

# Neuropsychological Approach to the Study of Special Aspects of Development of Preschool Children with Psychoverbal Pathology

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## Abstract

The article is devoted to the analysis of age dynamics in the formation of regulatory functions and speech in preschool age on the ground of the results of neuropsychological examination of children aged 5-7 years with conditional-normative and deviant development and being raised in polylingual and monolingual environment. Common and special characteristics of age dynamics in programming and control functions are highlighted. These characteristics are due to delay in development of certain brain structures and higher mental functions, as well as social environment factors, especially the specificity of language environment. The necessity of targeted psychological-pedagogical treatment in the terms of regulatory function formation in preschoolers is argued, with taking into account the specificity of psychopathological and environmental factors.

**Keywords:** neuropsychological diagnostics, polylingual and monolingual environment, programming and control, psychoverbal pathology, speech development, voluntary regulation

## 1. Introduction

Completed formation of psychic functions according to the child's age is one of the key factors of successful education. Steadily growing number of children with learning difficulties has determined much wider application of the neuropsychological approach during the development of remedial-developmental treatment methods (Akhutina & Pylaeva, 2008). When studying children with psychoverbal pathology, the most of researchers highlight the importance of preventive treatments allowing to prevent social disadaptation and reduce the severity of developmental deviations. The necessity to implement the developmental treatment as early as possible in its turn determines the importance of well-timed syndrome diagnosis but at the present time there are very few studies based on the neuropsychological approach and focused on preschool age.

This is a rarity though not a singularity when a study covers the specificities of psychoverbal pathology development at the level of interaction between brain systems and functions of a child being raised in a polylingual environment. In this regard, a particular importance for understanding the mechanism of psychic processes is given to comparative neuropsychological examination data analysis method, which assumes a comparison of the examination results collected from children of various age groups and being raised both in polylingual and monolingual environment.

Describing the culturological issues of neuropsychological diagnostics, the researchers, on the one hand, highlight the illegality of applying standard normals to different ethnic groups but on the other hand they note the shortcomings of applying ethnically specific normals (Pedraza & Mungas, 2008). At the same time, the experimental tests proved that cultural specificities influence on lateralization of verbal functions and on spatial disabilities (Ardila, 1995) and may also result in defects of various functional systems (Golden & Thomas, 2000). In paediatric population there are ethnic differences noted in attentiveness and behavior control tests (Byrd et al., 2008).

As part of this study supported by Russian Foundation for Humanities (project No. 14-16-12004), a comparative analysis of examination results of preschool children (5-7 years old) of different nosological categories, who are raised in polylingual and monolingual environment.

Considering the neuropsychological symptomatology of learning difficulties, the researchers highlight problems conditioned by insufficiency of programming and control (Pylaeva, 1998). The hypothesis of our study is a supposition that the specificities of speech and voluntary regulation formation in preschool age can be determined

by delay in development of certain brain structures and higher psychic functions, as well as social environmental factors, in particular the specificity of language environment. At that, the correlation of the specified factors depends on the age.

## 2. Methods

For neuropsychological examination and qualitative analysis of test results, the battery of tests by A. R. Luriya (T. V. Akhutina and others) adapted for children has been used (Akhutina et al., 2012). In this battery the programming and control unit is represented with the following tests: dynamic praxis, reciprocal coordination, graphical test, execution of rhythms by instruction, completion of sentences, telling a story based on the series of picture, choice behavior, Schulte tables, counting, doing sums, associative fields, "the odd one out". In our study the most of them have been used, except for Schulte tables, completion of sentences, doing sums and associative fields. As all neuropsychological tests reveal the symptoms of undevelopment of various brain structures and functional sections of brain, the analysis of the results includes the parameters characterizing insufficiency of programming and control and received while executing the tests, which were classified as other units by the authors of "Methods of neuropsychological examination of children of 6-9 years" (regulatory errors in Head test, oral praxis and postural praxis tests).

The program of neuropsychological examination of children traditionally includes speech tests. This study contains analysis of results of tests characterizing the development of both expressive and impressive speech: "Dialogue", "Naming objects", "Phrase composition", "Composition a story on a picture", "Understanding of words' meaning", "Understanding of lexico-grammatical structures" (Glozman, 2009).

