

Динамика парциальных зрительных функций у дошкольников и младших школьников 5–8 лет

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В статье рассматриваются структура и динамика парциальных зрительных функций (зрительная сегментация – выделение фигуры/фона, зрительная дифференциация форм, зрительная память) детей последнего года обучения в детском саду и первых двух лет обучения в школе. Данная работа представляет собой часть исследовательского проекта факультета образования Университета Палацкого в Оломоуце. Стимульный материал настоящего исследования был составлен из инструментария диагностики и переобучения венского профессора Б. Синделара. Инструментарий Синделара не имеет нормативов, цель исследования состояла в том, чтобы определить средние значения параметров вышеупомянутых функций зрительного восприятия детей и таким образом определить динамику развития этих функций в генеральной популяции. Выборку исследования составили ученики моравских и пражских школ, выборка составлялась по целевому и институциональному принципу. Поскольку опрос проводился количественно, для анализа собранных данных использовалась статистический критерий Манна–Уитни). Результаты исследования продемонстрированы таблицей и графиком для каждого субтеста.

Ключевые слова: обучаемость, ученики с особыми образовательными потребностями,

Для цитаты:

Валента М. Динамика парциальных зрительных функций у дошкольников и младших школьников 5-8 лет [Электронный ресурс] // Клиническая и специальная психология. 2019. Том 8. № 2. С. 1–15. doi: 10.17759/psyclin.2019080201 (на англ.)

For citation:

Valenta M. Dynamics of Visual Partial Functions in Children and Pupils from 5-8 Years of Age [Elektronnyi resurs]. Clinical Psychology and Special Education [Klinicheskaia i spetsial'naia psikhologiya], 2019, vol. 8, no. 2, pp. 1–15. doi: 10.17759/psycljn.2019080201 (In Engl., abstr. in Russ.)

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Dynamics of Visual Partial Functions in Children and Pupils from 5-8 Years of Age

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The article focuses on the structure and the dynamics of partial functions of visual skills (visual segmentation – visual differentiation of the figure/background, visual differentiation of shapes and visual memory) children during their last year at nursery school and their first two years of school attendance as a part of the research project of the Faculty of Education, Palacký University Olomouc. The stimulus material of the investigation was made up of diagnostic and reeducation instruments by Viennese professor B. Sindelar. The Sindelar's instrument has no norms, the aim of the investigation was to determine the median values of the performances in the aforementioned areas of visual perception of children and thus to determine the dynamics of the development of these functions in the intact population. The research sample consisted of children from pupils of Moravian and Prague schools – the last year of kindergarten and the first two years of elementary school, it was a deliberate and institutional sample selection. Since the survey had a quantitative design, a statistical procedure was used to analyze the collected data (median value, statistically significant difference between respondent groups was determined by the Mann–Whitney test). The results of the investigation were demonstrated by a table and a graph for each subtest.

Keywords: educability, pupils with the need for support measures, partial function deficits, school failure, basic research, visual functions.

An introduction to the issues

The article evaluates the partial results of ongoing research carried out at the Institute of Special Education Studies in the Faculty of Education in Olomouc. The research was focused on factors which affect the dynamics of educability in children and pupils with the need for special-education support measures; i.e. with special education needs.

It focuses on (for the needs of this study) the dynamics of the following visual-oriented partial (basal) functions:

- visual segmentation (visual differentiation of the figure-background);
- visual differentiation of shapes;
- visual memory.

The theoretical framework of the research is based on substantiated theory on the deficits of partial (basal) functions (further also DPF) by Sindelar [4–7] and on the empirical evidence of the author. The general theoretical basis of the research stems from neuropsychology, cognitive psychology and ontogenetic psychology. The article is a survey of research results that have been partially published in our monograph [9] and in the article focusing on the development of partial functions of preschool children and younger school age [8]. But other authors publishing their research have also been dealing with a similar subject of research, for example L. Felcmanová, [3], N. Aral, et al. [1], L. Werpup and F. Petermann [10], J. Bednářová and V. Šmardová [2].

