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Psychophysical Self-Regulation Training Is Prerequisite for Human Psychophysical Safety

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Abstract—The aim of the research is to discover how psychophysical self-regulation training influences person's psychophysiological functions. The knowledge is essential to create psychophysiological safety. Two groups of university students consisting of young men aged 19-21 were studied. The first group (experimental group) included young men who had been regularly trained according to relaxation psychophysical regulation system for 1-2 years; the second group (control group) included students who did not practice psychophysical self-regulation. The relaxation program of psychophysical regulation (PPR) developed by Mrs. T. Popova is based on psychophysical exercises (PPE) aimed to teach learners to attain rapid and deep body relaxation, and to train self-regulation of emotions and behavior. Electroencephalography, recording of psychomotor actions and heart performance, psychological testing of anxiety and psycho-emotional state were used to analyze psychophysiological functions. The research results showed that after psychophysical self-regulation there is a reduction in the heartbeat rate, blood pressure, anxiety, functional tension, as well as improvement of mood and general state, normalization of electroencephalography results, feeling of calmness and relaxation, and tolerance to a different opinion. All psychomotor parameters for the experimental group were higher than for the control group, which proves a beneficial influence of relaxation exercises on nerve functions. It has been concluded that it is prerequisite to train psychophysical self-regulation techniques to students as the fundamentals of psychophysiological safety and adequate social behavior.

Keywords—*psychophysical self-regulation, relaxation, students, heart, nervous system, psychophysiological safety*

I. INTRODUCTION

There has been an increase in the number of events all

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over the world connected with inadequate human behavioral reactions to life circumstances that caused human casualties. The following are the recent examples of such reactions which were reported by the press... A student shot his teacher and his classmates in Denver, the USA. Four people were wounded in the course of a traffic conflict with shooting which took place between drivers on one of highways in Surrey, Canada. A 17-year-old student and his friend were having fun jumping on people's cars. In the attempt to escape the scene he was knife-wounded in a belly by a law abiding citizen in the course of "self-defense".

And these are just a few latest examples which were widely discussed in the press. Unfortunately, many people have not been trained how to behave in aggressive environment, stressful and other life circumstances. While some universities provide courses of the first-aid assistance for emergencies, the techniques of psychophysical self-regulation are out of focus.

The modern education system contributes to students' psychosomatic disorders such as pronounced tension of body's functional state, performance degradation, exhaustion and nerve-regulatory functions disorder [1,2].

Children's extreme fatigue due to the intensification of education requires mobilization of adaptation mechanisms; it reduces adjustment abilities and influences negatively students' health [3]. The current teaching system does not contribute to brain flexibility, which is especially important in unpredictable and emergency situations.

College and university students also experience intensive academic loads and occasional stresses; they fail to follow a healthy life style. At examination period changes in students' psychophysiological parameters are observed, which manifest in increased anxiety, autonomic nervous system disorder and decrease of body's adaptation abilities [4].

Experts think that many unpleasant consequences could

have been avoided if people had known how to behave in different life circumstances. The absence of an academic subject on individual's psychophysiological safety in curriculum contributes to the development of inadequate reactions stereotype triggered by external actions, which gets fixed in the adult's behavior. All these facts show the necessity of development and embedment of psychophysiological safety programs together with psychophysical self-regulation courses into curriculum of basic and additional education.

In response to various influences a human experiences a certain emotional stimulation. When emotions are extremely powerful or negative a state of emotional strain may develop, which is accompanied by self-stimulation, high anxiety, fear and detrimental vegetative reactions.

A body possesses natural mechanisms of psychophysiological protection such as, for example, self-induced trance state, repression, avoiding stress and etc. To prevent inadequate reactions such qualities like self-control and self-improvement are to be developed since early childhood. These qualities will help a person to regulate his behavior under conflicting conditions of social influence or his own biological mechanisms, in particular, when a person is susceptible to compulsion and impulsiveness, and he is strongly dependant on external influence.

