NEPS
National Educational Panel Study

Research Data

Information on Competence Testing

NEPS Starting Cohort 2 — Kindergarten

From Kindergarten to Elementary School

Wave 4: Grade 2

LIfBi
LEIBNIZ INSTITUTE FOR
EDUCATIONAL TRAJECTORIES

Information on testing	
Test situation	Group testing (in small groups, N<15) in schools, 1 test instructor
Test sequence	The tests were held on three test days. **Test day 1:** mathematical competence **Test day 2:** reading speed, early reading competence and cognitive basic skills (non-verbal) **Test day 3:** listening comprehension Russian or Turkish for students with respective immigrant background: L1-screening (locator test) + L1-listening comprehension (main test)
Test duration (net processing time)	**Test day 1:** 31 min **Test day 2**: 18 min **Test day 3**: 27 min
Breaks	**Test day 2**: 15 minutes break between tests on early reading competence and cognitive basic skills **Test day 3:** 5 min break between L1-screening test and L1-main test; 5 min break during L1-main test

Information on the individual tests

Construct	**Number of Items**	**Allowed Processing Time**	**Survey Method**	**Next Measurement (until 2017)**
Test day 1				
Mathematical competence	24	ca. 30 min	Picture-based answer format	Grade 4
Domain-specific procedural metacognition				
regarding the mathematical domain	1	1 min	Picture-based answer format	Grade 4
Test day 2				
Reading speed	70	3 min	Paper-pencil	
Early reading competence (ELFE, subtest text comprehension)	20	7 min	Paper-pencil	
Cognitive basic skills (non-verbal)				
information processing (NEPS-BZT)	2 x 21 = 42	2 x 30 sec	Picture-based answer format	
mental performance (NEPS-MAT)	2 x 6 = 12	2 x 3 min	Picture-based answer format	

Domain-specific procedural metacognition				
regarding early reading competence	1	1 min	Picture-based answer format	
Test day 3				
Listening Comprehension Russian and Turkish				
L1-screening test Russian and Turkish	8	2 min	Picture-based answer format, given by CD	
L1-main test Russian and Turkish	44	23 min	Picture-based answer format, given by CD	
Domain-specific procedural metacognition				
regarding Russian and Turkish L1 main test	1	2 min	Picture-based answer format	

Preliminary note

The development of the individual tests is based on framework concepts. They constitute overarching concepts on the basis of which education-relevant competences are to be shown consistently and coherently over the entire personal history. Therefore, the following framework concepts that served as a basis for the development of the test tools to measure the above mentioned constructs are identical in the different studies.

The stage-specific measures are collected at certain points of time in the life course. Usually a repetition of measurement does not take place. They are also underlaid by superior concepts and on this basis the educationally relevant competencies are depicted.

Mathematical competence

In the National Education Panel Study, the construct of mathematical competence is based on the idea of mathematical literacy as was defined, for example, in PISA. Thus, the construct describes "[…] an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded mathematical judgments and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen." (OECD, 2003, 24). Regarding younger children, this idea refers to competent handling of mathematical problems in age-specific contexts. Accordingly, mathematical competence in NEPS is operationalized by items assessing more than pure mathematical knowledge; instead, solving the items requires recognizing and flexibly applying mathematics in realistic, mainly extra-mathematical situations.

