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Conference Paper

Neuropsychological Study of Resilience of School Graduates of the Region of Ecological Trouble

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Abstract

The article presents the data of neuropsychological research in the framework of a comprehensive study of the resilience of the youth population (secondary school graduates) of the region of ecological trouble – Zabajkal'skij kraj. The authors consider resilience as a systemic characteristic of the system 'man–life environment'. The model of resilience including psychophysiological, psychological and personal levels is offered. Standardized psychometric and neuropsychological methods are used to evaluate level's indicators. School graduates residing in ecologically unfavorable territories identified drift of psychophysiological level in the direction of lower standards and regulatory intensity indicators of psychological and personal levels of resilience. Using a neuropsychological approach with the aim of finding mechanisms to a reduction of the indicators of the psycho-physiological level of resilience allowed us to determine the presence of signs of deficiency of certain brain areas (posterior frontal and parietal). It was established that with the increase of degree of the ecology trouble territories of research, there is a reliable increase of mistakes of accomplishment by test subjects who live on them, the neuropsychological tests investigating visually spatial functions, and also functions of the serial organization of mental activity. Though there is the presence of correlations between indicators of different levels of resilience, but the rating and the explanation by virtue of their disparate data is difficult. The search for correlates in this case can be more aimed at proving the possibility of the existence of the proposed model of resilience, its consistency and productivity of the instruments that are used for its study.

Keywords: neuropsychological study, resilience, level of resilience, ecological trouble, secondary school graduates

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1. Introduction

The relevance of a comprehensive study of human resilience is determined by the presence of many risks of its preservation in a global environmental crisis, socio-economic stress in many countries (Casey et al., 2014; Bonanno, Romero & Klein, 2015; Mahnach, 2016). In both foreign and Russian psychology, the resilience of a person is interpreted by the majority of researchers mainly as an integral individual personal characteristic manifested in interaction with a complicated social environment (Nesterova, 2011; Ryilskaya, 2014; Laktionova, 2017). But the living environment of a person includes a natural component, also making a claim to resilience. For example, an environmentally degraded environment that adversely affects people's health may pose a threat to their resilience and mental health. The analysis of human interaction not only with social, but also with natural environment is necessary in the regions of ecological trouble.

2. Methodology

In our study, as part of the ecopsychological approach to the development of the psyche (Panov, 2014) resilience is understood as naturally given (energetically provided) and developed by society complex integral characteristic of man, a system property of the system 'man–living environment', providing the actual level of mental activity in these conditions. Resilience is a complex bio-psycho-social integrity.

This interpretation involves the inclusion in the content of the concept not only personal characteristics, but also the necessary neuropsychological, psychophysiological basis for their implementation, and for empirical study of the resilience of the integrated approach, in particular, the inclusion in the diagnostic program not only psychological, but also neuropsychological methods.

Otherwise, taking into account the most important natural prerequisites for human resilience in complicated conditions of a single living environment remains beyond the limits of psychological study.

The structure of the resilience is determined in accordance with the systematic human organization by A.N. Leontiev (1977, 1983) and differentiation of mental and psychological in L. Vygotsky's works (1982), in traditions of domestic psychological knowledge. A.N. Leontiev identified three levels of human organization: biological (man as an individual), psychological (man as a subject), social (man as a person),

in our work the last two levels are combined, according to L. Vygotsky, in one psychological level. Psycho-physiological, mental and personal levels are selected in the structure of the resilience (Figure 1)
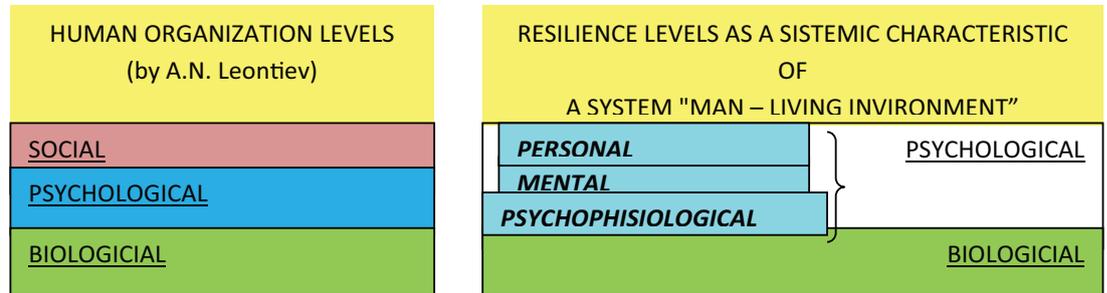
HUMAN ORGANIZATION LEVELS (by A.N. Leontiev)	RESILIENCE LEVELS AS A SISTEMIC CHARACTERISTIC OF A SYSTEM "MAN – LIVING INVIRONMENT"
SOCIAL	PERSONAL / MENTAL / PSYCHOPHISIOLOGICAL — PSYCHOLOGICAL
PSYCHOLOGICAL	
BIOLOGICIAL	BIOLOGICIAL

