

Dynamics of auditory partial functions in children and pupils from 5–8 years of age

(scientific paper)

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Abstract: *The article provides insight into the procedural aspect and the theoretical framework of investigating the factors which influence the educability and school success/failure rate amongst children in a research project of the Faculty of Education, Palacký University Olomouc. The article focuses on the structure and dynamics of partial functions of auditory skills in children during their last year at nursery school and their first two years of school attendance.*

Keywords: *educability, partial function deficits, school failure, auditory functions.*

1 Introduction

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 auditory-oriented partial (basal) functions:

- auditory differentiation of the figure-background
- auditory differentiation of speech
- auditory memory – phonemes

The theoretical framework of the research is based on substantiated theory on the deficits of partial (basal) functions (further also DPF) by Sindelar [1] and on the empirical evidence of both authors supplemented by the empirical evidence of so-called partial performance weakening. The general theoretical basis of the research stems from neuropsychology, cognitive psychology and ontogenetic psychology.

Adequate maturing and balanced development of partial (basic, basal) functions is a prerequisite for the development of more complex processes and complicated skills such as, for example, the three Rs: reading, writing and arithmetic skills. Deficits of partial functions (DPF) are thus one of the causes of specific learning and behavioural disorders.

DPF should be defined as a decrease in performance of individual factors or elements within a greater functional system which is necessary for mastering certain complex processes of adaptation. Such a general definition of a phenomenon includes, however, an extremely broad spectrum of disorders, and therefore, for the purposes of counselling and special education practice, the entire concept has been narrowed and, above all, specified.

Partial functions include (in a simplified way and for the purposes of the research project) a group of ten functions where a deficit in any of them can manifest itself by a similar symptom in the educability of a pupil (the same mistake, e.g. incorrectly written words in a dictation exercise, the same mistakes in reading).

Sindelar (detto) illustrates clearly the individual partial functions with the example of a language dictation written by a second grade pupil. In order to be able to write the dictated sentence correctly, the pupil has to be able to:

1. differentiate the voice of the teacher from other noises in the surroundings (auditory attention – auditory differentiation figure-background),
2. hold shortly the uttered sentence in their (auditory) memory,
3. divide the word into sounds – phonemes (auditory analysis),
4. discriminate the isolated phonemes from similar phonemes (auditory differentiation – phonemic hearing),
5. look up graphemes for the individual phonemes (visual memory),
6. not mix up similar graphemes (visual differentiation – visual acuity),
7. connect an appropriate phoneme with an appropriate grapheme; i.e. connect interperceptive information (intermodal function, the partial ability to create intermodal relations),
8. coordinate the fine motor skills of the fingers when writing (visual-motor coordination)
9. place the letters on the line on a correct spot and in a correct position (spatial orientation),
10. not mix up the sequence of phonemes and later graphemes and not forget any particular detail from the entire set of operations mentioned (perception of time sequence, seriality).

DPF diagnostics use the above outlined process scheme, instrumentally introduced by means of the normative diagnostics of psychology and special education

(both counselling and clinical), and has a preference for using the means of dynamic diagnostics.

2 Methodological aspects of the investigation – material and methods

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. 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. auditory segmentation (acoustic differentiation of figure and background)
- B. auditory differentiation of speech (phonematic discrimination)
- C. auditory memory (phonematic)

The battery explicitly – for the target group of respondents of a younger school age. [2]

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 to the second grade of primary school (i.e. children and pupils ranging between 5–8 years).

The selection of children and pupils for the research sample was executed in the form of intentional institutional selection, with 547 children and pupils in total.

Child/pupil	5yrs	6yrs	7yrs	8yrs	Total by grade
Nursery school	122	110	6	0	238
First grade primary	9	97	114	17	237
Second grade primary	0	0	29	43	72
Total by age	131	207	149	60	547

Note: 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 nursery school and both grades of 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 methodological tools and the process scheme of investigation on a selection of 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 auditory 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 of nursery school and in intact pupils of the first and second grades of primary school.

Statistical hypotheses (without null H):

H₁: There is a statistically significant difference in the results of the auditory segmentation (acoustic 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 auditory differentiation of speech (phonematic discrimination) 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 auditory memory (phonematic) 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 auditory segmentation (auditory differentiation figure – background), subtest Aa of the test battery:

We articulate the stimuli words to the pupil slowly and at an easy pace and wait if the pupil recognizes the vowel/sound O in the word; we keep our mouth covered by a sheet of paper to prevent the pupil from reading the sounds from our lips; we do not emphasize the words with an O sound and we avoid eye contact. If the pupil answers in a stereotypical way (yes-yes-yes... or no-no-no...) we choose an example and ensure that he or she understands the instruction correctly.

