NEPS
National Educational Panel Study

Research Data

Information on Competence Testing

NEPS Starting Cohort 2 — Kindergarten

From Kindergarten to Elementary School

Wave 2: Children in Kindergarten (5-6 years)

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Information on testing	
Test situation	Individual testing at the institutions, testing in a separate room, 1 survey supervisor
Test sequence	The tests are held on two test days. **Sequence on test day 1**: mathematical competence, cognitive basic skills with the part for perceptional speed **Sequence on test day 2**: early knowledge of letters, phonological information processing, delayed gratification, cognitive basic skills with the part for reasoning
Test duration (net processing time)	about 73 minutes
Breaks	very short breaks as individually required

Information on the individual tests

Construct	**Number of Items**	**Allowed Processing Time**	**Survey Mode**	**Next Measurement (until 2014)**
Mathematical competence	26	approx. 30 min	Picture-based answer format	After 1 year
Cognitive basic skills (nonverbal)				
Perceptional speed	42	90 sec	paper & pencil	After 2 years
Reasoning	12	6 min	paper & pencil	After 2 years
Stage-specific measures*				
Early knowledge of letters	26	approx. 3 min	verbal, material-based	-
Phonological information processing	58	approx. 30 min	verbal, material-based	-
Delayed gratification	1	approx. 1 min	verbal, material-based	After 4 years
Domain-specific procedural metacognition				
Regarding the mathematical competences	1	1 min	Picture-based answer format	See above

*Data not yet avalaible in SUF-Version 2.0.0

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.

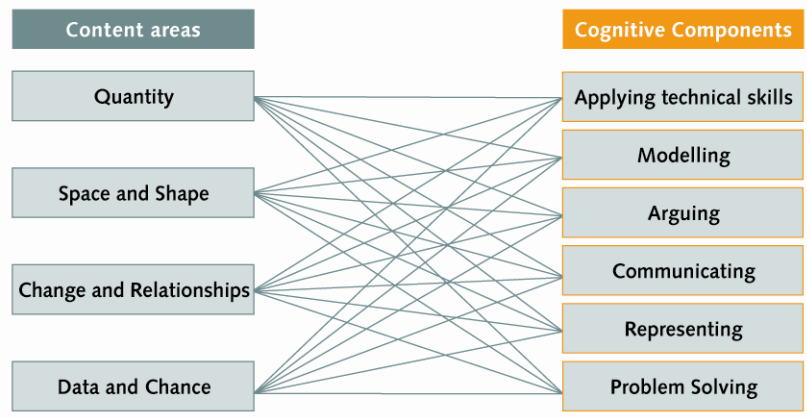

Fig. 1: Framework of mathematical competence in NEPS

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.
  Examples from the *elementary sector*: comparisons of sets, counting (ordinal/cardinal aspects of numbers), simple operations (e.g., adding)
  Examples from the *adult sector*: calculations of percentages and interests, calculations of area and volume, use of different units, simple equation systems
- **Space and Shape** includes all types of planar and spatial configurations, shapes or patterns.
  Examples from the *elementary sector*: recognizing geometric shapes, simple properties of shapes, perspective
  Examples from the *adult sector*: three-dimensional mathematical objects, geometric mappings, elementary geometric theorems
- **Change and Relationships** includes all kinds of (functional) relationships and patterns.
  Examples from the *elementary sector*: recognizing and continuing patterns, relationships among numbers, proportionality

Examples from the *adult sector*: interpreting curves or function graphs, properties of linear, quadratic, and exponential functions, extremum problems

- **Data and Chance** comprises all situations involving statistical data or chance.
  Examples from the *elementary sector*: intuitively assessing probabilities, collecting and structuring data
  Examples from the *adult sector*: interpreting statistics, basic statistical methods, calculating probabilities

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.

Bibliography

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Early knowledge of letters

The letter game makes it possible to assess the previous knowledge of a child in preschool age in the area of written language.

In this game a picture card with the letters of the alphabet is presented to the child. The order here was changed. For every letter the child will be asked if he or she knows the one respectively if he or she can name it. As an alternative it will also be assessed as correct if the corresponding sound (<b> instead of <be>) is spoken out.