Figure 1: The ratio of the levels of the system organization of man by A. N. Leontiev (left) and levels of psychological resilience in our work (right).

Based on the fact that the whole person is a unity of biological, psychological and social levels of his systemic organization, we can say that in his life there are interconnected bio-neuro-somatic and mental processes, states, properties. The existence of this unity is impossible without interaction with the natural and social environment. Indicators of psycho-physiological, mental and personality levels of resilience cannot be static after the change of the ecological characteristics of the living environment.

The purpose of the study is to conduct a theoretical and empirical research of the level of resilience of the youth population living in the region of environmental problems; to substantiate the possibility and need of the use of neuropsychological approach for studying the resilience of this category of people.

Materials and methods. The survey was conducted in October 2017 (at the beginning of the school year). The sample of the study was 121 students of 11 classes of secondary schools (average age of 16 years 7 months), permanently residing in the territories of Zabajkal'skij kraj with different degree of ecological trouble (Ekologicheskaya karta RF, 2016). In Chita – the administrative and economic center of the Zabajkal'skij kraj – the zone of ecological trouble – was a sample of 51 students (40 girls. 11 boys). In the urban – type settlement of Balej – the zone of ecological crisis – 45 students were examined (31 girls. 14 boys); in the city of Krasnokamensk – the zone of an emergency ecological situation – 25 (13 girls. 12 boys).

The ecological situation in Balej is determined by natural-climatic and anthropogenic factors, because of the long-time barbaric extraction of various valuable breeds. Krasnokamensk is a single-industry town, producing most of the uranium in Russia. Chita is a regional center and the complex of its determinants of environmental problems has

polymorphic anthropogenic and climatic adverse conditions (Gomboeva, 2012; Mixajlova & Soloduxina, 2016).

In the theoretical part of the study the methods of comparative analysis of theoretical and methodological bases of resilience researches, simulation of psychic phenomena were used.

The empirical part was done due to the following ways.

(A) Psycho-physiological level of resilience was characterized by indicators of execution of 47 neuropsychological samples, to assess the state of the motor (5 samples), visual (7 samples), somatosensory (4 samples), audio-motor (2), auditory and auditory-verbal (6), spatial (4), mnestic (4), executive (3) functions and the functions of reading (4), counting (4) and spelling (3) from the standpoint of domestic neuropsychology, involving qualitative and quantitative evaluation. To create the possibility of statistical processing was used traditional and the most common for domestic practice penalty score (similar to the aforementioned score in the works of Glosman Zh. M., 2012), where the performance was evaluated in the next continuum – without error – 0 points, non-performance – 3 points, that is, a high score of the sample corresponds to the low indicator. Qualitative qualification of the specifics of performance was also implemented in accordance with the aforementioned methodological standards (Akhutina & Melikyan, 2012; Balashova & Kovyazina, 2017).

(B) Mental level was assessed using indicators of intellectual development revealed with the application of progressive matrices by John. Raven.

(C) Personal level of resilience was performed with the indicators of the test of the hardiness of D. A. Leontiev, E. I. Rasskazova (2006).

Mathematical data processing was carried out using the non-parametric Kruskal Wallis H-test, which is the analog of the analysis of variance and used to compare more than 2 groups. It is impossible to determine the direction of the differences by H-test, so there is a table presenting average values (M) and standard deviations (σ) for a clearer description.

The Spearman correlation coefficient was used 1) to identify the presence/absence of interrelations between indicators of different levels of viability, 2) to confirm statistical validity of the proposed model of resilience, 3) to find the determination of indirect signs of consistency of psychological instruments for the study of resilience and 4) to search the most sensitive psychological and neuropsychological instruments for the study of psyche in environmental distress.

TABLE 1: The comparison of three groups according to the Kruskal–Wallis test and the average values and standard deviations.