The examination of children was held by practical logopaedists and speech pathologists of educational institutions included into the experimental program. A training seminar about the methods of neuropsychological diagnostics was given to the specialists. Besides, the participants of the experiment regularly consulted with the organizers.

The participants of the experiment were children in pre-school facilities in the amount of 215 persons.

The method of organization is cross-sectional method. As in our study an essential role is played by the social environmental factors for the analysis of results, the age groups of testees were formed due to the characteristics of the educational level: senior and preparatory groups of preschool facilities. Each of the age ranges included 4 groups involving children with conditional-normative development variation, with speech underdevelopment of the 3rd level, with general speech underdevelopment of the 1<sup>st</sup> and the 2<sup>nd</sup> levels and with developmental delay. The groups were formed due to findings of the psychological-medical-pedagogical commission as well as the indicators of expert judgement (teachers-logopaedists).

## 3. Results and Discussion

We shall review the results of the research of the programming and control unit indicators. In the range of a younger age (students in senior groups) the most difficult test for the conditional-normative selection was graphical test, which allows evaluating the degree of movement program acquisition, its automation, switching from one movement to another. The main difficulties in execution of the reviewed tests by children with deviant development were related to dynamic praxis and reciprocal coordination tasks as well as graphomotor test and story composition. The children with speech underdevelopment and developmental delay were noted with undevelopment of the regulatory chain of their own speech and the most expressed difficulties were illustrative for the children with developmental delay (Borisova, Kozina, & Chernova, 2014). According to the comparative analysis (Mann-Whitney U) of the average of demerit points for these tests in the subgroups of normatively developing preschoolers and children with developmental delay (group B), there are significant differences in the following parameters: program execution ( $p=0.001$ ) and errors of serial organization ( $p=0.019$ ) in the dynamic praxis test, program execution in the reciprocal coordination test ( $p=0.015$ ) and story composition ( $p=0.002$ ).

The trend of insufficiency of volitional component of psychic functions, revealed in the subgroup of preschoolers with developmental delay, is coherent with general notion about clinical-psychological structure of the defect for this deviation. Though not so frequently, but there are programming and control problems still noted while characterizing children with speech underdevelopment, and in this regard the results we have received allow to emphasize the importance of the task of correcting these difficulties in complex care of preschoolers with speech deviations.

The significance of well-timed correctional and developing work in this context becomes more obvious while reviewing age changes. It would be logical to suppose that while aging and forming the respective brain structures, the differences in the degree of development of programming and control functions between

preschoolers with psychoverbal pathology and with conditionally normative development will be leveled out. Nevertheless, the analysis of the experimental results proves the contrary, as the number of the parameters, by which the statistically significant differences are noted, rises sharply when comparing examination data collected in preparatory groups.

While comparing normally developing preschoolers (preparatory group) and their coevals with general speech underdevelopment, significant differences were highlighted by the following parameters: choice reaction ( $p=0.001$ ), program acquisition ( $p=0.0001$ ) and execution ( $p=0.004$ ) in the dynamic praxis test, correction task ( $p=0.002$ ), errors in following the program ( $p=0.025$ ) and the number of periods ( $p=0.031$ ) in the graphical test, the number of regulatory errors in Head's test ( $p=0.049$ ). The comparison of subgroups with normal development and developmental delay allows to state significant differences by the parameters: choice reaction ( $p=0.0001$ ), program acquisition ( $p=0.0001$ ) and execution ( $p=0.0001$ ), errors of serial organization ( $p=0.008$ ) in the dynamic praxis test, program execution in the reciprocal coordination test ( $p=0.008$ ), correction task ( $p=0.002$ ), the specificities of serial organization ( $p=0.01$ ), arrests ( $p=0.001$ ), average tempo of execution ( $p=0.02$ ) of the graphomotor test, the number of regulatory errors in Head's tests ( $p=0.002$ ).

