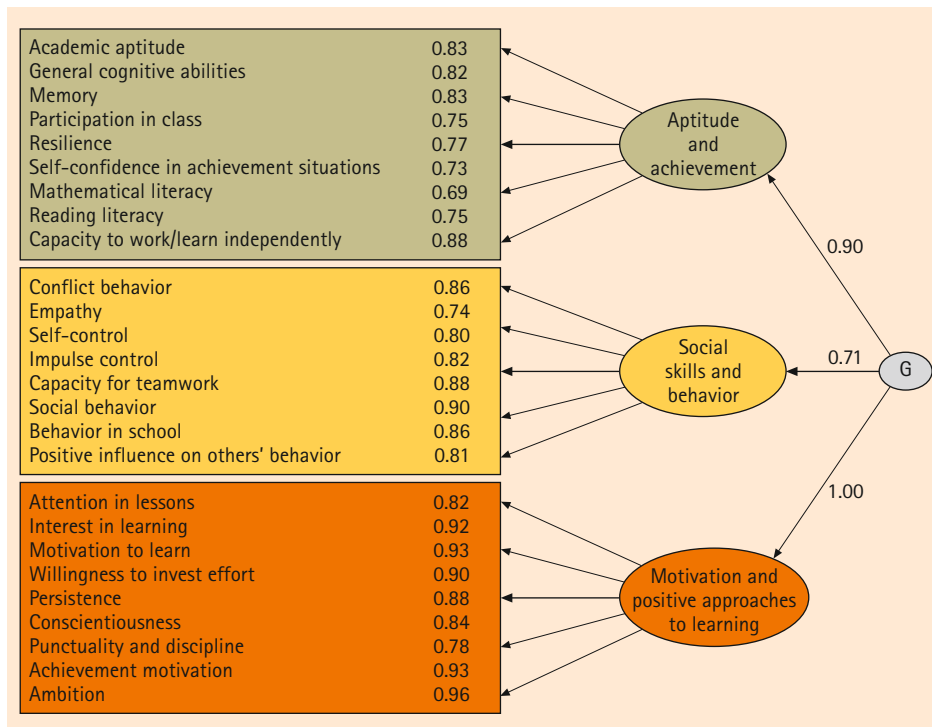


Figure 12. Teachers' assessments of individual student characteristics at the transition to secondary education: Factor structure.

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Teachers' Assessments of Relevant Student Characteristics

Grades are not everything—certainly not in the secondary tracking recommendations that elementary teachers make for their students at the end of elementary schooling. Apart from the grades attained, teachers' decisions are informed by their evaluations of the students' potential for learning and development. The teacher's role in recommending a secondary track for each individual student is thus complex: They need to both diagnose students' current abilities and predict their future development.

In recent years, teachers' diagnostic skills have been the subject of broad policy discussion. On the one hand, teachers are widely considered to have good diagnostic skills; on the other hand, studies have revealed a wide range in their diagnostic abilities. The *Progress in International Reading Literacy Study* (PIRLS) recently showed that the correlations between teachers' secondary track recommendations and students' scores on stan-

dardized assessments of spelling and reading comprehension were only moderate. However, this discussion often overlooks the fact that teachers take a variety of student characteristics into consideration when recommending a secondary track—these include aptitude, motivation, and participation in class, as well as conscientiousness and capacity for teamwork. Empirical studies examining these individual assessments at the transition to secondary education are rare, however. Anders, McElvany, and Baumert (2010) examined the specificity of teacher assessments of individual student characteristics. They further examined the relationship of teacher assessments of various student characteristics with students' sex, socioeconomic status, and immigration status, as well as their grades and the secondary track recommended. To this end, 231 teachers were asked to rate each of their students on 30 school- and instruction-related characteristics. Ratings were obtained for a total of 4,101 students, who were in grade 4 of elementary school at the time of

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Table 2
Predicting the Secondary School Recommended: Results of Regression Models

	Dependent variable: Tracking recommendation Gymnasium			
	Model 1		Model 2	
	B	SE (B)	B	SE (B)
Aptitude and achievement	0.75**	0.07	0.29**	0.08
Social skills and behavior	-0.14**	0.05	-0.07**	0.06
Motivation and positive approaches to learning	0.20**	0.07	0.10**	0.08
Mid-year grade mathematics			-0.29**	0.06
Mid-year grade German			-0.39**	0.07
R ²	0.72		0.83	

** $p < 0.01$.

the assessment. The participating teachers were also asked which secondary track they had recommended for each student. The results indicate that teachers generate an overall picture of each of their students, summarizing numerous individual characteristics to three overarching domains: *aptitude and achievement*, *social skills and behavior*, and *motivation and positive approaches to learning* (see Figure 12). The number of factors on which teachers base their assessments of their students is therefore limited. The study further examined the association of teacher assessments of relevant student characteristics with students' sex, socioeconomic status, and immigration status. It emerged that girls' *social skills and behavior* were rated higher than those of boys. Girls were also rated somewhat higher in the domain of *motivation and positive approaches to learning*. Moderate relations were found between family socioeconomic status and the domains *aptitude and achievement* and *motivation and positive approaches to learning*. Correlations with students' immigration status were low, however. A further finding was that, in total, the student characteristics in the three domains explained more than half of the differences observed in German and mathematics grades. The domain of *aptitude and achievement*

proved to be more important here than the other two domains. The Transition study thus provided empirical evidence that elementary teachers' recommendations of a secondary school track are based not only on students' grades but also on teachers' assessments of other relevant student characteristics (see Table 2).

TOSCA

There is no doubt that the transition to lower secondary education is one of the most important transitions in a student's educational career. However, later transitions—to upper secondary education and the tertiary sector, in particular—become increasingly important as educational pathways are opened up, allowing students to reconsider and revise earlier decisions (Maaz, Watermann, & Köller, 2009). To date, comparatively few studies have investigated these later transitions. The TOSCA study now provides a broad database allowing the transitions to upper secondary education and the tertiary sector to be thoroughly analyzed.

Vocational Interests

Vocational interests are regarded as strong determinants of educational and occupational decisions. However, it is clear that the process of educational and occupational specializa-

Table 3
Holland's Interest Domains (RIASEC) and Preferred Activities

<i>Interest domains</i>	<i>Preferred activities</i>
Realistic (R)	Activities that involve physical exertion and coordination and that produce concrete results.
Investigative (I)	Activities involving the symbolic and systematic investigation of physical, biological, or cultural phenomena.
Artistic (A)	Open unstructured activities involving artistic self-expression and creativity.
Social (S)	Activities that involve working with people to inform, help, or otherwise be of service to them.
Enterprising (E)	Activities that involve influencing, managing, or leading others.
Conventional (C)	Systematic activities requiring attention to accuracy and detail.

tion begins well before the clearly visible transition to vocational or higher education. First steps toward occupational specialization can be seen in the choices that students make at school—for example, in the advanced *Abitur* courses they choose or in the decision to enroll in *Gymnasium* schools specializing in certain fields at upper secondary level. These choices are closely related to later transitions to occupational training and higher education.

To date, the role of vocational interests in early phases of education (e.g., at lower secondary school) has barely been investigated. In particular, prospective studies investigating the relationship between vocational interests and educational decisions are scarce. The available studies point to substantial group differences—which are consistent with theoretical expectations—between upper secondary students enrolled in *Gymnasium* schools with differing specializations. However, these findings provide only indirect evidence that vocational interests guide the transition to upper secondary education through self-selection processes—it is equally possible that these differences are a function of socialization effects occurring at upper secondary level.

Against this background, Nagy and Husemann (2010) examined whether the structure of vocational interests differs before and after the transition to upper secondary education; the relationship between vocational interests

measured in lower secondary education and subsequent transition decisions; and to what extent differences in the interests of students enrolled in *Gymnasium* schools with differing specializations are attributable to self-selection processes or to socialization processes. The theoretical framework for this study was provided by John Holland's occupational choice theory. The centerpiece of the theory is a taxonomy of vocational interests that is distinguished by both its parsimony and the breadth of its applicability. Holland's model of vocational interests specifies six interest domains: *realistic* (R), *investigative* (I), *artistic* (A), *social* (S), *enterprising* (E), and *conventional* (C). Characteristic activities can be assigned to each of the six domains (see Table 3 for examples).

According to the calculus hypothesis, these six interest domains can be represented in a two-dimensional space by arranging them in a circle with the order R, I, A, S, E, and C, with similarity between the domains determining their relative position and proximity: Domains are located next to those to which they are most similar and opposite those to which they are most dissimilar. The strong version of the calculus hypothesis assumes that the structure of vocational interests can be represented by a perfect circle with equal distances between domains, whereas the weaker version does not expect the distances to be invariant. The structural model of vocational interests has important implications for the prototypi-

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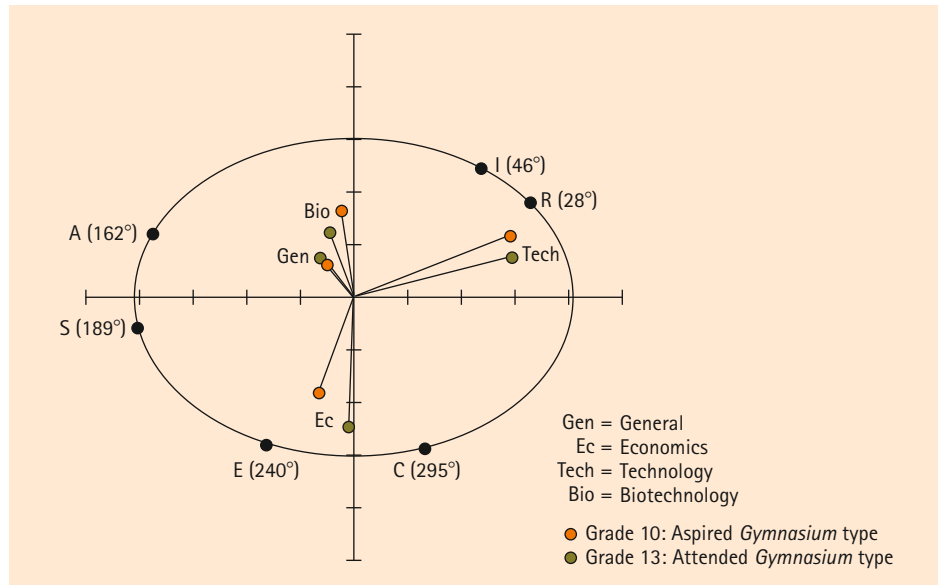


Figure 13. Elliptical structure of vocational interests of students aspiring to attend and attending specific *Gymnasium* types at upper secondary level in Baden-Wuerttemberg; mean interest profiles are represented as vectors.

