PSYCHOLOGY AND PSYCHIATRY

INDIVIDUAL VARIABILITY OF HIGHER MENTAL FUNCTIONS IN PRESCHOOL CHILDREN WITH REGARD TO THE MATERIAL PROSPERITY OF THE FAMILY (NEUROPSYCHOLOGICAL ANALYSIS)

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ABSTRACT

The problem of human individual development requires not just the accumulation and generalization of data, but also clarification, a systematic understanding of the individual variability of higher mental functions in relation to environmental factors and taking into account the risks associated with their formation.

The aim of the study. *To identify systematic patterns of correlation between individual variability of higher mental functions of preschool children and the material prosperity of their families.*

Materials and methods. *Traditional neuropsychological tests developed by A.R. Luria and adapted in the neuropsychology laboratory of the Faculty of Psychology at Lomonosov Moscow State University were used. We examined 180 preschool children from families with high, average, and low income.*

Results. *The greatest individual variability in the period of preschool age in relation to the level of material prosperity of the family, are the functions with a long period of formation, these are functions of block III of the brain, and the functions provided mainly by the left hemispheric parts of the brain. Children from the most affluent families have the highest indices of brain block III functions ($p < 0.001$) and left hemispheric functions ($p < 0.001$). Preschoolers from low-affluence families had indexes of both front brain function ($p < 0.001$) and left hemispheric function ($p < 0.001$) in the zone of negative values.*

Conclusion. *The empirical results of the study allow us to clarify that the factor of material prosperity of the family, both directly, factor-wise, and indirectly, cumulatively, through the system of proximal factors, can make its selective contribution to the variability of indicators of children's higher mental functions.*

Key words: *higher mental functions, material prosperity, preschoolers, variability, socio-demographic characteristics, neuropsychological analysis*

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ИНДИВИДУАЛЬНАЯ ИЗМЕНЧИВОСТЬ ВЫСШИХ ПСИХИЧЕСКИХ ФУНКЦИЙ ДОШКОЛЬНИКОВ В АСПЕКТЕ МАТЕРИАЛЬНОГО ДОСТАТКА СЕМЬИ (НЕЙРОПСИХОЛОГИЧЕСКИЙ АНАЛИЗ)

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РЕЗЮМЕ

Решение проблем индивидуального развития человека требует не просто накопления и обобщения данных, но и уточнения, системного понимания индивидуальной изменчивости высших психических функций в соотношении с факторами среды и учёта рисков, сопутствующих их формированию.

Цель исследования. *Выявить системные закономерности соотношений индивидуальной изменчивости высших психических функций детей дошкольного возраста с материальным уровнем их семей.*

Методы. *Применялись традиционные нейропсихологические пробы, разработанные А.Р. Лурией и прошедшие адаптацию в лаборатории нейропсихологии факультета психологии МГУ им. М.В. Ломоносова. Было обследовано 180 детей дошкольного возраста из семей с высоким, средним и низким уровнем доходов.*

Результаты. *Наибольшей индивидуальной изменчивостью в период дошкольного возраста в соотношении с материальным уровнем семьи подвержены функции с долгим периодом формирования – это функции III блока мозга, и функции, обеспечиваемые преимущественно левополушарными отделами головного мозга. Дети из наиболее обеспеченных семей имеют самые высокие показатели индексов функций III блока мозга ($p < 0,001$) и левополушарных функций ($p < 0,001$). У дошкольников из семей низкого материального уровня в зоне отрицательных значений оказались индексы функций как передних отделов головного мозга ($p < 0,001$), так и функций левополушарных отделов ($p < 0,001$).*

Заключение. *Полученные эмпирические результаты исследования позволяют уточнить, что фактор материального достатка семьи – как непосредственно, факторно, так и опосредованно, кумулятивно, через систему проксимальных факторов, – может вносить свой избирательный вклад в изменчивость показателей высших психических функций детей, что проявляется в более интенсивном темпе формирования одних групп функций и менее интенсивном – других, а также в выборе ведущей стратегии обработки информации, опирающейся на активность левого или правого полушария.*