We shall consider in details the results of some of the tests. In the subgroup of normally developing preschoolers over 80% of children learnt the program in the dynamic praxis test after the first presentation and the rest did after the second presentation. Then the best part of the participants changed from slow (18.8%) or step-by-step (68.8%) execution of the task to either unmistakable execution or execution with single errors and self-correction (56.3%). At the same time for 22.9% of preschoolers with developmental delay and 8.8% with general speech underdevelopment, learning of the program could be possible only after execution together on a verbal instruction, at that the further execution was non-automated, step-by-step, with many fails, occurring with increase of tempo, for 36.4% and 22.3% of children respectively.

The characteristics of serial organization of movement in the reciprocal organization test (Table 1) in the normal development subgroup also correspond with much higher level than in the groups of children with psychoverbal pathology: 56.3% of children showed smooth automated execution at once or after single failures in the beginning, in normal (81.3%) or a bit slow (18.8%) tempo. At the same time, performing a task with approximately the same tempo characteristics, a great part of children with developmental delay showed repeating failures and the lag of one hand with self-correction (44.1%) as well as successive execution (17.6%) of the reciprocal coordination task.

Unmistakable execution of choice reaction test (Table 1) was shown by 86.7% of participants in the normative group, the rest showed single impulsive reactions on the stage of breaking stereotype with ability to self-correct. In the groups with psychoverbal pathology single echopraxias were illustrative for 57.9% of children with general speech underdevelopment and for 71.4% of children with developmental delay. More than half of preschoolers with normal development (66.7%) and only one third of preschoolers with developmental delay (33.3%) did not make regulatory errors in Head's tests (60.0%).

Table 1. Marks for reciprocal coordination and choice reaction tests execution by preschoolers of preparatory groups (the percentage of children received the respective mark\*)

Mark	Reciprocal coordination: Execution					Reciprocal coordination: Tempo			Choice reaction: Execution			
	0	1	2	3	4	0	1	2	0	1	2	3
Group	0	1	2	3	4	0	1	2	0	1	2	3
Normal	56.3	6.3	25.0	.0	12.5	81.3	18.8	81.3	86.7	13.3	.0	.0
GSU	33.3	43.9	14.0	5.3	3.5	82.4	17.6	82.4	38.6	57.9	3.5	.0
DD	5.9	23.5	44.1	17.6	7.8	53.1	46.9	53.1	11.4	71.4	14.3	2.9

\*1) Reciprocal coordination. Execution: 0—changing for automated execution smoothly at once or after single failures in the beginning; 1—changing for automated movements after several failures or successive execution; 2—the presence of repeating failures, lags of one hand with self-correction; 3—successive execution (the movement is executed by one hand and then by another); 4—assimilation of movements of both hands.

2) Execution tempo. 0—normal or fast; 1—slow; 2—slow execution, the discomposition of movement occurs while increasing the tempo.

3) Choice reaction. Execution: 0—unmistakable execution; 1—single impulsive reactions (echopraxia) while

breaking stereotypes with self-correction ability; 2—expressed echopraxia with correction only after pointing out the mistake; 3—uncorrectable echopraxia.

Persisting and extension of differences in the characteristics of programming and control functions between preschoolers with conditionally-normative and deviant development in preparatory groups actualizes yet again the necessity of well-timed correctional-developing work, in order to prevent learning difficulties on the next age stage. It should be noted that the great majority of preschoolers with psychoverbal pathology, having taken part in this study, were taught in special groups or by a logopaedist in a logopedic room. It resulted in improvement of the children's speech sphere indicators but hardly contributed into regulatory functions development. When organizing correctional-developing work with preschoolers, it should be taken into account that difficulties with voluntary regulation and control are mostly found at the level of motional field, which is basic, as during a child's development the motional regulation is simultaneously improved and included into the level of voluntary regulation of psychic processes and functions (memory, attention, voluntariness of various forms of thinking) (Semago, 2011). Due to the data collected, the more logical is firstly to affect the sensorimotor level with further involvement of cognitive correction, as the application of motional methods activates interactions between different levels and aspects of psychic activity (Semenovich, 2002).

