

Neurobiological preconditions of behavioural adaptive strategies under extreme conditions of activity

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Abstract. The aim of the work was to identify neurobiological preconditions of efficiency behavioural adaptive strategies of subjects under extreme conditions of activity. The research used an instrumental study technique of making decisions under conditions of choosing among several alternative reactions. Psychodiagnostic testing was performed using blank methods: MMPI (Minnesota Multiphasic Personality Inventory), Cattell's 16 PF (Sixteen Personality Factor Questionnaire). The most sensitive marker of activity in extreme conditions with a high degree of uncertainty according to a number of criteria: time, weakly determined by the method of achieving the result is accidental selection method. Maximum activity efficiency demonstrate subjects who use «repeated» and «repeated N times in a row» behavior strategies. Probably, the set of response options to a situation which a subject has in his/her memory allows subjects to perform tasks in the shortest time. Such behavioural strategy leads to a decrease in the level of uncertainty of the environment, which can effectively prevent the damaging effects of stress, change negative emotions to positive, to act as a non-specific motive for various forms of behavior.

Key words: *extremeness, professional activity, uncertainty of the environment, strategies of behaviour.*

I. INTRODUCTION

Professional activity takes an important part in a person's life. The problem of the impact of extreme working conditions on mental and physical health stays relevant throughout decades. Various aspects are considered in the available literature: from conceptual apparatus of extreme activity to destructive changes in the body under the influence of negative working conditions [1, 2, 3, 6, 9, 12, 13, 16 - 18]. The ultimate goal of the research is development of complex prediction professional suitability of the subject of activity – the human – to effective implementation of its tasks with maintaining a certain level of health to what drew attention B. F. Lomov: « one of the goals of reflecting the activity of the subject is his/her professional suitability which can be considered as a system quality of a subject» [8]. Analysis of literature on various aspects of extreme professional

activity leads to the conclusion of fragmentation of the many accumulated facts, their often low comparability due to the difference of methodological and conceptual approaches. Therefore, it is almost impossible to reproduce the results. To contribution, researches of subjects of professional activity are carried out in natural conditions of the working environment which are accepted as standard. B. F. Lomov drew attention to the fact that the study of activity and its subject, means and conditions should be carried out only as it is necessary to understand its processes, states and characteristics of the subject. There was a number of system-forming components of the system of activity identified which include «motivation, purpose, planning of the activities, processing of current information, operational image, decision making, actions, verification of the results and correction of actions» [8]. These components do not exist in isolation they act as interrelated and perform various regulatory functions in preparation, organization and performance of activities. Influence on the formation of professional fitness has each of the following components. All of the above applies not only to psychology, but to neurophysiology closely connected with it.

Our purpose of the work was to identify neurobiological preconditions of efficiency behavioural adaptive strategies of subjects under extreme conditions of activity.

II. METHODOLOGY, SUBJECT AND OBJECT OF RESEARCH

The author's method involves three experimental models of activity of which more interest is free choice of

reaction generation – behaviour that doesn't depend on regularities of occurrence of stimulation on device panel with positive reinforcement. Psychodiagnostic testing was performed using blank methods: MMPI (Minnesota Multiphasic Personality Inventory) [1], Cattell's 16 PF (Sixteen Personality Factor Questionnaire) [10]. The subject of the study was cognitive-behavioral and personal construction of decision-making in an experimental environment «choice - monitoring» the pattern of appearing stimulations and neurohumoral reactions to the level of extreme working environment. The object of the study were chosen 1) patterns of decision-making according to success of performance of official duties by the staff of rescue formations [5].

Criteria of division into successful and unsuccessful employees were defined taking into account objective signs which reflect their professional productivity and views of the commission of competent experts [5]. The study involved 180 men - rescue workers of The Emergency Rescue Formation of the Arkhangelsk region who were recognized by the medical commission healthy. Taking into account features of activity all subjects were divided into 2 groups: the professional rescuers (113 men, or 59,3 % examined, average age $33,51 \pm 0,88$ years, average work experience as a lifeguard $14,05 \pm 0,65$ года) and freelance rescuers (67 men, or 40,7 % examined, average age $19,49 \pm 0,28$ years, average work experience as a lifeguard $0,70 \pm 0,15$ years).