Ключевые слова: *высшие психические функции, материальный уровень, дошкольники, изменчивость, социально-демографические характеристики, нейропсихологический анализ*

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INTRODUCTION

Since the second half of the 19th century, the focus of the central problems of psychology has been devoted to the study of the sources of individual variations in mental processes. It has been revealed that individual differences are in a complex relation of the complementary action of heredity and environment, as well as the activity of the individual himself. Heredity allows to ensure the stability of psychological properties of biological species, to transmit individual traits to the next generation; the environment provides variability of individual traits and the ability to adapt to changing conditions of life [1]. At the same time, heredity allows a very wide range of variations in the path of ontogenetic development, which are the result of various reactions of the organism – biochemical, physiological, psychological [2]. An obvious insight in this research context is the understanding that changing environments unfold the innate programmes of human manifestation in different ways. Along with this, in the process of development of human individuality there are areas more variable and sensitive to environmental influence, and relatively stable.

The functional brain activity organisation is one of the most important individual properties of a human being, objectively formed at the early stages of ontogenesis. Functional systems have a lifetime path of formation, are transformed in the process of realisation of a particular mental activity and are conditioned by social experience [3]. It is the early experience that largely determines which of the possible trajectories a person's developmental path will follow. The theory of "afferent field", introduced by P.K. Anokhin reveals the idea that a functional system possessing a certain complex of afferent impulses has a significant degree of maturity already in the period of early ontogenesis, and for a number of systems – already in the embryonic period [4]. At the same time, the afferentations included in the activity of a functional system, which are not involved in the process of realisation of a particular mental activity, begin to narrow down and pass into a latent state; meanwhile, only a small circle of active afferentations remains relevant [5].

Consequently, in the process of ontogenetic development, functional systems undergo intensive changes, as a result of which the same tasks are being implemented by completely different means, and the choice of strategies for solving tasks is conditioned by the factors of the child's social environment.

Considering that the social environment of early childhood is primarily the family, it is necessary to know which family environmental variables are of primary importance in the functional development of the child and what is the nature of their impact over the course of development. Having analysed scientific literature, it can be concluded that the variability of the morphofunctional state of the child's brain has a significant relationship with the socio-demographic characteristics of the family, including its integral component – socio-economic status [6, 7].

In considering the problems related to the socio-economic status of the family, two opposite strategies of its examination can be found in foreign studies. The first approach considers socio-economic status as a set of several interrelated factors combined into a common index (education, parents' profession, material prosperity) [6]. A different research strategy is presented by the authors [8], who insist that the relationship between these two variables (income and education), is not rigidly deterministic. For example, higher levels of education are associated with more favorable economic opportunities, including through higher income, more extensive social and psychological resources (higher social support, higher levels of control). That said, there are examples of people who are educated but earn relatively little; there are also reverse examples of people with no education who have achieved financial prosperity. Thus, different indicators of socio-economic status are not interchangeable, so there is a need to measure separate components of socio-economic status and separately assess the contribution of each of them – this approach gives a more detailed picture of the social status of a particular individual.

In our opinion, insufficient attention is paid to the study of the influence of such socio-demographic parameters of the family as its material status on the process of development of higher mental functions. The published data related to the problem under consideration are presented to a large extent in the works of foreign authors; there is a certain empirical deficit in Russian studies. It is important to note that this dependence (of economic status and individual differences) is not direct but mediated. The available literature notes that families with different material levels are characterized by specific environmental conditions, which affects various aspects of family functioning and, consequently, the process of ontogenetic development [9]. A certain part of studies [10, 11] points to unequal access to material and cultural resources to stimulate children's cognitive development, including through the opportunity to purchase a variety of educational games, books, joint leisure activities (visiting the theatre, museums, libraries, exhibitions, travel), etc. Moreover, as some authors note [12], there are significant differences between families with different economic status in the ability to give their children a continuous and quality education. D.N. Chernov [13] emphasizes that if parents have difficulties in the implementation of educational and developmental functions, they begin to "include" in these processes such social institutions as the system of additional education, hobby groups, music, art, sports schools, sections, etc., which, according to the author, partially compensates for the lack of parental attention.