As far as the ways of child's individual development are essentially conditioned by the character of interactions between biological and environmental conditions in ontogenesis, in our study a special interest issue is the analysis of results from the perspective of the language environment specificities' influence on voluntary regulation development.

For this purpose in the sampling structure of preschoolers, educated in senior and preparatory groups, 2 subgroups were highlighted for each group: 1—children being raised in families speaking one language, 2—being raised in polylingual environment (mostly bilingual). All groups were equalized by sex-age and nosological features.

Among the preschoolers of senior groups the execution of all tests appeared to be more available for children being raised in monolingual environment. Statistical evaluation of differences in the degree of severity of studied features (Mann-Whitney U) allowed to highlight the differences, as the most significant, by the following parameters: learning ( $p=0.002$ ) and execution ( $p=0.005$ ) of motional program, errors of serial organization of movements ( $p=0.002$ ) in the dynamic praxis test; the tempo of execution of reciprocal coordination test ( $p=0.048$ ); execution ( $p=0.02$ ) and following the program ( $p=0.005$ ) in the graphical test; the number of regulatory errors in the Head's tests ( $p=0.006$ ). Thus, in this age range the similarity or trends, noted in the groups of children with developmental delay and children being raised in polylingual environment, has become clearly visible.

Analysis of the results of testing preparatory groups reflects significantly more positive trends: by the most of the parameters, including the ones related to expressive speech directly, the preschoolers being raised in monolingual and bilingual families show much the same results. Statistically significant differences in the success of execution of the reviewed tests were not found in these subgroups.

We shall review the specificities of speech development of children in the researched groups. Analysis of speech behavior in "dialogue" test has shown that the most of children of the studied age group do not have expressed difficulties in endorsing dialogue. Almost a half of children of the 7<sup>th</sup> year of life and 40% of testees of the 6<sup>th</sup> year of life showed smooth, prosodically unchanged speech without thinking of words and presence of paraphasia. The rest testees, except for few children with clinically verified manifestation of expressed developmental delay, had some difficulties in conducting a dialogue with a conversation partner, such as light manifestations of speech as spontaneity, small problems with involving into dialogue or light manifestations of prosodic changes, making efforts to improve speech clarity.

In the "naming objects and actions" test 30% of children of senior group (the 6<sup>th</sup> year of life) and about 40% of testees of the 7<sup>th</sup> year of life named all shown objects and actions correctly. Most of them showed the search of nominations, extension of latency period while naming, as a rule, words of low-frequency group. Less than 10% of testees of each age group showed the presence of multiple paraphasias and perseverations with partial correction after being told with the first sound of the word. In the phrase composition task about 90% of children of the 7<sup>th</sup> year of life and almost 70% of children of older age group of kindergarten correctly and confidently composed expanded, accurate, correctly formalized in grammatical and fonetic sense phrases and made only small inaccuracies. Some number of testees (10% of children in preparatory group and 30% of children in senior group) made multiple verbal paraphasias, lexico-grammatical and fonetic errors when composing phrases.

It is an interesting fact that in the test of telling a story based on a picture the children composed a true story, told the storyline correctly, many of them gave a moral valuation to the storyline. Except for inaccurately selected verbs, no other lexico-grammatical errors were found in the composed stories. It appears probable that during correctional-developing education the students used to meet this kind of tasks quite often and composed stories by a picture with a storyline being close to the children's everyday communication with their nearest social surrounding. The children, who had some expressed difficulties when performing the above tasks (naming objects and actions, composing phrases), could not compose a connected story.

The factor of polylingualism of social surrounding (the presence of at least two languages spoken in family and in kindergarten), which has an importance for our study, did not show itself significantly; in the described speech tests many children with speech dysontogenesis had monolingualism mentioned in their personal data sheets.

It is supposed that till the age declared in the study (5-7 years) a situation described by J. M. Glozman takes place, when after 3 years old (children mostly enter a kindergarten at the age of 3 and above) the children are placed into other language environment (education and communication are held in Russian). In the author's opinion, the age after 3 years old is sensitive for successful learning the second language, which becomes major in communication with grown-ups and coevals (Glozman, 2009).