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cal shape of individual interest profiles. The calculus hypothesis implies that individuals tend to structure their interests according to a circular similarity structure (e. g., Nagy, Marsh, Lüdtke, & Trautwein, 2009). Nagy and Husemann (2010) based their analysis on two data sets obtained in the context of the TOSCA study: one from a sample of students at the end of grade 10 (TOSCA-10) and one from a sample of *Abitur* students at the end of grade 13 (TOSCA-2006). Interest structures were investigated using a specially developed factor analytic model that is capable of describing both the strong and the weak versions of the calculus hypothesis. In contrast to established approaches, which are only able to describe circular structures, this model also allows elliptical similarity configurations to be described. This model was applied simultaneously to four subgroups of students formed by the cross-classification of time of assessment (grade 10 vs. grade 13) and lower secondary school type attended (*Realschule* vs. *Gymnasium*). The results can be summarized as follows. First, for all subgroups, an elliptical similarity configuration showed a good fit to the data and was consistent with the expectations of

the calculus hypothesis. Second, the central parameters of the measurement model proved to be invariant across groups, meaning that the conditions for profile comparisons were satisfied. Third, the groups compared in the first step differed only in terms of their interest level, with lower interest levels in the older TOSCA-2006 subgroups. Figure 13 illustrates the interest structures observed in the subgroups examined. As shown, the sequence of interest domains (RIASEC) was in line with theoretical expectations. Nagy and Husemann (2010) further compared the interest profiles of *Realschule* graduates in TOSCA-10 with an earlier cohort of *Realschule* students in TOSCA-2006, who aspired to, or had already attended, the same types of *Gymnasium*. For each type of *Gymnasium*, they compared the key characteristics of the vocational interest profile (level, orientation, and differentiation) of the two student cohorts. The results again documented a decreasing trend in the profile level, reflecting the effect of age. There were also some significant differences in profile orientations, although their magnitude was small. The same applied to profile differentiation, where again only small effects were observed.

The interest profiles found for the various types of *Gymnasium* school are represented as vectors in Figure 13. The direction of the vectors represents the orientation of the mean interest profiles (i.e., the domains in which interests are highest). Their length is proportional to the differentiation of the mean interest profile. Long vectors indicate highly accentuated profiles (i.e., strong relations with transition decision), whereas short vectors represent less accentuated profiles (i.e., weak relations with transition decision). Three main conclusions can be drawn from Figure 13. First, as expected, an association was found between the orientation of interest profiles and the content focus of the *Gymnasium* in question. Second, the strength of the association of profiles with transition decisions differed across the various options. Third, the profile vectors of the groups of students aspiring to attend and attending the different *Gymnasium* types barely differed from one another.

Primary and Secondary Background Effects on Future Study Intentions and Access to Higher Education

The longitudinal TOSCA data also allow us to disentangle primary and secondary background effects at the transition to higher education. Watermann and Maaz (2010) examined the effects of primary and secondary disparities on both future study intentions and access to higher education. Because the broad base of achievement data available covers both students' abilities and qualifications earned, the TOSCA database may provide more valid estimates of the secondary background effect than have been possible in other studies.

The analyses showed that, even within the relatively homogeneous group of *Abitur* students at general *Gymnasium* schools in Baden-Wuerttemberg, social background effects operate at entry to higher education: Both social class and parental educational qualifications contributed significantly to the prediction of access to higher education. Thus, the data confirmed that the transition to higher education is another threshold at which *Abitur* students at general *Gymna-*

sium schools—who are already a positively selected group—undergo social selection. As expected, controlling for achievement-related variables substantially improved the prediction, with achievement playing a far greater role than family structure characteristics. As the effects of family structure characteristics decreased only slightly when achievement was controlled, it seems that primary background effects are very low, whereas secondary background effects play a greater role. However, it is important to see the findings of the rather low magnitude of primary and secondary effects of social background against the background that these analyses focused on students in the upper secondary level of general *Gymnasium* schools rather than encompassing the whole age cohort. Moreover, in contrast to the analyses of study intentions, the analyses of access to higher education revealed mathematical ability to play a more important role than qualifications or social background variables. These were the first empirical findings to show that student abilities outweigh their qualifications at the transfer to higher education.

The secondary social background effect was fully explained by a mediation model developed on the basis of the theory of planned behavior. Moreover, the variables specified in the theory of planned behavior proved to go far beyond the role of mediators: Inclusion of the variables (without control for future study intentions) led to a considerable improvement in model fit. Subjective norms were best able to discriminate between those who entered higher education and those who did not. Finally, when study intentions were controlled, the model estimates for subjective norms had an independent and thus direct effect on access to higher education.

These findings show that the social environment—as a psychological environment—is important for both the formation of study intentions and the maintenance or revision of those intentions. Moreover, subjective norms largely mediated the secondary background effect. The psychological variable of perceived behavioral control had no direct effect on access to higher education. *Abitur* grade and mathematical ability had relatively robust

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effects, indicating that the objective resources or opportunities associated with these characteristics facilitate access to higher education. These findings—as well as the only moderate relationship found between study intentions and access to higher education—show that analyses focusing on one aspect or the other provide only an incomplete picture of the decision-making process.

Looking Back and Ahead

Our studies on the all-important transitions to secondary, vocational, and higher education have consistently shown that family background has a profound effect on educational outcomes. Moreover, the available studies have provided increasingly sophisticated insights into the educational decision processes that underlie these social inequalities and into the role of institutional and regional factors at points of transition. The results of the studies are increasingly informing education policy decision making and reforms. However, little is yet known about the effects of the reforms implemented.

Jürgen Baumert and his team will continue to examine how educational decisions are made and how they are affected by individual, institutional, and structural factors. 2010 saw the initiation of the Berlin study, a new large-scale transition study to be conducted together with Kai Maaz and his team (including Michael Becker and Marko Neumann) at the University of Potsdam and Olaf Köller at the Leibniz Institute for Science and Mathematics Education (IPN). The study was commissioned by the Berlin state government to examine the effects of broad structural reforms of the secondary system that have recently been implemented in Berlin, with profound implications for the transition to secondary education.

Instead of four types of secondary school, the Berlin secondary school system has—since the 2009/10 school year—implemented only two secondary school types: the academic-track *Gymnasium* and the new “integrated secondary school,” which combines the previous *Hauptschule*, *Realschule*, and comprehensive tracks and offers all school-leaving qualifications up to the *Abitur*. Another change con-

cerns the choice of secondary school, which was previously determined largely by catchment areas. Parents are now, in principle, able to choose from all schools in the city, provided that places are available. If demand for places at a school exceeds supply, the school itself decides on the allocation of the majority of its places (60%). A further third of the available places are allocated by lottery; the rest are reserved for hardship cases. The underlying objective of the reforms is to ensure that all students reach their full academic potential and to considerably weaken the link between educational achievement and family background.

Objectives and Design of the Berlin Study

The Berlin study was designed to evaluate the new procedures for transition to secondary education and to investigate the effects of the recent structural reforms in various domains:

- student achievement levels and reduction in the proportion of at-risk students at the end of compulsory schooling;
- effects of the structural reforms on transitions to upper secondary education at *Gymnasium*, vocational training, and higher education;
- the relationship between family background and educational outcomes (educational transitions and student abilities);
- the strength of the link between the school type attended and the qualifications awarded.

A longitudinal multicohort design will be used to evaluate whether the reforms are achieving their stated objectives. Cohort 1 was drawn from the first cohort of students to transfer to secondary education under the new procedures. Cohort 1 comprises some 3,300 students from approximately 180 elementary school classes in Berlin. These students will be assessed at the end of grade 6 in the 2010/11 school year; their progress after transition to secondary education will be tracked on to grade 10. The parents and teachers of the participating students will also be included in the study. A cohort of Berlin students assessed between 2003 and 2005—that is, prior to the reforms—in the context of the Element study

provides the control group for Cohort 1. The Transition study (Maaz, Baumert, Gresch, & McElvany, 2010) will also provide reference data. The instruments administered to Cohort 1 will be aligned with those used in the Element and Transition studies. A first parent survey was conducted in December 2010; the main study will be conducted in elementary schools in May/June 2011. First results for Cohort 1 will be reported in 2012. Moreover, two cohorts of grade 9 to grade 12 students will be investigated, one of which

was educated in the old system and the other in the new system. The students will be assessed in grade 9 and surveyed at several points in their educational careers, with questions focusing on the transition to upper secondary education or vocational training as well as students' aspirations for higher education. The parents and teachers of these students will also be surveyed. First findings on these two student cohorts will be available in 2015.

The Research Team

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Research Area III: Reading Literacy and Language Skills

Introduction and Project Overview

Research Area III examines students' reading literacy and language skills. Using longitudinal, cross-sectional, and experimental approaches, we investigate how these skills develop and how they can be effectively assessed and promoted. Reading literacy is one of the core competencies required in school education, vocational training, and working and private life. Indeed, written language, whether in print or on the computer screen, is probably the most important medium for communicating information. Yet large-scale assessment studies such as PISA have revealed alarming interindividual differences in reading proficiency in all phases of reading development, with substantial numbers of students failing to reach minimum proficiency levels. Accordingly, many students in German secondary schools are unable to comprehend texts on a deeper level; their understanding is limited to simple information retrieval. This applies particularly to students from immigrant families or families with low socioeconomic status. One major focus of our research, which covers all important stages of reading development from elementary to secondary education, is therefore on the determinants of reading development and its promotion in disadvantaged students.

In 2009 and 2010, work in Research Area III focused on four main projects, each examining different aspects in the development of reading proficiency:

(1) The development of reading proficiency from grade 3 to grade 6 and its individual and social predictors were examined in the *Berlin Longitudinal Reading Study* (LESEN 3–6). In this phase of the project, particular attention was paid to reading motivation and to students with immigrant backgrounds.

(2) Complementary projects addressed the effective promotion of reading literacy. These projects include a meta-analysis of the effectiveness of family literacy programs, which was conducted as an international cooperation project, and the development of a questionnaire to assess teacher competence in the area of reading literacy.

(3) The *Text–Picture Integration* (BiTe) project, conducted in cooperation with the University of Landau and funded by the German Research Foundation (DFG), was initiated in

2007 to examine how students develop the ability to integrate text- and picture-based information with their teachers' guidance. This project was in its second phase in 2009 and 2010.

(4) At present, the assessment of reading proficiency is only loosely grounded in cognitive psychology and psycholinguistics. The *Cognitive Language Assessment* (CLAss) project aims to clarify the relationship between reading proficiency tests and the cognitive processes specific to reading.

Berlin Longitudinal Reading Study

Overview

Despite the vital importance of reading for educational, professional, and day-to-day life, recent assessment studies have repeatedly identified serious deficiencies in student reading literacy in Germany. Moreover, students' reading motivation seems to decrease with age. Apart from being a valued resource in its own right, intrinsic reading motivation is

Berlin Longitudinal Reading Study—Data Collection

- 772 students
- 33 participating whole classes
- Elementary schools in Berlin
- Study period: end of grade 3 (basic reading skills usually acquired) to end of grade 6 (transition to secondary school)
- Student, teacher, and parent questionnaires; student reading assessments

positively related to reading performance. In the *Berlin Longitudinal Reading Study* (LESEN 3–6), we have therefore investigated the development of reading comprehension and reading motivation from grade 3 to grade 6, analyzing their complex mutual influences from both a cross-sectional and a longitudinal perspective. Family background has also been identified as an important factor for influencing reading proficiency, with both immigrant background and low socioeconomic status emerging to be associated with lower performance levels. In 2009 and 2010, we therefore investigated (1) the role of intrinsic and extrinsic reading motivation, (2) the effects of mismatch between the home language and the language of instruction on immigrant students' reading acquisition, and (3) the unique and shared variance explained by psychological and sociological constructs when predicting reading literacy.