An important aspect of a child's development is his or her language environment. The process of a child's language socialization occurs through the natural inclusion of the child in the community spoken by his or her immediate environment. Thus, being oriented to the style preferences of the speakers of a language variant (dialect), it internalizes social standards and ideas about de-

sirable forms of communication [14]. The relationship between the volume of the child's vocabulary, the complexity of grammaticalization of utterances and various components of socio-demographic parameters of the family, such as income, parents' education, their profession, and quality of care, has been confirmed by empirical material from many studies [15, 16].

A cycle of research is devoted to the study of the psychological climate of families with different economic conditions. The authors note that the effect of emotional stability, sensitivity to the child's needs can be conditioned by the social position of parents [17]. For instance, the effect of emotional and psychological tension in low-income families due to financial instability, inconsistent employment of parents has been revealed, which in turn affects the quality of parental behavior [18]. Other studies have concluded that low family socio-economic status is associated with the presence of chronic stress and co-occurring anxiety [19]. Researchers have concluded that during critical periods of brain maturation, stressful conditions can have a "programming" effect and lead to irreversible and long-lasting changes [20]. Therefore, the effect of the stress response arising as a result of the penetration of various pathogens into the organism leads to a "programming" effect on the development of the brain. A pronounced stress response resulting from the administration of bacterial lipopolysaccharide to baby rats led to significant rearrangements in the central nervous system. The outcome of such stressful influence in the early postnatal period is the manifestation of behavioural disorders in sexually mature individuals [21]. The most specific consequences of such stress exposure in rodents include impaired stress tolerance, symptoms of anxiety, depressed state, decreased cognitive activity, and disorders of neuroplasticity processes that underlie learning and memory formation [22, 23]. The authors extrapolate that these kinds of stressors include disruption of their parental care of offspring, including maternal depression, changes in feeding patterns, and emotional upheaval [24].

Numerous data have been accumulated that suggest a strong correlation between anthropometric indicators of the newborn and the socio-economic status of the mother [25]. According to Yu.E. Veltischev [26], lagging anthropometric indicators of newborns (low weight, small head volume) are significantly common in families with insufficiently high socio-economic level. Low birth weight has long-term effects on mental and physical development in all subsequent stages of ontogenesis. Such consequences include, for example, problems in the formation of spatial functions and programming as well as control functions at school age [27]. There is a consensus of researcher's opinion that it is not the poor financial situation of the family itself that leads to poorer development, but a number of concomitant circumstances.

This analysis of the sources of the problem under study is not limited to this. Additionally, there are studies that consider the amount of time spent with the child and the number of books read, value orientations and attitudes, nutritional quality, living conditions [28], and many others as the main mechanisms of mediating the impact of family material prosperity in children's morphofunctional development.

Despite the fairly well-developed problem of explanatory mechanisms that influence the considered factors in children's intellectual and physical development and their performance in school, there are few studies devoted to children's neurocognitive development in our country. Essential is the understanding that the problem is interdisciplinary: individual differences of children in relation to material prosperity of the family are recognised as an acute problem from the point of view of general psychology, neuropsychology of individual differences, psychophysiology, paediatrics, sociological and economic sciences.

Therefore, the theoretical analysis of the problem made it possible to define the purpose of the study – to identify systemic regularities of correlations between individual variability of higher mental functions of preschool children and the material level of their families.

METHODS

Traditional neuropsychological tests developed by A.R. Luria [29] and adapted in the Laboratory of Neuropsychology of the Faculty of Psychology at Lomonosov Moscow State University were included in the study. Statistical processing of the data was performed using Univariate Analysis of Variance, with pairwise multiple comparisons with Scheffé correction. Data processing was performed using the IBM SPSS Statistics 26 software package (IBM Corp., USA).

180 preschool children were examined, the average age was 6.5 years. Neuropsychological diagnostics was carried out individually with each child. The duration of the examination was 55–70 minutes.

Distribution of children into groups was carried out by means of stratometric modeling strategy of the sample – with the help of a specially designed questionnaire. Strata were material level of the family: high level of income (more than two subsistence minimums per family member) – 26 % of families; average level of income (from one to two subsistence minimums per family member) – 35 % of families; low level of income (less than one subsistence minimum per family member) – 39 % of families.

