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NEUROPSYCHOLOGY OF INDIVIDUAL DIFFERENCES AS A BRANCH OF CLINICAL PSYCHOLOGY: SOME AREAS OF RESEARCH AND PRACTICAL USE

Assoc. Dr. Elena V.BUDYKA[1]

Abstract

The results of long-term studies of individual psychological differences conducted using neuropsychological approach were presented. It is based on the idea that the features of interhemispheric asymmetry are indirectly manifested in the lateral organization of the main analyzer systems: motor, auditory, auditory-speech, visual. An individual set of lateral features characterizes the lateral profile of an individual. It is assumed that, depending on the specific profile of a person, the left-hemisphere or right-hemisphere strategy of processing information and regulating functions prevails, and this, accordingly, determines his individual characteristics. The individual psychological characteristics, differences in indicators of the functional state and individual health for representatives of different lateral types are described. In particular, young men with left-sided signs in the visual system were characterized by the best objective indicators of health and low subjective assessments. In girls, the indicators of cognitive processes differ with the predominance of different signs of functional asymmetry in the motor manual system, and the fluctuations of these indicators during the ovarian menstrual cycle - with differences in the lateral organization of not only the manual, but also the visual sphere.

Keywords: Neuropsychology of individual differences, interhemispheric functional brain asymmetry, lateral signs, motor and sensory functions, cognitive processes.

[1] Assoc. Dr., A.I. Yevdokimov Moscow State University of Medicine and Dentistry - Moscow/Russia. ORCID ID: 0000-0002-9501-1305, ev-mgu@yandex.ru

Introduction

At present, Clinical Psychology is a differentiated area of knowledge, inside which there are a number of areas with specific approaches to the analysis of various phenomena, methods and techniques used in research and practical work (Tvorogova, 2006). One of the areas of Clinical Psychology is Neuropsychology, which has the task of studying the brain bases of mental activity, as well as the specifics of the violations of the higher mental functions (HMF) in different brain pathology. It is obvious that when assessing the impeded processes, the knowledge of normal functions (of the process, states, etc.) is highly needed, which in turn requires information about the interpatient variability of standards (Leutin et al 2005: 368; Moskvin et al 2011: 367, Nikolayeva et al 2012: 139-142, Khomskaya 1999: 410-413). The study deals with the neuropsychology of individual differences. In particular, neuropsychology of individual differences attempts to detect particularities of brain organization that contribute to individual psychological differences between healthy individuals of different ages and both sexes. As synonyms of the name of this area there used the names "differential neuropsychology" and "neuropsychology of the norm" (Tvorogova 2006; Khomskaya et al 2011).

One of the approaches in detecting interhemispheric bases of individual differences is to consider them as specific brain organization features, including interhemispheric interaction and interhemispheric functional asymmetry (i.e. disparity of the contribution made by the left and right hemispheres in the implementation of the HMF). Herewith the initial position of neuropsychological theory of brain organization of higher mental functions is that any mental activity is ensured by the brain as a whole (Khomskaya et al 1991: 42-47).

Neuropsychological approach to the study of individual differences is based on the assumption that the specific features of interhemispheric asymmetry are indirectly manifested in lateral organization of the basic detecting systems: motor, auditory, audio-verbal, visual (Bragina et al 1981: 288, Efimova 2007, Moskvin et al 2011; Khomskaya et al 2011). The combination of signs of asymmetry inherent in an individual is called differently, in particular, "individual asymmetry profile" (Bragina et al 1981), "functional sensorimotor asymmetry profile" (Leutin et al 2005; Nikolayeva et al 2012; Fomina 2006), "lateral organization profile (LOP) of motor and sensory functions" (Budyka et al 2010; Moskvin et

al 2011; Khomskaya et al 1991), etc. It is anticipated that depending on an individual's asymmetry profile there may be prevalent either left or right hemisphere information processing strategy and functions regulation, and consequently, this defines the individual psychological characteristics (Bragina et al 1981, Moskvin et al 2011; Nikolayeva et al 2012; Poborský 2013; Khomskaya 1999; Khomskaya et al 2011).