The Role of Intrinsic and Extrinsic Reading Motivation

One in-depth research focus was on the longitudinal relationships of intrinsic and extrinsic motivation with reading literacy development. In particular, we (a) investigated reading amount as a mediator between motivation and reading literacy and (b) probed for bidirectional relationships between reading motivation and reading literacy, controlling for previous reading literacy (Becker, McElvany, & Kortenbruck, 2010). Structural equation models with latent variables showed that the relationship between intrinsic reading motivation and later reading literacy was mediated by reading amount, but not when previous reading literacy was included in the model. A bidirectional relationship was found between extrinsic reading motivation and reading literacy: Grade 3 reading literacy negatively predicted extrinsic reading motivation in grade 4, which, in turn, negatively predicted reading literacy in grade 6. These findings are of high relevance for practice and research, especially in calling attention to how educators and parents articulate reading-related expectations and to the detrimental impact of extrinsic motivation on the development of reading literacy. In

cooperation with Ana Taboada (George Mason University, USA), we further examined the important role that extensive reading plays for L2 learners (Taboada & McElvany, 2009), thus linking this line of research with our second research focus on the effects of family and cultural background.

The Role of Family Background and Effects of Mismatch Between School and Home Language on Immigrant Students' Reading Acquisition

The role of family background has been one of the focal points of our research since the beginning of the *Berlin Longitudinal Reading Study*. Drawing on research findings concerning family influences on educational outcomes, in general, and reading proficiency, in particular, we investigated the influence of family structure and process variables on children's reading proficiency, vocabulary, reading motivation, and reading behavior (McElvany, Becker, & Lütke, 2009). A model was proposed in which the predictive effects of family structure variables on reading proficiency are mediated by reading-related family process variables and by individual characteristics. The hypothesized effects were tested empirically using longitudinal data obtained from 772 elementary students in grade 3 to grade 6. The findings confirmed the multifactorial structure of reading socialization in the family as well as a complex pattern of relationships between family structure and process variables, individual reading-related characteristics, and reading proficiency. Furthermore, considering the family as the primary agent of reading socialization, we investigated processes of intergenerational transmission in reading habits, behavior, and attitudes (McElvany & Becker, 2009). These analyses focused on families with children at the end of grade 6, who had already acquired basic reading skills. Based on theorizing about reading socialization and on attempts to explain gender-specific differences, we proposed a general structural model in which parental attitudes and behavior predict children's attitudes and behavior. Additionally, we probed for differential effects of home characteristics depending on the children's gender.

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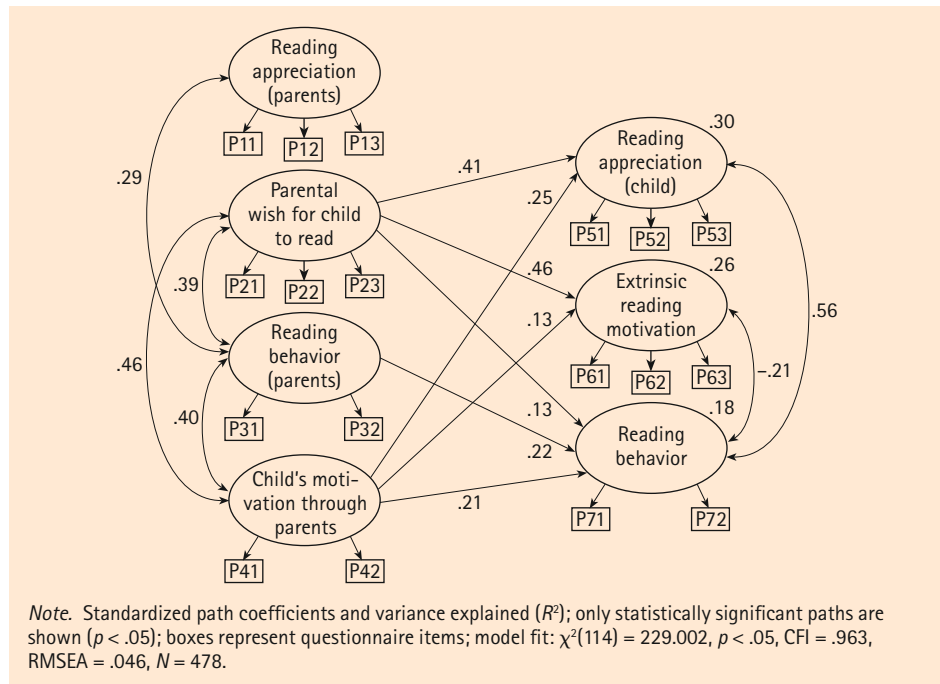


Figure 14. Intergenerational transmission of reading as a cultural tool: Structural equation model.

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The results depicted in Figure 14 support the hypothesis that reading-related attitudes and behavior are transmitted within the family. Further analyses revealed differential effects of family characteristics for boys and girls. For example, the perceived parental wish for children to read a lot had a strong effect on boys' extrinsic reading motivation, but for girls it also had an additional effect on reading behavior. We further investigated the longitudinal effects of immigrant background on reading literacy, specifically in cases of mismatch between the school and home language. Mastery of the language of instruction, especially its written form, is a precondition for successful participation in class and the acquisition of academic knowledge and skills. Reading literacy is thus thought to play an important role in explaining group differences in the educational participation of students with and without immigrant backgrounds. In order to identify points of intervention for the reduction of differences in educational outcomes, we therefore need to be able to pinpoint and explain similarities and differ-

ences in the reading acquisition process in multilingual and monolingual children. In the context of the *Berlin Longitudinal Reading Study*, we addressed the following three research questions: (1) Is mismatch between school and home language a significant predictor of reading literacy in grade 3 and of the increase in reading skills from grade 3 to grade 6? (2) Do achievement gaps disappear when socioeconomic status and/or cultural capital are taken into account? (3) Are there group-specific differences in the power of socioeconomic status and/or cultural capital to predict reading acquisition? Our main results are summarized in Box 1.

Evaluating Psychological and Sociological Constructs as Predictors of Reading Literacy
Theoretical models and research on the psychology of reading have identified numerous individual factors as influencing the complex processes of reading and comprehension, including cognitive as well as motivational, emotional, and behavioral factors. Social process and status variables have also been discussed as relevant from several perspectives

Main Findings on the Effects of Immigrant Background on Reading Literacy

- Mismatch between the home language and the language of instruction has a negative effect on the level of text comprehension and vocabulary in grade 3 and on vocabulary acquisition from grade 3 to grade 6.
- When socioeconomic status and cultural capital were successively entered into the autoregressive cross-lag panel-model, immigrant background remained as a significant predictor.
- Multiple group analyses revealed substantially reduced predictive power of socioeconomic status and cultural capital for text comprehension in the group of children with an immigrant background.

Box 1.

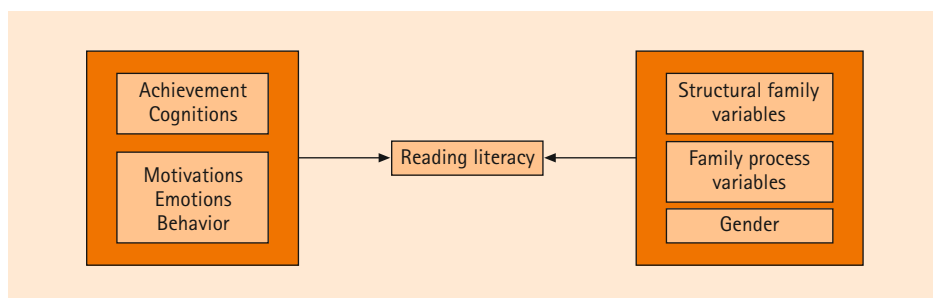


Figure 15. Psychological and sociological constructs predicting reading literacy.

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(see above). In recent analyses (McElvany & Becker, 2010), we have examined the relevance of a broad set of factors for reading literacy and determined the proportions of unique and shared variance explained by each (see Figure 15). First, cross-sectional analyses investigated the relations of individual and social factors with reading literacy among grade 6 students—an age that is crucial for the development of reading literacy. Second, analyses examined which proportions of the variance were specific and which were shared when individual and social structure and process factors were considered simultaneously. The results point to a clear and consistent predominance of cognitive factors over other areas of influence and highlight the importance of intellectual abilities and processes for reading literacy. This finding can usefully inform not only future research, but also practice, in terms of how the limited resources available to schools can best be applied to foster various aspects in the domain of reading.

Promoting Reading Literacy: Analyzing the Effectiveness of Family Literacy Programs and Assessing Teacher Competence

Reading Promotion: Family Interventions

In the *Berlin Parent–Child Reading Program*, a quasi-experimental intervention study integrated in the *Berlin Longitudinal Reading Study*, we examined the effectiveness of a systematic family-based intervention to support reading literacy and strategy use (McElvany & Artelt, 2009). Subsequently, we have investigated the potentials and challenges of family literacy interventions, and specifically the question of implementation quality, by evaluating our study in Germany as well as a study from the Netherlands targeting kindergarten and school-age children. The resulting publication identified, analyzed, and discussed aspects of implementation quality that may enhance or diminish the effectiveness of family literacy interventions (McElvany & Van Steensel, 2009). Three types of implementation variables were identified: (1) intensity and quality of parent–child

Key Reference

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Table 4
Differences and Similarities Between Family Literacy Policy and Programs in the Netherlands and in Germany

Aspect	Differences	
	The Netherlands	Germany
Nationwide family literacy programs	Yes	No
Development	Initial focus of early childhood education on home-based approaches; has now moved toward center-based programs	Started with some center-based approaches; now an increasing interest in home-based programs
Role of home language in program concepts and materials	Greater	Lower
<i>Similarities</i>		
<ul style="list-style-type: none"> • Family-based activities in both countries profit from experiences in other countries: Many programs in Germany resemble programs in the Netherlands, and most programs in both countries are, to some extent, based on internationally developed and implemented programs. • More research is needed on program effects, implementation quality, and other potential mediators. • There is room for improvement in the overall methodological quality of research. • Lobbying work for family literacy programs is required in both countries: in the Netherlands, focusing on defending existing programs; in Germany, on establishing a stable and comprehensive structure of family literacy programs. 		

activities, (2) support and training provided for parents, and (3) participation. Potential points of intervention were proposed for improving implementation quality in all three areas.

Finally, we reviewed current family literacy policies, programs, and evaluation studies in the Netherlands and in Germany (McElvany, Van Steensel, Guill, Van Tuijl, & Herppich, in press). One of our core findings is that family literacy as a central, organized, and structured system of interventions is still in its infancy in Germany, whereas the Netherlands can look back on a more comprehensive history in this area. Our comparison of family literacy policy and programs in the Netherlands and in Germany revealed both similarities and major differences (see Table 4).

