# Developmental Dynamics and Social Disparities in Early Education-Related Child Development: Results from the BiKS-3-18 Study

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**Abstract**

The development of domain-specific competencies and the emergence of social disparities start well before school entry. These early developments have been suggested to be highly relevant to later developments, educational pathways, and participation in society. Longitudinal large-scale studies, in particular, provide important insights into relevant individual preconditions, developmental trajectories, and their relation to learning opportunities in different learning environments. Against this background, this paper presents selected results of the longitudinal and interdisciplinary study BiKS-3-18 with a special focus on education-related facets of child development at preschool age, their interrelations, predictive impact, and connection to environmental conditions. In particular, we (1) present results on early emerging individual differences between children, their stability over time, and their relation to children's socioeconomic family background (SES). (2) With a special focus on language development, we address the impact of child characteristics and the dynamics of early child development by presenting findings (a) on changing developmental relations between working memory and language acquisition and (b) on the interrelations between early child language and children's

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social-cognitive, metacognitive, and social-emotional development. (3) Finally, we report findings on the importance of individual differences and SES-related disparities, particularly in the language domain, for later school-related language competencies and school performance.

**Keywords**

Early child development · Individual differences · SES-related disparities · Dynamic relations between developmental domains · Impact of language on school-relevant competencies and school grades

## 1 Introduction

The development of domain-specific competencies and the emergence of social disparities start well before school entry (Brooks-Gunn and Duncan 1997; Halle et al. 2009; Hansen and Joshi 2007; Weinert et al. 2017). These early developments have been suggested to be highly relevant to later developments, educational pathways, and participation in society (Heckman 2013; Noble et al. 2007). Bioecological models of child development highlight the significant role of children's developing prerequisites and their interaction with proximal and more distal environmental conditions (Bronfenbrenner and Morris 2006). Longitudinal large-scale studies, in particular, provide important insights into relevant individual preconditions, developmental trajectories, and their relation to learning opportunities in different learning environments. Moreover, they enable research on the significance of early experiences and developments for children's future development and educational pathways (see Hachul et al. 2019). Against this background, this paper presents selected results of the longitudinal and interdisciplinary study BiKS-3-18 with a focus on education-related facets of child development at preschool age, their interrelations, predictive impact, and connection to environmental conditions. Thereby, special attention is paid to child language as a particularly important developmental domain with high impact on other educationally relevant developments as well as on later learning at school.

The BiKS-3-18 study was designed and conducted by the research unit "Educational Processes, Competence Development, and Formation of Educational Decisions in Preschool and School Age" (BiKS).[1] It started when children were

[1] The research unit BiKS was funded by the German Research Foundation. This paper summarizes selected results drawing mainly on data that were conceptualized and collected within the framework developed by BiKS Project 3 (developmental psychology; grant to

on average 3 years of age tracing their development until the end of primary school at about ten years. Two subsequent projects continued and expanded the study by following the students and their families beyond primary school into adolescence.[2]

***Overview of the Main Issues Addressed in the Present Paper***

Contrary to overarching developmental theories, child development has been shown to be rather domain-specific, i.e., different domains of development place different demands on children, which they master more or less easily. Thus, a child might be advanced in one area of development but less so in another, leading to domain-specific developmental differences within an individual; likewise, interindividual differences and developmental trajectories have been suggested to be domain-specific. From a psychological perspective, investigating the stability and change of these developments is of high relevance. For instance, important questions are: To what extent do early domain-specific differences (e.g., in the language domain) predict later differences in the same domain? Do early differences in one domain (e.g., in language) impact on the progress and developmental trajectories in other developmental domains (e.g., social-emotional development)? Besides these internal, possibly dynamic mechanisms of child development, bioecological models highlight their interaction with environmental conditions. In particular, the 'Specificity Principle' suggests specific environmental conditions to impact on specific developments in specific individuals and at specific time-points in development (Bornstein 2017, 2019a, b). Furthermore, theoretical accounts of domain-specific development propose that some developments at some time-points might be more prone to environmental influences and stimulating processes than others; e.g., nativistic theories of language acquisition imply less environmental impact on early grammar than on early vocabulary (e.g., Chomsky 1981; Fodor 1983; Pinker 1994; Van der Lely and Pinker 2014; Vasilyeva and Waterfall 2011).

S. Weinert; WE 1478/4–1 to 4–4) and affiliated PhD-projects (e.g., Dubowy 2010; Ebert 2011) in collaboration with the research unit's framework project and the other BiKS projects.

[2] The follow-up study BiKS*plus*-3-13 was funded by the German Research Foundation (grants to S. Weinert, H-G. Rossbach, and G. Faust; WE 1478/8–1; FA 650/3–1; RO 820/15–1); the BiKSplus-3-18 follow-up study was funded by the German Ministry of Education and Research (grant Nr: B8578).

The present paper addresses those issues by drawing on data from the BiKS-3-18 study and particularly on the measurements conceptualized within the developmental psychology project (BiKS Project 3). In particular, we focus on children's education-related domain-general and domain-specific development during preschool years and beyond and on the dynamic interrelations between their developmental trajectories as internal conditions of child development. Thereby, special attention is given to child language and its relation to other developments as well as to family background and thus to the early emergence of SES-related disparities in child development. Beforehand, we will give an overview of the BiKS-3-18 study with a focus on the framework and design of the longitudinal assessments of domain-general (e.g., working memory, nonverbal reasoning, speed of information processing) and domain-specific facets (e.g., mathematics, language, factual content knowledge) of child development. Thereafter we present selected results on developments in these areas. In particular, we report on the stability of individual differences over time, and on interrelations between different areas of development with a special focus on the relation between child language and other areas of development, including social-cognitive and social-emotional development. Furthermore, we present results of the BiKS-3-18 study on relations to later school-related, so called "academic" language competencies and school grades. Thereby we also address the predictive impact of early disparities related to family background on these outcomes.

## 2 The BiKS-3-18 Study and the Longitudinal Assessments of Education-Related Facets of Child Development

### 2.1 General Outline of the Design, Sampling, and Assessments of the BiKS-3-18 Study

The design of the BiKS-3-18 study draws on the assumptions of bioecological models of development (e.g., Bronfenbrenner and Morris 2006). According to these models, internal factors in the sense of individual resources, developmental trajectories, and relations between different developmental domains interact with educational processes and environmental conditions in the family and in (educational) institutions to produce developmental changes. These are influenced by more distal factors such as the families' socioeconomic status (SES; e.g., parental education, occupation, and family income) and are embedded and indirectly influenced by broader cultural and societal contexts.

Against this background, the BiKS-3-18 study followed approximately 550 children from 97 preschools in Bavaria and Hesse longitudinally

- with age-appropriate standardized tests on their development in the (meta)cognitive and language area;
- with (partially semi-standardized) observations in the children's homes and educational institutions as well as
- with questionnaires and computer-assisted interviews given to parents and to relevant context persons in preschools and, later-on, schools and to the children themselves (see Homuth et al. this volume).

Assessments started shortly after the children had entered preschool at the age of approximately 3 years in 2005 with annual, sometimes semiannual measurement points (survey waves) until the age of 13 and a follow-up online survey at the age of about 18 years in 2020. The standardized tests cover a broad range of facets of the children's domain-general (e.g., working memory, nonverbal reasoning, speed of information processing) and domain-specific (e.g., mathematics, language, factual content knowledge) development. In addition, aspects of social-emotional and personality development as well as of the development of self-regulation were assessed from a multi-informant perspective by parents' and (pre)school teachers' judgements and, later on, also via self-evaluation. Another important feature of the BiKS-3-18 study is a detailed assessment and recording of global and domain-specific environmental stimulation, covering proximal process characteristics and more distal structural characteristics of preschools, schools, and the children's homes (see Rossbach et al. this volume). Special attention was paid to the assessment of indicators of the socioeconomic, educational, and language characteristics of the children's families.

***The sampling procedure*** aimed at including a broad range of child, family, and institutional characteristics (see Homuth et al. this volume) and allowed for tracking the children's development from early preschool through primary school and beyond. The 550 children from 97 selected preschools were scheduled to regularly start formal schooling in fall 2008. Upon entry into school, the classmates of the "BiKS children" were also invited to take part in the study, so that the sample increased to about 1000 children (see Homuth et al. this volume for a more in-depth description of the sample across assessment waves). Beyond primary school, the children (and their parents) were tracked individually and later on (last wave in 2020) mostly via an online survey.

***Measurements of domain-general and domain-specific facets of child development and in-depth assessments of environmental factors.*** Tables 1, 2, and 3

**Table 1** BiKS-3-18: Assessments of facets of child development in the cognitive, language, and metacognitive area in preschool

| | 1. MP autumn 2005 | 2. MP spring 2006 | 3. MP autumn 2006 | 4. MP spring 2007 | 5. MP autumn 2007 | 6. MP spring 2008 |
|---|---|---|---|---|---|---|
| | Mean age 3;9 years | Mean age 4;0 years | Mean age 4;8 years | Mean age 5;0 years | Mean age 5;7 years | Mean age 6;1 years |
| | all children (97 preschools) | subgroup (44 preschools) | all children (97 preschools) | subgroup (44 preschools) | all children (97 preschools) | all children (97 preschools) |
| **Language:** | | | | | | |
| Vocabulary, receptive | PPVT-R (research version) | | PPVT-R (research version) | | PPVT-R (research version) | |
| Vocabulary, productive | Riddle (K-ABC) | | | | | |
| Grammar, receptive | Sentence comprehension (SETK3-5) | TROG-D (shortened) | TROG-D (shortened) | TROG-D (shortened) | TROG-D (shortened) | TROG-D (shortend) |
| Sentence production | Encoding of semantic relations/ picture description (SETK 3–5) | | Encoding of semantic relations (SETK 3–5) | | Encoding of semantic relations (SETK 3–5) | |
| Morphology | Plural formation (SETK 3–5) | | | | | |
| Listening Comprehension, text-level | | Story comprehension (Wimmer 1982)[1] | | Story comprehension (Wimmer 1982)[1] | | |

(continued)

