THE YOUNG SCHOLARS

Yatsenko N.A.

Psychophysiological and psychological features of controllers of telecommunication networks in extreme conditions of professional activity

Psychophysiological and psychological features of 67 controllers of telecommunication companies (dispatchers and shift engineers) with different levels of professional progress are *investigated. It is ascertained that the efficiency of professional activity of controllers of telecommunication networks in extreme situations is determined by a specific combination of lateral organization, typological characteristics of a person, sympathetic-parasympathetic mechanisms of regulation of a functional state and coping strategies with difficulties.*

Key words: *controllers of telecommunication networks, tolerance to stress, extreme conditions of professional activity, coping strategies.*

The research is conducted within the framework of the analytical departmental special-purpose program «The Development of Scientific Potential of Higher School (2009–2010)», the project ROST-NICh-734.

Successfulness of functioning of automated control systems depends on reliability and efficiency of activity of controllers. It becomes especially actual if controllers work in various extreme conditions (air traffic controllers, railway transportation dispatchers, controllers of nuclear power plants, controllers of telecommunication networks and others). Mistakes in their work cause grave, sometimes tragic consequences when the result of their work and at times health and lives of many people depend on efficiency of decisions and successfulness of their actions. Therefore the study of psychophysiological features of a person-controller which can affect the results of his/her professional activity has an important theoretical and applied value.

A great number of researches of psychological and psychophysiological aspects of controllers in intensive and extreme situations of professional activity are devoted to studying adaptable potential of a person [1, 5]. Some researches are connected to studying features of functional states of professionals in extreme situations [3, 4]. The analysis of works of these researchers allows us to ascertain that a large role of functions of intellectual and emotional-volitional components is a characteristic feature for the work of controllers.

The activity of a controller has got a number of the features determined by the following tendencies of development of modern industry [11].

1. The number of objects (and their parameters) which should be operated are increasing with development of technical equipment. It complicates and raises a role of operations of planning and organizing work, controlling and managing industrial processes.

2. Remote control systems are developing. A person becomes more and more remote from controlled objects. He/she can conclude about their condition dynamics not relying on direct observation, but on the basis of signals' perception from the information display devices imitating the real industrial objects. Carrying out remote control, a person receives the required information in code (i.e. as readings of meters, indicators, measuring devices, etc.). It causes necessity of decoding and mental comparison of the received information with a condition of the real controlled object.

3. The increase of complexity and speed of development of industrial processes makes keen demands for accuracy of actions of controllers, and for the speed of their decision-making in management. The responsibility for performing actions is increasing extensively as a mistake of a controller even in the simplest action can break the work of the whole system. In this connection the problem of criteria of complexity of work of controllers is posed in a different way. The basic criterion becomes not physical aspect of work, but its neuropsychic intensity.

4. Under the circumstances of modern industry working conditions of a person are changing. For some kinds of work of a controller it is typical a restriction of motion activity which does not only appear in the general reduction of muscular work, but is also connected to preferred use of small groups of muscles [10]. Sometimes a controller should do the work under the circumstances of isolation from the habitual social environment, surrounded by devices and indicators. And if these devices are designed without taking into account psychophysiological features of the controller, or represent him/her the false and distorted information, then there is a situation which is figuratively called «a conflict» of a person with devices.

5. Increasing automation of productive processes demands a controller to be always ready for urgent actions. At normal behavior of a process the basic function of a controller is its checkup and supervision. When distortions emerge, the controller should sharply turn monotonous work under «operational rest» conditions to active, vigorous efforts focused on elimination of the emerged deviations. And at the same time he/she should process a plenty of information, take and implement a correct decision during a short period of time. It results in sensory, emotional and intellectual overstrains.

For such kind of controllers' work as an operator-supervisor (a dispatcher, a controller) information and conceptual models as well as processes of decision-making have a great importance [8]. The operator-supervisor can work in a postponed service mode. Such type of activity is mass for systems working in real time (operators of a radar station, dispatchers of various types of transport, controllers of telecommunication networks, etc.).

The analysis of activity of controllers of telecommunication networks carried out by us has shown that their work is tightly correlated with the following psychological components.

1. Perception of information (connected to waiting for a signal, a state of vigilance, readiness for reception of information, active information search).

2. Processing the information (problem-solving and decision-making of a different intellectual level, functioning of mechanisms of short-term memory).

3. Regulating actions.

The prominent feature of professional work of controllers of telecommunication networks consists in a wide and dynamic variety of professional situations: from a situation of waiting and readiness up to extreme emergency situations. The majority of researches of professional activity of controllers are connected to studying psychological aspects of self-control of functional state of controllers under extreme conditions [3, 7, 9]. The number of works studying the activity of controllers under monotonous and waiting conditions is much less [2].

Meanwhile, in the modern scientific literature there are practically no researches studying influence psychophysiological and psychological features of controllers of telecommunication networks on their functional state during dynamics of their professional work which is characterized by the change of professional situations from waiting condition up to extreme emergency situations.