Methodological Aspects of the Investigation

The aim of the project is the identification, description and comparison of the determinants of educability and its dynamics amongst children and pupils with the need for special education support measures.

The quantitative design of the investigation was applied to the data collections using the variable “test battery DPF Sindelar” focused on the below stated markers [6]. Unified stimulus material was used (“mid” material from the testing tasks for the target group of the first grade of primary school) for the comparison (and the analysis of factors which affect the dynamics of individual basal functions, thus also affecting the educability of a child or pupil) of the target groups (nursery school – first grade of primary school – second grade of primary school):

- A. visual segmentation (visual differentiation of figure and background)
- B. visual differentiation of shapes
- C. visual memory

The research has been carried out through an investigation of children (pupils) from four Moravian regions and Prague in the form of longitudinal research – children were observed from their last (preparatory) year of pre-school education (nursery school) to the second grade of primary school (i.e. children and pupils ranging between 5–8 years). A sample of children and pupils was selected by deliberate institutional selection (non-randomized) from nursery and primary schools working with the university. The selection criteria were the age of children and pupils and the absence of disability (partial function deficit). Children and pupils diagnosed with deficiency (pedagogical-psychological examination from the center) were excluded from the research.

The selection of children and pupils for the research sample was executed in the form of intentional institutional selection, there were 547 children and pupils in total (Table 1).

Table 1

Research group					
Child/pupil	5yrs	6yrs	7yrs	8yrs	Total by grade
Nursery school	122 (46/76)	110 (42/68)	6 (4/2)	0	238
First grade primary	9 (3/6)	97 (40/57)	114 (61/53)	17 (11/6)	237
Second grade primary	0	0	29 (16/13)	43 (22/21)	72
Total by age	131	207	149	60	547

Note. The number of boys and girls, respectively, is shown in brackets. There is only one specification given in the respondent table – the age – with respect to the fact that the statistical analysis did not demonstrate any difference in the performance of girls and boys in the monitored subtests. The sample included intact children and pupils with no DPF diagnosed (or any deficit suspected). The table also shows the amount and age of the children attending the nursery school and both grades of the primary school – the statistical analysis of the collected data worked with these differentiations as well.

The research itself was preceded by *pre-research* which verified the methodology tools and the process scheme of investigation on a selection of the target groups with the following numbers of respondents (testing stimulus material).

The research problem and the question of the published stage of investigation were phrased in the following manner: are there dynamics in the development of visual partial functions in intact children and pupils on the continuum preparatory year of nursery school – first grade primary school – second grade primary school? If so, what are its dynamics?

The factual hypotheses were verified by statistical processing of quantitative data aimed at differences in the maturation of the observed partial functions in intact children of the preparatory year at nursery school and in intact pupils of the first and second grades of primary school. The Mann–Whitney U test method was used to determine statistically significant differences between designated groups of respondents.

Statistical hypotheses (without null H):

H₁: There is a statistically significant difference in the results of the visual segmentation (visual differentiation of figure and background) subtest in intact children of the preparatory year of nursery school and in intact pupils of the first and second grades of primary school.

H₂: There is a statistically significant difference in the results of the visual differentiation shapes subtest in intact children of the preparatory year of nursery school and in intact pupils of the first and second grades of primary school.

H₃: There is a statistically significant difference in the results of the visual memory subtest in intact children of the preparatory year of nursery school and in intact pupils of the first and second grades of primary school.

A. Stimulus material for the subtest of visual segmentation – differentiation of figure and background (abstract image), subtest B of the test battery.

The pupil draws a copy of the image based on the original picture which is placed in front of them as a model for the entire period of time. He or she draws with a soft-lead pencil on A4 drawing paper. The task was assigned to the children and students by a trained institute staff (PhD student), who explained the task to the whole group and then watched the participants understand the task. Each participant had the opportunity to do another picture if he didn't like the original one. There was not any time limitation for the tasks. Data collection was carried out with the assistance of ten trained staff of the Institute (PhD students). All material was included in the research.