The methodology of families (respondents) distribution by income level is based on the normative criterion. The classification of population groups by income, developed by experts of the All-Russian Center for Living Standards, is taken as a basis: the least well-off (low-income), well-off below the average level, middle-income, high-income [30]. In contrast to this classification, we have identified three groups of families by income level – low, average and high. The average-income family group combined lower-middle-income and average-income families.

The criterion for assignment to a certain group are social standards – subsistence minimum, socially accept-

able (restorative) consumer budget, consumer budget of average income and consumer budget of high income [30]. When classifying families to the low-income group, we follow the absolute monetary approach (households with average per capita monetary incomes below the subsistence minimum are recognized as poor). As a threshold value separating the group of families with low and average income, the value of two subsistence minimums is adopted, since the socially acceptable (recovery) consumer budget is not less than 2–2.5 subsistence minimums.

All children were pupils of municipal budget preschool educational organizations. The following facts were the criteria for selection of the participants: absence of diagnosed neurological disorders, cerebral-organic pathology, and developmental deviations. All lived in a two-parent full family where they were the only child (42 %), or had one sibling (51 %), less frequently – two siblings (7 %). The sample population, allocated with regard to stratification of family material status, was equalized by sex of children (50 % of boys and 50 % of girls, respectively). Mothers of 47 % of children have higher education, 36 % have specialized secondary education, and 17 % have secondary education. 31 % of preschool children are brought up by fathers with higher education, 26 % – with specialized secondary education, 42 % – with secondary education.

The analysis of children's higher mental functions was carried out in accordance with the approach proposed by A.R. Luria [3], based on the idea of a structural-functional model of the three brain blocks activity considering interhemispheric asymmetry. To this end, during the processing of the quantitative parameters of the samples, a procedure was performed to calculate generalised (aggregated) indicators – neuropsychological indices, which included the most unambiguously interpretable parameters of performed samples (a total of 122 parameters).

Functional features of movements and speech serial organisation, as well as programming, control and regulation of arbitrary forms of activity are presented in a generalised index – the index of the III block of the brain (cerebrum anterior). This indicator includes a quantitative assessment of test performance: graphomotor coordination, dynamic hand praxis, reciprocal coordination, choice reaction, rhythms according to instructions, syllabic structure of words, text retelling (the criteria of programming and grammatical design of the utterance, as well as the semantic adequacy of the utterance were assessed).

The index of Block II functions reflects the state of kinaesthetic functions (oral and manual praxis), functions of visual-spatial, visual and auditory information processing.

Since Block II of the brain (block of reception, storage and processing of information, posterior cortex of cerebrum) is functionally lateralised, it includes two indices – index of information processing by left-hemispheric and by right-hemispheric type.

The left hemisphere function index (sinistrocerebral index) is represented by quantitative assessments of oral praxis, lexical components of text processing, right hand finger posture praxis, comprehension of complex logical and grammatical constructions, and auditory-verbal memory (short-term and long-term).

The right hemisphere function index (dextrocerebral index) was assessed by the performance of left-hand finger posture praxis, copying a table, recognising undrawn images, and the volume of involuntary auditory-spatial and visual-spatial memory.

The obtained index values have undergone a standardization procedure. Standardized z-scores were calculated using the formula: $z = (x - \mu) / \sigma$. According to the presented formula, the sample mean for this parameter was subtracted from the value of the individual indicator for the parameter, and the obtained result was divided by the standard deviation. The correlation of these indicators made it possible to obtain neuropsychological profiles reflecting the functional state of children's higher mental functions.

RESULTS

The presented standardized indices allow us to see how much and in what (better or worse) direction the individual value of the index of functions of Blocks III or II (left or right hemisphere) of the preschoolers' brain deviates from the average group value (Fig. 1).

The presented indices' values and their deviations from group averages indicate the unevenness in the development of functions of Block III of the brain, as well as the left hemisphere within the population of preschoolers in correlation with the material level of the family. The most stable indices are presented in the right hemisphere function indices.