This paper summarizes the results of the work performed within the framework of the neuropsychology of individual differences by the research group under the direction of Professor E.D. Khomskaya (Budyka et al 2010; Efimova 2007; Efimova et al 2009; Moskvin et al 2011; Khomskaya 1999; Khomskaya et al 1991; Khomskaya et al 2011), using the evaluation technique for the lateral organization profile of motor and sensory functions and typology of lateral organization developed by E.D. Khomskaya, I.V. Efimova (Khomskaya et al 1991; Khomskaya et al 2011). Based on the above typology after determining the individual lateral profile, each examinee is assigned to one of five types of lateral organization profiles: 1) "pure" right-handers; 2) right-handed persons with dominant right hand and combinations of signs of sensory asymmetry; 3) ambidextrous; 4) left-handed with combinations of signs of sensory asymmetry, and 4) "pure" left-handers. "Pure" right-handers are characterized by only right-sided asymmetry signs. Right-handed persons with combinations of signs of asymmetry are those with the predominance of right hand and various combinations of signs of asymmetry in the audio-verbal and visual systems. Ambidextrous persons are individuals with the symmetry of hands and the various lateral signs in the audio-verbal and visual systems. Left-handed persons with combinations of signs of asymmetry are those with the predominance of left hand and various combinations of signs of asymmetry in the audio-verbal and visual systems. "Pure" left-handed are people with the left-sided signs of asymmetry.

We are going to consider some of the studies in neuropsychology of individual differences, and the main results achieved.

Individual Psychological Features of Representatives of Different Types of Lateral Organization Profile (LOP)

Synthesis of the results obtained in a series of studies, has served as the basis for the descriptions of some individual psychological features of different types of lateral organization profile, the detailed studies may be found in various publications (Budyka et al

2010; Efimova 2007; Efimova et al 2009; Moskvin et al 2011; Khomskaya 1999; Khomskaya et al 1991; Khomskaya et al 2011). It should be noted that most of the series studies detected differences related to sex. The data presented below characterize the male examinees.

The most obvious differences were observed among representatives of the opposite lateral organization profile groups – “pure” right-handers, on the one hand, and the “pure” left-handers and left-handed persons with combinations of signs of asymmetry (together), on the other (Efimova 2007; Khomskaya et al 1991; Khomskaya et al 2011). For example, motor, cognitive, and emotional processes of individuals in the first group compared to the second were characterized by higher dynamic indicators (both speed and regulatory). At the same time, "physiological price" of physical and intellectual load for "pure" right-handers was higher than that for left-handers and left-handed persons with combinations of signs of sensory asymmetry. Along with that, the right-handers had the above average self-evaluation of health and well-being and fewer complaints which indicate psychological and emotional maladaptation. The data obtained in different series of studies showed differences in the emotional sphere of representatives of the opposite groups: "pure" right-handers often showed the predominance of positive emotional subsystems, while left-handers and left-handed persons with combinations of signs of sensory asymmetry demonstrated the prevalence of the negative one. It was registered both at the level of emotional reactions and emotional states. In our point of view, this fact may be taken into account in the context of clinical psychology.

Representativity of persons belonging to the considered LOP differs in various types of the examined samples. The so-called "creative" professions are the most frequently chosen by left-handers and left-handed persons with combinations of signs of sensory asymmetry, while technical professions and occupations that require rapid response and high reliability – by right-handers (Moskvin & Moskvina, 2011; Khomskaya & Efimova, 1991). Consideration of the results of the series of studies concluded that in the majority of the samples, the most common type of LOP was the type of right-handed persons. Individual psychological features of people of this type are quite diverse. When the right hand dominance is combined with one left sensory sign (dominant left ear for speech or dominant left eye) the individual psychological characteristics were closer to those of the "pure" right-handed. The situation was reverse in the presence in LOP of two left-hand lateral signs in these sensory systems, in

this case special features of such persons were more similar to those found with the left-handed.

Heterogeneous is the group of ambidextrous persons (Efimova, 2007), whose individual psychological characteristics are often similar to those described as the left-handed persons with combinations of signs of asymmetry and left-handers. Ambidextrous persons quite often inherent in the reduced dynamics of cognitive and motor processes, frequent are fragile self-esteem of the current functional status and high trait anxiety (Khomskaya, Efimova, Budyka, & Enikolopova, 2011).

Below are the results of more individualized studies that extend the understanding of individual differences in various spheres of persons with diverse signs of functional asymmetry.

Differences in Indices of Functional States in Representatives of Different LOP Types

Outlined in the previous section individual differences of opposite groups divided by the LOP types may be taken into account in the analysis of functional states which is important in the research and practical experience of a clinical psychologist. It is known that while assessing functional states there mainly are used indicators of regulation (in particular, vegetative) of cardiovascular system, various sensory-motor reactions (for example, simple and complex (SVMR and CVMR) visual-motor reactions) and other psychophysiological data (Efimova et al 2009; Tvorogova 2006, Nikolayeva et al 2012). The subjective assessment of the functional state is also often carried out (Tvorogova 2006).

Studies of individual differences conducted in neuropsychology have led to the conclusion that the characteristics of the functional state of males with different lateral organization of motor and sensory systems vary. For example, in the study of male job seekers in the bodies of Internal Affairs (73 people), the following results have been notably recorded (Budyka et al 2010). Best average time visual-motor responses and performance indicators of the quality of work with the proof-correction samples were noted in males when there are symmetrical or left-hand signs in LOP (table 1).