Instruction: *I will be saying some words to you now. Listen carefully and tell me if you hear the sound O in the word.*

Stimulus material:

POKUD – MOST – břeh – DROZD – pecka – guma – nebe – DORT – RÁDIO – MÁSLA – AUTO – tužka – tele – OCET – OBRAZ – zajíc – ocas – dveře – prase – ORNAMENT – ruka – KAKAO – čapka – pruh

Assessment: for each correct answer (yes × no) we assign one point; i.e. the maximum number of points scored in the test is 24.

B. Stimulus material for the subtest of auditory differentiation of speech (phonematic discrimination), subtest C of the test battery:

We give the first sample pair of words **bon – bon** to the pupil and ask if both words are the same or not and check if he or she understands the question. If the pupil answers incorrectly, we explain that both words are the same and repeat the words to the pupil. We repeat the process with the second sample pair of words **pol – pul** with the difference that if the pupil answers incorrectly, this time we explain why both words are different.

During the actual test we pay attention to pronouncing all pairs with the same accent, i.e. not emphasizing different phonemes (sounds). We do not make eye contact with the child and keep our mouth covered so that the pupil cannot read from our lips.

Instruction: *I will always say two nonsense words to you. They do not mean anything. Listen carefully – you will tell me if these two words are the same or not.*

Stimulus material:

sample pairs: **bon – bon**, **pol – pul**.

material for the actual test (20 pairs): **rut – rut**, **kip – gip**, **ful – vul**, **nus – mus**, **hik – hik**, **lar – lar**, **hep – hep**, **desk – desk**, **pem – bem**, **tes – tes**, **bim – bem**, **zus – zuz**, **bid – bit**, **mez – mez**, **psom – som**, **tal – tal**, **hob – hub**, **vap – vap**, **kro – krol**, **vis – vis**.

Assessment: for each correct answer (yes × no) we assign one point; i.e. the maximum number of points scored in the test is 20.

Note: in case of the pairs **zus – zuz**, **bid – bit** always emphasize the last sound.

C. Stimulus material for the subtest of auditory memory (phonematic), subtest F of the test battery:

The pupil repeats after the teacher four groups of sounds which gradually grow in difficulty regarding auditory memory (a cluster of two, three, four and five sounds). The stimulus material is divided into two columns (I and II) of sounds. Column I is primary stimulus material, we only use the sounds from column II when the pupil is unable to repeat the groups of sounds from column I without mistakes. We begin with a group of two sounds from column I; if the pupil repeats the sounds after us correctly and without mistakes we proceed to the group of three sounds from column I, etc. If the pupil, however, makes a mistake in reproducing a certain group of sounds, we provide him or her a group with the same number of sounds from column II. If and when he or she repeats them correctly, we return to column I and continue with the next (more difficult) sound group. If the pupil is not able to reproduce the alternative group from column II, we end the test.

I.	II.
a k	n s
m v š	r b ť
p s u č	ž a t c
e ř a b t	k z e č m

Instruction: *I will be saying sounds to you and you will repeat them after me.*

Assessment:

4 points – the pupil repeats all the lines of the sounds with no mistakes (either from column I or column II)

3 points – the pupil repeats three lines of the sounds with no mistakes (either from column I or column II)

2 points – the pupil repeats two lines of the sounds with no mistakes (either from column I or column II)

1 point – the pupil repeats one line of the sounds with no mistakes (either from column I or column II)

Results of the investigation

Medians

GROUPS	nursery 5yrs	nursery 6yrs	first grade 6yrs	first grade 7yrs	second grade 7yrs	first grade 8yrs	second grade 8yrs
medians	18,0	18,0	20,0	22,5	23,0	23,0	24,0

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

GROUPS	nurs. 5yrs: nurs. 6yrs	nurs. 6yrs: first gr. 6yrs	first gr. 6yrs: first gr. 7yrs	first gr. 7yrs: second gr. 7yrs	second gr. 7yrs: first gr. 8yrs	first gr. 8yrs: second gr. 8yrs	All groups in total
<i>p</i>	0,02	0,00	0,00	0,01	0,20	0,00	0,000