Instruction: Copy this picture as well as you can. *Stimulus material:* see Appendix I. *Assessment:* 0 points – the picture is completely different from the original, or it is not drawn at all; 0.5 point – the picture contains elements of the original (gross errors in spatial orientation and in the picture layout); 1 point – the picture contains minor mistakes – inaccuracies, overlaps in space and layout; 2 points – the copy is identical to the original

According to B. Sindelar, the pupils draw five different pictures in the test. For our purposes we only chose one from the original images (the easiest) image. The reason for this was that the test was exceptionally time-consuming, also having a discouraging effect on the pupils (the images were too difficult). The results published in this article are partial (focused only on visual perception) with respect to the overall stimulus material given to children and pupils in the test battery. The time it took to fill the battery was about one lesson, which was tiring for some children.

B. Stimulus material for the subtest of visual differentiation of shapes, subtest D of the test battery

We give the pupil a set of twenty cards with two pictures, beginning with the card with alarm clocks where it is quite easy to recognize the differences (watches differed in their bells, see Appendix). If the pupil answers incorrectly, we ask him or her to look carefully again; if he or she does not find the difference, we show it to him or her (however, he or she does not score a point). We do not provide help with the following pictures. We place the cards on top of one another, so that the pupil can always see only one pair of pictures; we place the next card only after the pupil answers. The standard exposure time is up to ten seconds; if the child takes longer to analyze the pictures, it might indicate a compensation mechanism being used, however, the time is not quantified here (not

awarded points). Data collection was carried out with the assistance of ten trained staff of the Institute (ten PhD students for all data collection). All material was included in the research.

Instruction: I will always show you two pictures and you will tell me if they are completely the same, or if they differ in something. *Stimulus material:* see Appendix II. *Assessment:* for each correct answer (the same x not the same) we assign one point, i.e. the maximum points scored in the test is 20. The answer key: cards with the same pictures (an engine, a candle, a bed, a lamp, a leafy tree, a girl, a snail, a butterfly, a hat, a window).

C. Stimulus material for the subtest of visual memory (pictures and images), subtest Ga + Gb of the test battery

Ga – Visual memory – pictures

We line up a set of eight pictures in front of the pupil from left to right (from the pupil's perspective) at a pace of approximately two seconds per picture. Then, at the same pace and in the same direction, we turn the pictures face down. The pupil also looks at the pictures during the turning. Finally, we give the pupil a second set of the same but shuffled pictures (i.e. the pictures are not in the same order as in the exposed line) and ask him or her to place a lower line of pictures below the upper line ("the same below the same"). Throughout the test we try to eliminate the danger of the pupil trying to help remember (visually) the pictures by naming them. We point out to him or her that he or she needs to be quiet, or hold his or her tongue pressed between their teeth. Data collection was carried out with the assistance of ten trained staff of the Institute – PhD students.

Instruction: Look at the pictures carefully, try to remember them and their place in the order as they follow one after another. *Stimulus material* – see Appendix III A.

Assessment: the correct picture in the correct position – 1 point (max. 8 points). The task was not limited in time, just like the other tasks in the battery.

Gb – Visual memory – images

The test is similar (instruction, assessment) to the previous one; the difference is that the stimulus material comprises geometrical images which are more abstract in their nature than the specific pictures. Data collection was carried out with the assistance of ten trained staff of the Institute – PhD students.

Instruction: Look at the pictures carefully, try to remember them and their place in the order as they follow one after another. *Stimulus material:* see Appendix III B. *Assessment:* the correct picture in the correct position 1 point (max. 8 points).

Results of the investigation

The following tables show the standards for the development of visual functions of children and pupils in individual sub-functions (visual segmentation – differentiation of