Table 1 shows the average values of time (SVMR and CVMR), as well as evaluating advances and lags in reaction to a moving object (RMO).

Table 1

The Average Time SVMR and CVMR, RMO Score Ratings for Groups of Men with Different LOP Types

Group	Indicators			
	SVMR (ms)	CVMR (ms)	Score of advances with RMO, points	Score of lags with RMO, points
"Pure" right-handers, n = 25	281,2±20,2	379,7*±36,4	4,11*	4,89
Right-handed with combinations of asymmetry signs, n = 32	292,5*±16,0	404,7*±28,6	3,94	4,63
Ambidextrous, n = 6	291,7±16,5	372,3±5,5	3,67	4,50
"Pure" left-handers, left-handed with combinations of sensory asymmetry signs, n = 10	273,6*±16,3	382,7±37,3	3,70*	4,60

Note: * significant differences in rates of different groups (p from 0.01 to 0.05 for different comparisons) that are identified using the U Mann-Whitney criterion.

High performance speed with the used digital (modified Bourdon test) and verbal (Munsterberg technique) proof-correction samples with lower performance quality were demonstrated by those with right signs functional asymmetry, which is illustrated in table 2.

Table 2

The Average Time and Error Rate in Digital Bourdon test for Examinees with Different LOP Types

Group	Indicators			
	Time		Average error frequency	
	Form 1	Form 2	Form 1	Form 2
"Pure" right-handers	250,5*±58,1	218,2*±45,9	1,6*±0,5	1,3±0,4

Right-handed with combinations of asymmetry signs	**250,9±55,0	**209,2±48,1	**1,5±0,5	1,4±0,7
Ambidextrous	261,7±46,9	238,2±32,6	1,0±0,2	0,9±0,5
"Pure" left-handers, left-handed with combinations of sensory asymmetry signs	**383,6*±77,4	**355,7*±112,2	**0,7*±0,2	0,5±0,5

Note: * and * significant differences (p from 0.01 to 0.05 for different comparisons) groups, which differ according to LOP type.

As mentioned above, a comprehensive assessment of the functional state often comprises indicators of vegetative regulation of the cardiovascular system, including the results of the analysis of heart rate variability (HRV) according to the methodology of R.M. Bayevsky (Aghadjanian et al 2010; Aghadjanian et al 2006; Bayevsky et al 2009; Nikolayeva et al 2012). Given that the latter reflect the regulatory mechanisms of the whole body, it may be possible to use them while describing the physical (somatic) health in general (Aghadjanian et al 2006).

Differences in Rates of Individual Health Representatives of Different LOP Types

For clinical psychology health issue (not only mental but also physical) is important. It is obvious that, on the basis of the biopsychosocial model of health, it is necessary to review the components of health in their unity that defines the need for interdisciplinarity and complexity of analysis. Researches' attention is aimed at clarifying the criteria of health standards, as well as assessment of individual's health. Considering this, the interest of neuropsychology of individual differences to this issue is understandable. Despite the fact that it is interdisciplinary, various health research studies often underestimate the typological features of the body, although special literature is replete with evidence that they affect many aspects of health. Health studies are hampered not only by the complexity of evaluation, but, more importantly, by understanding it as a phenomenon. Mainly it is considered as qualitatively specific human condition characterized by the flow of such processes, which ensures optimum life and adapt to constantly changing external conditions of the environment. Therefore, the adaptive approach to health analysis continues to remain

relevant, because any activity (physical and mental) is accompanied by a certain stress level of adaptation and regulatory mechanisms. On the assumption of the stated provisions, comprehension of the level of health or its graduation are based on analysis of peculiarities of adaptation to the effects of various external factors (Aghadjanian et al 2010; Aghadjanian et al 2006; Efimova et al 2009).

In neuropsychology of individual differences there were held various series of studies of individual health of students, with distinct signs of functional asymmetry. In accordance with the above views, individual health was described in terms of degree, graduation or level. As mentioned above, the assessment of the gradations of physical health while its complex description is quite often fulfilled on the basis of statistical analysis of heart rhythm variability (HRV) (Bayevsky et al 2009; Wolfe et al 2016).

Neuropsychological approach has been applied in the analysis of the differences of vegetative regulation of cardiac rhythm with male students, with different signs of asymmetry (Budyka et al 2017; Efimova et al 2016). The known HRV assessment methodology based on variational analysis of pulsogramms was applied (Bayevsky et al 2009; Poborský 2013; Wolfe et al 2016). Upon the results of five-minute recorded segments of ECG, the researchers estimated about 40 indicators, reflecting HRV and the ratio of contributions of the sympathetic and parasympathetic divisions of the autonomic nervous system in the regulation of the cardiovascular system. The obtained data gave grounds for prenosological diagnostics of physical health, i.e. level of individual health is determined (Aghadjanian et al 2010; Bayevsky et al 2009). The considered study involved first year students (140 people), the average age is 18.4 ± 1.3 years old. The examined students had been conditionally healthy, according to the institution clinic report, and had no acute or chronic diseases.