**Table 1** (continued)

| | 1. MP autumn 2005 | 2. MP spring 2006 | 3. MP autumn 2006 | 4. MP spring 2007 | 5. MP autumn 2007 | 6. MP spring 2008 |
|---|---|---|---|---|---|---|
| | Mean age 3;9 years | Mean age 4;0 years | Mean age 4;8 years | Mean age 5;0 years | Mean age 5;7 years | Mean age 6;1 years |
| **Working Memory, Speed of Information Processing:** | | | | | | |
| Phonological loop | Nonword repetition (SETK 3–5) | | Nonword repetition (SETK 3–5) | | Nonword repetition (SETK 3–5) | |
| Memory span | Digit span (K-ABC) | Digit span (K-ABC) | Digit Span (K-ABC) | Digit span (K-ABC) | Digit span (K-ABC) | |
| Nonverbal memory span | Hand Movements (K-ABC) | | Hand Movements (K-ABC) | | Hand Movements (K-ABC) | |
| Speed of Information Processing | Item identification speed (fast word repetition) | – | Rapid automatized naming (RAN; Denckla and Rudel 1976) | Rapid automatized naming (RAN; Denckla and Rudel 1976) | Rapid automatized naming (RAN; Denckla and Rudel 1976) | Rapid automatized naming (RAN; Denckla and Rudel 1976) |
| **Nonverbal Cognitive Abilities, Content Knowledge, Numeracy Skills:** | | | | | | |
| Nonverbal cognitive abilities | Categories Analogies (SON-R 2½ - 7) | Analogies (SON-R 2½ - 7) | Categories Analogies (SON-R 2½ - 7) | Analogies (SON-R 2½ - 7) | Categories Analogies (SON-R 2½ - 7) | Analogies (SON-R 2½ - 7) |
| Factual content knowledge | Faces & Places (K-ABC) | | Faces & Places (K-ABC) | | Faces & Places (K-ABC) | |
| Numeracy skills | Arithmetics (K-ABC) | Arithmetics (K-ABC) | Arithmetics (K-ABC) | Arithmetics (K-ABC) | Arithmetics (K-ABC) | Arithmetics (K-ABC) |

(continued)

**Table 1** (continued)

| | 1. MP autumn 2005 | 2. MP spring 2006 | 3. MP autumn 2006 | 4. MP spring 2007 | 5. MP autumn 2007 | 6. MP spring 2008 |
|---|---|---|---|---|---|---|
| | Mean age 3;9 years | Mean age 4;0 years | Mean age 4;8 years | Mean age 5;0 years | Mean age 5;7 years | Mean age 6;1 years |
| **Precursors of Reading:** | | | | | | |
| Phonological awareness | – | – | Rhyming (BISC)[1] | | | |
| Letter knowledge | | | Letter naming[1] | Letter naming[1] | | Letter naming[1] |
| **Metacognition, Theory of Mind, Mental Vocabulary, Verbal Self-control:** | | | | | | |
| Metacognition, declarative[4,5,6] | – | Knowledge about learning and memory[3] | Knowledge about learning and memory[3] | Knowledge about learning and memory[3] | Knowledge about learning and memory[3] | |
| Theory of mind[4,6] | – | False belief tasks[2,3] Knowledge-access task[2,3] | False belief tasks[2,3] Knowledge-access task[2,3] | False belief tasks[2,3] Knowledge-access task[2,3] | False belief tasks[2,3] (incl. second-order tasks) | |
| Mental vocabulary[4,7] (in-depth comprehension) | – | | based on Astington and Pelletier (1997)[3] | based on Astington and Pelletier (1997)[3] | based on Astington and Pelletier (1997)[3] | |

(continued)

**Table 1** (continued)

| | 1. MP autumn 2005 | 2. MP spring 2006 | 3. MP autumn 2006 | 4. MP spring 2007 | 5. MP autumn 2007 | 6. MP spring 2008 |
|---|---|---|---|---|---|---|
| | Mean age 3;9 years | Mean age 4;0 years | Mean age 4;8 years | Mean age 5;0 years | Mean age 5;7 years | Mean age 6;1 years |
| Procedural Meta-cognition[5,7] | | | Memory task[3] (allocation of study time, confidence judgments, evaluation of difficulty) | Memory task[3] (allocation of study time, confidence judgments, evaluation of difficulty) | Memory task[3] (allocation of study time, confidence judgment, evaluation of difficulty) | |
| Verbal Self-control[5,7] | | | Puzzle, magnetic game[3] | Puzzle, magnetic game[3] | Puzzle, magnetic game[3] | |

Notes: MP = Measurement Point. SETK 3–5, TROG-D, K-ABC, SON-R 2½ - 7, BISC: standardized tests with norms (see test index in the appendix); PPVT- unpublished German research version;
[1] only older children from the 44 preschools (139 children);
[2] only younger children from the 44 preschools (128 children);
[3] procedures used in the context of affiliated dissertations (cf. Dubowy 2010; Ebert 2011);
[4] see Ebert 2011, 2015 for more detailed task description and development;
[5] see Dubowy 2010 for more detailed task description and development;
[6] 44 preschools, 267 children;
[7] 11 preschools, 68 children (additionally tested in the context of dissertation projects).

**Table 2** Assessments of facets of child development in the (meta)cognitive and language area in primary school

| | School Year 2008/2009 | School Year 2009/2010 | School Year 2010/2011 | School Year 2011/2012 |
|---|---|---|---|---|
| | End of 1st grade | End of 2nd grade | End of 3rd grade | End of 4th grade |
| **Language:** | | | | |
| Vocabulary, receptive | *PPVT-R (research version)* KFT (Subtest 1) | *PPVT-R (research version)* KFT (Subtest 1) | *PPVT-R (research version)* KFT (Subtest 1) | *PPVT-R (research version)* |
| Grammar, receptive | TROG-D – adapted for group setting | TROG-D – adapted for group setting | TROG-D – adapted for group setting | |
| Listening comprehension (text-related; academic language demands) | Self-constructed (version V1) | Self-constructed (version V1) | Self-constructed (version V2) | Self-constructed (version V2) |
| **Reading:** | | | | |
| Reading comprehension | Text comprehension (ELFE 1–6) | Text comprehension (ELFE 1–6) | Text comprehension (ELFE 1–6) | Text comprehension (NEPS-Test)[2] |
| Reading Speed | | *SLS 1–6* | *SLS 1–6* | *SLS 1–6* |
| **Working Memory, Speed of Information Processing:** | | | | |
| Memory span (verbal short-term memory) | | | *Digit span (K-ABC)* | *Digit span (K-ABC)* |
| Speed of information processing | *Rapid automatized naming (RAN*; Denckla & Rudel, 1976*)* | *Rapid automatized naming (RAN)* | | |
| **Nonverbal Cognitive Abilities (Reasoning), Mathematical Skills, Metacognition:** | | | | |
| Nonverbal cognitive abilities | CFT 1 (Subtests 3–5) | CFT 1 (Subtests 3–5) | CFT 20-R (Subtest Matrices) | CFT 20-R (Subtest Matrices) |
| Mathematical skills | *Arithmetics (K-ABC)* HRT 1–4 (Add, Sub, Supplement) | *Arithmetics (K-ABC)* HRT 1–4 (Add, Sub, Supplement) | *Arithmetics (K-ABC)* HRT 1–4 (Add, Sub, Supplement) | *Arithmetics (K-ABC)* HRT 1–4 (Add, Sub, Supplement) |

(continued)

**Table 2** (continued)

| | School Year 2008/2009 | School Year 2009/2010 | School Year 2010/2011 | School Year 2011/2012 |
|---|---|---|---|---|
| | End of 1st grade | End of 2nd grade | End of 3rd grade | End of 4th grade |
| Metacognition, declarative[1] | Self-constructed (version V1) | Self-constructed (version V1) | Self-constructed (version V2) | Self-constructed (version V2) |
| Mental vocabulary[3] | Self-constructed according to Astington and Pelletier (1997) | Self-constructed according to Astington and Pelletier (1997) | Self-constructed based on Astington and Olson (1990) | Self-constructed based on Astington and Olson (1990) |

Notes: *in italics:* assessments in individual settings at home only for children of the original sample; all other procedures: assessments in the classroom context (original BiKS sample and classmates); for children of the original BiKS sample who could not be tested in the classroom context, the listening comprehension, mental vocabulary, and metacognition were additionally assessed at home. PPVT, KFT, TROG-D (shortened), ELFE1-6, SLS1-6, CFT1, HRT, K-ABC standardized tests with norms (see appendix).
[1] see Haberkorn et al. 2014 for a detailed description of the tasks.
[2] see Weinert et al. 2019 for an overview.
[3] see Ebert 2020a for a detailed description of the tasks

present an overview of the direct measurements of children's abilities, skills, and competencies in the (meta)cognitive and language area conducted in the BiKS-3-18 study during preschool years (Measurement points (MP) 1 through 6), primary school years (MP 7 through 10), and after primary school (MP 11 through 13). Assessments included both domain-general and domain-specific indicators of child development and systematically differentiated verbal and nonverbal measures as well as measures that have been suggested to be more prone to environmental influences (i.e., that highly depend on education, e.g., specific content knowledge and specific education-dependent skills such as arithmetic skills) and those that are thought to be less influenced by environmental stimulations (e.g., indicators of nonverbal reasoning and working memory). Further, assessments covered both tests of important specific skills such as specific numeracy or language skills as well as broader measures of children's functional competencies such as measures on mathematical and reading literacy (Weinert and Artelt 2019, for a discussion of this distinction).