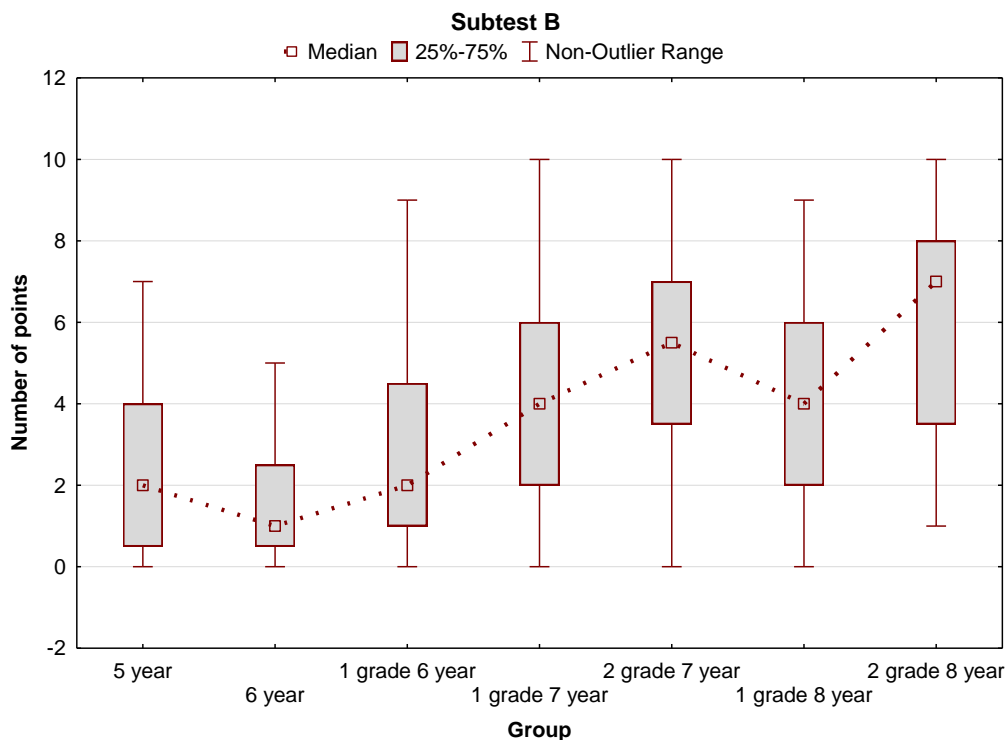
figure and background / abstract image, visual differentiation of shapes, visual memory /pictures and images) – median. The first table is always supplemented with a graph. The second table of each sub-function then, on a statistical basis (Mann–Whitney test), establishes statistically significant differences between two selected groups of probands (eg pre-school children aged 5 and 6). Significant differences are highlighted in red.

Visual segmentation – differentiation of figure and background (abstract image), subtest B of the test battery. We compared the distribution of different age groups with respect to the median of an analysis variable using the nonparametric Mann–Whitney test (Table 2, Graph 1). We found statistically significant differences in all comparative groups of respondents except for the group of 7-year-olds in second grade and 8-year-olds in first grade.

Table 2

Probabilities (for the Mann–Whitney test) when comparing the following groups

Groups	nurs. 5yrs: nurs. 6yrs	nurs. 1st gr. 6yrs	1st gr. 1st gr. 7yrs	1st gr. 2nd gr. 7yrs	2nd gr. 1st gr. 8yrs	1st gr. 2nd gr. 8yrs	All groups in total
<i>p</i>	0,03	0,01	0,00	0,03	0,14	0,03	0,000



Graph 1. Medians for subtest B

Subtest of visual differentiation of shapes, subtest D of the test battery.