A meta-analysis on the effectiveness of family literacy programs was conducted in cooperation with colleagues from the universities of Amsterdam and Tilburg (McElvany, Herppich, Van Steensel, & Kurvers, 2010; Van Steensel,

McElvany, Kurvers, & Herppich, 2011). The meta-analysis analyzed the results of 30 recent effect studies (1990–2010), covering 47 samples, and distinguished between effects in two domains: comprehension-related skills and code-related skills. A small, but significant, mean effect size emerged. There was only a minor difference between comprehension- and code-related effect measures. Moderator analyses revealed no statistically significant effects of three types of moderators derived from the publications reviewed: program characteristics, sample characteristics, and study characteristics. The results highlight the need for further research into how programs are implemented by parents and children, how program activities are incorporated into existing family literacy practices, and how program contents are conveyed to parents. In an additional publication, these results were contextualized within the results of other meta-analyses (Van Steensel et al., 2011).

Reading Promotion: Teacher Competence

A second research approach to effective ways of promoting reading literacy focused on the teacher as the primary agent of reading instruction. Recognizing the importance of teacher competence (see Research Area IV), the *Conditions for the Development of Reading Literacy at School* (CODE R) project drew on the COACTIV framework to develop a questionnaire assessing teacher competence in the area of reading literacy. The questionnaire covers elementary and secondary school teachers' knowledge, motivation, beliefs, self-regulation, and diagnostic skills in this area. Initial results for professional knowledge suggest that our theory-based test reliably measures teachers' content and pedagogical content knowledge in the area of reading literacy (McElvany, 2010c). A statistically significant, but only moderate, correlation emerged between the two knowledge subtests, indicating that the two theoretically differentiated areas of knowledge can also be empirically distinguished. Differences in teachers' knowledge were not systematically linked to teaching experience. This result is in line with findings from Research Area IV in the domain of mathematics. Thus, practical experience in schools alone does not seem to suffice to consolidate or increase teachers' professional knowledge. Rather, systematic in-service teacher training seems necessary.

In view of previous empirical findings on the significance of metacognition for reading comprehension and learning, we placed a special focus on teachers' knowledge about metacognition, both in general and specifically for reading, and their judgments of the relevance of this knowledge. Our research objectives were (1) to identify the knowledge about metacognition that should be available to teachers, (2) to compare it with the knowledge they actually have and examine any misconceptions that might be barriers to effective instruction, and (3) to explore teachers' perceptions of the relevance of knowledge about metacognition for teaching. Five areas of relevant knowledge were identified and operationalized by 49 items in 28 multiple-choice tasks. Findings showed

that elementary school teachers ($N = 135$) did have some relevant knowledge about metacognition. However, misconceptions were found in all five areas. Moreover, in general, teachers do not seem to attribute as much relevance to knowledge about metacognition as to other areas of reading-related knowledge.

Developing and Assessing Proficiency Models of Text–Picture Integration (BiTe) Overview

As most school textbooks contain texts with instructional pictures (e.g., graphs, photos), the ability to extract and integrate information from both sources is critical for learning. Analogous to skill development in other domains, the development of students' ability to integrate textual and graphical information is likely to be considerably influenced by the instruction their teachers provide. Accordingly, models describing the structure and development of this competence at the student level should be complemented by corresponding models of teacher competence, particularly diagnostic skills.

The classroom use of texts with instructional pictures entails several problems. First, students often have misconceptions about the interpretation of instructional pictures. Second, many teachers are unaware of these misconceptions. Third, text–picture integration is neither taught systematically in German teacher education programs nor recognized as an important instructional goal (McElvany, Becker, & Lüdtke, 2009). Against this background, the *Text–Picture Integration* (BiTe) project investigates students' ability to integrate text- and picture-based information and teachers' ability to promote successful text–picture integration (Schnotz et al., 2010). The project is a cooperative endeavor of the Institute and the University of Koblenz-Landau. It is part of the *Priority Program "Competence Models for Assessing Individual Learning Outcomes and Evaluating Educational Processes"* (SPP 1293), which is funded by the German Research Foundation (DFG). The project is currently in the second phase of funding (2009–2011; see Figure 16), and a third phase is planned.

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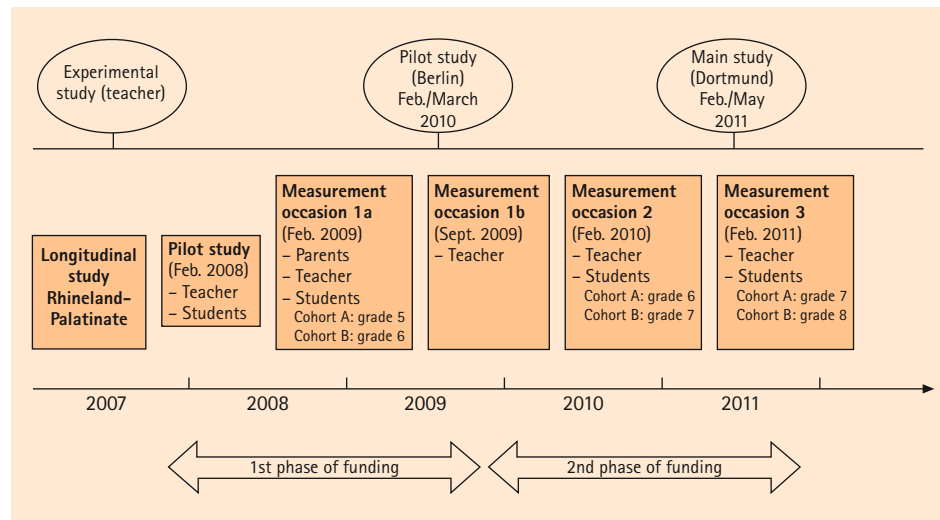


Figure 16. The Picture-Text Integration (BiTe) project: Overview of study design.

© BiTe

Diagnostic Skills

One focus of the second phase of the BiTe study has been on the assessment of teachers' diagnostic skills. Diagnostic skills are required for the adequate preparation, implementation, and evaluation of instruction and are thus a core component of teacher competence. Different aspects of diagnostic skills can be distinguished, and numerous studies have investigated the accuracy of teacher judgments in various domains. McElvany, Schroeder et al. (2009) were the first to study teachers' diagnostic skills in the context of texts with integrated pictures. The results are in line with earlier research indicating teacher judgments to be only moderately accurate. In fact, some aspects of teachers' diagnostic skills were found to be even less well developed than in previous studies. These findings, together with the rather weak correlations between teaching experience and the different aspects of diagnostic skills, highlight the need to enhance teacher education in the field of text-picture integration. Additionally, the research team recently investigated the reliability of widely used measures of teachers' diagnostic skills. Lintorf et al. (in press) raised substantial doubts about the reliability of some of the commonly used measures and discussed implications for future research.

Professional Development in the Field of Text-Picture Integration

The BiTe study has also addressed the connection between diagnostic skills and instructional behavior. According to the study's theoretical model, diagnostic skills influence instructional decision making, and this relationship is moderated by pedagogical content knowledge. Empirical evidence of these associations is lacking, however. To close this gap in the research, we first conducted a pilot study with a pre/posttest design and a control group to evaluate a video-based continuing professional development intervention in the field of text-picture integration. Comparison of the knowledge of the intervention and the control group at posttest clearly showed that the intervention was successful. Furthermore, regardless of prior knowledge or perceived quality of the intervention, all participants in the experimental group profited equally from the intervention in terms of increased knowledge. These results are highly relevant: From a theoretical point of view, they confirm that professional knowledge is learnable; from a practical point of view, the intervention appears to be a promising approach for in-service teacher education. Other results from the BiTe project are also promising with regard to professional development. Beyond knowledge and diag-

nostic skills, we expected teachers' personal characteristics to be further crucial determinants of their instructional behavior (see Schroeder et al., 2011). These characteristics include beliefs, motivation, self-efficacy, and self-regulation in the area of text-picture integration (see Research Area IV). Our data indicate positive levels of these characteristics (McElvany et al., 2010c). For instance, the participating teachers were clearly aware of the relevance of integrative reading for successful learning and had positive attitudes toward the topic with respect to their own instruction. In conclusion, the conditions for teaching students to integrate information from texts and pictures seem good—as long as teachers have the necessary didactic competence.

Language Assessment and Cognitive Predictors of Reading Ability

Reading is a complex cognitive skill that draws on many component processes and resources. The processes involved in comprehending a text include decoding single words, syntactic and coreferential processing, inferencing, and constructing a coherent representation of the overall meaning of the text. Because these processes are heterogeneous, the assessment of reading comprehension is a challenging task. Numerous tests and online methods for the assessment and investigation of reading processes have been developed. In educational research, reading comprehension is generally assessed by means of offline measures presented after the text has been read. Multiple-choice items are commonly used for this purpose, although other more informal measures are also used in instructional settings. It is well known that performance on multiple-choice comprehension items is influenced by processes associated with students' text processing as well as by processes necessary during the response decision phase. However, precisely which processes influence students' performance on different types of items remains a matter of debate in educational psychology and assessment. The *Cognitive Language Assessment* (CLAss) project was initiated in summer 2008 to clarify the relationship between reading

proficiency tests and the cognitive processes specific to reading.

What Readers Have and Do

Interestingly, very little is known about what students actually *do* while reading the texts in reading comprehension tests—which cognitive processes they engage in and which of these processes have consequences for their comprehension performance. In order to successfully comprehend a text, readers have to construct a stable text-based representation and generate a coherent situation model. To this end, they have to engage in the complex, dynamic, and continuous allocation of attention to several component processes of reading as they read, and they need to execute these processes in an efficient and coordinated fashion. However, readers' resource allocation is also constrained by their verbal resources. As a result, students' resource allocation strategies and verbal resources interact and are likely to have unique as well as shared effects on comprehension. To further complicate the picture, the interacting effects of resource allocation and verbal ability on comprehension may depend on characteristics of the comprehension questions and on the way the test is administered.

To close this knowledge gap, we investigated the reading behavior of 15-year-old students who were reading texts to answer multiple-choice items (Schroeder, in press-b). Students' word-by-word reading times were collected as a fine-grained online measure of their reading behavior. We asked 125 students to read the texts of the reading-comprehension test on computers using the "moving-window" method. In this paradigm, the letters of a text are replaced by the symbol "~". When the reader presses the space bar, the first word of the text is revealed. At the next press of the space bar, the first word is concealed again and the second word revealed, and so forth (see Figure 17). After reading the text in this manner, the students answered the corresponding questions. We were thus able to measure how much time each reader spent on each word of a text and, at the same time, to assess reading comprehension.