In addition, and particularly in affiliated PhD-projects (see Sect. 2.2), special emphasis was placed on the development of metacognition and a theory of mind

**Table 3** Direct and report measures of domain-specific competencies and cross-domain abilities in the BiKS-3–18 study beyond primary school

| | School Year 2014/2015<br>7th grade | School Year 2015/2016<br>8th grade | Last measurement point in 2020 |
|---|---|---|---|
| Language (target, parent[2]) | Receptive vocabulary: PPVT-R (research version) | Listening comprehension (DELKO, Marx and Stanat 2009) | |
| Reading Literacy | | NEPS-Test on text comprehension[1] | |
| Mathematical competence | NEPS-Test[1] | | |
| Metacognition, procedural, declarative | NEPS-Test[1] | NEPS-Test[1] | |
| Theory of mind | Strange Stories (Happé 1994; German adaptation Rakoczy et al. 2012) | Sarcasm (O'Reilly et al. 2014) | |
| Working memory: phonological loop,<br>central executive | digit span forward<br>digit span backward | | |
| Verbal fluency (target, parent[2]) | Word fluency test (RWT; fast generation of animals) | Word fluency test (RWT; fast generation of m-words) | |
| Cognitive flexibility (target, parent[2]) | Word fluency test with task shifting (RWT; sports, fruit) | Word fluency test with task shifting (RWT; fast generation of g-/r-words) | |
| Knowledge test (target, parent) | | | Knowledge test (developed by U. Schroeders; Steger et al. 2019) |

(continued)

**Table 3** (continued)

| | School Year 2014/2015<br>7th grade | School Year 2015/2016<br>8th grade | Last measurement point in 2020 |
|---|---|---|---|
| **Aspects of Development Assessed via Questionnaires and Interviews** | | | |
| Social behavior (SDQ: target and parent judgement) | Hyperactivity/Inattention; Interaction with peers;<br>Behavioral problems; Prosocial behavior; Emotional problems (all SDQ 11–16; Goodman 2005)<br>Empathy (Früh and Wünsch 2009) | Aggressiveness (Little et al. 2003)<br>Hostile attribution (Zdravkovic 2012) | Hyperactivity/Inattention; Interaction with peers;<br>Behavioral problems; Prosocial behavior; Emotional problems (all SDQ 18+; Goodman 2005)<br>Empathy (Früh and Wünsch 2009)<br>Aggressiveness (Little et al. 2003) |
| Affective-motivational attitude | Joy of learning (BiKS-3–10; FEESS 3–4; Rauer and Schuck 2003) | Joy of school (FEESS 3–4; Rauer and Schuck 2003)<br>Joy of learning (BIJU)<br>Learning effort (FEESS 3–4; Rauer and Schuck 2003)<br>School Attitude (BiKS-3–10) | School Attitudes (PISA 2009) |
| Life coping / Life satisfaction | Academic self-concept (BiKS-8–18)<br>Well-being (KIDSCREEN)<br>Satisfaction (NEPS)<br>School grades, School career | Academic self-concept (BiKS-8–18)<br>Well-being (KIDSCREEN)<br>Satisfaction (NEPS)<br>Self-esteem (NEPS)<br>Delinquent behavior (Lösel and Bliesener 2003)<br>School grades, School career | Academic self-concept (BiKS-8–18)<br>Well-being (KIDSCREEN)<br>Satisfaction (NEPS)<br>Delinquent behavior (Lösel and Bliesener 2003)<br>School grades, School career<br>Health condition (KiGGS) |

(continued)

**Table 3** (continued)

| | School Year 2014/2015<br>7th grade | School Year 2015/2016<br>8th grade | Last measurement point in 2020 |
|---|---|---|---|
| Learning Environment | Parenting style (Wild 1999)<br>Stimulation (Caldwell and Bradley 2003)<br>Leisure activities (BiKS-3–10)<br>Family climate | Leisure activities (SOEP)<br>Quality of homework support (Dumont et al. 2014)<br>Class climate | Parenting style (Wild 1999)<br>Leisure activities (BiKS-3–10)<br>Emotional support by parents (PISA 2015) |

Notes: partly subscales; RWT: standardized test with norms (see appendix). Instruments are partially adopted from other studies (NEPS, SOEP, BIJU, KIDSCREEN, KIGGS, PISA) or developed by other groups (see references).

[1] see Weinert et al. 2019.

[2] Parent's indicator for vocabulary, fluency, flexibility were only assessed at one measurement point (see text)

(ToM), i.e., the developing understanding of one's own and others' cognition and the development of self-regulation. Moreover, in-depth analyses of characteristics of adult-child interactions extending the measurements of the educational BiKS Project 2 (Rossbach et al. this volume) were conducted.

Family background indicators (e.g., parental education, occupation, and family income; language background and language use in the family) and measures of children's social-emotional development were assessed via questionnaires and computer-assisted interviews with parents as well as by preschool and school teachers' questionnaires in cooperation with the other BiKS projects. Concerning social-emotional development, BiKS Project 3 focussed in particular on aggressive behavior, emotional self-regulation, peer relations/cooperative behavior, shyness, and attention/concentration which were coherently assessed across waves using a multi-informant approach.

## 2.2 Longitudinal Assessment of Child Development Across Waves

***Preschool period.*** To assess educationally relevant facets of (meta)cognitive and language development (which we will also refer to as "competence development" further on), a total of six measurement waves were carried out every six months during the preschool period. Data collection took place in the preschools, where the children were tested in playfully designed individual settings by extensively trained project staff (at 1 to 4 days per measurement point). At the first wave (Measurement point (MP) 1) in fall 2005, all participating children ($N = 547$) were tested on three test days. They were presented with various standardized, internationally compatible tests that focused on different facets of children's cognitive and language development. As Table 1 shows, we assessed, for example, indicators of receptive and productive language (vocabulary; grammar: morphology; sentence production and comprehension), working memory (digit span; pseudoword repetition; nonverbal short-term memory),[3] speed of information processing (rapid automatized naming),[4] basic nonverbal cognitive abilities (reasoning; categorization), as well as indicators of children's numeracy skills and

[3] See Knöferle (2014) for a detailed description of the tasks (i.e., tasks/items that were not taken from standardized tests).

[4] See Ebert and Weinert (2013) for a detailed description of this task.

their factual content knowledge. Six months later (spring 2006, MP 2) about half of the children ($n = 267$) were again examined in central areas of development (language, working memory, basic nonverbal abilities, factual content knowledge, metacognition) with a smaller number of tests on one test day. On a second test day, these children were presented with additional measures. For instance, some of them received tasks on their theory of mind (see Ebert 2011, 2015 for more information), others on story comprehension (see Ebert and Weinert 2013). In fall 2006 and 2007 (MP 3 and 5), children's (meta)cognitive and language development were again assessed in the entire sample on two test days each, with the sub-sample of 267 children receiving supplementary tests on a third test day. The latter group was also tested again in spring 2007 (MP 4) in key areas of development. In spring 2008, i.e., at the last assessment wave before school enrollment (MP 6), (school-relevant) cognitive and language tests were again presented to all children. Since children who had started school early were no longer in preschool at the last two assessment waves, the testing of these children took place at their homes with a reduced test battery due to time constraints.

***Additional in-depth assessments.*** In addition, a small, but systematically selected sub-sample of 68 mainly monolingual children representing a wide range of SES and individual differences was tested in depth at measurement points 3 to 5 within affiliated PhD-projects (Dubowy 2010; Ebert 2011). These assessments focused on the acquisition of self-regulation (procedural metacognition, e.g., allocation of study time, evaluation of task difficulty; verbal self-regulation via private speech assessed during videotaped individual playful task situations: see Dubowy 2010) as well as on the acquisition of metacognitive knowledge about memory and learning (i.e., declarative metamemory; see Dubowy 2010; Ebert 2011), the development of a theory of mind, i.e., the developing understanding of one's own and others' cognition and particularly of the significance of mental states as guiding human behavior, and the understanding of mental terms (Ebert 2011). Most of these assessments took place on an additional day in the preschools (individual setting). In this sample, also three semi-standardized dyadic interaction situations between the main caregiver and the child were realized in the home context and recorded on video (joint picture-book reading, memory game, construction game; see Ebert 2011).

***During primary school years***, direct measures of the children's (meta)cognitive and language development and other important school-relevant and school-related competencies were assessed at four measurement points mainly in the class context (group setting). The original BiKS sample was expanded to include their classmates (see Homuth et al. this volume). In addition to the assessments in

the classroom setting, the children of the original BiKS sample were additionally tested in the home context with selected instruments that had already been used in preschool and required an individual test setting. Children of the original BiKS sample who could not be examined in the school context, e.g., because the school refused to participate, were tested individually at home in central developmental areas. Assessments addressed the following areas of development: language (listening comprehension: in particular, receptive vocabulary; receptive grammar: sentence comprehension; listening comprehension of texts featuring "academic language" characteristics of the language of schooling[5]); reading (text comprehension; reading speed); mathematics; metacognitive knowledge about memory and learning (also called 'declarative metacognition'; note that declarative metacognition includes 'metamemory', i.e., the knowledge about memory); basic nonverbal abilities; information processing speed; verbal short-term memory (see Table 2).

In addition, within BiKS Project 3, at school age, several school lessons (mathematics, German, social studies and general sciences) were recorded on audio media (four measurement points: end of first grade, beginning and end of second grade, beginning of third grade; 56 classes, three lessons each) to analyze the effects of teachers' language on children's (meta)cognitive and language development beyond preschool on the one hand, and on their school performance on the other hand.

***Beyond primary school,*** three further assessment waves took place, the first two in individual settings at the children's homes and the last measurement wave was conducted in 2020 mainly as an online survey. When children were in Grade 7 and about 12 to 13 years of age, as well as one year later (see Table 3), the children were again presented with language tests (receptive vocabulary, listening comprehension of texts[6]), with tests on reading literacy and mathematical competence (tests developed and used in the National Educational Panel Study (NEPS); see Autorenteam Kompetenzsäule 2020; Weinert et al. 2019 for descriptions). Further assessments covered indicators of children's theory of mind (measured via short stories: strange stories, sarcasm; see Ebert 2020b for a short description of these tasks), of working memory (digit span forward as an indicator of the capacity of phonological short-term memory (and the phonological loop of working

[5] See Kotzerke et al. (2013) for a brief description of this test developed by the BiKS Project 3.

[6] See Ebert (2020a, b) for a description of the task adopted from DELKO (Marx and Stanat 2009).

memory, respectively); digit span backward as an indicator of the central executive of working memory), and procedural metacognition (NEPS-indicator on metacognitive judgements of performance). Besides standardized tests and tasks, a focus was on social behavior, motivational attitudes, life satisfaction, well-being, school career and success, as well as on leisure activities as outcome measures; furthermore, indicators of parenting behavior and family climate were assessed (e.g., parenting style, stimulation, family climate). As those measures were a special focus of the respective assessment waves, indicators are also listed in Table 3. This latter focus was also addressed in the online survey at the last measurement point when the participants were about 18 years old. In addition, during these last three waves, some short indicators of parents' knowledge (last wave in 2020), their verbal fluency and cognitive flexibility (in 2014/2015) as well as their vocabulary skills (2015/2016) were assessed once with parallel tests given to the target persons.