The obtained data were analyzed using the package Statistica (StatSoft Inc.USA, version 7,0). For all indicators, the evaluation of the distribution of signs on the normality was carried out with the use of the criteria for the Shapiro-Wilk test. In a normal distribution of the indicators and equality of variances of the studied signs to exclude the null hypothesis, the Student's t-test was used and for descriptive statistics - arithmetic mean and standard deviation. To distinguish the distribution from the normal one nonparametric statistics methods were used. The parameters of descriptive statistics for quantitative indicators are given in the form of a median (Me) and interquartile range (25th; 75th percentiles – q25; q75). To

compare the intergroup data The Mann criterion was used and Whitney's test for independent samples. Identification of the relationship of indicators was carried out with the help of rank correlation analysis of r-Spearman. The critical level of significance (p) when testing statistical hypotheses in the study was accepted $\leq 0,05$.

III. RESULTS

The conducted instrumental testing in an experimentally created environment in free choice mode was interpreted by us as activity in the conditions of uncertainty of the environment. The famous Yerkes – Dodson biological law states that for optimal level activity is needed an appropriate level of arousal [19]. At the same time, there is an appropriate level of stress. D. Hebb supplemented the law with the provision on the optimal level of stimulation of afferent systems [14]. Subsequent studies have shown [15], that the threshold of sensitivity to stimulation is repeatedly reduced if stimulations are random and/or they are virtually impossible to control which means that the subject cannot change the situation by his behavior. Thus, uncertainty is understood as a subjective assessment of our own ability to anticipate events (predictability) and/or influence them (controllability). In our previous studies it was established preference for choice in conditions of free activity is decisive in the overall structure of the behavioural act [3]. Accordingly, the proportion of the three types of choice (single, repeated, repeated N times in a row) it was taken as a basis for comparing the results of testing highly successful (HSR) and low successful (LSR) rescuers.

Tab. 1

Differences in structural parameters in the conditions of "free" activity between high-and low-success rescuers (M \pm SD)

Choice preference, %	HSR	LSR	p - value
Repeated choice	48,01 \pm 3,50	32,47 \pm 3,99	0,041
Repeated N times in a row	47,55 \pm 3,97	29,55 \pm 4,01	0,001
Single choice	46,81 \pm 4,33	63,04 \pm 4,67	0,032

Analysis of the results showed that HSR have all kinds of choices were presented equally. In group LSR on

the contrary, there was a dominance of the «single» type of choice (tab.1).

The prevalence of single choice in an accidental environment can be interpreted as a limited set of behavioral stereotypes of the subject. Accordingly, any change in the environment in terms of increasing uncertainty causes difficulties in the activities of this group of persons. It should also be noted a lower average rate of reactions (average time between reactions) in group HSR ($0,95 \pm 0,05$ against $0,74 \pm 0,04$, $p=0,030$), that indicates a large time spent in the decision-making process. From a psychological point of view, the LSR were much more prone to disturbing reactions and suspiciousness than HSR (7 scale MMPI ($55,38 \pm 1,52$) and ($51,12 \pm 1,21$) T-points, $p = 0,003$; factor O of the test 16 PF ($5,46 \pm 0,14$) and ($4,48 \pm 0,12$) correspondingly, $p < 0,01$). They are more tense, less satisfied with their social status, more frustrated and irritable (factor Q4 test 16 PF ($5,1 \pm 0,15$) and ($4,22 \pm 0,13$) correspondingly, $p = 0,004$); their self-esteem is at a lower level, and the need for communication is met with less effort. At the same time highly successful rescuers are more sustained, more resistant to emotional stress, more determined (factor C test 16 PF ($7,16 \pm 0,15$) and ($6,12 \pm 0,13$) correspondingly, $p < 0,001$). Fundamental differences in the structural parameters of behavior between groups of professional and freelance rescuers with free choice were not found, that allows us to assume universality of the method of ranking offered.

IV. CONCLUSIONS

A. N. Leontiev's concept of activity [7] as «the process of interaction of the subject with the object» and his further postulates about the activities as about inner, our concept of differentiated behavioral activity in extreme conditions is confirmed by the subjective characteristic of a person. The most sensitive marker of activity in extreme conditions with a high degree of uncertainty according to a number of criteria: time, weakly determined by the method of achieving the result is accidental selection method. Maximum activity efficiency demonstrate subjects who use «repeated» and «repeated N times in a row» behavior strategies. Probably, the set of response options to a

situation which a subject has in his/her memory allows subjects to perform tasks in the shortest time. Such behavioural strategy leads to a decrease in the level of uncertainty of the environment, which can effectively prevent the damaging effects of stress, change negative emotions to positive, to act as a non-specific motive for various forms of behavior.

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