No.	LOCALITY	BALEJ		KRASNOKAMENSK		CHITA		p
	Descriptive statistic parameter of Samples and Tests	M	σ	M	σ	M	σ	
1	Dynamic Praxis	**1.21/**	*0.31*	**0.92**	*0.48*	0.38	*0.22*	0.001
2	Logical and grammatical constructions understanding	**0.7**	0.56	0.58	*0.37*	0.19	*0.12*	0.03
3	Head's Samples	0.38	*0.26*	0.5	*0.27*	0		0.008
4	Ferster's Sample	0.3	*0.12*	**1**	*0.79*	0.38	*0.24*	0.002
5	Constructive Praxis	0.44	*0.29*	**0.92**	*0.49*	0.23	*0.15*	0.001
6	Memorizing twice per three words	0.4	*0.21*	**0.9**	0.56	0.15	*0.08*	0.004
7	Cube Drawing	0.3	*0.21*	**0.82**	0.59	0.15	*0.1*	0.005
8	Luria Square Test	0.2	*0.12*	**0.76**	0.48	0.38	*0.33*	0.01
9	Phrase Spelling	0.03	*0.02*	0.7	*0.39*	0	*0*	0.0002
10	Unfinished Images	0.1	*0.07*	0.56	0.38	0.35	*0.18*	0.004
I	Raven Test	48.7	*4.98*	47.2	*6.4*	52.4	*13.6*	0.005
II	Hardiness Test	86.7	*15*	77.4	*22*	96.5	*23.9*	0.01

The program Statistica 13.0 was used for calculations. Population based data analysis was used.

3. Results

The results are summarized in Table 1. According to the obtained data, 10 out of 47 neuropsychological samples revealed significant differences between the indicators of the subjects living in different territories. Some samples show the lowest rates of the residents of the zone of environmental crisis (Balej), the others – in the zone of environmental emergency (Krasnokamensk), which may indirectly indicate the specifics of the ecopathogenic effect on the psyche in these areas.

According to the results of the diagnosis using psychometric methods, it can be concluded that there are differences in the indicators of the resilience of subjects living in areas, which differ in the degree of environmental distress. So, according to the test J. Raven, free from cultural and socio-psychological restrictions, a significant drift of indicators in the direction of the reduced norm with the deterioration of the ecological situation of the territory of residence of the subjects was found. We can also say about the indicators of personal resilience level according to the results of the hardiness test.

TABLE 2: The significant correlation coefficients between indicators of neuropsychological and psychometric examinations in the three groups ($p \leq 0.05$ Spearmen correlation – Statistica 13.0).

No.	LOCALITY	RESEARCH INSTRUMENT		
		Neuropsychological Sample	Raven Test	Hardiness Test
1	BALEJ	Words Spelling		0.31
2	BALEJ	Numbers Comparison		0.32
3	BALEJ	Luria Square Test		0.36
4	KRASNOKAMENSK	Constructive Praxis	**−0.52**	
5	KRASNOKAMENSK	How many times do I knock	0.59	
6	CHITA	Ferster's Sample	0.56	

Indicators of mental and personal resilience levels of subjects living in the zone of environmental emergency (Krasnokamensk) are lower than the indicators of those who live in the zone of environmental crisis (in Balej) or trouble (in Chita).

The results of the study of correlation between indicators of different resilience levels are presented in Table 2.

According to Table 2, most of the existing relationships are direct, that is, in our case, taking into account the specifics of neuropsychological assessment, they fix the following type of dependence: the worse performance of samples corresponds to the higher indicators of intellect and resilience, with the exception of a single inverse correlation coefficient of indicators of the sample 'Constructive praxis' and non-verbal intellect (indicating a clear dependence – the worse performance of the sample, the lower non-verbal intellect), and only in one group.

It should be noted that there are practically no coincidences in samples that demonstrate correlations and simultaneously decrease in indicators in different groups of subjects. The majority of the data is fragmented, with the exception of Ferster's Sample and Luria square test (test of memorizing 10 words).

Psychometric indicators of resilience (J. Raven Test, Hardiness Test) are mostly within the limits of normative values, which is understandable in view of the conditional normativity of the studied school graduates and the impact of possible compensatory mechanisms (primarily mechanisms of social compensation) (Saraeva, 2014), included at higher levels of resilience.

But the indicators of psychophysiological level, reduced by some samples in subjects living in different environmentally disadvantaged areas, may be indicators of a special structure of the resilience of this category of youth.