The data obtained in the course of the study showed that significant differences of HRV indicators were found with the examinees with different laterals signs in visual system. In particular, with left-handed asymmetries in visual system the condition of examinees was considered as satisfactory adaptation, and with right-handed asymmetries in visual system – as intenseness of regulatory systems, reflecting the lower level (gradation) of health (Budyka et al 2017; Efimova et al 2016).

Individual Psychological Features of Different LOP Types Representatives in Females

In case a clinical psychologist participates in the diagnosis of functional state of women, it is conventional to analyze the impact of hormonal level changes during ovarian-menstrual cycle on women's health (Nikolayeva et al 2012; Khomskaya et al 2011). In addition, the use of neuropsychological approach to the study of functional states involves taking into account the peculiarities of interhemispheric asymmetry.

The study of some indicators of functional state of women in the neuropsychology of individual differences focused on a number of series of studies, some results of which are set out below. One of them examined the individual characteristics of cognitive processes of female students depending on: 1) interhemispheric functional asymmetry and 2) taking into account fluctuations of functional states associated with the change in hormonal levels during ovarian-menstrual cycle (OMC). The study consisted of two sections. The first section deals with analysis of traditionally assessed functional states of the operational and dynamic components of several cognitive processes with female students who have different signs of functional asymmetry. The second describes some of these components changes due to fluctuations of the functional condition of examinees within the ovarian menstrual cycle and functional asymmetry.

The research was carried out on female university students (a total of 127 people) aged 18-20. The following methods were applied: modified digital Bourdon test, Landolt's Rings test, Stroop Color-Word Interference test, techniques for estimation of time of simple visual-motor reaction (SVMR) and complex visual motor reaction (CVMR), motor and modified blank tapping tests. The influence of hormonal fluctuations on the functional state of girls within the ovarian menstrual cycle (OMC) was studied in four phases: menstrual, follicular, ovulation and premenstrual. The definition of the cycle phase was based on the examinees' evidence. The technique for evaluating response time was performed by the girls with their dominant hand (Budyka et al 2016).

The results obtained in the first phase demonstrated that with the prevalence of right sign asymmetry in the motor manual and audio-verbal systems of the girls there were detected higher speed and regulatory indicators of different cognitive processes, and in the presence of symmetrical and left signs in the motor manual system the speed of visual and motor reactions and the quality of correctional samples were higher. In particular, there were registered higher speed indicators in performance of visual perceptive, verbal, simple

counting and graphics operations, as well as better abilities for arbitrary regulation of performance of simple and complex programs of cognitive activities with the girls with the dominant right hand. Right-handed examinees with right-sided audio-verbal organization system had higher speed of verbal and visual-perceptive operations (Budyka et al 2016).

The second phase of the work under consideration traced a correlation of the nature of fluctuations of the dynamic indicators of motor and cognitive processes within OMC with the peculiarities of lateral organization of motor manual and visual functions. Therefore, examinees with the dominant right hand showed better SVMR indices in the follicular phase of the cycle, while the higher dynamic characteristics of complex cognitive activity – in the ovulatory phase. Representatives from the opposite group (ambidextrous and left-handed) didn't demonstrate significant fluctuations of the studied processes within OMC (Budyka et al 2016).

Considering the signs of asymmetry, the following differences were noted in the visual system. The tested persons with the leading right eye showed significantly lower latent response time in the ovulatory phase compared to that obtained in the menstrual phase. The girls with the dominant left eye or with the symmetry in the visual system were polarized: in the menstrual phase they indicated the lowest average value of SVMR time, but a significant increase in the reporting indicator was detected in the ovulatory phase of the cycle. Furthermore, it was found that the dynamic characteristics of cognitive processes did not change significantly within the OMC of the examinees with right signs asymmetry in the visual system and characterized by fluctuations of the surveyed girls symmetric and left-hand signs asymmetry in the visual system. In particular, the latter had significantly different indices in productivity of Landolt test in the menstrual and ovulatory phases of the cycle (average productivity was lower in the menstrual phase) (Budyka et al 2016).

Summing up, the current work has set forth the results of several studies in neuropsychology of individual differences, which affirm the possibility of using neuropsychological approach to their identification, characterize separate directions of analysis and could serve as a basis for further work with the purposes of accumulation of information in this area and its practical use.

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