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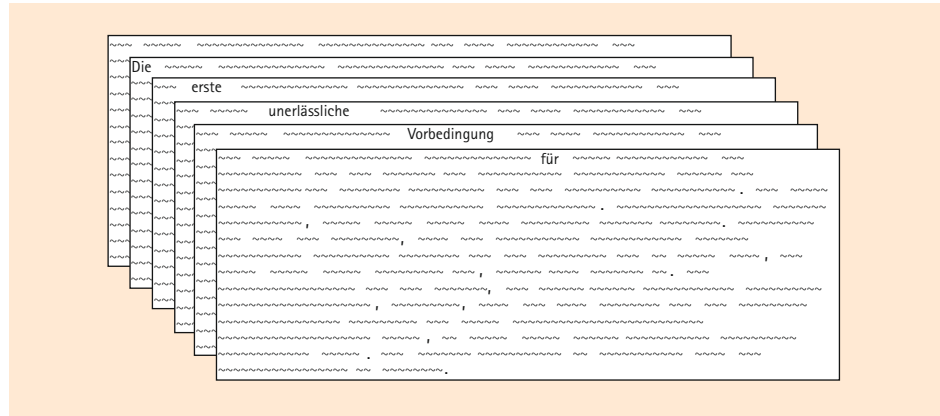


Figure 17. The first words of a text as read in the moving-window paradigm.

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The allocation of resources to several cognitive processes at the word, sentence, and text level was measured by relating reading times to linguistic variables of the text that are sensitive to these processes. We further explored whether reading-time components were influenced by students' verbal ability and investigated their unique and shared effects on comprehension. The availability of the texts during question answering was manipulated experimentally, and differential effects for different text and item types were investigated.

Results showed that there were substantial interindividual differences in resource allocation to the different component processes. Further analyses revealed that this variance was systematically related to students' verbal ability and to their reading comprehension: There were both unique and shared effects of reading-time components and verbal ability on test performance. In sum, approximately 50% of the variance in comprehension was explained by the combined effects of the two sets of variables. Approximately one third of this variance was associated with interindividual differences in text processing—either because ability effects were mediated by reading behavior or because strategic differences in resource allocation contributed independently to comprehension. Students with higher verbal ability and better comprehension encoded infrequent concepts more carefully, spent more time on conceptual

integration, and updated their situation model more carefully. However, comprehension did not depend on resource allocation to a single linguistic feature, but on the orchestration of several interrelated processes. Overall, the results of the present study are in opposition to those of studies that found no relationships between text processing behavior and reading. Instead, the present study suggests that there are moderate, but stable, relations between verbal abilities and text processing behavior, indicating that readers' processing strategies are sensitive to the available resources.

Analyzing High- and Low-Skilled Readers' Word Decoding Processes

A second line of studies in the CLAss project focused on low-skilled readers' word decoding processes. There is ample evidence that low-skilled readers have problems with word identification and lexical access. Readers who differ in reading comprehension ability generally also differ in the accuracy and speed with which they decode letter strings and access the meaning of words. Although there is wide acknowledgment that low-skilled readers have difficulties with word decoding, the precise locus of these deficits remains unclear. Word identification is a complex process involving visual perception, sublexical phonological processing, and retrieval of semantic information from the mental lexicon. Because impairments in each of these subprocesses necessitate different remedial activities, it is

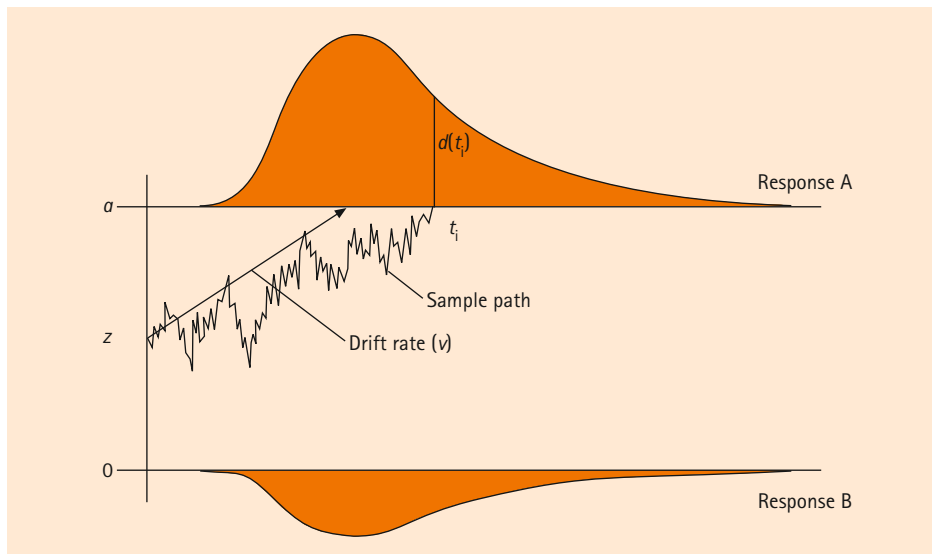


Figure 18. Graphical illustration of the diffusion model.

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important to understand where exactly in the word recognition architecture the deficits of less-skilled readers are located.

In one study (Schroeder, in press-a), we concentrated on low-skilled readers' nonword deficit, that is, on the fact that low-skilled readers typically perform much worse on nonwords or uncommon words than on common words. A prominent explanation of this deficit in opaque orthographies, such as English, is that low-skilled readers have a fundamental phonological deficit that impedes the acquisition of reliable sublexical decoding procedures. In a lexical decision experiment, we tested another plausible account of the nonword deficit that is particularly attractive for German: that low-skilled readers rely less on syllabic and multiletter information. In German, syllable structure is complicated because German syllables are usually closed and often contain many consonant clusters. As a consequence, assembly of the phonological code is more complicated in German and involves the use of complex multiletter rules. To test the hypothesis that low-skilled readers in German use multiletter information inefficiently, we manipulated the way words were presented to the students. In one condition, letter strings were presented in standard format. In a second condition, letter

strings were presented in MiXeD cAsE, which is known to disrupt the use of multigrapheme information. When the stimuli were presented in standard case, low-skilled readers showed a substantial nonword reading deficit, that is, they had particular problems decoding nonwords. When stimuli were presented in MiXeD cAsE, in contrast, high-skilled readers showed the same nonword reading deficit as low-skilled readers. In other words, both groups were equally impaired in nonword processing. This finding indicates that, in normal reading, high-skilled readers make use of multiletter information to speed up phonological decoding, but that they were unable to do so in the mixed-case condition. In contrast, low-skilled readers tend to decode graphemes in isolation and rely less on suprasegmental information, even in normal reading.

In a second study (Schroeder, in press-c), high- and low-skilled readers' word decoding processes in two lexical decision experiments were analyzed using the diffusion model. Diffusion models have recently been used to dissociate the cognitive processes involved in the lexical decision task. They allow task performance to be decomposed into several unobserved psychological processes, each represented by a parameter of the model (see Figure 18). In particular, response perfor-

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mance is decomposed into a component that represents the speed of information uptake from the stimulus (called drift rate), a response caution parameter, a component indexing response bias, and a parameter that represents the time spent on processes unrelated to the decision process, such as stimulus encoding and motor response execution. Results showed that low-skilled readers' deficits were consistently attributable to lowered drift rate parameters; the nondecision component and response caution varied little between low- and high-skilled readers. This pattern of results was observable under a wide range of conditions, including polysyllabic and monosyllabic stimuli as well as words presented in standard and mixed-case format. This pattern of findings suggests that the processing deficits of low-skilled readers result from impaired lexical processes and not from deficits in low-level perceptual processing. Furthermore, results indicate that low-skilled readers' deficits are partly attributable to the

inefficient use of the fast word-level route in high-frequency word recognition. However, the main processing deficit of low-skilled readers originates from the letter level and relates to phonological processing.

Outlook

Work on the projects that emerged from Research Area III will continue. Nele McElvany is now at the Technical University of Dortmund, from where the *Berlin Longitudinal Reading Study* and the BiTe project are now being coordinated. The *Berlin Longitudinal Reading Study* is being conducted in ongoing cooperation with Michael Becker, who is now at the University of Potsdam. Sascha Schroeder is now at the University of Kassel, where work on the CLAss project is being continued. For example, a study is currently being prepared on shallow processing and how students can be taught to invest their cognitive resources more efficiently during reading.

Research Area IV: Professional Competence of Teachers and Cognitive Activation in the Classroom

Research Area IV focuses on the teacher as a critical lever for improving the functioning and outcomes of the educational system. Building on our earlier research on powerful learning environments, our research program has progressed from describing features of high-quality classroom instruction to identifying the knowledge and skills that teachers need to create such successful learning environments. Drawing on a theoretical model of teacher competence, we have devised tools and procedures to tap interindividual differences in the knowledge, beliefs, and psychological functioning of teachers and found that these aspects of teacher competence are systematically linked to differences in instructional quality. Our most recent focus has been on how teachers acquire this professional competence. We have examined the learning experiences provided in the teacher education system and how teachers' professional competence changes over their education and career. A key source of data in this context is the COACTIV-R study, a longitudinal study investigating teacher candidates' professional development during the practical phase of teacher education.

Work in Research Area IV integrates research on instructional quality and research on teachers' professional competence. This work was inspired by the analyses of instructional quality conducted in the context of the *Learning Processes, Educational Careers, and Psychosocial Development in Adolescence and Young Adulthood* (BIJU) study, which led to the first systematizations of the field, especially with respect to domain-independent dimensions of instructional quality. The paradigm was further developed, particularly in terms of methods, in the German national extensions to the *Third International Mathematics Study* (TIMSS) and analyses of the TIMSS Video data. These empirical findings provided the basis for a model of "good instruction": a cognitively activating learning environment that offers students opportunities for insightful learning through the selection and implementation of cognitively challenging tasks and that, at the same time, provides adaptive support for individual students' learning processes in an effectively structured context.

Our research thus focuses on three general features of instruction that are crucial for insightful learning processes in secondary school mathematics: cognitively activating elements, classroom management, and individual learning support. It is important to note that the uptake of learning opportunities depends both on the students themselves (in terms of their individual strengths and

weaknesses) and on situational affordances and constraints (Kunter & Voss, 2011). Successful instruction thus hinges on the degree to which instructional strategies are suited to the needs of both the situation and the students. Instructors need to provide challenging tasks, monitor student learning, and adapt their teaching as appropriate to support active and independent knowledge construction across the whole class.

Yet, it is no easy matter to create challenging and suitable learning conditions for groups of students whose motivation and prior knowledge may differ greatly. Such deliberate, but, at the same time, flexible and adaptive classroom practice depends on a solid knowledge base, supported by adaptive beliefs and psychological functioning. Until recently, teachers' professional competence had rarely been measured by quantitative means. To close this knowledge gap, we have developed a model of professional teacher competence and instruments for its empirical assessment (Kunter & Klusmann, 2010a; Kunter, Klusmann, & Baumert, 2009). The model combines aspects of teacher knowledge, beliefs, motivations, and psychological functioning. It is based on the idea that teachers acquire their professional competence in both their initial training and classroom practice. Hence, we see teachers not only as providers of education but also as professional learners. Like their students, teachers acquire their skills through the active construction

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of knowledge and uptake of the learning opportunities available to them. In the first step of our research program, we developed and validated empirically sound measures to tap the theoretically postulated aspects of teacher competence. Second, as a crucial part of the validation process, we investigated the link between teachers' competence and the quality of their instruction, examining the relative importance of the different dimensions of domain-specific knowledge. Building on these results in a third step, we extended our theoretical approach from a focus on teachers' subject-related knowledge and skills to a broader model of teacher competence that encompasses noncognitive aspects, such as motivation and self-regulation as well as subject-unspecific aspects of professional knowledge. Fourth, we investigated the malleability of teacher competence and how it can be improved in formal teacher education.