Functional indices in preschoolers from low-income families are significantly reduced (Block III and left hemisphere index), which can be regarded as a manifestation of a sign of deficit of these functions. It should be emphasised that the relative decrease in the indices is not evidence of fatal impairment of certain functions, but of signs of partial deficiency and insufficiency of their formation to the level of the same-age population.

By applying single factor analysis of variance with pairwise multiple comparisons with Scheffe's correction, the following results were obtained as summarised in Table 1.

Preschoolers from the most affluent families had the highest indices of brain Block III function indices (differences with Group 2 ($p = 0.046$) and Group 3 ($p < 0.001$)) and sinistrocerebral indices (differences with Group 3; $p < 0.001$). Compared to them, preschoolers from average-income families have uniformly stable indicators of all functions, but their index values are lower than those of children who are more successful in functional development. In preschoolers from families of low material prosperity, the function indices of both cerebrum anterior (differences with Groups 1 and 2; $p < 0.001$) and sinistrocerebral indexes (differences with Group 1; $p < 0.001$) were in the range of negative values.

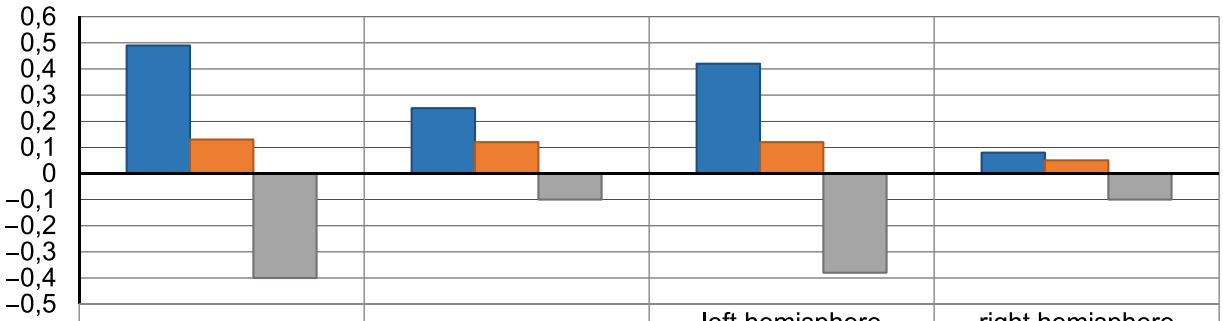


FIG. 1.
Standardized average values of the indices of higher mental functions in preschool children in relation to the level of material prosperity of the family

TABLE 1

LEVELS OF DIFFERENCES IN THE INDICATORS OF THE FUNCTIONS OF PRESCHOOL CHILDREN IN RELATION TO THE LEVEL OF MATERIAL PROSPERITY OF THE FAMILY

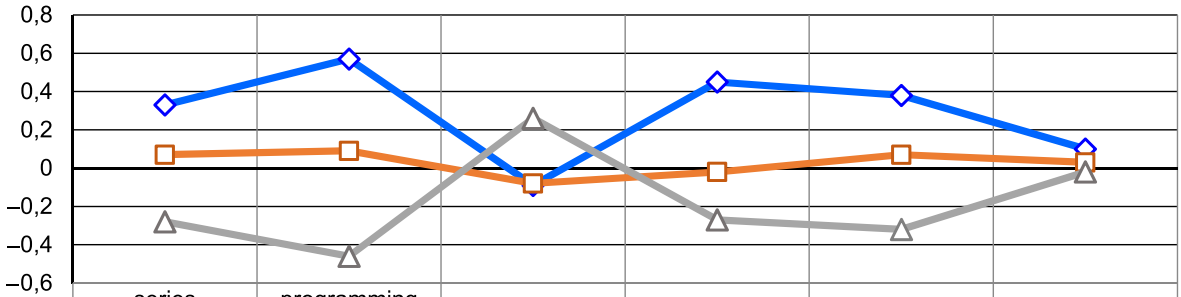
Indicators	Material prosperity (1 – high; 2 – average; 3 – low)				
	Level of difference			ANOVA	
	1–2	1–3	2–3	Sig	F
Brain Block III indices	0.046	< 0.001	< 0.001	< 0.001	15.57
Brain Block II indices	0.050	< 0.001	0.014	< 0.001	9.35
Sinistrocerebral indices of the brain	–	< 0.001	0.002	< 0.001	11.00
Dextrocerebral indices of the brain	–	–	–	–	0.64

The obtained results indicate individual unevenness of children's higher mental functions and require a more differentiated analysis of individual indices of higher mental functions, which will enable us to determine the reason of increased or decreased overall indices of brain block indices and to obtain neuropsychological profiles of preschool children of the selected groups (Fig. 2).