Table 1: *Auditory segmentation (auditory differentiation figure-background)*

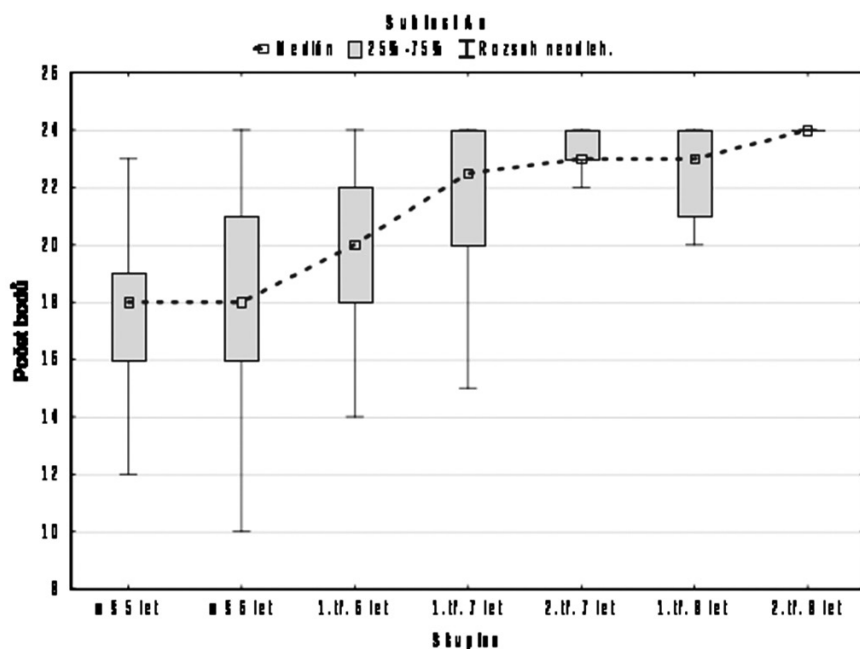


Figure 1: Auditory segmentation (auditory differentiation figure-background)

Medians

GROUPS	nursery 5yrs	nursery 6yrs	first grade 6yrs	first grade 7yrs	second grade 7yrs	first grade 8yrs	second grade 8yrs
medians	17,5	17,0	18,0	18,0	19,0	18,0	18,0

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

GROUPS	nurs. 5yrs: nurs. 6yrs	nurs. 6yrs: first gr. 6yrs	first gr. 6yrs: first gr. 7yrs	first gr. 7yrs: second gr. 7yrs	second gr. 7yrs: first gr. 8yrs	first gr. 8yrs: second gr. 8yrs	All groups in total
p	0,05	0,00	0,70	0,03	0,06	0,01	0,000

Table 2: Auditory differentiation of speech (phonematic discrimination)

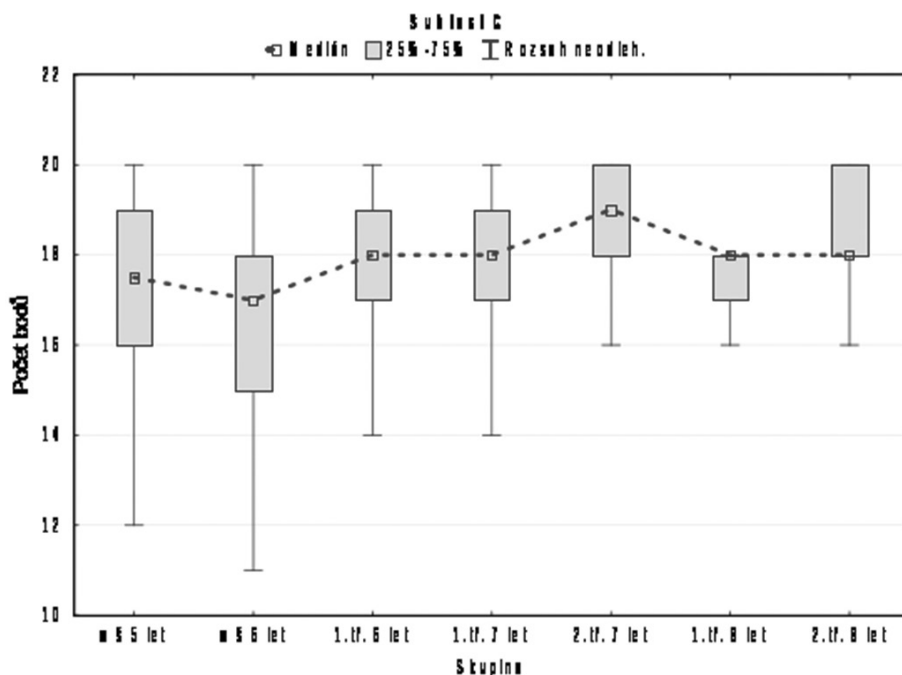


Figure 2: Auditory differentiation of speech (phonematic discrimination)