Psychophysical self-regulation (PPR) provides techniques and means, i.e. psychophysical exercises (PPE), which allow people to change intentionally their behavior, state, well-being, mood and even health by the force of their will. Thanks to self-regulation skills it is possible to regulate stress state. Psychophysicologists know that moderate quantity of stress stimulus is useful for adaptation and psychofunctional improvement. The best studied and widely used method is relaxation. Relaxation is a safe technique as it frequently occurs autogenously and it is a basic state for other psychophysiological exercises.

Psychophysical self-regulation methods and techniques are getting more widely used for health care and education of children and teenagers. American scientists have proved the necessity to create Children's Mental Health Services [5]. Correction of psychophysical state is especially important for children with developmental disorder [6]. Some authors believe that psychophysical self-regulation techniques may be used starting with pre-school age.

II. AIM

To determine how psychophysical self-regulation training influences human psychophysiological functions.

III. METHODS

The psychophysical regulation program that we have developed [7] is based on psychophysical exercises (PPE) aimed to teach learners to attain rapid and deep body relaxation. Apart from usual methods for muscle relaxation the program included psychophysical exercises to

concentrate attention on body parts or imagined (mental) images during breathing out, as well as breathing exercises and practices to regulate emotions and behavior.

The university students under the test were organized in two groups: group I (experimental) included male university students aged 19-21, who regularly were trained according to the psychophysical regulation system 2-3 times a week for 1-2 years; group II (control) included students who did not practice psychophysical self-regulation. Each group consisted of 17 people. All subjects were quite healthy, they did not do any sport and each participant signed informed consent for the test (The research was conducted on voluntary informed consent of the subjects, in compliance with the protocol approved by the Ethical Board of the Russian Academy of Sciences).

Functional state of central nervous system was determined by NS-Psycho Test, a computer psychophysiological complex [8]. At the same time to diagnose neurodynamic functions, the rate of psychomotor reactions was recorded before and after performing local muscle work until exhaustion, i.e. until it was impossible to maintain effort at the targeted level. A procedure of maintaining 1/3 of maximum grip on a wrist dynamometer was used as a local load. The multichannel electroencephalography from 16 cup electrodes connected with ear electrodes and localized according to the 10-20 system was recorded by Neuron Spectrum (Neurosoft, Russia). Computer assisted electroencephalography included spectral and correlation analysis that was performed using company-developer's software.

Functional state of cardiovascular system was analyzed by heart response to static local load. The subjects had their blood pressure (BP) and heartbeat rate (HBR) measured while sitting on a chair before, during and after the load. The heart regulatory processes were evaluated by heart rhythm variability both at rest and local load conditions. Cardiointervalogram was recorded for 5 minutes by R.M. Baevskiy's method [9]; using a computer program the following indicators of the central regulatory mechanisms activity were analyzed: mode amplitude (MA) and regulatory systems tension index (TI).

Also, a self-evaluation of psycho-emotional state was done using questionnaires (on general state, activity and mood) according to [10]. A scale was used for the estimation: below 4 points – low level of psycho-emotional state, from 4 to 6 points – normal level, above 6 points – high level. Trait and situational anxiety was estimated under the methodology [11].

The result data processing was done by means of Statistica 6.0 suite (StatSoft, the USA) and SPSS suite. We tested the results for compliance with the normal distribution law and found that the main group was largely a uniform distribution. We calculated the arithmetic mean (M) of the ordered sample, the standard error of the mean (m), and the Student's t -distribution, while accepting the critical importance value for the verification of statistical

hypotheses to be 0.05.

IV. RESULTS

The research results show that after psychophysical exercises all subjects had lower heartbeat rates and blood pressure levels (Table 1).

TABLE I. CHANGES IN HEARTBEAT RATE AFTER RELAXATION.