The neuropsychological profiles and the results of the analysis of variance presented in Figure 2 confirm the significant effect of the material prosperity of the family in terms of programming and control functions ($p < 0.001$), serial organisation of movements and speech ($p = 0.004$), visual ($p < 0.001$) and auditory ($p < 0.001$) functions, and kinaesthetic praxis ($p = 0.053$). Less differentiated index scores are presented in the functions of visual-spatial information processing.

Children from high-income families (Group 1) have high indices of function: serial organization of movements (differences with Group 3; $p < 0.001$), arbitrary regulation of activity and speech (differences with Groups 2 ($p = 0.008$) and 3 ($p < 0.001$)), auditory functions (differences with Groups 2 ($p = 0.011$) and 3 ($p < 0.001$)), and visual functions (differences with Group 3; $p < 0.001$). Against the background of high indices of almost all higher mental functions, preschool children from the most affluent families show a decrease in the indices of kinaesthetic information processing functions (differences with Group 3; $p = 0.042$).

Analysis of the results of neuropsychological tests for the study of the functions of serial organisation of movements and speech gives the following picture: preschoolers from high-income families (Group 1) demonstrate advantages in the characteristics of dynamic praxis – this is manifested in a better ability to automate a motor skill ($p = 0.017$), fewer errors in the reproduction of the motor programme and a faster rate of work-



	series organization	programming and control	kinesthetic	auditory	visual	visual-spatial
high (1)	0,33	0,57	–0,09	0,45	0,38	0,1
average (2)	0,07	0,09	–0,08	–0,02	0,07	0,03
low (3)	–0,28	–0,46	0,26	–0,27	–0,32	–0,02

FIG. 2.

Indices of various components of the higher mental functions associated with the functions of blocks III and II of the brain in preschool children from families with high (1), middle (2) and low (3) income levels

in-progress ($p = 0.004$). High indices also differentiate this group of children in the ability of serial speech organisation, namely in grammatical structuring when retelling a text ($p < 0.001$). Children from average-income families (Group 2) have some difficulties in automating the motor skill: in the dynamic praxis test, in most cases, their programme execution varies from individual series – "packs" – to smooth change of programme elements (differences with Group 1; $p = 0.040$). However, they make no errors whatsoever in the execution of the programme, or there are isolated difficulties associated with the violation of the movement sequence. The arising difficulties in children of this ontogenesis norm are also connected with the grammatical design of the utterance: in retelling, the text is most often composed in a rather monotonous way, without using complex sentences or with violation of word order (differences with Group 1; $p = 0.006$). Children from low-income families (Group 3) are less efficient in learning and automatising motor skills (differences with Groups 2 ($p = 0.040$) and 1 ($p = 0.005$)) and have the lowest indices of speech utterance serial organisation (differences with Groups 2 ($p = 0.006$) and 1 ($p < 0.001$)), mainly associated with the presence of single non-coarse agrammatisms or paragrammatisms.

Sample analysis of the programming and control function tests showed that children from families with high material prosperity demonstrated higher speed characteristics of the choice reaction (differences with Group 3; $p < 0.001$). In goal-directed activities programmed by verbal instruction, they have the highest productivity (differences with Groups 2 ($p = 0.019$) and 3 ($p = 0.001$)). Group 1 children were also more successful in constructing the semantic programme of an utterance ($p < 0.001$); they made fewer errors caused by inertia. Their productivity of free association actualisation is more productive (differences with Groups 2 ($p = 0.04$) and 3 ($p = 0.04$)). Children from average-income families show relative weakness of functions of activity arbitrary regulation, associated mainly with programming of speech utterance (differences with Group 1; $p = 0.001$) and actualisation of free associations (differences with Group 1; $p = 0.04$) with rather stable high indicators in the choice reaction test. The results of all samples measuring arbitrary regulation of activity and speech by children from the least affluent families indicate insufficient involvement of prefrontal mechanisms of attention to stimulus presentation (differences with Groups 2 ($p = 0.002$) and 1 ($p = 0.001$)), as well as in sentence and text construction (differences with Groups 2 ($p = 0.004$) and 1 ($p < 0.001$)).