Data Base: The COACTIV Research Program

Since its inception in 2002, the COACTIV research program has been systematically developed at the Institute (see Table 5). The research program is dedicated to the study of the structure, development, and consequences of teachers' professional competence. The first main study in the program was COACTIV, a research project embedded in the longitudinal extension of PISA 2003. Within this first main study, we first developed a theoretical model of teachers' professional competence as well as instruments for its assessment. The opportunity to link the COACTIV teacher data to longitudinal data obtained from their students in the PISA 2003/2004 assessment allowed us to test the practical relevance of this professional competence for the quality of teachers' instruction and for student learning outcomes.

The second main study in the COACTIV research program was COACTIV-Referendariat (COACTIV-R), which ran from 2007 to 2009. COACTIV-R investigated teacher candidates' acquisition of professional knowledge during the obligatory 2-year phase of teaching practice (i. e., the *Referendariat*) that is required to become a fully licensed teacher in Germany. COACTIV-R investigated the

development of professional competence during this second phase of teacher education using a longitudinal study design with two points of measurement and two cohorts of teacher candidates in consecutive years. A focus of the study was on the development and testing of new instruments to assess the generic pedagogical/psychological knowledge of beginning teachers. At the same time, the existing instruments were revised and extended.

The most recent element of the COACTIV program is the project entitled *Broad Educational Knowledge and the Acquisition of Professional Knowledge in Teacher Candidates (BiWiss)*, which is being conducted in cooperation between the Institute, the University of Frankfurt a. M., the University of Duisburg-Essen, and the University of Munster. This third main study, which will run from 2009 to 2012, focuses on the university-based component of teacher training and examines the teacher candidates' broad educational knowledge. These three main studies were complemented by several smaller ones. After the initial COACTIV study, we tested the construct validity of our newly developed assessments of mathematics teachers' content knowledge and pedagogical content knowledge in selected contrast populations (COACTIV Construct Validation Study). This study was initiated at the Institute and conducted at the University of Kassel as part of a project funded by the German Research Foundation (DFG). To learn more about the development of professional competence during teacher education, we carried out a study with university students in 2008 (COACTIV-Students). The cross-cultural validity of the new assessments was tested in a comparative study with practicing teachers in Taiwan (COACTIV-International). This study was conducted in spring 2009 as a collaborative project of the Institute and the National Academy of Educational Research (NAER) in Taipei. In a fourth validation study, *Stress and Burnout in the Teaching Profession: An In-Depth Analysis of the Role of Personal and Institutional Resources (BELE)*, we tested the capability of the COACTIV instruments to assess motivation and self-regulatory skills in a sample of clinically stressed teachers.

Table 5
Overview of the COACTIV Research Program

<i>Main studies</i>	<i>Design</i>	<i>Focus</i>
COACTIV	<ul style="list-style-type: none"> • 194 mathematics teachers • Embedded in PISA 2003/2004 • Repeated measurement (1 year) 	<ul style="list-style-type: none"> • Development of measures • Links between teacher competence/ instruction/students
COACTIV-R	<ul style="list-style-type: none"> • 856 mathematics teacher candidates • Repeated measurement (1 year) 	<ul style="list-style-type: none"> • Validation of competence model • Description of development during teacher training • Identification of individual and institutional conditions for development
BilWiss	<ul style="list-style-type: none"> • Approx. 3,500 graduates of university teacher education programs • Test of educational knowledge • Subsample: Repeated measurement (1 year) 	<ul style="list-style-type: none"> • Analysis of the structure of educational knowledge • Comparison of students in different teacher education programs
Smaller studies	<ul style="list-style-type: none"> • COACTIV Construct Validation Study • COACTIV-Students • COACTIV-International (Taiwan) • BELE (Stress and Burnout in the Teaching Profession) 	

The results of all of these studies have fed into the development of a theoretical framework that systematizes the structure, antecedents, and effects of teachers' professional competence. To make this framework and the wealth of empirical results available to a broader audience and to give a comprehensive overview of our research, we have recently published an edited volume reporting the main findings of the program (Kunter, Baumert et al., 2011). A version adapted to an English-speaking audience is in preparation and is expected to be published in late 2011.

A Model of Teachers' Professional Competence

The theoretical basis for our work on teachers' professional competence is a general model of professional competence that draws on Weinert's work on the concept of competence, combining it with the taxonomic approaches of Shulman and Bromme and with approaches from motivational psychology (see Figure 19). The model distinguishes between teachers' professional knowledge, beliefs, motivational characteristics, and self-regulation and postulates that all of these aspects of teacher competence are needed to meet the demands of the profession. We place a particular focus

on the classroom situation and on identifying those teacher characteristics that contribute to effective instructional practice, with positive effects on student learning outcomes. Taking a multicriterial approach, we also consider other criteria of professional success, which are labeled "Teacher outcomes" in Figure 21, and encompass aspects of continuing professional development and occupational well-being (Klusmann, Kunter, & Trautwein, 2009; Richter, Kunter, Klusmann, Lüdtke, & Baumert, 2011).

Central Aspects of Professional Competence

At the core of our empirical work is an understanding of competence as the knowledge, skills, attitudes, and motivational variables needed to master specific situations. The term "professional competence" applies this concept to the world of work and particularly to complex and demanding professions such as teaching, in which the mastery of situations depends on the interplay of knowledge, skills, attitudes, and motivation. There is ample evidence that teachers' professional knowledge, beliefs, work-related motivation, and ability for professional self-regulation are important determinants of their teaching success. In our research, we have specified these aspects of

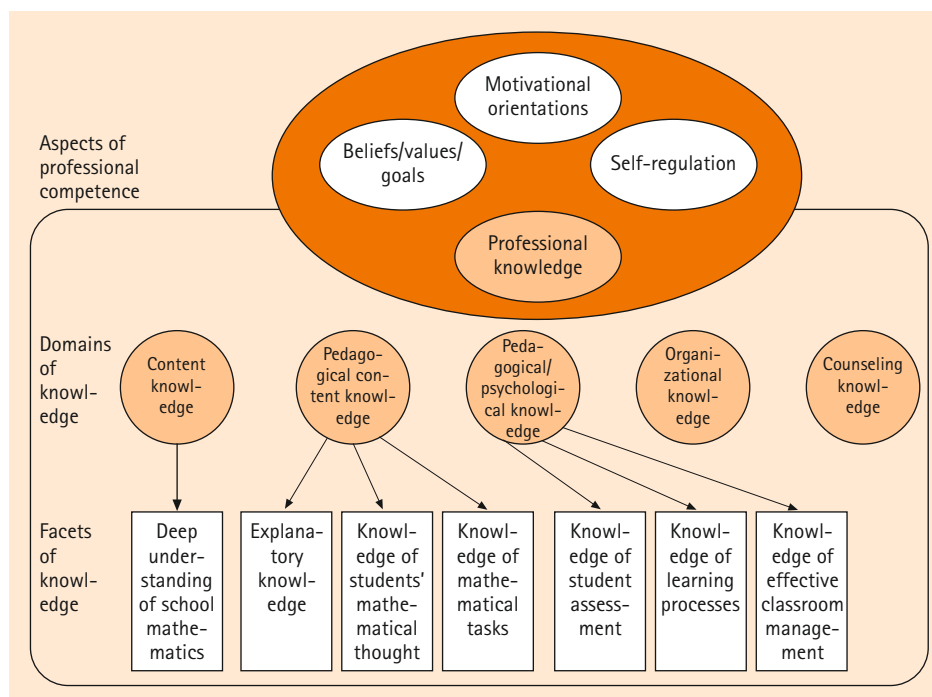


Figure 19. The COACTIV model of teachers' professional competence as specified for mathematics teachers.

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teacher competence to apply to mathematics teachers in secondary education.

Professional knowledge is a core component of teachers' professional competence. One of our major research objectives in recent years has been to develop a comprehensive taxonomy of this knowledge. Drawing on Shulman and Bromme, we have distinguished several domains of teachers' professional knowledge (see Figure 19). *Content knowledge* is conceptualized as a deep mathematical understanding of the content to be taught. This professional knowledge includes a masterly command of the content of the school mathematics curriculum, but neither this school-level knowledge nor everyday mathematical knowledge equip teachers for the challenges of preparing and delivering instruction. Content knowledge is therefore distinguished from *pedagogical content knowledge*, which Shulman defines as the knowledge necessary to make mathematical content accessible to students. Three facets of pedagogical content knowledge are considered crucial: knowledge of strategies for representing and explaining learning content in a specific subject, knowl-

edge of the didactic potential of tasks and sequences of tasks for learning processes, and knowledge of subject-specific student cognitions. As a further dimension of knowledge that is directly relevant to classroom practice, *pedagogical/psychological knowledge* comprises the generic cross-curricular knowledge needed to create and optimize teaching and learning situations, including a basic understanding of developmental and educational psychology, and knowledge of lesson planning, instructional methods, and classroom management strategies. Teachers' professional knowledge also includes the broader educational knowledge needed especially for their work outside the classroom, such as knowledge about the organization of the school and the school system and a capacity for adaptive and effective communication, particularly with laypeople.

Drawing on data from the first COACTIV study, we found that content knowledge and pedagogical content knowledge both made unique contributions to explaining differences in the quality of teachers' instruction and their students' outcomes. The embedding of COACTIV

in the longitudinal PISA 2003/2004 assessment allowed us to link student and teacher data, thus creating a quasi-experimental situation in which differences in student achievement were directly attributable to differences in teacher knowledge. Multilevel structural equation modeling revealed a substantial positive effect of pedagogical content knowledge on students' learning gains that was mediated by the provision of cognitively activating and adaptive instruction. Pure content knowledge, although systematically linked to pedagogical content knowledge, was not directly linked to higher instructional quality (Baumert, Kunter et al., 2010).

Teachers' beliefs are implicit or explicit conceptions that influence their perception of the environment and their behavior. We distinguish professional values and ethics; epistemological beliefs about the structure, development, and validation of knowledge; and beliefs about learning content, lesson planning, and instructional practice. Specifically for mathematics instruction, two opposing belief sets can be described both theoretically and empirically. On the one hand, teachers may take a "transmission view" that draws on traditional learning theories and tends to see students as passive receivers of information. On the other hand, teachers may take a "constructivist view" that endorses the principles of active and constructive learning. Drawing on data from the first COACTIV study, we found that the latter is more conducive to high-quality instruction than the former (Voss, Kleickmann, Kunter, & Hachfeld, 2011).

Motivational Orientations and Self-Regulation

The teaching profession is characterized by a relative lack of external constraints on—or control of—teachers' behavior. The typical career path offers few direct incentives or rewards to enhance occupational commitment. At the same time, the profession makes high demands on teachers' attention, energy, and frustration tolerance. Adaptive motivational orientations and self-regulation skills are thus vital for teachers to succeed in their jobs in the long term. Aspects of intrinsic motivation, such as enthusiasm, interests, control beliefs,

and self-efficacy beliefs, seem important for the development and maintenance of occupational commitment (Kunter, 2011a). Indeed, our research showed that teachers' enthusiasm for teaching was systematically linked to their instructional quality and their students' outcomes (Kunter, 2011b).