Phonological information processing

The majority of tasks on test day 2 examine the children's phonological information processing. Phonological information processing includes the areas of phonological awareness (attention to the formal features of spoken language) as well as the phonological working memory (short-term and immediate saving of spoken language/auditory information). Corresponding performances allow a good prediction of the first reading steps.

The numbers game

The numbers game is taken out of the "Kaufman Assessment Battery for Children" (K-ABC). The ability to repeat a verbally given row of numbers in heard order shall be examined (numerical order memory). This is a measurement for the immediate span of memory which has proven to be important in many areas of development.

In the process of the numbers game the child listens to numerical orders and is then asked to repeat them in the heard sequence. Here it is important that the request to the repetition happens through facial expression and eye contact because otherwise the process of memorizing in the phonological working memory will be disturbed. This task will be conducted with criteria of termination (for details see the script of the leading assessors).

The game "Build the right word"

The game "Build the right word" is taken out of the "Test für Phonologische Bewusstheitsfähigkeiten" (TPB) and corresponds to the task "Onset-Reim-Synthetisieren". It deals with the assessment of phonological awareness. Phonological awareness is important because measures performances in this area in the preschool age are a good indicator for the written language performances in the elementary school.

In this game the children are asked to match the Onset1 and the Rhyme2 of a word, which they hear in a gap of about one second, to the word. For instance they are presented "N" and "uss" via CD and following this the child is asked to add them together ("Nuss"). The examples of the tasks are supported by hand movements. The task will be conducted with criteria of termination.

The rhyme game

The task is taken out of the "Bielefelder Screening zur Früherkennung von Lese-Rechtschreibschwierigkeiten" (BISC). The rhyme game is linked to the language performances of the child which are often contained in the acts of gaming. Word pairs are read out to the child (e.g. trees – chair; wind – child) and subsequently the child is asked to decide whether the words rhyme or not.

The rhyme game consists of altogether 14 items whereas the first four ones serve as practice examples. For the description of items easy nouns were used. This task will be conducted without criteria of termination.

The turn game

The turn game is taken out of the "Hamburg-Wechsler-Intelligenztest für Kinder III" (HAWIK-III). The ability to recite a verbally given row of numbers in the reverse order shall be examined. This task gathers performances of the working memory.

In the implementation of this turn game the child hears rows of numbers whereas the first two serve as practice examples. Subsequently the child is asked to repeat the row of numbers in the reverse order. Each task consists of two numerical orders i.e. the child is shall repeat a numerical order of the same length twice and in reverse order but with different numbers. Because of the difficulty of this task it is likely to come to a termination of the turn game already after some tries.

The search game

This task is taken out of the "Münsteraner Screening zur Früherkennung von Lese-Rechtschreibschwierigkeiten" (MÜSC). In the MÜSC the task is destined for a group process. For the single sessions in the NEPS study the task was correspondingly adjusted.

The search game assesses the ability to recognize initial sounds and therefore measures an aspect of phonological awareness. The child is requested to match a sound, that he or she is hearing, to a picture out of a row of pictures which name contains the given sound (e.g. auditory signal: <AU>, picture row shows: Pfeil – Auge – Ski). The child is then asked to point his/her finger on this picture. A picture row consists of three images. This task will be conducted without criteria of termination.

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Delayed gratification

The surprise is a tasked which shall assess the self-regulating abilities of a child and which is based on the paradigm by Mischel (1974). Such abilities are often connected to better performances, stress resistance and self-confidence. In this task a gratification can either be given immediately or with delay (delayed gratification) – the decision about when the gratification happens is all alone up to the child. The child decides whether he/she wants to go without an immediate gratification in order to receive a greater gratification in future. The greater gratification can nonetheless only be achieved through waiting.

In the NEPS study the child will be shown a cloth bag but he/she cannot see its content. At the same time it will be informed about his courses of action: Either he/she takes a surprise out of the bag immediately or he/she waits until the next day and then receives two surprises out of the bag. Without knowing what the surprise(s) are the child has to make a decision.

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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 in combination with the competence tests of the individual domains, the procedural aspect of metacognition is not assessed as a direct measure of such planning, monitoring and controlling activities but as a metacognitive judgement that refers to the control of the learning performance during (and/or shortly after) the learning phase (also see Nelson & Narens, 1990). After the study participants have taken their competence tests, they are requested to rate their own performance. They are asked to state the portion 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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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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