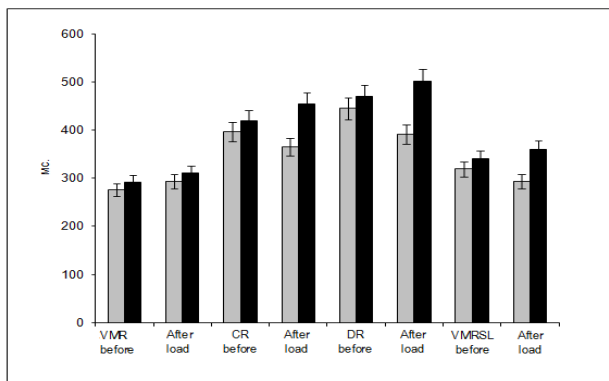
Groups	Indicators	
	Situational anxiety	Trait anxiety
Control group II	40,5 ±2,5	49,5 ±1,5
Experimental group I	31,5 ±4,5*	48,0 ±5,0

Note: * – statistical difference with initial values, at p < 0,05.

Heart rhythm structure monitored every two minutes during 10-minute period while psychophysical exercises were being performed showed uneven changes. So, at the first stages connected with visualization of images which were new for the subjects, there was some increase of mode amplitude (MA) and tension index (TI), and at the stage of relaxation development the parameters decreased which proved reduction of activity of central and sympathetic impact on the heart.

The research results showed that all the subjects who had acquired several psychophysical exercises usually featured a lower heartbeat rate and lower blood pressure after performance of psychophysical exercises. At the same time the subjects noted improvement of general condition and mood, and said they felt calm and relaxed.

After psychophysical exercises had been performed for 10 minutes, some changes in the computer-assisted testing were observed (Figure 1). All psychomotor indicators for the experimental group were higher than for the control group that proves beneficial effect of the relaxation exercises on the nervous processes mobility.



Note: 1st column – experimental group, 2d column - control group. SVMR - simple visual-motor reaction rate, CR - choice reaction, DR - discrimination reaction, VMRSLS - visual-motor reaction rate under static loads.

Fig. 1. Changes in neurodynamic indicators for the subjects in the experimental and control group

After a local load procedure with a wrist dynamometer,

in the experimental group during simple visual-motor reaction test there was some slowdown in reaction, but subsequent tests showed a tendency to an increase of all reactions rates compared to the initial levels. The data indicate a rapid recovery of excitability of the central nervous system, balance of the processes of excitation and inhibition in the subjects of the experimental group.

Therefore, the computer-assisted testing reveals that psychophysical exercises have a pronounced retarding impact on vegetative functions and a stimulating impact on neurodynamic functions.

The work results demonstrate that most students of the group II possess a higher situational anxiety than students of the group I (table 2). These facts prove that the subjects from the experimental group are better adapted to situations connected to psycho-emotional tension.

Therefore, our data prove that while performing relaxation psychophysical regulation exercises the body experiences significant changes in psycho-functional state.

The facts obtained in this work demonstrate the relaxation effect of psychophysical exercises on vegetative functions and the optimizing effect on locomotive apparatus functions, including recovery processes acceleration. The results of the questionnaire survey and the oral survey showed that students, who have mastered self-regulation skills, featured keener interest in the majors and in getting advanced knowledge, as well as higher self-confidence, tolerance to a different opinion and reduced irritability.

TABLE II. ANXIETY INDICATORS FOR STUDENTS, POINTS

Heartbeat rate bpm	Blood pressure bpm	Blood pressure mmHg
Initial values		
75,51 ± 2,06	119,19 ± 1,70	75,41 ± 3,05
After performing psychophysical regulation		
68,37 ± 2,08*	115,48 ± 5,77	68,70 ± 2,05*

Note: * - statistical difference between the groups

This Certain changes were revealed on the subjects' electroencephalograms while they were performing psychophysical exercises. At the background recording period for the subject K-v (20 years old) alpha activity was observed in all deflections with predominance in the occipital region (O1A1). When closing eyes there was a significant increase of alpha-rhythm power in frontal, central and occipital deflections.

Changes in bioelectrical activity of the cerebral cortex during relaxation state generation are of greatest interest. At the initial stage of relaxation (Fig. 2), an increase in the intensity of the power and alpha - rhythm index is observed in all deflections (average frequency is 10.5 Hz); at this time the second frequency zone of alpha - activity is being

formed (average frequency is 7.8 Hz).