At the same time, self-regulation skills (i. e., the ability to distance oneself from one's work and to cope adaptively with stress) are needed to maintain occupational commitment in the long term and to preclude unfavorable motivational and emotional outcomes. Our data confirmed that better self-regulation skills were systematically linked to higher instructional quality, better student motivation, and lower rates of teacher exhaustion (Klusmann, Kunter, & Trautwein, 2009).

Domain-General Knowledge

Our research on teachers' professional competence was motivated by the observation that German mathematics teachers, in particular, seemed to lack knowledge of how to make mathematical content comprehensible to their students. In the first phase of our research program, we focused on teachers' domain-specific knowledge, content knowledge, and pedagogical content knowledge. However, it is clear that there is much more that teachers need to know in order to create powerful learning situations. In our ongoing studies, we have therefore extended the focus of our research from teachers' subject-related knowledge and skills to the domain-general knowledge needed in the teaching profession. In the COACTIV-R and BilWiss studies, we have developed measures to test teachers' domain-general knowledge and are examining the practical relevance of this knowledge for classroom practice and learning outcomes. One area of domain-general knowledge that is particularly relevant for the classroom situation is teachers' general pedagogical/psychological knowledge (PPK). This can be defined as the knowledge needed to create and optimize teaching-learning situations across subjects, including declarative and procedural knowledge of classroom management, teaching methods, classroom assessment, and student heterogeneity. Although

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Table 6
Examples of Items Developed to Tap General Pedagogical/Psychological Knowledge

<p><i>Knowledge of classroom management</i> Videotaped vignette (situation): The class is looking at a topic in depth. There is a class discussion of an interesting task; the teacher keeps asking questions. Most of the students are concentrating. Mario is sitting in the second row. He calls out something that has nothing to do with the topic under discussion. His response prompts some students to giggle and mess about. The teacher doesn't react and tries to keep the class discussion going. Mario sits back, crosses his arms, and does not participate any further. At some point, he begins to rummage around in his bag and takes out a tennis ball, which he then holds in his hands. The class takes no notice of him and carries on working. Mario begins to throw the ball gently into the air and catch it.</p> <p>Short-answer questions: (A) How do students interfere with instruction? Please describe all disruptive behaviors you have seen in as concrete terms as possible. (B) A boy in the class has been playing with a ball at his desk. Imagine you are the teacher and are concerned that he will at some point start throwing the ball around. What could you do to prevent him from doing so without interrupting the class discussion? Please list all concrete steps you could take.</p>
<p><i>Knowledge of teaching methods</i> It is often observed that some students do not give their best effort in group work contexts. Please give ... (A) possible reasons for this phenomenon (2–3 sentences). (B) possible ways of structuring group work to alleviate the problem (2–3 sentences).</p>
<p><i>Knowledge of classroom assessment</i> You have set your class a test. You want to grade Peter according to ... (A) a social frame of reference. With what do you have to compare Peter's performance in the test? (B) an individual frame of reference. With what do you have to compare Peter's performance in the test? (C) an objective (criterion-based) frame of reference. With what do you have to compare Peter's performance in the test?</p>
<p><i>Knowledge of student characteristics</i> Imagine that you have told your class you will be setting them a test next week. A colleague tells you that he thinks Maria suffers from high test anxiety. Which of Maria's characteristics could be seen as indicators for high anxiety in achievement situations? Report all the characteristics that come to mind.</p>

PPK is thought to be an important aspect of teacher quality, it has to date seen little empirical investigation—largely because no direct and valid measure of PPK has previously been available.

In order to close this gap, we have developed a 39-item measure using multiple-choice items, short-answer items, and video-based items to assess PPK. One part of the test involves short video vignettes presenting critical classroom situations in terms of preventive/proactive classroom management. These videos, which show authentic scenes re-enacted by grade 5 to grade 7 classes, are presented to participants. After each sequence, written short-answer questions are administered, the first question requiring the identification of critical elements in the scene and the second question assessing strategies for preventing or

dealing with the problem. Other items tapping teachers' knowledge of teaching methods, assessment, and student heterogeneity are presented in traditional paper-and-pencil format. Table 6 gives examples of our test items. The PPK test has been developed and optimized in several pilot studies. Experts have rated the items to be relevant for teaching, domain general, and authentic. The COACTIV-R study provided further evidence for the measure's validity. Data obtained from 746 German teacher candidates supported the hypothesized nomological network of PPK; the measure was sensitive to differences between groups; and variations in PPK did not overlap to any great extent with variations in discriminant constructs, such as domain-specific knowledge, beliefs, and general reasoning abilities. Furthermore, PPK was positively

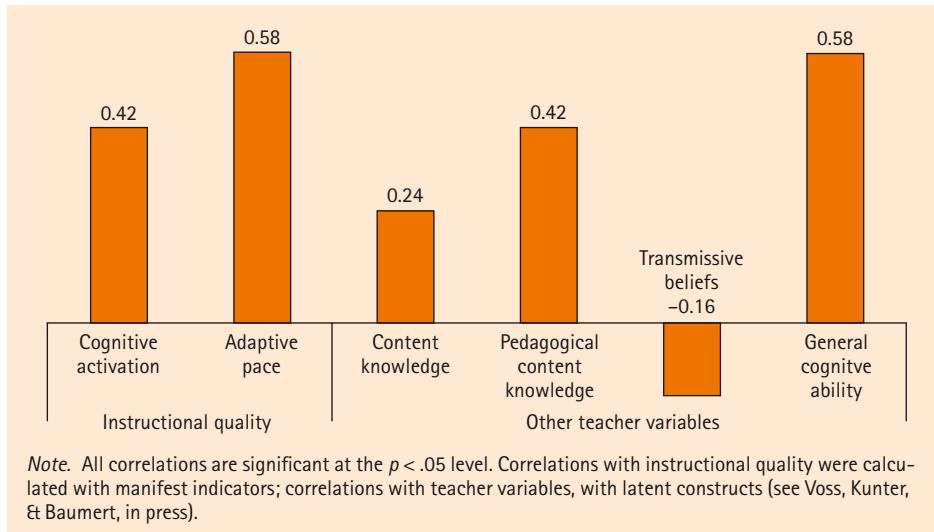


Figure 20. Criterion validity of the PPK test: Correlations with discriminant constructs and teaching quality.

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associated with indicators of instructional quality as seen from the students' perspective (see Figure 20).

PPK (along with content knowledge and pedagogical content knowledge) represents knowledge that is directly relevant for teachers' classroom practice. However, teachers' professional responsibilities go beyond classroom teaching. They are also expected to advise students and parents, to guide and support students with nonacademic problems, and to engage in school development processes. Specific professional knowledge is again needed to succeed in all these tasks. In our latest study within the COACTIV research program, we focus on this broad educational knowledge. The BilWiss study examines the relevance of the broad educational knowledge (spanning educational science, educational psychology, educational law, and the sociology of education) that teacher candidates acquire during university training for their later professional practice. The objective is to empirically test the hypothesis that this broad educational knowledge provides a necessary conceptual framework that enables teachers to properly interpret and reflect on school-related events and that thus informs their professional development. The study was initiated in October 2009 as

a joint project with researchers from the universities of Munster und Duisburg-Essen. In a first step, we analyzed teacher training curricula and conducted a Delphi study with 49 experts in teacher education. On this basis, we developed a taxonomy specifying the components of broad educational knowledge needed to master the task of teaching. These components were then operationalized in a knowledge test of more than 300 items that are currently being tested and fine-tuned in pilot studies. The test will be implemented in a large sample of teacher candidates at the end of their university-based training to provide first descriptive data. The relevance of the components assessed for actual classroom practice will then be investigated in a longitudinal study with beginning teachers during their obligatory teaching practice and in their entry year.

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Cooperation Partners

Detlev Leutner,
University of
Duisburg–Essen
Ewald Terhart,
University of Munster

The study is supported by a grant from the German Ministry for Education and Research

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Kunter, M., Kleickmann, T., Klusmann, U., & Richter, D. (2011). Die Entwicklung professioneller Kompetenz von Lehrkräften. In M. Kunter, J. Baumert, W. Blum, U. Klusmann, S. Krauss, & M. Neubrand (Eds.), *Forschung zur professionellen Kompetenz von Lehrkräften: Ergebnisse des Projekts COACTIV* (pp. 55–68). Münster: Waxmann.

The Development of Professional Competence

At the core of our model of professional competence is the idea that aspects of teachers' professional competence are generally learnable and teachable. Our results to date show that teachers differ considerably in all aspects of competence investigated as well as in the structure of their knowledge. In our recent studies, we have therefore focused on the processes that support the development of teachers' professional competence. We consider teachers—like their students—to be professional learners who develop their competence through the uptake of learning opportunities available to them and the active construction of knowledge. These learning opportunities may be formal learning arrangements, such as teacher education or professional development courses, or learning opportunities in the immediate school context (e.g., when particular problems in a class need to be addressed). The form and frequency with which these learning situations occur is often subject to contextual influences (e.g., the educational system; see Figure 21). However, the mere existence of learning opportunities is not the decisive factor in determining whether competence develops. Teachers' uptake of learning opportunities depends not

only on situational affordances and constraints but also on the characteristics of the teachers themselves. Personal characteristics that may influence teachers' learning behavior and career choices include their general cognitive abilities, prior knowledge, beliefs, and long- and short-term goals (Kunter, Kleickmann, Klusmann, & Richter, 2011). The determinants of teacher competence have rarely been examined directly in empirical research. Studies on the impact of teacher education programs on teachers' knowledge and beliefs have provided some indirect pointers. However, many of these studies used distal rather than proximal measures of teacher competence and were cross-sectional in design. Moreover, there has been no specific investigation of the interplay between various competence aspects (e.g., knowledge and motivation) or of the relations between personal characteristics (i.e., traits) and professional competence. Our new studies COACTIV-R and BilWiss were initiated to help close this gap in the research. In these studies, we explicitly target the role of different elements of teacher education programs in supporting the development of teacher candidates' professional competence. These studies combine longitudinal designs, systematic quasi-experimental variation of different

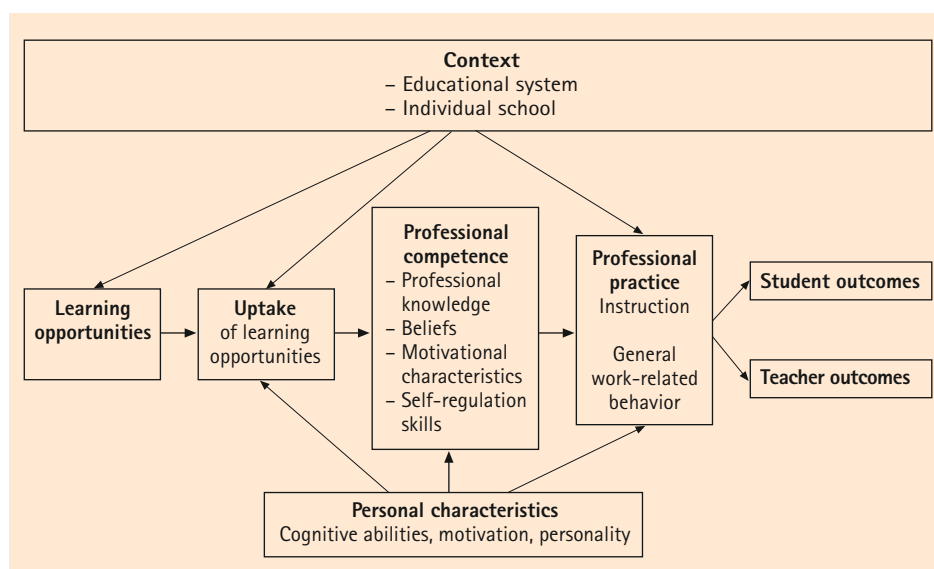


Figure 21. Determinants and effects of teachers' professional competence.