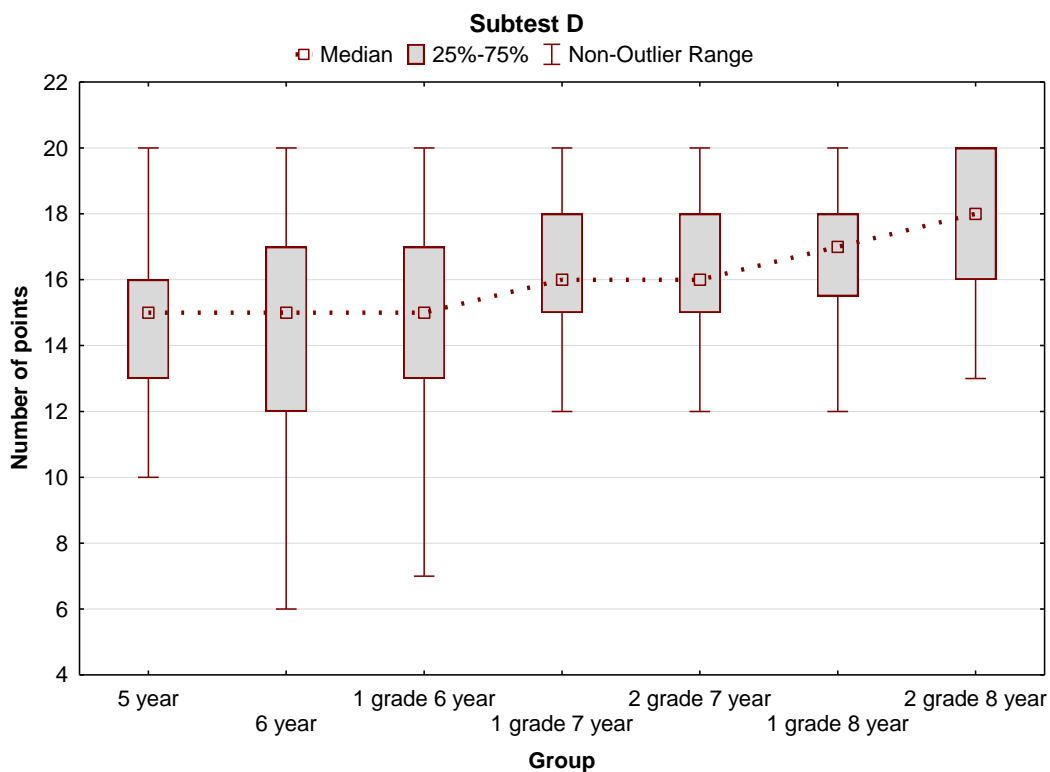
We compared the distribution of different age groups with respect to the median of an analysis variable using the nonparametric Mann-Whitney test (see Table 3, Graph 2).

We found statistically significant differences in two comparative groups of respondents: first grade (6-year-old pupils versus 7-year-old pupils) and first grade 8-year-old pupils versus second grade 8-year-old pupils.

Table 3

Probabilities (for the Mann-Whitney test) when comparing the following groups

Groups	nurs. 5yrs: nurs. 6yrs	nurs. 6yrs: 1st gr. 6yrs	1st gr. 6yrs: 1st gr. 7yrs	1st gr. 7yrs: 2nd gr. 7yrs	2nd gr. 7yrs: 1st gr. 8yrs	1st gr. 8yrs: 2nd gr. 8yrs	All groups in total
<i>p</i>	0,90	0,19	0,00	0,90	0,68	0,04	0,000



Graph 2. Medians for subtest D

Subtest of visual memory (pictures and images), subtest Ga + Gb of the test battery.