Medians

GROUPS	nursery 5yrs	nursery 6yrs	first grade 6yrs	first grade 7yrs	second grade 7yrs	first grade 8yrs	second grade 8yrs
medians	3,0	3,0	3,0	4,0	4,0	3,0	4,0

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

GROUPS	nurs. 5yrs: nurs. 6yrs	nurs. 6yrs: first gr. 6yrs	first gr. 6yrs: first gr. 7yrs	first gr. 7yrs: second gr. 7yrs	second gr. 7yrs: first gr. 8yrs	first gr. 8yrs: second gr. 8yrs	All groups in total
p	0,02	0,03	0,01	0,49	0,06	0,02	0,000

Table 3: Auditory memory (phonematic) subtest

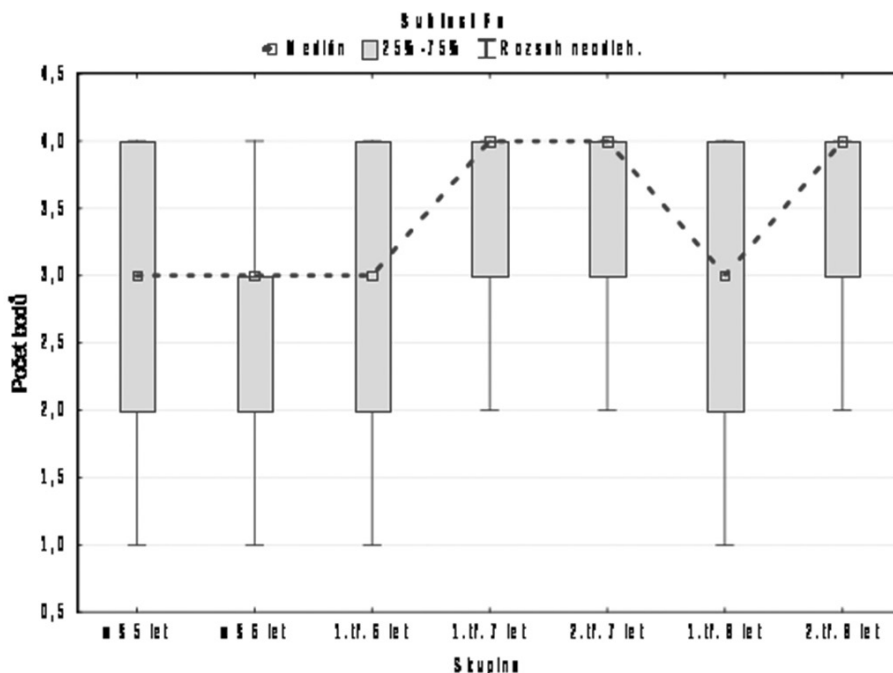


Figure 3: Auditory memory (phonematic) subtest

Discussion of the investigation results

The quartile graphs above demonstrate in a relatively clear way the data distribution in samples which focused on auditory 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:

- in case of an auditory differentiation figure-background there is – on the level of vowels – a clear rising trend in the function in time with a certain retardation in 8-year-old pupils in the first grade (the comparison with 7-year-olds in the first grade also did not show a statistically interesting difference) which might be explained by potential issues in the area of school readiness (and deferred entry to primary school).
- there is also a similar situation to the previous function in the case of phonematic discrimination with the difference that the retardation (even regression) of the function took place with 8-year-old first graders and second graders in relation to 7-year-old pupils (see U-test second grade 7yrs vs. first grade 8yrs and 6-year-old vs. 7-year-old first graders).

- concerning the phonematic auditory memory, a general increase is also apparent with a drop and stagnation when comparing 7-year-old vs. 8-year old pupils (in case of 8-year-old first graders the potential cause might again be related to starting school attendance and its subsequent deferral).

3 Conclusion

In conclusion, we can reject (under the entire sample) the null hypotheses of all three hypothetical statements.

The above stated results represent the first 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 the figure and background on the level of consonants, auditory memory and differentiation of speech on a verbal level, visual memory and visual differentiation, intermodal function, visual motor skills, spatial orientation and seriality.

References

- [1] SINDELAR,B.: Diagnosis and Treatment Practices in the Field of ADD/ADHD/HD in Europe, Council of Europe Publishing, 2000.
- [2] SINDELAR,B (2007). Diagnostická metoda k zjišťování deficitů dílčích funkcí u školních dětí (příručka). Bratislava-Brno: Psychodiagnostika.

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