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learning opportunities, and psychometrically sound proximal measures of teacher competence, thus making it possible to draw conclusions on the efficacy of different elements of teacher education.

In Germany, teacher education is organized in three phases. During the first, university-based, phase, teacher candidates acquire theoretical knowledge. This phase has often been criticized for being too theoretical. As outlined above, the core research question of the new BilWiss project is to examine the practical relevance of the knowledge that teacher candidates acquire in university for their later classroom practice. In the second, teaching placement, phase (*Referendariat*), teacher candidates gain practical knowledge by observing lessons and teaching classes themselves. During this 2-year phase, they are both teachers and students, teaching their own classes, but being supervised by a mentor and attending preparatory seminars. After completion of the *Referendariat*, teachers are fully licensed and enter the workforce. The structured learning opportunities of the *Referendariat* offer great potential for development and are the subject of the COACTIV-R study (R meaning *Referendariat*). The third phase of teacher education comprises all learning opportunities available to teachers after their formal education is completed. As we explain below, it is during this phase that individual differences in prior knowledge and motivation probably have the greatest influence on the uptake of learning opportunities.

Competence Development in the Second Phase of Teacher Education: The COACTIV-R Study
COACTIV-R is a longitudinal study with two main measurement points and two cohorts: teacher candidates in the first and second year of the *Referendariat*. Data were collected in four federal states (Bavaria, Baden-Wuerttemberg, North Rhine-Westphalia, and Schleswig-Holstein), which were chosen because they differ systematically in the structure of the *Referendariat*. The first wave of data collection took place between fall 2007 and spring 2008; data were obtained from 856 teacher candidates training to teach mathematics at lower secondary level in all

school tracks. The second wave of data collection ran from fall 2008 to spring 2009, with data from a further 570 teacher candidates being obtained. A follow-up assessment was carried out in summer/fall 2010 to investigate the participants' professional development after completion of the *Referendariat*. First analyses of the data from the first measurement point of COACTIV-R confirm the importance of structured learning opportunities for the acquisition of professional knowledge. Consistent with the different curricula implemented for teacher candidates qualifying for different school types, we found that *Gymnasium* teacher candidates, who receive more instruction in their teaching subjects, outperformed other candidates in terms of content knowledge and pedagogical content knowledge. At the same time, teacher candidates qualifying for nonacademic tracks, who receive more instruction in pedagogy and psychology, outperformed the *Gymnasium* teachers in the PPK test (Kleickmann & Anders, 2011). Regarding the development of the different aspects of teacher competence during the *Referendariat*, first analyses show distinct trajectories. Whereas professional knowledge shows only small linear increases, motivational variables seem to follow a U-shaped pattern, with high starting values that drop off over time and then recover. Beliefs, on the other hand, seem to remain stable throughout the induction phase. Supplementary studies have examined specific aspects of teacher candidates' professional competence in more detail. A trajectory study tracked short-term change in beliefs, motivation, and emotions by assessing a subsample of teacher candidates from North Rhine-Westphalia at three additional points of measurement between those of the main assessment. In a diary study, a cross-state subsample of teacher candidates gave daily reports on their learning activities and psychological well-being over a 2-week period, allowing short-term fluctuation in emotional and motivational variables to be examined. In a mentoring study, another subsample of teacher candidates provided information on their in-school mentors and teaching practice. Finally, in an instructional quality study, we obtained

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Voss, T., Kunter, M., & Baumert, J. (in press). Assessing teacher candidates' general pedagogical/psychological knowledge: Test construction and validation. *Journal of Educational Psychology*.

student ratings of the instruction of a smaller subsample of teacher candidates at three points of measurement, allowing us to examine the relationship between the candidates' professional competence and performance in the classroom. First results from the COACTIV-R study have been reported in the dissertations of Thamar Voss, who investigated teachers' PPK (see above), and Dirk Richter, who studied the effects of mentoring on teachers' professional development. In his analyses, Dirk Richter found that mentors represent an important learning opportunity that can foster the development of teacher candidates' professional competence—in particular, their motivational development and well-being. However, the quality of mentoring differs substantially between mentors, and it is only mentors who provide instructional and emotional support and who interact with their mentees in a constructivist fashion who have a significant effect on their mentees' development (Richter, Kunter, Lüdtke, Klusmann, & Baumert, in press; Voss, Kunter, & Baumert, in press).

The Uptake of Learning Opportunities After Teacher Training

Given the temporal span of the teaching career, it is clear that the development of professional competence is not completed at the end of the *Referendariat* and that self-regulated professionalization is particularly important during independent teaching practice. In almost all educational systems, teachers' in-service professional education is less strictly structured than their pre-service training. In Germany, in particular, there are few formal regulations on the extent to which practicing teachers are expected to participate in continuing professional development or on the contents to be covered.

Modern views of professional development characterize professional learning not as a short-term intervention, but as a long-term process of engaging in various learning activities throughout the teaching career. Thus, professional development can be defined as uptake of formal or informal learning opportunities that deepen and extend teachers' professional competence. Formal learning opportunities are structured learning environ-

ments with a specified curriculum, such as graduate courses or mandated staff development. They represent a main component of the "training model" of professional development that assumes that teachers update their knowledge and skills by means of workshops and courses. In many European countries and states of the United States, teachers are required to attend such activities on a regular basis. As such, they are the most widely used form of professional development. Informal learning opportunities, in contrast, do not follow a specified curriculum and are not restricted to certain environments. They include individual activities, such as classroom observation and reading professional literature, as well as collaborative activities, such as conversations with colleagues and parents, mentoring activities, teacher networks, and study groups. Participation in these activities is generally not mandatory, but is at teachers' own initiative.

There has been little previous empirical investigation of the learning opportunities used by teachers or of why teachers chose particular forms of professional development. Drawing on our model of competence development, we were therefore interested in the degree to which individual teacher characteristics influence the uptake of particular learning opportunities. In the first COACTIV study, we asked in-service teachers to report on their professional development activities over the last 2 years. We found great variation in teachers' participation in formal professional development courses. On average, teachers participated in 3.5 courses (or 38 hours training) over the 2 years. However, many teachers invested substantially more time in continued professional development and 19% did not report any. We found a systematic link between teachers' motivation and their engagement in professional development courses, with highly engaged teachers participating in more courses. Furthermore, we found that teachers often chose their learning opportunities based on their existing knowledge and interests, rather than trying to overcome deficits (Richter, 2011).

Another study examined teachers' uptake of formal and informal learning opportunities

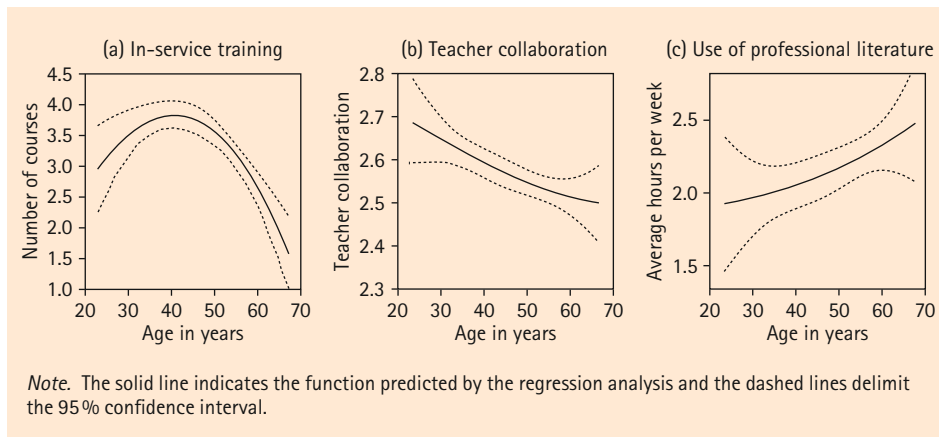


Figure 22. Uptake of formal and informal learning opportunities as a function of teachers' age.

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across the career cycle. Analyses were based on data from the extended COACTIV study, in which 1,939 German secondary teachers were asked about several aspects of their professional life. Results showed that formal learning opportunities (in-service training) were used most frequently by mid-career teachers, whereas informal learning opportunities showed contrasting patterns of use across the teaching career. Specifically, use of professional literature increased with teacher age, whereas teacher collaboration decreased (see Figure 22; Richter et al., 2011).

Summary and Outlook

The COACTIV research program understands professional competence to be those malleable profession-specific individual characteristics such as knowledge, beliefs, motivational orientations, and self-regulation skills that teachers need to meet the demands of their profession. Our analyses show that teachers can differ markedly in their levels of professional competence. Moreover, the empirical data confirm that these differences are reflected in their teaching practice and that all theoretically postulated aspects of teacher competence significantly predict successful teaching outcomes: We found that deep pedagogical content knowledge, constructivist beliefs, enthusiasm for teaching, and the ability to manage personal resources were associated with higher instructional quality and better student outcomes. Our

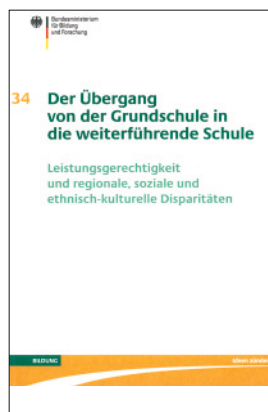
findings further suggest that the competencies teachers need to provide high-quality instruction and to succeed in their profession can be distinguished from everyday experience and general knowledge. Professional competence is acquired in a process spanning the whole career and involving formal academic training, guided practice, self-regulated professionalization, and, ideally, cooperative continuing professional development. Our findings of systematic differences in professional competence, depending on the school track for which teachers are qualifying or in which they are working, as well as first longitudinal data, indicate that teachers' professional competence is subject to processes of change and that these processes are influenced by the context of training and professional practice. At the same time, it is important not to overlook the relevance of individual characteristics in the uptake of learning opportunities. The recently initiated COACTIV studies on the development of professional competence will continue to address these research questions after conclusion of the Research Center's work, as the researchers involved in the COACTIV program will continue to cooperate closely.

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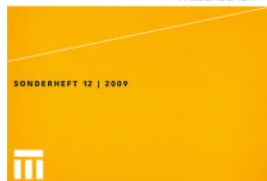
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