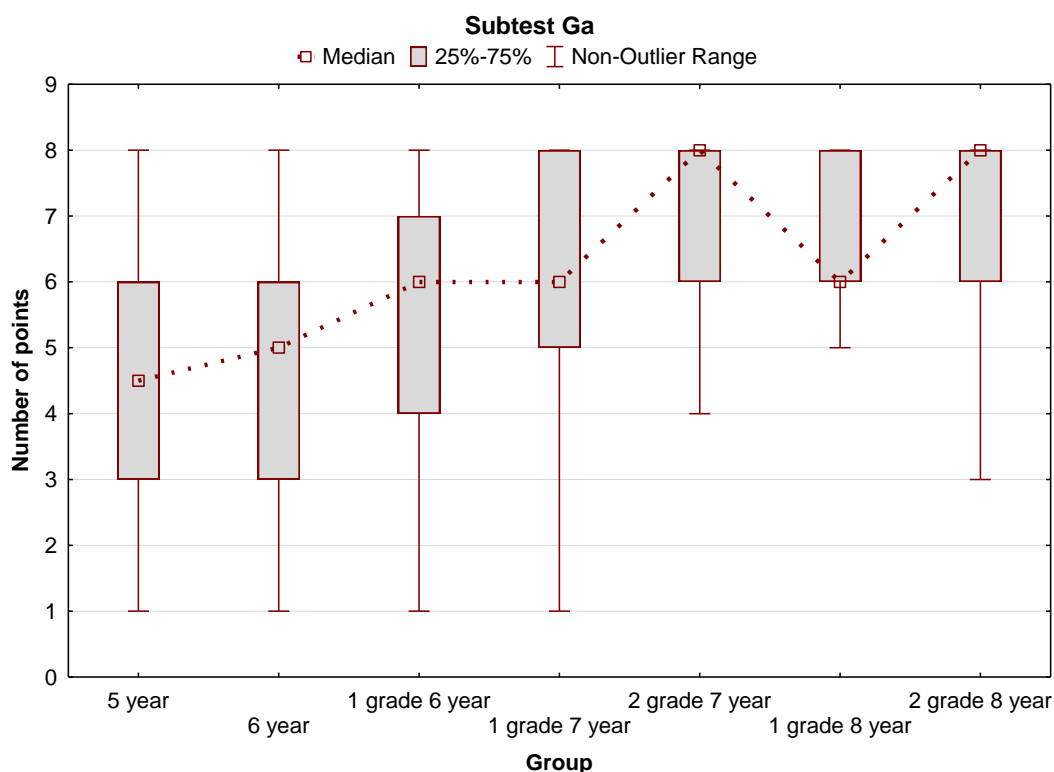
Ga Visual memory – pictures

We compared the distribution of different age groups with respect to the median of an analysis variable using the nonparametric Mann-Whitney test (see Table 4, Graph 3). We found statistically significant differences in two comparative groups of respondents: first grade (6 versus 7 year) and first grade 7-year-old pupils versus second grade 7-year-old pupils.

Table 4

Probabilities (for the Mann-Whitney test) when comparing the following groups

Groups	nurs. 5yrs: nurs. 6yrs	nurs. 6yrs: 1st gr. 6yrs	1st gr. 6yrs: 1st gr. 7yrs	1st gr. 7yrs: 2nd gr. 7yrs	2nd gr. 7yrs: 1st gr. 8yrs	1st gr. 8yrs: 2nd gr. 8yrs	All groups in total
<i>p</i>	0,10	0,09	0,03	0,00	0,44	0,42	0,000