At the second stage (beginning of visualization) there was a significant increase in the alpha rhythm power in the occipital region. At the same time, the power increase of the low frequency region of the alpha rhythm continued.

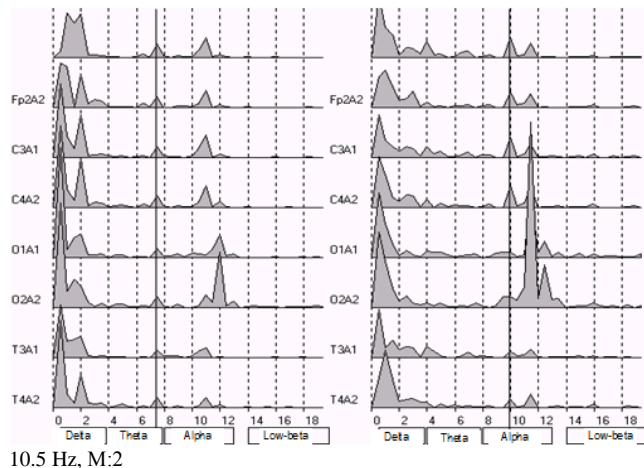


Fig. 2. Spectral analysis of electroencephalogram taken while psychophysical exercises were being performed

At the final period of relaxation state generation, a pronounced generalization of the alpha and theta rhythm was observed in the low-frequency region (8 Hz) with a slight predominance of power in the right hemisphere. It should be noted that the subjects described this state as euphoria. Coming out of the state of relaxation, the subjects felt refreshed, full of strength and energy.

All the data suggest that practicing psychophysical exercises leads to the functional state changes, which are characterized by normalization of vegetative functions, cortical-subcortical relationships and psycho-emotional state. At the period when regular classes for students under the program of psychophysical self-regulation were taught, no cases of inadequate and antisocial behavioral reactions were recorded. During the survey, all members of the experimental group noted some improvement in mood, benevolence and self-control.

V. DISCUSSION

Therefore, regular practice of relaxation psychophysical regulation exercises contributed to normalization of students' psychophysiological functions, which is prerequisite for adequate behavioral reactions. Press publications, films and TV effect negatively people's psyche, causing negative emotions, aggressiveness and irritability, turning a person into an obedient creature that blindly executes the orders and that is even capable of self-destruction [12].

Regular relaxation exercises lead to harmonization of the functional state by restoring the balance between the processes of excitation and inhibition. A person who regularly practices relaxation techniques is characterized by

tranquility and self-control in emergency situations. Relaxation contributes to normalization of locomotive apparatus functions [13] and hormonal sphere [14], as well as to self-control development. Various methods of relaxation exercises designed to correct psycho-emotional state are also proposed [15].

Self-control are processes by which a person is able to control his behavior under the contradictory influence of social environment or his own biological mechanisms, in particular, when a person is susceptible to compulsion and impulsiveness, and he is strongly dependant on external influence.

Inadequate reactions are associated with affective state which is due to the strong excitation focus in the brain cortex. As a result, the inhibitory process weakens, and the cerebral cortex loses ability to control the flow of impulses from the subcortical centers. Mastering self-regulation techniques will help to cope with this state using a switching mechanism.

The task of education is to teach a person how to meet his needs using techniques acceptable by the society where he lives. It is possible to develop a stereotype of an adequate mental reaction in a person, at least at the level of protection from simple speech aggression. The task of emotional self-regulation is to learn to restrain, sometimes suppress, and sometimes to keep the expression of emotions in the body at the optimal level. It is possible only if a person has a proper, adequate reaction to all stimuli, i.e. his behavior fully corresponds to the circumstances. This is how a mentally healthy person feels.

It can be said that psychological safety is the basis of adequate behavioral reactions. [16]. Training in psychophysical self-regulation is an alternative to the existing aggressive social environment [17].

VI. CONCLUSION

The results of our work suggest that teaching university students according to the relaxation psychophysical self-regulation programs tends to improve their psycho-emotional state, to reduce functional tension and may be used as a means to create psychophysiological safety. Psychophysiological safety is prerequisite for adequate behavioral reactions in person's social adaptation.

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