## 3 Selected Empirical Findings: Domain-Specific Trajectories, Interrelations Between Domains, and Environmental Conditions

In the following, we report selected findings on children's development during preschool years with special attention given to child language. We thereby focus on both environmental factors and child characteristics that are relevant to children's language and (meta)cognitive development and present results on the predictive impact of early developments, particularly in the language domain, on later outcomes. In particular, we (1) present results on early emerging domain-specific performance differences between children, their stability across time, and their relation to children's socioeconomic family background (SES). (2) With a focus on language development, we address the impact of child characteristics and the dynamics of early child development by presenting findings (a) on changing developmental relations between working memory and language acquisition and (b) on the interrelations between early child language and children's social-cognitive, metacognitive, and social-emotional development. (3) Finally, we report findings on the importance of early individual differences in child development, particularly in child language, and SES-related disparities for later school-related language competencies and school performance.

## 3.1 Early Emergence and Stabilization of Domain-Specific Individual Differences and Their Relation to Family Background

Of course, children differ in their individual resources and potentials from the very beginning of their lives. From early on, children's individual abilities and prerequisites interact with their learning environments. In the following we summarize findings of the BiKS-3-18 study documenting that domain-general cognitive abilities and specific knowledge-based skills can be distinguished already at the age of 3 years. In addition, we report findings that show that individual differences in those domain-specific developments that are particularly prone to environmental conditions, stabilize early and are significantly associated with the children's family background.

***Early Stabilization of Domain-Specific Individual Differences***

One important result of the BiKS-3-18 study is that individual differences in education- and knowledge-dependent skills as well as SES-related disparities in these developments emerge and stabilize early in preschool age and thus long before school entry (Weinert et al. 2010).

As Weinert et al. (2010) document, already at the age of 3 years shortly after having entered preschool, results of the BiKS-3-18 study demonstrate a differentiated achievement profile: Children who are more or less advanced in one area of development are not necessarily accelerated or restricted in other developmental areas. Exploratory factor analysis and multidimensional scaling of the broadly assessed early indicators of children's domain-general cognitive abilities (verbal working memory, nonverbal cognitive abilities) and their domain-specific (language and numeracy) skills showed the theoretically predicted differentiation between achievement domains already at the age of 3 years. As expected, a distinction can be made between a language factor, a working memory factor, and a reasoning factor. As suggested by models of skill and knowledge acquisition, indicators of knowledge-based numeracy skills loaded on all three factors, while children's achievement on a factual knowledge test loaded particularly on the language and working memory factor (Weinert et al. 2010, p. 38).

Although all children showed substantial developmental progress over the next years, the observed individual differences between children remained rather stable across the preschool period (Weinert et al. 2010, p. 40; see Table 4).

In particular, the early emerging interindividual differences in language and knowledge-based skills (numeracy skills; factual knowledge) proved to be very stable between ages 3 and 5 even when controlling for age differences (see Table 4).

**Table 4** Early achievement differences at the age of 3 years predicting differences at the age of 5 years (stabilities of individual differences over a two-year-period) (adapted from Weinert et al. 2010, p. 40)

| | *r* (age controlled) | *n* |
|---|---|---|
| Language skills | 0.74** | 442 |
| Knowledge-based skills | 0.86** | 456 |
| Verbal working memory | 0.49** | 434 |
| Nonverbal abilities | 0.47** | 441 |

*Note:* ** $p < 0.01$. *n*: number of subjects. *r:* correlation

In agreement with other longitudinal studies, measures of verbal memory and nonverbal cognitive abilities showed comparatively lower stability of individual differences (Weinert et al. 2010; see also, e.g., Niklas et al. 2010; Schneider et al. 1998).

Thus, especially children's education-dependent domain-specific developments (early language, numeracy skills, factual content knowledge) showed an early stabilization of individual differences. As we report in more detail below, these differences have a major impact on further development. These developments may be characterized by a cumulative acquisition process under relatively constant environmental conditions. This may explain the early stabilizations of the interindividual differences. However, it must be taken into account that the assessment of working memory and nonverbal abilities could be influenced to a greater extent by situation-dependent attentional processes in young children, which may restrict reliability and thus stability.

Over and above the high stability of individual differences in the education-dependent domain-specific developments in language, numeracy skills, and factual knowledge, additional analyses show that the performance variance in these skills does not decrease over the preschool period, but rather increases over time. Concerning the development of receptive vocabulary, for example, a substantial increase in variance by about 36% showed up (Weinert et al. 2010, p. 41), which is, at least partially, due to increasing differences (Matthew effect) between children with a German and a non-German family language background (Ebert et al. 2013; Weinert and Ebert 2017). Yet, despite high stabilities of individual differences in developmental trajectories, a large amount of variance (e.g., more than 40% in the language domain) remains unexplained by preceding performance differences hinting to internal and external influencing factors that may explain changes in individual differences and developmental trajectories (see below and Lehrl et al. this volume).

***Early Emergence of Disparities in Domain-Specific Development Related to Family Background***

It is one of the alarming results of the BiKS-3-18 study that significant disparities in education-related areas of child development (i.e., language, numeracy skills, and factual content knowledge) are already present in early preschool age, both as a function of the family's language background (Dubowy et al. 2008; Ebert et al. 2013) and in connection with parents' SES as indicated by parental education, occupation, and family income (Ebert et al. 2020; Weinert et al. 2010, 2012; Weinert and Ebert 2013). At the same time, the children's performance in nonverbal reasoning tasks was less associated with children's family background (Dubowy et al. 2008; Kurz et al. 2008; Weinert et al. 2010).

In particular, BiKS findings show that—despite substantial heterogeneity within social groups—SES-related disparities were particularly pronounced in the language area (Weinert et al. 2010, p. 39). This is troubling because—as already mentioned—differences in early language development prove to be relatively stable over time and are considered and empirically demonstrated to be highly important for other areas of development including knowledge acquisition, social-cognitive (theory of mind), metacognitive, and social-emotional development as well as school performance (see Sect. 3.2, 3.3).

Considering different models of language acquisition, it is particularly interesting that SES-related disparities are not only evident in children's vocabulary, but also in their early grammar at the age of only three years (Weinert and Ebert 2013). In fact, SES-related disparities in early vocabulary and grammar were even comparable and, depending on the family background indicator, explained between 6 and 12% of the observed variance between (monolingual German-speaking) children. This did not change significantly over preschool years although all children included in the study attended preschool (Weinert and Ebert 2013). Note that these analyses considered monolingual children only to not confound disparities due to families' SES with multilingual development.

Thus, contrary to nativistic assumptions (in the tradition of Baker 2001; Chomsky 1981; Pinker 1994; see Weinert and Grimm 2018), not only vocabulary but also early grammar acquisition seems to be affected by family background and environmental language stimulation. More recent results using data of the German National Educational Panel Study further confirm this finding for even younger children (Attig and Weinert 2020). Regarding children from families with a background of migration (or more precisely: with a non-German language background), performance gaps in vocabulary further increased compared to children without a background of migration over the course of preschool (for addi-

tional results on children with a background of migration see Ebert and Weinert this volume; Dubowy et al. 2008; Ebert et al. 2013).

At school, SES-related disparities prove to be particularly pronounced when it comes to more sophisticated "academic language" requirements (Kotzerke et al. 2013, 2014; see also Berendes et al. 2013). With regard to rather basic language skills necessary in everyday language use, social and migration-related differences decrease in the course of primary school, as children from socially disadvantaged families and non-German-speaking homes increasingly master tasks, e.g., on basic sentence comprehension in German (Ebert and Weinert this volume; Kotzerke et al. 2014). However, concerning the comprehension of more complex sentences used in the language of schooling, some children still show significant limitations even in third grade (Ebert and Weinert this volume; Kotzerke et al. 2014; see also Berendes et al. 2013). These findings converge with other empirical results documenting increasing SES-related disparities in academic language proficiencies in the language of schooling as well as an increasing gap between children with and without a background of migration over primary school years (e.g., Volodina et al. 2020).

## 3.2 Developmental Relations Between Domains of Development

Although research shows that child development and the acquisition of competencies are domain-specific endeavors with domain-specific trajectories, there are also important and dynamic developmental relations between domains (e.g., Weinert 2020, 2022, for overviews). Thereby the specific relations and direction of influence between domains may change dynamically across development (Weinert and Ebert 2017). The BiKS findings that are reported in the following underline this assumption and highlight the importance of differentiating between the prediction of *outcomes* and the prediction of *developmental progress*. We focus here on relationships between language development and other areas of development to illustrate that development in the important and educationally highly relevant domain of language is not only stable, but also dynamic and interrelated with various other areas of development.

***Working Memory as an Important Predictor of Early Vocabulary Acquisition: Group-Specific Differences and Changing Relations***

It is well documented that interindividual differences in working memory capacity and children's vocabulary *status* are substantially associated both simultaneously

and across ages (Ebert et al. 2013; Knöferle 2014; for overviews Gathercole and Baddeley 1993; Weinert 2010, 2020). Yet, for vocabulary *growth*, the BiKS findings show that individual differences in measures of working memory capacity prove to be predictive especially in the early phases of vocabulary acquisition (Ebert et al. 2013; Weinert et al. 2012). In particular, using growth curve modeling, an effect of working memory capacity on vocabulary *growth* (slope) between age three and five years could only be demonstrated in children with a non-German language background and thus with a comparatively limited vocabulary in the majority language German (Ebert et al. 2013) as well as in monolingual German-speaking children with comparatively limited language skills at the beginning of the study (Weinert et al. 2012) but not for monolingual children with more advanced vocabulary skills. At the same time, differences in working memory were substantially associated with children's vocabulary at the first measurement point in all groups (intercept).

Further analyses show, that despite simultaneous and time-delayed associations between various measures of verbal working memory (digit span, pseudoword repetition; Knöferle 2014, p. 166), only pseudoword repetition predicted the *changes* in individual differences in vocabulary within cross-lagged panel analyses (Knöferle 2014, p. 168, 206). Thus, the BiKS findings substantiate and extend the assumption, that particularly the repetition of pseudowords, i.e., the immediate reproduction of prosodically structured non-words, is predictive for vocabulary progress (Knöferle 2014; see Gathercole 1995 for related findings). Moreover, the relation between working memory and vocabulary may change across development (e.g., Gathercole and Baddeley 1993). In the early phases of vocabulary development, working memory is particularly predictive as BiKS data show. Later on, the acquired vocabulary seems to become "a major pacemaker in the developmental relationship" (Gathercole et al. 1992, p. 887; see Weinert 2010, for an overview).