This hypothesis can be confirmed while examination of the children of 3-5 years old, when the process of active learning of a language will be not as delayed as at 5-7 years; the authors hope to see more expanded picture of active learning of the second language and the specificities of psychoverbal development of a bilingual child in further studies.

Analysis of the results of studying the specificities of the testees' impressive speech (table 2) has shown that in the group of educates of the 6<sup>th</sup> year of life almost half of them (42%) do not have difficulties with understanding objects and actions named. They correctly and confidently matched all named words with pictures at the first presentation. In the group of children of the 7<sup>th</sup> year of life the percentage of such results is higher (61.6%). These points at a positive dynamics of overcoming difficulties in forming impressive speech during correctional work till the school age. The rest part of the testees showed single mistakes in understanding speech by impulsiveness type with further self-correction. There were rare cases of expressed difficulties with formation of understanding speech in the form of multiple errors (alienation of the sense of words, fonetic and semantic changes, perseverations or skips when showing pairs of pictures) with partial correction or multiple necessity of repeated presentation. Such results were collected in the group of students with expressed versions of psychoverbal pathology (general speech underdevelopment and the 1<sup>st</sup> level of speech development, developmental delay with neurological symptoms).

The second test, oriented to studying the specificities of understanding of lexico-grammatical structures, has shown that the children from the studied group have fewer difficulties in this area. 48% of testees of the 6<sup>th</sup> year and 75% of students of the 7<sup>th</sup> year of life showed correct and confident matching of all shown phrases and instructions with pictures or actions at the first presentation. The rest children with few exceptions made single mistakes in understanding of passive structures or they had a necessity of repeated presentation.

Table 2. Marks for execution of the test for understanding of words' meanings and logical grammatical structures by preschoolers of senior and preparatory groups (the percentage of children received the respective mark\*)

Mark	Understanding of words' meanings			Understanding of logical grammatical structures			
	0	1	2	0	1	2	3
Group	0	1	2	0	1	2	3
Senior	42.0	47.7	10.2	48.3	46.0	4.6	1.1
Preparatory	61.6	33.0	5.4	75.0	24.1	0.9	0

\*1) Understanding of words meanings: 0—correct and confident match of all shown words/pairs of words with pictures at the first presentation; 1—single errors in understanding by the type of impulsiveness with self-correction or one-time necessity of repeated presentation; 2—multiple errors (alienation of the sense of words, fonetic and semantic changes, perseverations or skips when showing pairs of pictures) with partial correction or multiple necessity of repeated presentation.

2) Understanding of logical grammatical structures: 0—correct and confident match of all presented phrases and instructions with pictures or actions at the first presentation; 1—single errors in understanding of passive structures or one-time necessity of repeated presentation; 2—multiple errors In understanding of reciprocal active

and passive structures with partial correction; 3—uncorrectable errors of all types specified above in more than a half of the presented phrases.

The results of these tests correlate to the data pointing at mono/polylingualism. Bilingual children had some difficulties in the speech perception field and polylingualstestees showed expressed difficulties.

In a whole, the study results show that the specificities of language environment influence on the special aspects of formation of 5-7-year-old children's impressive speech in polycultural regions. It indicates the necessity to examine the speech perception processes in depth and to develop an expanded program of negotiation of such difficulties till the school age, in order to prevent problems with the formation of written speech.

#### 4. Conclusion

Thus, it can be expected that in multicultural, most of all in polylingual, environment the psychic development of children, particularly the formation of speech and voluntary regulation of activity, comes in a somewhat different tempo. In our opinion, the experimental data do not allow to assert univocally that till the end of preschool age the key characteristics of voluntary field of monolingual and bilingual children are equalized and do not require special attention in further. Taking into account that the development of psychic functions and their specific components flows due to the laws of heterochronia and asynchronicity and each stage of psychic development of children requires not only potential readiness of the complex of certain brain structures to serve it, but also external demand for constant increase of maturity and power of one or another psychological factor (Semenovich, 2005), we should highlight the relevance of targeted psychological-pedagogical treatment in regard of speech development and formation of programming and control functions, in terms of the specificity of psychopathological and culturological factors.

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