The urgency of research of psychophysiological features of controllers of telecommunication networks in extreme conditions is caused by the contradiction: on the one hand the expansion of the telecommunication services market demands creation of effective and reliable control systems made for psychological and psychophysiological resources of effective activity of the controllers in extreme situations, on the another hand there is no theoretical and applied basis of researches for the given profession. The problem of research of psychophysiological and psychological features of controllers of the telecommunication networks, influencing on their functional states in extreme conditions of their professional activity, is of interest not only for theorists, but also for practical experts, and even so the number of applied researches in this area is scant [6]. In this connection the problem of research of psychophysiological characteristics of a controller in dynamics of various professional situations is rather actual.

The purpose of the work is to study psychophysiological and psychological features of controllers of telecommunication networks in extreme conditions of their professional activity.

The object of research is 67 higher-educated controllers (dispatchers and shift engineers of operational management departments) of the telecommunication company «TransTeleCom-Kavkaz», aged from 25 till 42 years old.

Methodical techniques of research: «Diagnostics of a level of emotional burnout by V.V. Boyko», «Test of a self-estimation of tolerance to stress by S. Kouhen and G. Villianson», «Technique of individual coping strategies (strategies of overcoming) determining by E. Hiem», «Questionnaire of formal-dynamic characteristics of personality (QFDCP) by V.M. Rusalov», «Questionnaire of characteristics of nervous system by Strelyau», «Technique of profile determining of lateral organization (PLO)» (computer version), technique «Choice of a side» by E.P. Torrens.

Parameters of successfulness of controllers have been diagnosed by means of the computer program which simulated standard operations of monitoring, detection, analysis and decision-making, which are inhered in the given type of controllers' activity. Examinees did a simple type of controllers' activity such as a technique «Shultz tables» (computer version) and a complex type of controllers' activity which included 10 different tasks: moving target tracking and complex sensomotor reaction in hindrances and information stress conditions; attention dividing in combination with cognitive tasks solving in conditions of dissimilar perceptual field and time pressure; percept-images discerning together with a complex sensomotor reaction of a choice, etc. If a controller made a mistake, they mechanically heard through headphones an audible warning signal with frequency of 1000 Hz, volume of 60 dB, which was estimated by them as loud and unpleasant and was considered as an additional hindrance, raising a degree of extremeness in a situation modelling professional work of controllers.

Successfulness of activity of controllers was estimated in accordance with a complex parameter of psychomotor characteristics: average reaction time and its variability, a number of mistakes in each task, and also general parameter of productivity and time of fulfillment of each task.

The estimation of a functional state of controllers was carried out in background and functional tests by means of recording of psychophysiological correlates of the functional state (FS): period of breathing, phasic component of galvanic skin response (by Tarkhanov), parameters of cardiac rate (CR) according to plethysmogram. The analysis of parameters of breathing, cardiac rate and galvanic skin response was carried out by artifact-free 5-minute sector of polygrammes. Amplitude and temporal parameters of cardiac rate were analyzed: a frequency of cardiac rate (FCR), a parameter of variability of cardiac rate (SDNN), an average length of RR intervals, an index of stress (IS). Such parameters of galvanic skin response as amplitude (A) and length (L) were analyzed. Polygraph detector «Polarg-M» was used for diagnostics of vegetative parameters.

Statistical data manipulation was conducted with help of standard methods of mathematical statistics using «STATISTICA 6.0» software package. MANOVA (multivariate analysis of variance), calculation of average values and the comparative analysis of differences of average values of researched variables by Mann-Whitney U-test were made. A degree and characteristics of correlations between variables were revealed by means of Spearman correlation test.

The following **conclusions** are drawn as a result of the carried out research.

1. All controllers of telecommunication networks displayed that cognitive tasks solving in conditions of dissimilar perceptual field and attention dividing in conditions of time pressure in the process of a quick change of a situation of waiting to an extreme emergency situation lead to a sharp decrease in productivity, increase in number of mistakes and reaction time. It allows us to consider the given conditions as extreme ones for the researched category of controllers.

2. It was shown that professionally successful controllers differed from their less successful colleagues with higher parameters of productivity, lesser time of sensomotor reaction to the moving object, better attention dividing, higher ability for discernment and comparison of significant information in extreme conditions of professional activity.

Professionally successful controllers of telecommunication networks are characterized by a combination of a imbalance of nerve processes towards inhibition, an average degree of emotionality and speed in communicative sphere together with the well-defined predominance of right-side profile of lateral organization (the right hand, the right eye and the right ear), which indicates the domination of the left cerebral hemisphere. This group of controllers is characterized by high tolerance to stress in combination with preference for using adaptive emotional coping strategies in extreme emergency situations. The tolerance to stress of professionally successful controllers of telecommunication networks is interrelated with ill-defined emotionality in psychomotor sphere and preference for adaptive emotional coping strategies.