***Developmental Relations Between Early Language and the Development of Theory of Mind and Metamemory Knowledge***

Acquiring a theory of mind (ToM) is thought to be highly relevant to both social-emotional as well as cognitive development (e.g., Ebert 2011, 2015; Lockl et al. 2017). "Theory of mind" means the developing ability of children to attribute mental states to themselves and others and to understand that people act according to their mental states (such as beliefs, wishes, knowledge) which may differ between persons and may also deviate from reality. Metamemory knowledge (or declarative metamemory; both terms are used interchangeable in the following) also addresses children's developing understanding of one's own and others' minds but with a special focus on memory (e.g., understanding that one may forget things; that it is harder to remember more items compared to fewer items; that additional

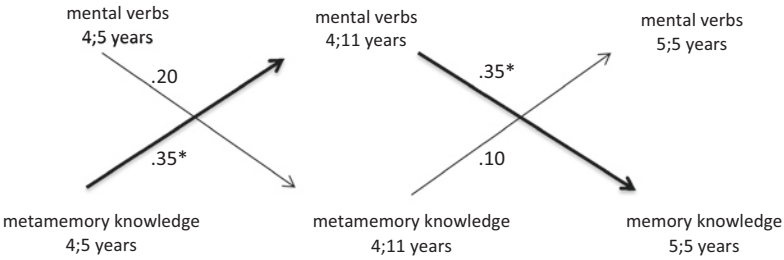
study time may be helpful; Ebert 2011, 2015; Haberkorn et al. 2014; Kreutzer et al. 1975; Lockl and Schneider 2006, 2007; Lockl et al. 2016; Wellman 1977).

As language is an important means for communication as well as for coding mental states and complex propositions which are often used when talking about mental states, language has been suggested to impact on children's ToM development. The significant role of language for acquiring ToM is empirically supported by experimental (e.g., Lohman and Tomasello 2003), quasi-experimental (e.g., Nilsson and de Lopez 2016; Peterson and Siegal 2000), and longitudinal studies (e.g., Weinert and Ebert 2017, for a brief overview). Following other findings (see Milligan et al. 2007, for a meta-analysis), the BiKS-3-18 study shows that children's early language skills are highly predictive for later ToM performance (Ebert 2011, 2015, 2020a, b). Over and above predicting later ToM *performance*, analyses of the BiKS-3-18 data (Ebert 2011, 2015) show that early language skills also predict ToM *development* over the preschool years which in turn predicts the development of metamemory knowledge. In particular, children's early language skills at age 3;2 were closely related to both their ToM and their metamemory knowledge at age 3;8 (both intercept), and thus predictive of both performances half a year later. In addition, early language also predicted ToM *development* over the next years (slope) and, though less pronounced, progress in metamemory knowledge (Ebert 2015). Further—as already mentioned—early ToM understanding remained an important pacemaker for the development of metamemory knowledge (i.e., declarative memtamemory), at least in preschool age (Ebert 2011, 2015), but not in school age (Ebert 2020a).

Looking at an extended developmental period up to age 13, the BiKS-3-18 study demonstrates that early language skills in preschool age predict changes in ToM also between age 5;6 years and 12;8 years (Ebert 2020b). Here, it was particularly sentence comprehension, rather than vocabulary, that proved predictive of change in ToM over time. However, investigating this longer developmental period there are also effects of early ToM on children's language competencies, particularly on changes in vocabulary (Ebert 2020b) and listening comprehension (Ebert 2020a).

Findings of the BiKS-3-18 study according to Ebert's (2011) analyses also demonstrate that the relations between specific language skills and metamemory knowledge are subject to dynamic changes over preschool age (see Fig. 1).

Thus, at the age of about 4 ½ years, basic knowledge about memory (declarative metamemory) predicted the acquisition of a differentiated in-depth understanding of mental terms (i.e., understanding the exact meanings of mental verbs, such as *know*, *remember*, *believe*, *forget*). Later on, this relation changed. Now it was the understanding of specific word meanings (mental verbs) that predicted




Notes: * $p < .01$. Significant relations (controlling for autoregressive effects) are in bold.

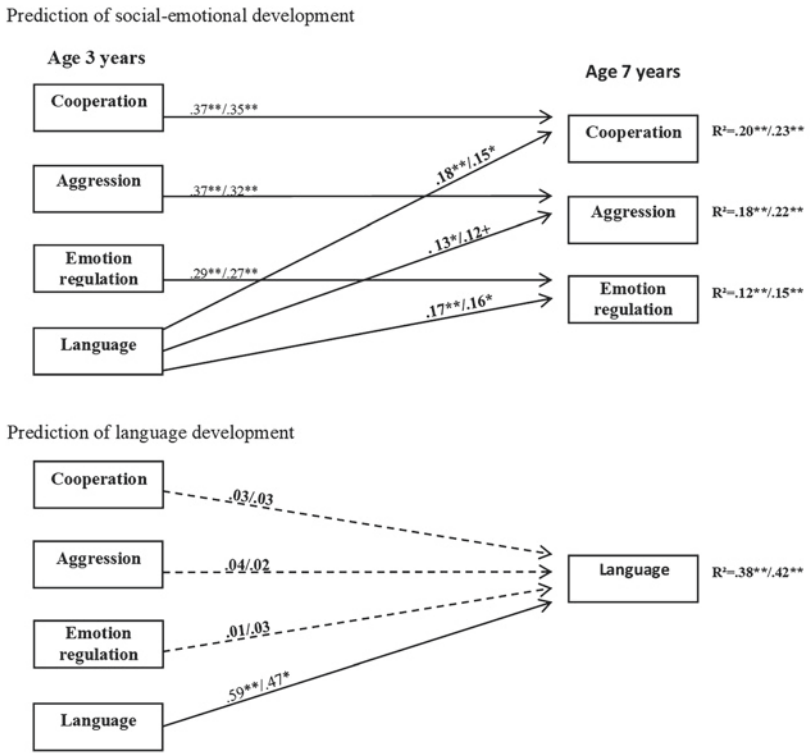
**Fig. 1** Cross-lagged correlations (controlling for autoregressive effects) between comprehension of mental verbs (such as know, remember, believe, forget) and metamemory knowledge between 4 ½ and 5 ½ years of age (age in years and months; adapted from Ebert 2011, p. 335)

changes in metamemory knowledge as a cross-lagged panel analysis suggested (see Fig. 1). This implies that children are working on an understanding of the mental world, with a relatively general knowledge about mental processes such as memory (declarative metamemory) initially predicting the acquisition of specific word meanings. Once these are acquired, they contribute to the further acquisition of metamemory knowledge.

Note that the BiKS-3-18 study not only showed early roots and developments of declarative metamemory but also allowed to study early developing facets of procedural metacognition (e.g., verbal self-regulation, study time allocation, judgements on task difficulty). As shown by Dubowy (2010), these facets were not closely related to each other. Yet, these developments have been suggested to be particularly important for later school learning.

***The Predictive Impact of Early Language on Later Social-Emotional Outcomes***

An important result of the BiKS-3-18 study is that children's early language development as measured by tests on vocabulary and grammar is not only related to their later cognitive and metacognitive skills and knowledge, but also to their social-emotional competencies. This is shown, for example, by cross-lagged panel analyses conducted by Rose et al. (2016; see Fig. 2). These analyses document, that differences in children's early language skills at age 3 predicted both children's social-emotional outcomes at the end of first grade (as judged by parents and teachers in a multi-informant perspective) as well as the *changes* of individual differences across a 4-year-period from early preschool into school (see




*Note.* Path coefficients (1st coefficient based on model without additional controls ($N = 551$; $\chi^2 = 28.15$ (df = 6); $p < .01$; CFI = .97; TLI = .88; RMSEA = .08; AIC = 6561.61) / 2nd coefficient based on model with additional controls ($N = 531$; $\chi^2 = 27.60$ (df = 6); $p < .01$; CFI = .97; TLI = .80; RMSEA = .08; AIC = 13166.40). + $p < .10$, * $p < .05$, ** $p < .01$

**Fig. 2** Path-model on the relation between social-emotional and language development from age 3 to age 7 (adapted from Rose et al. 2016, p. 70)

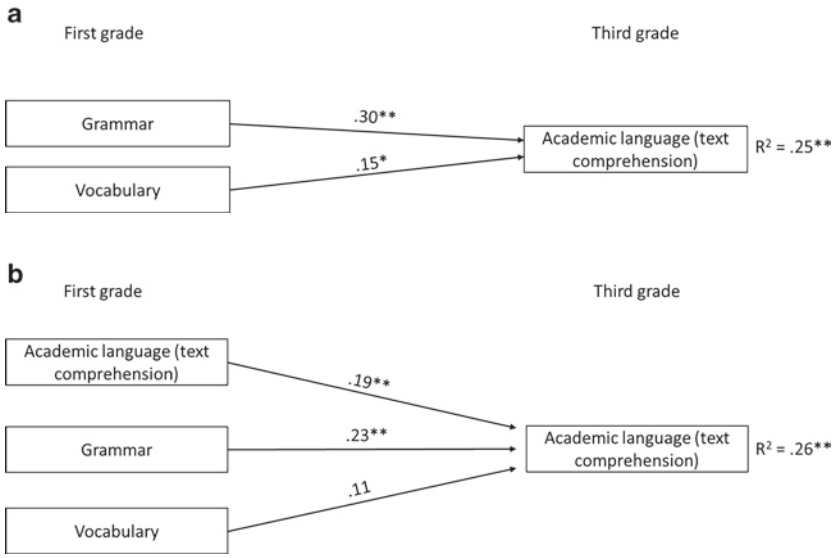
Fig. 2; cross-lagged panel analysis statistically controlling for early differences in children's social-emotional skills and additionally for family's socioeconomic and language background, children's sex, and their nonverbal cognitive abilities at first measurement point). The relations proved to be unidirectional as early social-emotional skills did not significantly predict language development during that time period when early language skills were taken into account (Rose et al. 2016). Further analyses extended these relations to also hold from age three to

eight years (Grade 2) and even over 10 years (Rose et al. 2022, 2018a, 2018b). Possible explanations why early language impacts on social-emotional development are multifold. On the one hand, language can support social-emotional self-regulation through self-directed private speech (e.g., Prizant and Wetherby 1990); on the other hand, verbal communication is important for relationships with peers and for coping with conflicts (e.g., via verbal conflict resolution). In addition, restricted language comprehension might contribute to developing a so-called hostile attribution bias, i.e., a tendency to attribute a hostile intent in case of conflicts or injuries in ambiguous situations (Rose et al. 2022) leading to reactive aggression (e.g., Dodge 1980). In support of this assumption, path models using BiKS-3-18 data showed that children's language skills at age 3 predicted aggressive behavior (self-ratings on facets of aggression) and hostile intention attributions over 10 years, even when controlling for important child and family characteristics and initial levels of aggressive behavior at age 3. Moreover, the hostile intention attributions mediated the predictive impact of early language on later aggressive behavior (Rose et al. 2022).