Graph 3. Medians for subtest Ga

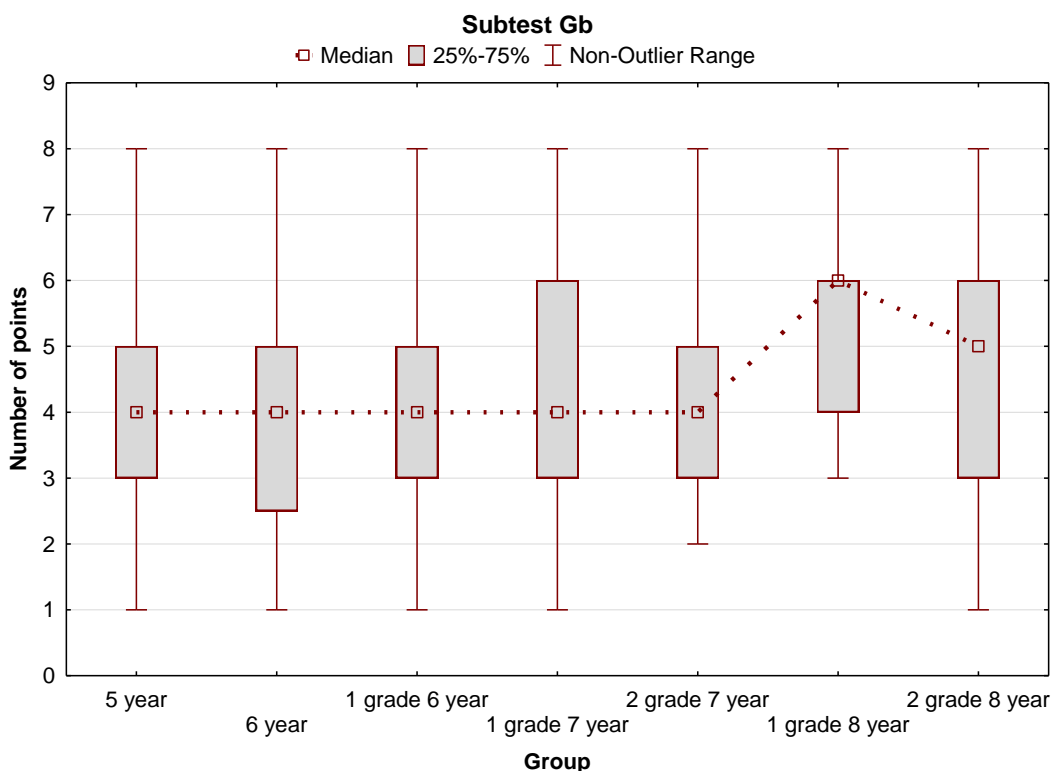
Gb Visual memory – images

We compared the distribution of different age groups with respect to the median of an analysis variable using the nonparametric Mann-Whitney test (see Table 5, Graph 4). We did not find any statistically significant differences in comparative groups of respondents except for the group of seven-year-olds in second grade and eight-year-olds in first grade.

Table 5

Probabilities (for the Mann-Whitney test) when comparing the following groups

Groups	nurs. 5yrs: nurs. 6yrs	nurs. 6yrs: 1st gr. 6yrs	1st gr. 6yrs: 1st gr. 7yrs	1st gr. 7yrs: 2nd gr. 7yrs	2nd gr. 7yrs: 1st gr. 8yrs	1st gr. 8yrs: 2nd gr. 8yrs	All groups in total
<i>p</i>	0,80	0,43	0,12	0,99	0,03	0,18	0,000



Graph 4. Medians for subtest Gb

Discussion of the results

The quartile graphs above demonstrate in a relatively clear way the data distribution in samples which focused on visual partial functions; the Mann–Whitney test tables then indicated the statistical significance of differences on the level of significance 0,05. The dynamics of the observed functions are evident from the graphs with the fact that:

1. in case of visual segmentation (subtest B) there is a clear rising trend in the maturation of the function in time with the fact that the quartile graph recorded a drop in case of 6-year-old children at nursery school and in 8-year-old pupils in the first grade of primary school which might be explained by potential issues in the area of school readiness (and deferred entry to primary school in these children);

2. in visual differentiation of shapes (subtest D), there is a noticeable, moderately rising, trend in maturation of the partial function over time with a stagnation in 6-year-old children and pupils at nursery school as well as in the first grade of primary school and in 7-year-old pupils (second grade);

3. subtest Ga – visual memory for the pictures manifests sharp development (with a prevailing overall rising tendency). There is an interesting drop in 8-year-old first graders in respect to the performance of one year younger second graders (the explanation might again lie in potential issues of these children which are related to deferral of school attendance). In case of visual memory for geometrical images (i.e. more abstract stimulus material), there is an apparent constant tendency in case of the continuum 5-year-old children at nursery school up to 7-year-old pupils of the second grade of primary school.

In conclusion, we can state that is it possible to reject (under the entire sample) the null hypotheses of all three hypothetical statements.

The results of the survey correspond to the research focused on the development of visual perception in pre-school and younger schoolchildren by Bednářová and Šmardová [2] – mean the dynamics of the development of visual functions. In part, they also correspond to the data provided by the authors L. Werpup and F. Petermann [10], but our research concerned intact children and pupils, while the above research was aimed at pupils with already diagnosed deficits by the function of skills (accounting deficit).

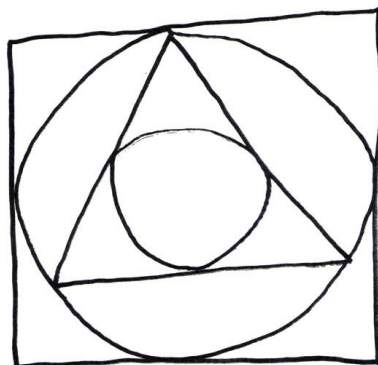
The above stated results represent the second published part of an extensive investigation. In subsequent research reports we will gradually focus – with a sample of intact children and pupils of the age range in question – i.e. nursery school – second grade of primary school (the most sensitive period from the point of view of development of partial functions related to academic skills) – on the dynamics of such partial functions as auditory differentiation of figure and background on the level of consonants, auditory memory and differentiation of speech on a verbal level, intermodal function and spatial orientation. The strength of the survey is a relatively large sample of respondents; the weakness of the survey is the non-randomized sample selection and the imbalance in the age subgroups of respondents.