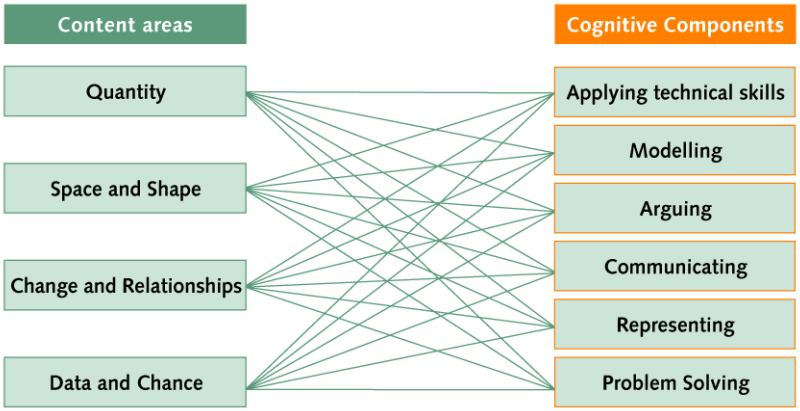

Fig. 1: Framework of mathematical competence in NEPS

The NEPS framework of mathematical competence distinguishes between content-related and process-related components (cf. Fig. 1). In detail, the content areas are characterized as follows:

- **Quantity** comprises all kinds of quantifications when numbers are used to organize and describe situations.
- **Space and Shape** includes all types of planar and spatial configurations, shapes or patterns.
- **Change and Relationships** includes all kinds of (functional) relationships and patterns.
- **Data and Chance** comprises all situations involving statistical data or chance.

The cognitive components of mathematical thinking processes are distinguished as follows:

- **Applying technical skills** includes using known algorithms and remembering mathematical knowledge or calculation methods.
- **Modelling** includes the representation in a situation model and in a mathematical model as well as interpreting and validating results in real-life situations.
- **Arguing** includes assessing explanations and proofs, but also developing own explanations or proofs.
- **Communicating** requires communication on mathematical contents and includes, among other things, the correct and adequate use of mathematical technical terms.

• **Representing** comprises the use and interpretation of mathematical representations such as tables, charts or graphs.

• **Problem Solving** takes place, when there is no obvious approach, and, therefore, includes systematic trying, generalizing or examining special cases.

This differentiation renders the framework concept of mathematical competence in NEPS compatible with both the PISA studies and the German National Mathematics Education Standards. The test items used in NEPS refer to one content area that is mainly addressed by the item, but may well contain several cognitive components.

In order to test mathematical competence independently from reading competence, all items are read aloud by the interviewers. The children answer by choosing either between different pictures or different Arabic numbers, most of which are below 20. As the children are abecedarians, pictures are used instead of page numbers in order to ensure that all students are working on the correct item.

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Metacognition

Metacognition is the knowledge and control of the own cognitive system. According to Flavell (1979) und Brown (1987), declarative and procedural aspects of metacognition are differentiated which are both covered in the National Education Panel.

Procedural metacognition

Procedural metacognition includes the regulation of the learning process through activities of planning, monitoring and controlling. Within the framework of NEPS the procedural aspect of metacognition – in combination with the competence tests of individual domains – is not assessed as a direct measure of such planning, monitoring, and controlling activities but as a metacognitive judgement that refers to monitoring of learning performance during (and/or shortly after) the learning phase (also see Nelson & Narens, 1990). After participants have taken their competence tests, they are requested to rate their own performance. They are asked to state the number of questions presumably answered correctly.

Usually, one question is asked per domain. For competence domains that can be divided into coherent individual parts (e.g. reading competence referring to different texts), the inquiry of procedural metacognition is referred to these parts as well, which, of course, leads to a longer processing time.

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Reading speed

In all NEPS cohorts, in addition to the reading competence test, which focuses on reading comprehension, an indicator of reading speed is collected, which is primarily determined by basic reading processes or their automation. The Salzburg Reading Screening for grades 1-4 (Mayringer & Wimmer, 2005; courtesy of the publisher Hans Huber) is used for the starting cohort 2 (grade 2)[1]. The instrument is administered on paper in A4 format for filling in with a pen. The child is presented with simple sentences that can usually be answered on the basis of general world knowledge alone, i.e. no specific prior knowledge of the content is required (e.g. "Mice can fly"). After each sentence, it must be stated whether the content of the sentence is correct ("correct") or not ("incorrect"). The instruction is given at the beginning by the interviewer. In the classroom context it is guided interactively with the completion of six exercise sentences on a poster. The test contains a total of 70 sentences, most of which are short (one line). When completing the test, children differ primarily in terms of how many sentences they can complete correctly in the given time. Differences between test subjects in the proportion of incorrectly completed sentences are negligible due to the fact that the material is not very demanding in terms of content. The measure of reading speed is the number of sentences correctly completed within the three-minute processing time.[2]

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1 In SC1 (grades 2 and 4), the SLS 2-9 is used with 100 sentences (in 3 minutes).