## 3.3 Individual and SES-Related Differences in School-Relevant Skills and Their Impact

The results reported so far show early emerging individual differences and SES-related disparities in children's domain-specific development which remain rather stable across preschool age or even increase during this time. Further, shortly before school entry (MP 6) BiKS-3-18 data document severe differences between children in school-relevant abilities and skills as well as SES- and migration-related disparities related to family background (Kotzerke et al. 2013; see also Ebert and Weinert this volume). In particular, in monolingual German-speaking families we found substantial differences in their children's numeracy skills, letter knowledge, and sentence comprehension depending on their mothers' education, though there were no differences in the children's basic nonverbal cognitive abilities (Kotzerke et al. 2013). Interestingly, when comparing children with and without a background of migration (language background) no differences showed up in the children's letter knowledge (under control of family's SES as indicated by the Highest International Socio-Economic Index of Occupational Status [HISEI]; Ganzeboom et al. 1992). Yet, children with a background of migration showed clear limitations with respect to their German language proficiency (sentence comprehension; group difference between children without and with a background of migration (both parents; only one parent): effect size = 0.12).

The latter was especially true for children whose both parents speak a mother tongue other than German (Kotzerke et al. 2013; see also Ebert and Weinert this volume). The differences in sentence comprehension explained substantial variance in later text-related listening comprehension in German (also when statistically controlling for children's nonverbal cognitive abilities and family's SES). As summarized in Fig. 3, analyses by Kotzerke et al. (2012) suggest that listening comprehension of texts that included features that have been suggested to be typical for the language of schooling (i.e., children's academic language proficiency) in Grade 3 is related to both children's earlier vocabulary and grammar skills at school entry. This result (i.e., the predictive relation of early language for later text-related listening comprehension) holds even up to the age of 13 (Ebert 2020a, b). While both vocabulary and grammar skills at primary school entry are predictive for later differences in academic language proficiency (text comprehension; Fig. 3a) and even across an extended time period (Ebert 2020b),




*Note*. Coefficients are standardized Beta-weights (additionally controlling for differences in basic nonverbal cognitive abilities (CFT-1, Cattell et al. 1997) and SES (ISEI: International Socio-Economic Index of Occupational Status, Ganzeboom et al. 1992) in first grade. * p < .05. ** p < .01. Analyses by Kotzerke et al. 2012.

**Fig. 3** Results of regression analyses predicting later academic language proficiency (listening comprehension of texts characterized by academic language features)—with (3b) and without (3a) controlling for differences in Grade 1

children's grammatical skills (comprehension of sentences differing in grammatical structure) proved to be particularly predictive for the *development* of text comprehension over primary school years. As Fig. 3b shows, grammar is even predictive for later academic language proficiency when controlling for early performance differences in academic language in Grade 1, for nonverbal cognitive abilities (CFT1; Cattell et al. 1997) and family's SES (ISEI; Ganzeboom et al. 1992). Early vocabulary as well as nonverbal abilities both lose their significant predictive impact on later academic language (text comprehension) when controlling for earlier differences in academic text comprehension at school entry (see also Kotzerke et al. 2013).

Further, as predicted, listening comprehension of texts with features of academic language explained a substantial proportion of variance in children's school performance in second grade—even in monolingual German-speaking children. This was shown for children's school performance (school grades) in social studies and general sciences ($r = 0.52$) as well as in German ($r = 0.41$), and mathematics ($r = 0.36$) (Kotzerke et al. 2013; see Table 5). The substantial relation between language skills and school grades remained significant even when controlling for children's age and nonverbal cognitive abilities (see Table 5). The importance of early language skills for school performance is also substantiated by their predictive relation to later reading comprehension (Ebert 2020a, b; Ebert and Weinert 2013). Further analyses show, that the children's (sophisticated) academic language skills explained the comparatively largest share of the variance in achievement in social studies and general sciences—compared to children's age, nonverbal cognitive abilities, and family's SES—and mediated the SES-related disparities: Social background characteristics lost their effect on children's school performance when children's language skills were included into the model (Weinert et al., in prep.; see also Kotzerke et al. 2013). Similar findings, although not as pronounced, are also found for the subjects German and mathematics. Thus, language seems to be an important mediator of the observed SES-related disparities in school performance even in monolingual children.

## 3.4 Conclusions and Prospects

The BiKS-3-18 study allows to analyse the early emerging individual differences and SES-related disparities in school-relevant areas of child development, their dynamic interrelations and important internal and external influencing factors. With a special focus on the important domain of language, this chapter summarized results on the stability, dynamic interrelations, and the impact of early indi-

**Table 5** Relation between (academic) language proficiency (test on listening comprehension) and school performance (teacher judgement) in second grade (monolingual children) (adapted from Kotzerke et al. 2013, p. 127)

| Academic language skills | German | Mathematics | SSS |
|---|---|---|---|
| Bivariate correlation ($n = 208$) | −0.41** | −0.36** | −0.52** |
| Controlled for nonverbal abilities ($n = 205$) | −0.33** | −0.29** | −0.46** |
| Controlled for age & nonverb. abilities ($n = 199$) | −0.31** | −0.27** | −0.45** |

*Note: ** $p < 0.01$ (two-tailed), negative relations are due to school grades ranging from 1 (highest grade) to 6 (lowest grade); nonverbal cognitive abilities: CFT 1 (Cattell* et al. *1997). SSS: social studies & general sciences*

vidual and SES-related disparities. The reported findings show pronounced and stable individual differences and SES-related gaps in early education-dependent and educationally relevant domain-specific skills, especially in early language skills. These prove important for other school-relevant competencies and developments, e.g., metamemory development, the development of a theory of mind, and facets of social-emotional development such as emotional self-regulation, peer relations/cooperative behavior, and aggression. Early language skills are also predictive of children's later more sophisticated academic language proficiency, which is highly relevant to learning across school subjects (including mathematics, see e.g., Table 5; Ebert 2020a; Kotzerke et al. 2013; see also Heppt et al. 2020). Children with advanced language skills at an early age perform better at school and are rated as more socially competent and socially acceptable by their parents and teachers.

Because early child language is particularly important for further development and associated with a variety of developmental domains, the question arises as to which factors in the home-learning environment as well as in institutional settings might contribute to successful language development (see Lehrl et al. this volume). The observation of early emerging and rather stable SES-related disparities in early language development as well as results showing a Matthew effect, i.e., an increasing gap in more sophisticated academic language skills in school age (e.g., Volodina et al. 2020) with a significant impact on school performance (Heppt et al. 2020; Schuth et al. 2017; see also Sect. 3.3) points to important influencing factors in the home-learning and early institutional environments as assumed in bioecological models of development (e.g., Bronfenbrenner and Morris 2006). The BiKS-3-18 study provides important insights into the dynamics of developmental trajectories as well as into the complex interplay between the home-learning and the institutional

learning environments, which were especially recorded in the educational BiKS Project 2 (see Rossbach et al. this volume). In particular, as documented in Lehrl et al. (this volume), the BiKS-3-18 study supports the Specificity Principle (Bornstein 2017) by showing that both vocabulary and grammar acquisition are influenced by the learning environment from early on (see Sect. 3.1 this chapter), with different aspects of the learning environment promoting either of them (Ebert et al. 2020; Lehrl et al. 2012; Weinert and Ebert 2017; see Lehrl et al. this volume). Further, these different aspects of the learning environment are not highly associated (see also Attig and Weinert 2020; Ebert et al. 2020). Thus, families that show more effective stimulation of children's vocabulary development do not necessarily promote children's grammar or early reading (e.g., letter knowledge) to the same extent (Ebert et al. 2020; Lehrl et al. 2012). In addition, SES-related disparities in different language skills, such as vocabulary, grammar, early reading, are related to different language promoting factors as summarized in Lehrl et al. (this volume).

Overall, findings of the BiKS-3-18 study hint to a significant impact of early child development on later developments and educational success. Individual differences and SES-related disparities emerge early in life and relate to further developmental trajectories in other areas of development as shown in the present chapter for language development. Furthermore, individual differences are influenced by distal (e.g., SES as shown in the present chapter or language background of the family, see Ebert and Weinert this volume) and by differentiated proximal factors of the learning environments (see Lehrl et al. this volume for findings of the BiKS-3-18 study). The high impact of early child development on future development and school success has important practical implications: In particular, early child language and child development should be addressed by early promotion programmes targeted to families, children, and institutions to reduce the early emerging SES-related gaps and to foster all children in their development.

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## References


Astington, J. W., & Olson, D. R. (1990). Metacognitive and metalinguistic language: Learning to talk about thought. *Applied Psychology, 39*, 77–87. https://doi.org/10.1111/j.1464-0597.1990.tb01038.x

Astington, J. W., & Pelletier, J. (1997). *Metacognitive Vocabulary Test* (Unpublished test materials). Institute of Child Study, University of Toronto.

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

Autorenteam Kompetenzsäule (2020). *Längsschnittliche Kompetenzmessung im NEPS: Anlage und deskriptive Befunde* (NEPS Survey Paper No. 80). Leibniz-Institut für Bildungsverläufe, Nationales Bildungspanel. https://doi.org/10.5157/NEPS:SP80:1.0

Baker, C. (2001). *Foundations of bilingual education and bilingualism* (3rd ed.). Multilingual Matters LTD.

Berendes, K., Dragon, N., Weinert, S., Heppt, B., & Stanat, P. (2013). Hürde Bildungssprache? Eine Annäherung an das Konzept „Bildungssprache" unter Einbezug aktueller empirischer Forschungsergebnisse. In A. Redder & S. Weinert (Eds.), *Sprachförderung und Sprachdiagnostik—interdisziplinäre Perspektiven* (pp. 17−41). Waxmann.

Bornstein, M. H. (2017). The specificity principle in acculturation science. *Perspectives on Psychological Science: A Journal of the Association for Psychological Science, 12,* 3−45. https://doi.org/10.1177/1745691616655997

Bornstein, M. H. (2019a). Fostering optimal development and averting detrimental development: Prescriptions, proscriptions, and specificity. *Applied Developmental Science, 23*, 340−345. https://doi.org/10.1080/10888691.2017.1421424

Bornstein, M. H. (2019b). "It's about time!" Ecological systems, transaction, and specificity as key developmental principles in children's changing worlds. In R. D. Parke & G. H. Elder (Eds.), *Children in changing worlds: Sociocultural and temporal perspectives* (pp. 277−286). Cambridge University Press.