4. Conclusions

According to the theoretical and empirical analysis of the problem of resilience of a person living in an ecologically disadvantaged living environment, it is possible to conclude about the novelty and productivity of using a neuropsychological approach to such study. The interpretation of resilience as a bio-psycho-social phenomenon, the allocation of psychophysiological level in the structure of resilience and the use of neuropsychological method can be very promising for the search of brain mechanisms of specific indicators of resilience of the youth living in the region of environmental distress.

However, at this moment, there are more reasons for related questions than answers, how does the human psyche and such integral structure as the resilience react on the ecological trouble.

The identification of a significant reduction in the performance of neuropsychological samples (exploring the spatial functions and functions of serial organization of mental activity), depending on the degree of environmental distress of the territory can set the direction of the search for psychophysiological mechanisms of human resilience. So, to our knowledge, serial organization is more sensitive to the degree of ecological trouble (the bigger it is, the lower the implementation rate of the sample is), and spatial functions are more sensitive to monoecopatogenic influence. The sensitivity of the most recently formed in the ontogenesis brain areas (in this case, frontal and parietal-temporal-occipital (parietal) is understandable, and consistent with multiple theoretical data (Homskaya, 1997) Empirically, neuropsychological studies of the influence of ecological trouble more often identify non-specific neurodynamic weakness (Chernoby'l'skij sled,1992; Homskaya, 1997; Morozova, 2007) which in our sample (in the qualitative qualification of neuropsychological diagnostic errors) is erased slight character, not dominating over cortical dysfunction.

Correlation analysis shows the existence of relationships between the indicators of neuropsychological and psychometric examination, which are within the norm, but reduced neuropsychological indicators do not have clear relationships. So, with samples, pointing to weakness in the posterior frontal and parietal brain areas, correlations were not detected, that probably indicates the difference in orientation of the neuropsychological and psychometric instruments for the study of resilience. Probably psychometric methods are more 'rough' for the resilience diagnostic than the neuropsychological.

The search for correlates in this case is more productive to prove the possibility of existence of the proposed model of resilience and some consistency of the diagnostic instruments that are used for its comprehensive study. In general, the problem requires multidimensional analysis (Southwick et al., 2014) at both empirical and theoretical levels.

Acknowledgements

References

[1] Akhutina, T. V. and Melikyan, Z. A. (2012). Nejropsixologicheskoe testirovanie: obzor sovremenny'x tendencij. K 110-letiyu so dnya rozhdeniya A. R. Luria [Neuropsychological testing: an overview of current trends. To the 110th anniversary of the birth of A. R. Luria]. *Clinical Psychology and Special Education*, vol. 2. Retrieved from http://psyjournals.ru/psyclin/2012/n2/52599.shtml (last accessed August 28, 2017) [in Russian].

[2] Balashova, E. Yu. and Kovyazina, M. S. (2017). *Nejropsixologicheskaya diagnostika v voprosax i otvetax* [*Neuropsychological diagnostics in questions and answers*]. Moscow. Genezis [in Russian].

[3] Bonanno, G. A., Romero, S. A., and Klein, S. I. (2015). The temporal elements of psychological resilience: An integrative framework for the study of individuals, families, and communities. *Psychological Inquiry*, vol. 26, pp. 129–169.

[4] Casey, E. C., Finsaas, M., Carlson, S. M., et al. (2014). Promoting resilience through executive function training for homeless and highly mobile preschoolers, in S. Prince-Embury and D. Saklofske (eds.) Resilience Interventions in Diverse Populations. New York: Springer.

[5] Chernoby'l'skij sled. Psixologicheskie posledstviya Chernoby'l'skoj katastrofy'. Sbornik statej. [Chernobyl trail. The psychological consequences of the Chernobyl disaster. A collection of articles]. Minsk, 1992 [in Russian].

[6] *Ekologicheskaya karta RF. Neblagopriyatnye regioni* [*Ecological map of Russia. Disadvantaged regions*]. Retrieved from http://www.stihi.ru/2013/11/02/4686 (last accessed August 10, 2016) [in Russian].

[7] Glozman, Zh. M. (2012). *Nejropsixologicheskoe obsledovanie: kachestvennaya i kolichestvennaya ocenka danny'x* [*Neuropsychological examination: Qualitative and quantitative data evaluation*]. Moscow: Smy'sl [in Russian].