2 The test for the higher cohorts was redesigned for the purposes of the NEPS (Zimmermann, Artelt, & Weinert, 2014; Zimmermann, Gehrer, Artelt & Weinert, 2012), but it is also based on the test construction principles of the two Salzburg reading screenings (e.g. Auer, Gruber, Mayringer & Wimmer, 2005). It lasts two minutes.

Early reading competence

The operationalization of reading competence in the National Educational Panel Study (NEPS) during the early school years (i.e., elementary school Grade 2) does not follow the overall NEPS framework regarding the measurement of reading competence (see Gehrer, Zimmermann, Artelt, & Weinert, 2013). Studies on the development of reading competence report that children first have to figure out how letters and written words map onto their phonological form and to master basic decoding processes before they can begin to read for meaning (Cain, 2010; Ebert & Weinert, 2013). At the end of elementary school, children exhibit a more complex reading comprehension, which exceeds basic reading ability (Klicpera & Gasteiger-Klicpera, 1993; McElvany, Kortenbruck, & Becker, 2008). As the reading tests based on the NEPS framework include longer texts and require more sophisticated text comprehension, they are applied only from school Grade 4.

In order to (a) conduct a reliable and valid measurement of reading comprehension in early elementary school and (b) enable a comparison of the construct with the following school years, a widespread standardized test (i.e., A Reading Comprehension Test for 1st-6th Graders [ELFE 1-6], Lenhard & Schneider, 2006) was applied in the NEPS for children in Grade 2.

The main objective of ELFE 1-6 is to measure early reading comprehension and not orthographic knowledge or articulation ability. The early reading comprehension is measured by ELFE 1-6 using the following levels or subscales:

- Word comprehension (decoding and synthesizing)
- Reading speed (threshold of visual word recognition)
- Sentence comprehension (extracting meaning through reading and syntactic ability)
- Text comprehension from short stories (finding information, sentence comprehensive reading, deductive thinking)

The **subscale text comprehension** was employed in NEPS in the second grade of Starting Cohort 2. Children were required to answer 20 questions that related to 13 short texts based on 2-7 sentences. Therefore, ca. 1-3 questions were asked about each of the texts. The children had to choose one out of four options by marking it. Just as in the original test, a 7 min time-out was applied.

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Cognitive basic skills (non-verbal) – Perceptual speed and reasoning

In NEPS, cognitive basic skills are measured based on the differentiation between "cognitive mechanics" and "cognitive pragmatics" following Baltes, Staudinger and Lindenberger (1999). While the former is measured using task contents as education-independent, new and domain-unspecific as possible, the tasks for measuring cognitive pragmatics are based on acquired skills and knowledge (Ackerman, 1987). Consequently, some of the domain-specific performance tests used within the framework of NEPS may serve as indicators of pragmatics.

In contrast to this, the tests of basic cognitive skills aim at assessing individual differences of fluid cognitive abilities. While these are subject to age-related changes, in comparison to the education- and knowledge-related competences they prove to be less culture-, experience- and language-dependent. In this context, these tests provide an individual basis and differentiating basic function for the acquisition of education-dependent competences.

Among the facets of cognitive mechanics, two common marker variables stand out: **perceptual speed** and **reasoning**.