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

Brooks-Gunn, J., & Duncan, G. J. (1997). The effects of poverty on children. *The Future of Children*, *7*, 55−71. https://doi.org/10.2307/1602387

Caldwell, B. M., & Bradley, R. H. (2003). *HOME inventory administration manual.* University of Arkansas.

Chomsky, N. (1981). *Lectures on government and binding.* Foris.

Denckla, M. B., & Rudel, R. G. (1976). Rapid „automatized" naming (R.A.N.): Dyslexia differentiated from other learning disabilities. *Neuropsychologia, 14,* 471–479. https://doi.org/10.1016/0028-3932(76)90075-0

Dodge, K. A. (1980). Social cognition and children's aggressive behavior. *Child Development, 51,* 162–170. https://doi.org/10.2307/1129603

Dubowy, M. (2010). *Metagedächtnisfähigkeiten und selbstbezogene Sprache bei Vorschulkindern – zwei verwandte Aspekte kindlicher Selbstregulation?* Logos.

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

Dumont, H., Maaz, K., Neumann, M., & Becker, M. (2014). Soziale Ungleichheiten beim Übergang von der Grundschule in die Sekundarstufe I. Theorie, Forschungsstand, Interventions- und Fördermöglichkeiten. *Zeitschrift für Erziehungswissenschaft, 17*(1), 141−165. https://doi.org/10.1007/s11618-013-0466-1

Ebert, S. (2011). *Was Kinder über die mentale Welt wissen – Die Entwicklung von deklarativem Metagedächtnis aus der Sicht der "Theory of Mind"*. Dr. Kovač.

Ebert, S. (2015). Longitudinal relations between theory of mind and metacognition and the impact of language. *Journal of Cognition and Development, 16,* 559−586. https://doi.org/10.1080/15248372.2014.926272

Ebert, S. (2020a). Early language competencies and advanced measures of mental state understanding are differently related to listening and reading comprehension in early adolescence. *Frontiers in Psychology, 11,* 952. https://doi.org/10.3389/fpsyg.2020.00952

Ebert, S. (2020b). Theory of mind, language, and reading: Developmental relations from early childhood to early adolescence. *Journal of Experimental Child Psychology, 191,* 104739. https://doi.org/10.1016/j.jecp.2019.104739

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

Ebert, S., Lockl, K., Weinert, S., Anders, Y., Kluczniok, K., & Rossbach, H.-G. (2013). Internal and external influences on vocabulary development in preschool age. *School Effectiveness and School Improvement, 24,* 138−154. https://doi.org/10.1080/09243453.2012.749791

Ebert, S., & Weinert, S. (2013). Predicting reading literacy in primary school: The contribution of various language indicators in preschool. In M. Pfost, C. Artelt & S. Weinert (Eds.), *The development of reading literacy from early childhood to adolescence* (pp. 93−149). University of Bamberg Press.

Ebert, S., & Weinert, S. (2024). Development of majority language competencies in children from different family language backgrounds: Results of the BiKS-3–18 Study. In S. Weinert, H.-G. Rossbach, J. von Maurice, H.-P. Blossfeld & C. Artelt (Eds.), *Educational processes, decisions, and the development of competencies from early preschool age to adolescence: Findings from the BiKS cohort panel studies*. Springer.

Fodor, J. A. (1983). *Modularity of mind: An essay on faculty psychology.* MIT Press.

Früh, W., & Wünsch, C. (2009). Empathie und Medienempathie. *Publizistik, 54,* 191−215. https://doi.org/10.1007/s11616-009-0038-9

Ganzeboom, H. B. G., De Graaf, P. M., & Treiman, D. J. (1992). A standard international socio-economic index of occupational status. *Social Science Research*, *21*, 1−56. https://doi.org/10.1016/0049-089X(92)90017-B

Gathercole, S. E. (1995). Is nonword repetition a test of phonological memory or long-term knowledge? It all depends on the nonwords. *Memory and Cognition*, *23*, 83−94. https://doi.org/10.3758/BF03210559

Gathercole, S. E., & Baddeley, A. D. (1993). Phonological working memory: A critical building block for reading development and vocabulary acquisition? *European Journal of Psychology of Education, 8*, 259−272. https://doi.org/10.1007/BF03174081

Gathercole, S. E., Willis, C., Emslie, H., & Baddeley, A. D. (1992). Phonological memory and vocabulary development during early school years: A longitudinal study. *Developmental Psychology, 28*, 887−898. https://doi.org/10.1037/0012-1649.28.5.887

Goodman, R. (2005). Strengths and Difficulties Questionnaire (SDQ). Information for researchers and professionals about the Strengths & Difficulties Questionnaires. *Sdqinfo.* http://www.sdqinfo.org/py/sdqinfo/b3.py?language=German

Haberkorn, K., Lockl, K., Pohl, S., Ebert, S., & Weinert, S. (2014). Metacognitive knowledge in children at early elementary school. *Metacognition and Learning, 9*, 239−263. https://doi.org/10.1007/s11409-014-9115-1

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

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

Hansen, K., & Joshi, H. (2007). *Millenium Cohort Study. Second survey. A user's guide to initial findings.* Institute of Education, Centre for Longitudinal Studies.

Happé, F. (1994). An advanced test of theory of mind: Understanding of story characters' thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. *Journal of Autism and Developmental Disorders, 24*, 129−154. https://doi.org/10.1007/BF02172093

Heckman, J. J. (2013). *Giving kids a fair chance*. MIT Press.

Heppt, B., Köhne-Fütterer, J., Eglinsky, J., Volodina, A., Stanat, P., & Weinert, S. (2020). *BiSpra 2–4. Test zur Erfassung bildungssprachlicher Kompetenzen bei Grundschulkindern der Jahrgangsstufen 2 bis 4.* Waxmann.

Hertel, S., Hochweber, J., Mildner, D., Steinert, B., & Jude, N. (Eds.) (2014). *PISA 2009 Skalenhandbuch.* Waxmann. https://doi.org/10.25656/01:9554

Homuth, C., Lehrl, S., Volodina, A., Weinert, S., & Rossbach, H.-G. (2024). From preschool to vocational training and tertiary education—study design of BiKS-3–18. In S. Weinert, H.-G. Rossbach, J. von Maurice, H.-P. Blossfeld & C. Artelt (Eds.), *Educational processes, decisions, and the development of competencies from early preschool age to adolescence: Findings from the BiKS cohort panel studies.* Springer.

Knöferle, A. M. (2014). *Is it rhythm? – Zusammenhänge zwischen Arbeitsgedächtnisleistungen, Prosodienutzung und musikalischen Fähigkeiten beim Worterwerb.* Dr. Kovač.

Kotzerke, M., Ebert, S., & Weinert, S. (2014). Wieso, weshalb, warum? Die Entwicklung des Grammatikverständnisses von der ersten bis zur dritten Klasse. In M. Mudiappa & C. Artelt (Eds.), *BiKS – Ergebnisse aus den Längsschnittstudien* (pp. 73−86). University of Bamberg Press.

Kotzerke, M., Röhricht, V., & Weinert, S. (2012, September). *Bildungssprachliche Kompetenzen in der Grundschule: Prädiktoren und Leistungszusammenhänge* (Poster

presented at the 48th Congress of the German Association for Psychology (DGPs)). Bielefeld, Germany.

Kotzerke, M., Röhricht, V., Weinert, S., & Ebert, S. (2013). Sprachlich-kognitive Kompetenzunterschiede bei Schulanfängern und deren Auswirkungen bis Ende der Klassenstufe 2. In G. Faust (Ed.), *Einschulung. Ergebnisse aus der Studie „Bildungsprozesse, Kompetenzentwicklung und Selektionsentscheidungen im Vorschul- und Schulalter (BiKS)"* (pp. 111–135). Waxmann.

Kreutzer, M. A., Leonard, C., & Flavell, J. H. (1975). An interview study of children's knowledge about memory. *Monographs of the Society for Research in Child Development, 40*, 1–60. https://doi.org/10.2307/1165955

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

Lehrl, S., Ebert, S., Rossbach, H.- G., & Weinert, S. (2012). Die Bedeutung der familiären Lernumwelt für Vorläufer schriftsprachlicher Kompetenzen im Vorschulalter. *Zeitschrift für Familienforschung, 24,* 115–133. https://doi.org/10.20377/jfr-181

Lehrl, S., Rossbach, H.-G., & Weinert, S. (2024). Fostering early competence development through home and preschool learning environments—A summary of findings from the BiKS-3–18 study. In S. Weinert, H.- G. Rossbach, J. von Maurice, H.- P. Blossfeld & C. Artelt (Eds.), *Educational processes, decisions, and the development of competencies from early preschool age to adolescence: Findings from the BiKS cohort panel studies*. Springer.

Little, T. D., Jones, S. M., Henrich, C. C., & Hawley, P. H. (2003). Disentangling the 'whys' from the 'whats' of aggressive behaviour. *International Journal of Behavioral Development, 27,* 122–133. https://doi.org/10.1080/01650250244000128

Lockl, K., Ebert, S., & Weinert, S. (2017). Predicting school achievement from early theory of mind: Differential effects on achievement tests and teacher ratings. *Learning and Individual Differences, 53,* 93–102. https://doi.org/10.1016/j.lindif.2016.11.007

Lockl, K., Händel, M., Haberkorn, K., & Weinert, S. (2016). Metacognitive knowledge in young children: Development of a new test procedure for first graders. In H.- P. Blossfeld, J. von Maurice, M. Bayer & J. Skopek (Eds.), *Methodological Issues of longitudinal surveys: The example of the National Educational Panel Study* (pp. 465–484). VS Verlag für Sozialwissenschaften.

Lockl, K., & Schneider, W. (2006). Precursors of metamemory in young children: The role of theory of mind and metacognitive vocabulary. *Metacognition and Learning*, *1*, 15–31. https://doi.org/10.1007/s11409-006-6585-9

Lockl, K., & Schneider, W. (2007). Knowledge about the mind: Links between theory of mind and later metamemory. *Child Development, 78,* 148–167. https://doi.org/10.1111/j.1467-8624.2007.00990.x

Lösel, F., & Bliesener, T. (2003). *Aggression und Delinquenz unter Jugendlichen.* Wolters Kluwer.