Individual differences in kinaesthetic praxis condition were caused by higher productivity of left-handed finger poses by preschoolers from low-income families (differences with Group 1; $p = 0.042$).

Auditory-verbal functions in children from maximally affluent families are characterised by high amounts of involuntary (differences with Group 3; $p = 0.050$) and arbitrary short-term memory (differences with Group 3; $p = 0.001$), as well as delayed reproduction and resistance to interference (differences with Group 3; $p < 0.001$). Children from average-income families are comparable to those from materially prosperous families in terms of auditory-verbal memory capacity, but errors (verbal substitutions based on semantic proximity) indicating difficulties in the left-hemispheric strategy of information processing are quite frequent among them (differences with Group 1; $p = 0.039$). Deterioration of auditory information processing in the preschoolers from low-income families occurs as a result of a decrease in memory indices of this modality (differences with Groups 2 ($p = 0.004$) and 1 ($p = 0.001$)) and, in addition, an increase in word distortions during their reproduction (differences with Groups 1 and 2; $p < 0.001$), an increase in the number of errors associated with verbal substitutions based on semantic proximity (differences with Group 1; $p = 0.032$).

The visual functions of preschoolers from families with a high material level of family are character-

ized by the predominance of analytical, left-hemispheric strategy of visual information processing, which is well traced in the productivity of samples on identification of crossed-out (differences with Group 3; $p = 0.011$) and superimposed images (differences with Group 3; $p < 0.001$). Children from average-income families have the same productivity of recognising perceptually complex images as the preschoolers from maximally affluent families, but they more often make verbal-perceptual errors in the form of forgetting exact names and using semantically similar words (differences with Group 1; $p = 0.040$), which is an indicator of left-hemispheric complexities. Preschoolers from the least financially affluent families have difficulties recognising both crossed-out (differences with Group 1; $p = 0.011$) and superimposed images (differences with Group 1; $p < 0.001$). In addition, there was an increase in verbal-perceptual errors (differences with Group 1; $p = 0.020$).

Indicators of visual-spatial functions in preschool children in general have low values and do not differentiate the preschoolers by the level of their formation, but some components of these functions (projection representations) in children from families with a high material level of family tend to decrease. Since preschool age is not a sensitive period for the formation of these functions, children of this age are characterised by a low level of their formation. An intensive leap in their development should be expected at a later age in the process of purposeful learning.

DISCUSSION

As to the results obtained in general, it should be noted that the empirical data of this study suggest that a significant proportion of the environmental dispersion (from 6 to 23 %) of individual differences in the development of structural components of children's higher mental functions is determined by the factor of family affluence. Individual variability of preschool children's mental functions in relation to the level of family affluence is associated with the preconditions of a more accelerated rate of development of some functions, associated with the risk of "weakening" or "stealing" of other developing functions or with a significant decline in functional capabilities.

The most dynamic restructuring of functional systems occurs in the sensory periods of development and leads to significant changes in the mental component of ontogenesis. Each such developmental period is task-oriented. If in the sensory period of certain functions formation the society offers conditions not corresponding to the real preconditions of the child's development, the formation of functional systems of the brain may follow a disharmonious path of development. As a result, more intensive and advanced development of some functions can lead to increased differentiation of the brain and "stealing" in the development of those functions that are at the stage of their optimal formation. Otherwise, as a result of insufficient impact of external social factors, there is underdevelopment of higher mental functions and a decrease in the rate of their formation in relation to the average population level of development, which allows us to talk about partial deficit of mental processes.

According to the results of this study, the functions with a long period of formation – these are the functions of the brain Block III, and the functions provided mainly by the left hemispheric sections of the cerebrum – are subject to the greatest individual variability during preschool age in correlation with the material prosperity of the family.