Highly successful controllers of mixed type of profile of lateral organization are characterized by a smaller degree of tension of regulatory systems, more balanced vegetative homeostasis in extreme emergency situations, and also tendency of using productive emotional coping strategies.

Frequency of cardiac rate and length of galvanic skin response are considerably less expressed in functional tests against background, and the level of parameters of variability of cardiac rate (SDNN), index of stress (IS) and amplitude of galvanic skin response is higher in professionally successful controllers of telecommunication networks preferring emotional productive coping strategies than in controllers resorting to rather adaptive and nonadaptive emotional coping strategies, which reflect the less tension of control mechanisms of the first ones.

Controllers of telecommunication networks of the average level of successfulness are characterized by a combination of high strength of the nervous system and imbalance towards excitation, high emotionality in intellectual sphere together with the ill-defined sensomotor asymmetry and the average level of tolerance to stress.

The increase of frequency of cardiac rate of controllers of telecommunication networks of the average professional successfulness in an extreme situation is accompanied by decrease of parameter of respiratory arrhythmia (RMSSD) which is connected to the increase of a defense reflex, becoming of hyperadaptive reaction for data traffic and onset of fatigue. In an extreme situation the fulfilment of a complex activity by controllers of the average level of successfulness is accompanied by the increase of the number of mistakes and background spontaneous fluctuations of galvanic skin response which reflect becoming of hyperadaptive reaction and fatigue, and also a higher level of tension than their highly successful colleagues have.

3. It is proved that the primary factor influencing on the functional state of controllers is the necessity of fulfilment of a complex cognitive activity with a high level of responsibility in conditions of a quick change of a situation of waiting to an extreme situation.

It is detected an effect of interaction of psychophysiological factors (characteristics of nervous system and feature of functional interhemispheric asymmetry) influencing on dynamics of functional state of the controllers in extreme conditions. And during the change of a situation of waiting to an extreme emergency situation the capital contribution to the dynamics of functional state of highly successful controllers make psychological factors (tolerance to stress, coping strategies, formal-dynamic properties of personality), and psychophysiological factors (characteristics of nervous system, feature of functional interhemispheric asymmetry) of controllers of the average level of successfulness.

4. The influence of features of functional interhemispheric asymmetry on dynamics of functional state of controllers in a situation of waiting is mediated to a greater extent by psychological factors: a high level of tolerance to stress, the type of coping strategies, formed style of thinking; and in extreme conditions by psychophysiological factors: characteristics of nervous system, characteristics of temperament and features of sympathetic-parasympathetic mechanisms of regulation.

The practical value of the work consists in an opportunity of using the results received in the research for developing biotechnical complexes modelling controllers' activity, allowing us to monitor unfavorable mental and functional states of controllers in order to prevent intensive and stressful states and monotonia, to support the accuracy of controllers' activity, and to prevent them from inadmissible shifts of functional states.

References

1. Antipov V.V. Psychological adaptation to extreme situations. – M.: VLADOS-PRESS, 2002. – 176 p.
2. Gorbov F.D., Lebedev V.I. Psychoneurological aspects of work of controllers. – M.: Medicine, 1975. – 207 p.
3. Dikaya L.G. Mental self-control of a functional state of a person (system-activity approach). – M.: Publishing house «Institute of psychology of the Russian Academy of Science», 2003. – 318 p.
4. Dikaya L.G., Krylova G.Ju. Situational and personal determinants of process of becoming a professional in internal affairs bodies of the Russian Federation. // The year-book of the Russian psychological society: Special issue. – V. 2. – M.: Eslan, 2005. – P. 361–363.
5. Dyachenko M.I., Kandybovich L.A., Ponomarenko V.A. Readiness for activity in intensive situations. Psychological aspect. – Minsk: Publishing house University, 1985. – 206 p.
6. Zheglova K.Ju. Features of dynamics of forming mental burnout in controllers of telecommunication connection: the abstract of thesis for the candidate of psychological sciences. –Yaroslavl, 2007.
7. Leonova A.B., Medvedev V.I. Functional states of a person during labour activity. –M., 1981. – 135 p.

8. Sergeev S.S., Saraeva V.E. Automated system of psychological vocational selection for train dispatchers. // Psychological researches: the collection of scientific and methodical materials. – Issue 1. – SPb., 2000. – P. 29.
9. Smirnov B.A., Korolev A.V. Laboratory manual of engineering psychology. – Kh.: National Aerospace University «Kharkov aircraft institute», 2004. – 164 p.
10. Frishman E.Z. Dynamics of sensorial-perceptual activity of a person at monotonia and fatigue: the psychophysical approach. // Psychological magazine. – V. 11. – № 5. – 1999. – P. 6.
11. Shibaev V.A., Psyadlo E.M. Computer psychognostic complex for vocational selection and training of operators «POROK-5». – Release bulletin / Odessa's centre of scientific technical and economic information. – № 282. – Odessa, 1999. – P. 21.