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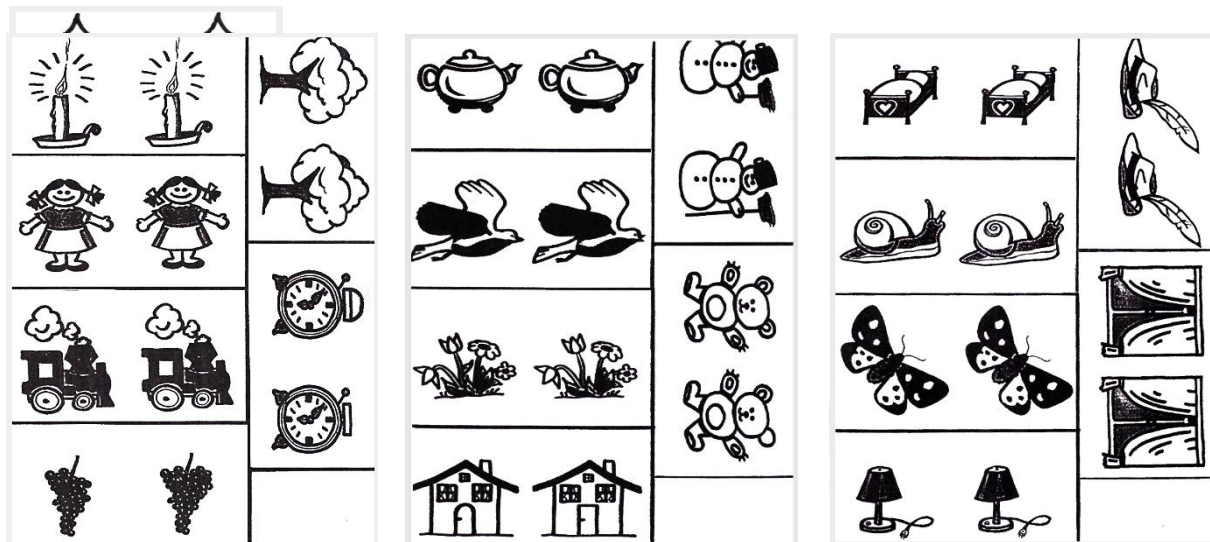
APPENDIX I

Stimulus material for the subtest of visual segmentation – differentiation of figure and background (abstract image), subtest B of the test battery



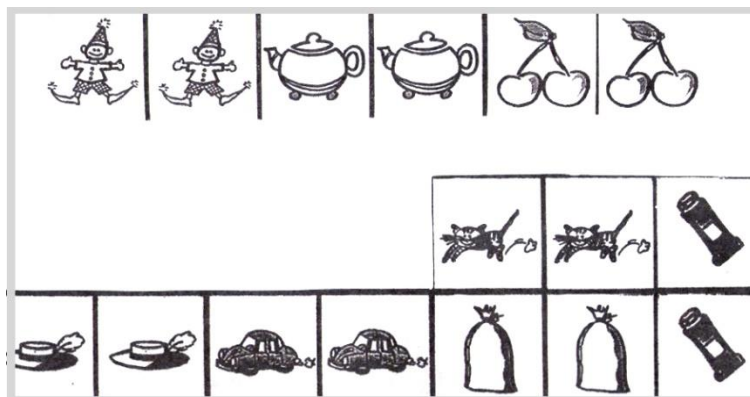
APPENDIX II

Stimulus material for the subtest of visual differentiation of shapes, subtest D of the test battery



APPENDIX III A

**Stimulus material for the subtest of visual memory (pictures),
 subtest Ga of the test battery**



APPENDIX III B

**Stimulus material for the subtest of visual memory (images),
 subtest Gb of the test battery**