The most intensive rate of development of arbitrary activity regulation functions and serial organisation of movements provided by the work of the cerebrum anterior, as well as functions provided by the left-hemispheric strategy of information processing (auditory-verbal functions and analytical components of visual perception mediated by speech) with relatively isolated lag of motor functions and right-hemispheric components of visual-spatial information processing is observed in preschoolers from families with high material prosperity. Evidently, a targeted intensive speech exposure leads to increased verbal loads upon the child, thereby stimulating the development of the speech areas of the brain. According to several data [31], the classificatory method associated mainly with the work of the left hemisphere reaches a proper level of development only by the end of adolescence, and the structural method, carried out by the right hemisphere, has a certain degree of maturity already in the period of preschool age. Early intensive verbal load can be considered to create prerequisites for the active development of left hemisphere functions and "steal" right hemispheric capabilities, including kinaesthetic functions and some components of visual-spatial information processing. Since visual and spatial functions are associated with the work of long-forming tertiary sections of the cortex of the brain Block II, including the right hemisphere, which reach their developmental optimum at an older age and are closely related to the learning process, it is essential to further investigate the dynamics of their development, which would enable us to clarify the distant consequences of a more intensive rate of formation of functions provided by the left hemisphere.

As family material prosperity decreases, the risk of "weakening" most of children's functional abilities increases. Children from low-income families are likely to have deficits in the functions of programming and control of arbitrary forms of activity, serial organisation of movements, mainly speech, as well as impaired ability to process auditory information and some speech-mediated analytical components of visual perception. Notwithstanding the fact that the decrease in material prosperity of the family is accompanied by a weakening of verbal functions and activity arbitrary regulation, it has a positive effect on the formation of kinesthetic hand praxis and some aspects of visual-spatial functions. Considering this variant of the child's norm, one may consider

that the decrease in the functional capabilities of the anterior and sinistrocerebral parts of the cerebrum reflects a variant of the partial deficit of the mental component of ontogenesis.

CONCLUSION

Every society is characterised by socio-economic inequalities, but the most effective social strategy that can improve the quality of life of the population in any country is to invest in child development: the earlier in childhood this contribution is made, the more effective the social returns will be years later.

Since the cerebrum in the early period is highly plastic and represents an open system capable of restructuring, the preschool age is such an important period for studying systemic regularities of correlations between individual variability of higher mental functions and factors of the family environment. It is in the preschool age that the variability in morphofunctional cerebral development reaches more than 30 %, and then there is a gradual decrease in the "plasticity" of the cerebrum, and the environmental influence begins to inevitably lose its relevance [32]. Thus, remedial interventions become less effective. Consequently, it is important that early experiences meet children's developmental potentials and that the differing socio-demographic characteristics of the family are taken into account in the design of the teaching and learning process.

The presented conceptual approaches, within the framework of which the search for connecting links between socio-demographic parameters of the family and structural and functional self-organisation of higher mental functions is conducted, were supplemented by empirical data of our study, which made it possible to specify that the factor of material wealth of the family both directly, factor-wise, and indirectly, cumulatively, through the system of proximal factors, can make its selective contribution to the variability of indicators of children's higher mental functions, which is manifested in more intensive formation of some groups of functions, and less intensive – others, as well as in the choice of the leading strategy of information processing, relying on the activity of the left or right hemisphere.

In conclusion, we note that the unevenness in the development of structural and functional components of children's higher mental functions is normative, not pathological. Such unevenness has a large adaptive effect: the population as a whole benefits from the presence of different abilities in different individuals. On the other hand, the transition to a new world order and a new technological mode, to new principles of social selection puts high demands on the psychophysiological characteristics of children. Under these conditions, the uneven development of higher mental functions can lead to the fact that weak structural links of the functional system can become a deterrent to further development and successful learning of the child. The results of this study can be useful to parents, teachers, specialists of preschool and other educational organizations. Analyzing the development of children before school and identifying their living conditions makes it possible to identify different groups of children who need help from the first days of school life.

Conflict of interest

The authors of this article declare no conflicts of interest.

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