[8] Gomboeva, N. G. (2012). Ecologo-fiziologicheskie, etnicheskie osobennosti adaptacii cheloveka v usloviyah vostochnogo Zabaykalya i problem zdorovya naselenia [Ekologo-physiological and ethnic features of human adaptation in the conditions of Eastern Transbaikalia and problems of population health]. Extended abstract of Doctor's thesis. Moscow [in Russian].

[9] Laktionova, A. I. (2017). *Zhiznesposobnost i socialnaya adaptacia podrostkov* [*The Resilience and Social Adaptation of Adolescents*]. Moscow. Publishing house "Institute of psychology RAS» [in Russian].

[10] Leontiev, A. N. (1977). *Deyatelnost. Soznanie. Lichnost.* [*Activity. Consciousness. Personality*.]. Moscow: Politizdat [in Russian].

[11] Leontiev, A. N. (1983). *Nachalo lichnosti – postupok. Izbranny'e psixologicheskie proizvedeniya: V 2-x t* [*The Beginning of the Individual – the Act. Selected psychological works*] – V. 1, pp. 381–385. Moscow: Pedagogika [in Russian].

[12] Leontiev, D. N. and Rasskazova, E. I. (2006). *Test zhiznestoikosti* [*Hardiness Test*]. Moscow: Smyisl [in Russian].

[13] Mahnach, A. V. (2016). *Zhiznesposobnost cheloveca I semyi: socialno-psihologicheskaya paradigma* [*The Resilience of the Person and the Family: Socio-psychological Paradigm*]. Moscow: Publishing house "Institute of psychology RAS» [in Russian].

[14] Mixajlova, L. A. and Soloduxina, M. A. (2016). Prirodny'e i antropogenny'e geoximicheskie anomalii Zabajkal'skogo kraya. Sovremenny'e problemy' nauki i obrazovaniya [Natural and anthropogenic geochemical anomalies in Zabaykalsky Krai. *Modern Problems of Science and Education* [Electronic scientific journal]], vol. 5 (publication date September 30, 2016). Retrieved from http://www.science-education.ru/ru/article/view?id=25224 (last accessed February 26, 2018) [in Russian].

[15] Morozova, I. L. (2007). Nejropsixologicheskaya struktura zaderzhki psixicheskogo razvitiya doshkol'nikov, prozhivayushhix na territorii e'kologicheskogo neblagopoluchiya. [Neuropsychological structure of mental retardation of preschoolers, living on the ecologically trouble territory]. *Extended abstract of Candidate's thesis*. Moscow [in Russian].

[16] Nesterova, A. A. (2011). Socialno-psihologicheskaya koncepcia zhiznesposobnosti molodyozhi v situacii poteri raboty [The socio-psychological concept of the

resilience of young people in a situation of job loss]. *Extended abstract of Doctor's thesis*. Moscow [in Russian].

[17] Panov, V. I. (2014). *Ecopsihologia: Paradigmalnyi poisk* [*Ecopsychology: Paradigm search*]. Moscow, Saint-Petersburg: Psychological Institution RAE; Nestor-History [in Russian].

[18] Ryilskaya, E. A. (2014). Psihologia zhiznesposobnosti cheloveka. [Psychology of a man resilience]. *Extended abstract of Doctor's thesis*. Yaroslavl [in Russian].

[19] Saraeva, N. M. (ed.) (2014). *Psixologicheskaya adaptaciya cheloveka v oslozhnenny'x usloviyax zhiznennoj sredy': kollektivnaya monografiya* [*Psychological Adaptation of a Man in the Complicated Conditions of the Life*]. Chita: publishing house of Zabgpu [in Russian].

[20] Southwick, S. M., Bonanno, G. A., Masten, A. S., et al. (2014). Resilience definitions theory and challenges: Interdisciplinary perspectives. *European Journal of Psychotraumatology*, vol. 5, pp. 1–14.

[21] Vy'gotskij, L. S. (1982). *Voprosy' teorii i istorii psixologii. Sobranie sochineniy* v 6 t [*Problems of Theory and History of Psychology*. Coll. Op. in 6 volumes], vol. 1. Moscow: Pedagogika [in Russian].

[22] Homskaya, E. D. (1997). Analiz posledstvij Chernoby'l'skoj katastrofy' s pozicij e'kologicheskoj nejropsixologii [The analysis of the consequences of the chernobyl disaster from the standpoint of environmental neuropsychology. *Psychological Journal*, vol. 18, no. 6, pp. 84–95 [in Russian].