Lohmann, H., & Tomasello, M. (2003). The role of language in the development of false belief understanding: A training study. *Child Development, 74,* 1130–1144. https://doi.org/10.1111/1467-8624.00597

Mang, J., Ustjanzew, N., Leßke, I., Schiepe-Tiska, A., & Reiss, K. (Eds.) (2019). *PISA 2015 Skalenhandbuch. Dokumentation der Erhebungsinstrumente.* Waxmann. https://doi.org/10.25656/01:17449

Marx, A., & Stanat, P. (2009). *Entwicklung eines Hörverstehenstests für Jugendliche* (Paper presented at the 72nd Congress of the Arbeitsgruppe für empirische pädagogische Forschung (AEPF)). Landau, Germany.

Milligan, K., Astington, J. W., & Dack, L. A. (2007). Language and theory of mind: meta-analysis of the relation between language ability and false-belief understanding. *Child Development,* 78(2), 622−646. https://doi.org/10.1111/j.1467-8624.2007.01018.x

Niklas, F., Schmiedeler, S., & Schneider, W. (2010). Heterogenität in den Lernvoraussetzungen von Vorschulkindern. *Zeitschrift für Grundschulforschung*, *3*, 18−31.

Nilsson, K. K., & de Lopez, K. J. (2016). Theory of mind in children with specific language impairment: A systematic review and meta-analysis**.** *Child Development, 87*, 143−153. https://doi.org/10.1111/cdev.12462

Noble, K. G., McCandliss, B. D., & Farah, M. J. (2007). Socioeconomic gradients predict individual differences in neurocognitive abilities. *Developmental Science*, *10*, 464−480. https://doi.org/10.1111/j.1467-7687.2007.00600.x

O'Reilly, K., Peterson, C. C., & Wellman, H. M. (2014). Sarcasm and advanced theory of mind understanding in children and adults with prelingual deafness. *Developmental Psychology, 50*, 1862−1877. https://doi.org/10.1037/a0036654

Peterson, C. C., & Siegal, M. (2000). Insights into theory of mind from deafness and autism. *Mind and Language, 15,* 123−145. https://doi.org/10.1111/1468-0017.00126

Pinker, S. (1994). *The language instinct*. William Morrow and Company.

Prizant, B. M., & Wetherby, A. M. (1990). Toward an integrated view of early language and communication development and socioemotional development. *Topics in Language Disorders, 10*, 1−16.

Rakoczy, H., Harder-Kasten, A., & Sturm, L. (2012). The decline of theory of mind in old age is (partly) mediated by developmental changes in domain-general abilities. *British Journal of Psychology, 103,* 58−72. https://doi.org/10.1111/j.2044-8295.2011.02040.x

Rauer, W., & Schuck, K. D. (2003). *Fragebogen zur Erfassung emotionaler und sozialer Schulerfahrung von Grundschulkindern dritter und vierter Klassen (FEESS 3–4).* Beltz.

Rose, E., Ebert, S., & Weinert, S. (2016). Zusammenspiel sprachlicher und sozial-emotionaler Entwicklung vom vierten bis zum achten Lebensjahr – eine längsschnittliche Untersuchung. *Frühe Bildung, 5,* 66−72. https://doi.org/10.1026/2191-9186/a000254

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

Rose, E., Weinert, S., & Ebert, S. (2018b). The roles of receptive and productive language in children's socioemotional development. *Social Development, 27,* 777−792. https://doi.org/10.1111/sode.12317

Rose, E., Ebert, S., & Weinert, S. (2022). Associations of preschoolers' language skills with aggressive behaviour, positive peer relations, and the hostile intent attribution from preschool to early adolescence. *European Journal of Developmental Psychology, 19*, 828–846. https://doi.org/10.1080/17405629.2021.1978971

Rossbach, H.-G., Blaurock, S., Grosse, C., Kluczniok, K., Kuger, S., Lehrl, S., & Smidt, W. (2024). Quality of learning environments in early childhood. In S. Weinert, H.-G. Rossbach, J. von Maurice, H.-P. Blossfeld & C. Artelt (Eds.), *Educational processes, decisions, and the development of competencies from early preschool age to adolescence: Findings from the BiKS cohort panel studies*. Springer.

Schneider, W., Bullock, M., & Sodian, B. (1998). Die Entwicklung des Denkens und der Intelligenzunterschiede zwischen Kindern. In F. E. Weinert (Ed.), *Entwicklung im Kindesalter* (pp. 53−74). Psychologie Verlags Union.

Schuth, E., Köhne, J., & Weinert, S. (2017). The influence of academic vocabulary knowledge on school performance. *Learning & Instruction, 49,* 157−165. https://doi.org/10.1016/j.learninstruc.2017.01.005

Steger, D., Schroeders, U., & Wilhelm, O. (2019). On the dimensionality of crystallized intelligence: A smartphone-based assessment. *Intelligence, 72*, 76−85. https://doi.org/10.1016/j.intell.2018.12.002

van der Lely, H. K. J., & Pinker, S. (2014). The biological basis of language: Insight from developmental grammatical impairments. *Trends in Cognitive Sciences, 11,* 586−595. https://doi.org/10.1016/j.tics.2014.07.001

Vasilyeva, M., & Waterfall, H. (2011). Variability in language development: Relation to socioeconomic status and environmental input. In S. B. Neuman & D. K. Dickinson (Eds.), *Handbook of early literacy research* (Vol. 3, pp. 36−48). Guilford.

Volodina, A., Weinert, S., & Mursin, K. (2020). Development of academic vocabulary across primary school age: Differential growth and influential factors for German monolinguals and language minority learners. *Developmental Psychology, 56*, 922−936. https://doi.org/10.1037/dev0000910

Weinert, S. (2010). Beziehungen zwischen Sprachentwicklung und Gedächtnisentwicklung. In H.-P. Trolldenier, W. Lenhard & P. Marx (Eds.), *Brennpunkte der Gedächtnisforschung: Entwicklungs- und pädagogisch-psychologische Perspektiven* (pp. 147−170). Hogrefe.

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

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

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

Weinert, S., Artelt, C., Prenzel, M., Senkbeil, M., Ehmke, T., Carstensen, C. H., & Lockl, K. (2019). Development of competencies across the life course. In H.-P. Blossfeld & H.-G. Rossbach (Eds.), *Education as a lifelong process: The German National Educational Panel Study (NEPS)* (Edition ZfE, 2nd ed., pp. 57−82). Springer.

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

Weinert, S., & Ebert, S. (2013). Spracherwerb im Vorschulalter: Soziale Disparitäten und Einflussvariablen auf den Grammatikerwerb. *Zeitschrift für Erziehungswissenschaft, 16*(3), 303−332. https://doi.org/10.1007/s11618-013-0354-8

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

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

Weinert, S., Ebert, S., Lockl, K., & Kuger, S. (2012). Disparitäten im Wortschatzerwerb: Zum Einfluss des Arbeitsgedächtnisses und der Anregungsqualität in Kindergarten und Familie auf den Erwerb lexikalischen Wissens. *Unterrichtswissenschaft, 40*, 4−25.

Weinert, S., & Grimm, H. (2018). Sprachentwicklung. In W. Schneider & U. Lindenberger (Eds.), *Entwicklungspsychologie* (8th ed., pp. 445−470). Beltz.

Wellman, H. M. (1977). Preschoolers' understanding of memory-relevant variables. *Child Development, 48,* 1720−1723. https://doi.org/10.1111/J.1467-8624.1977.TB03991.X

Wild, E. (1999). *Elterliche Erziehung und schulische Lernmotivation* (Habilitation). Sozialwissenschaftliche Fakultät der Universität Mannheim.

Wimmer, H. (1982). *Zur Entwicklung des Verstehens von Erzählungen.* Huber.

Zdravkovic, A. (2012). *Effects of parent-child aggression, maternal warmth and child processing mechanisms on hostile attribution bias.* Unpublished dissertation.

## Appendix: Test Directory

BISC. Jansen, H., Mannhaupt, G., Marx, H., & Skowronek, H. (2002). *Bielefelder Screening zur Früherkennung von Lese-Rechtschreibschwierigkeiten.* Hogrefe.

CFT 1. Cattell, R. B., Weiß, R. H., & Osterland, J. (1997). *Grundintelligenztest Skala 1* (5th rev. ed.). Hogrefe.

CFT 20-R. Weiß, R. H. (2006). *Grundintelligenztest Skala 2 mit Wortschatztest (WS) und Zahlenfolgetest (ZF)* (4th ed.). Hogrefe.

ELFE 1–6. Lenhardt, W., & Schneider, W. (2006). *Ein Leseverständnistest für 1. bis 6. Klassen.* Hogrefe.

HRT 1–4. Haffner, J., Baro, K., Parzer, P., & Resch, F. (2005). *Heidelberger Rechentest.* Hogrefe.

K-ABC. Melchers, P., & Preuß, U. (2005). *Kaufman-Assessment Battery for Children* (German ed., 7th ed.). Swets & Zeitlinger.

KFT 1–3. Heller, K., & Geisler, H. J. (1983). *Kognitiver Fähigkeitstest für 1. bis 3. Klassen.* Beltz.

PPVT. Dunn, L. M., & Dunn, L. M. (1997). *Peabody Picture Vocabulary Test.* American Guidance Service.

PPVT-R (unpublished German research version). Rossbach, H. G., Tietze, W., & Weinert, S. (2005). *Peabody Picture Vocabulary Test—Revised.* Unpublished German research version based on Dunn & Dunn, 1981. Universität Bamberg/FU Berlin.

RWT. Aschenbrenner, S., Tucha, O., & Lange, K. W. (2000). *Regensburger Wortflüssigkeits-Test.* Hogrefe.

SETK 3–5. Grimm, H. (2001). *Sprachentwicklungstest für drei- bis fünfjährige Kinder.* Hogrefe.

SLS 1–6. Mayringer, H., & Wimmer, H. (2005). *Salzburger Lese-Screening für die Klassenstufen 1–4.* Huber.

SON-R 2 ½-7. Tellegen, P., Winkel, M., Wijnberg-Williams, B. J., & Laros, J. (2005). *Snijders-Oomen non-verbaler Intelligenztest.* Hogrefe.

TROG-D. Fox, A. (2011). *Test zur Überprüfung des Grammatikverständnisses.* Schulz-Kirchner.