Perceptual speed marks the basal speed of information processing (*"speed"*). In NEPS, this is measured by the **Picture Symbol Test (NEPS-BZT)**. This is based on an improved version of the Digit-Symbol Test (DST) from the tests of the Wechsler family by Lang, Weiss, Stocker and von Rosenbladt (2007). Analogously to this improved version, the NEPS-BZT requires the performance to enter the correct figures for the preset symbols according to an answer key.

Reasoning serves as key marker of mental performance (Baltes et al., 1999). The NEPS reasoning test **(NEPS-MAT)** is designed as a matrices test in the tradition of the typical reasoning tests. Each item of the matrices test consists of several horizontally and vertically arranged fields in which different geometrical elements are shown – with only one field remaining free. The logical rules on which the pattern of the geometrical elements is based have to be deduced in order to be able to select the right complement for the free field from the offered solutions.

Both tests have been designed in such a way that they can be effectively used without changes to the item sets across as many age groups as possible and relatively independent from the subjects' mother tongue. Currently, they are administered as paper-and-pencil tests, while computer-aided administration is generally possible.

The results of both tests provide an estimator of basic cognitive skills which, however, is not directly comparable to the overall result of a traditional intelligence test (IQ). It rather permits controlling for differential initial capacities in the competence acquisition process.

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Listening Comprehension in the First Languages (L1[1]) Russian and Turkish

The effects of immigrant students' first language proficiency on their educational success are still highly disputed. On the one hand, theoretical perspectives and empirical evidence suggest positive effects of L1 proficiency on second language acquisition and on educational success within the country of residence (e.g., Cummins, 1979; Hesse, Göbel, & Hartig, 2008). On the other hand, neutral and negative effects of L1 proficiency are proposed (e.g., Esser, 2006; Dollmann & Kristen, 2010; Scheele, Leseman, & Mayo, 2010). The empirical evidence of this controversy is, however, unsatisfactory because there is a lack of investigations systematically assessing L1 proficiency with objective tests (cf. Kristen et al., 2011).

In order to elucidate this controversy within the NEPS, the L1 proficiency of students from the two largest immigrant groups in Germany—that is students whose families immigrated from the area of the Former Soviet Union or from Turkey—is measured with objective tests. The NEPS assesses L1 proficiency at three measure points that are particularly relevant for educational trajectories: at secondary school level in Grade 9 and Grade 7 as well as at elementary school level in Grade 2. The proficiency in Russian and Turkish at these three measure points is assessed with listening comprehension tests specifically developed for this purpose (for Grade 9: Edele, Schotte, Hecht, & Stanat, 2012; Edele, Schotte, & Stanat, 2015; for Grade 7: Taraszow, Schotte, Edele, Hecht, & Stanat, in preparation; for Grade 2: Taraszow, Schotte, & Heppt, 2014). The assessment of listening comprehension was chosen as a dimension of language proficiency because children of immigrants typically acquire the L1 within their family context and do not necessarily read or write their L1.

The listening comprehension tests Russian and Turkish at elementary school level consist of an age-appropriate fantasy story divided into eight short text units. Every text unit is followed by four to seven questions in a dichotomy format (yes-no), totaling to 44 test items. Both, text units and subsequent questions were audio-recorded by native speakers of Russian or Turkish and were presented by CD in a standardized manner. The texts were presented twice; the questions were presented once after the second text presentation and before the students were asked to answer them. The listening comprehension tests Russian and Turkish are an adaptation of the BiSpra test (Heppt, Dragon, Berendes, Stanat, & Weinert, 2012). In order to ensure that student's test performance is independent from prior knowledge, the L1-tests comprise a newly developed fantasy story including made-up words, which are equally unfamiliar to all participants. The listening comprehension tests were examined and validated in extensive pilot studies (Taraszow, Schotte, & Heppt, 2014).

[1] The term first language (L1) is used interchangeably with the language of the family's country of origin, irrespective of whether the student acquired this language prior to German, as the labeling L1 suggests, or simultaneously.

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