



HUMAN FUNCTIONAL MOTOR ACTIVITY DURING ACOUSTIC STRESS

ФУНКЦИОНАЛЬНО-ДВИГАТЕЛЬНАЯ АКТИВНОСТЬ ЧЕЛОВЕКА ПРИ АКУСТИЧЕСКОМ СТРЕССЕ



Meshcheryakov Alexey – PhD, Associate Professor, Head of the Laboratory of Fitness Technology SRI Sports at the Russian State University of Physical Culture, Sport, Youth and Tourism (SCOLIPE), Moscow, Russia, aleksei236@rambler.ru

Мещеряков

Алексей Викторович – канд. биол. наук, доцент, заведующий лабораторией физкультурно-

оздоровительных технологий НИИ Спорта Российского государственного университета физической культуры, спорта, молодежи и туризма (ГЦОЛИФК), Москва, Россия

Keywords: sport, stress, reaction activity.

Abstract. *The authors discuss the impact of sound effects «shock» or «explosive» type structure on the human behavioral response. In the experiment, they note individually-typological motor-mental reaction to the impact of extreme acoustic stressor.*

Ключевые слова: спорт, стресс, реакция, деятельность.

Аннотация. *В статье обсуждается вопрос о влиянии звуковых воздействий «ударного» или «взрывного» типа на структуру поведенческой реакции человека. В эксперименте отмечена индивидуально-типологическая двигательно-психическая реакция на воздействие экстремального акустического стрессора.*

Introduction. April 15, 2013 during the Boston marathon there was a terrorist attack (explosion). In connection with the possibility of the emergence of such an extreme situation in the sporting and professional activities of any person, it seems to us relevant to study activities in similar situations.

Considering the problem of the impact of strong sound signals on human beings, as well as literature sources, it can be stated that certain data have been accumulated on the mechanisms of action of acoustic stressors on the organism and the processes of its adaptation. Physiological and mental mechanisms of perception and processing of high intensity of stressful information signals are relatively well studied in industrial production. Acoustic effects can have a destructive effect on human organs [1]. Investigations of relatively low-intensity, long-term acoustic factors, the effects of which continue or are repeated at a certain frequency, have been widely conducted in industry. Studies on the impact of sound effects «shock» or «explosive» type are relatively few [2, 4], which states the

possibility of observation, but does not provide a sufficiently complete picture of the physiological, mental and adaptive processes, depending on such influences.

We hypothesized that a certain reaction to an unexpected loud sound (pat, etc., including an explosion) is an unconditioned reflex formed in the process of evolution. Such an impact includes a conditioned genetically protective response and is noted in the scientific literature [5]. A loud signal almost always has a stressful effect, in case of unexpectedness it can be extreme, and with repeated actions it can cause adaptive changes in the body [4].

The study is intended to determine the features of the functional-motor activity in the structure of the behavioral response as to as a reaction to short extreme acoustic effect.

Materials and Methods. The experiment was attended by cadets-pilots of the Ulyanovsk Higher Civil Aviation School, engaged in sports (track and field athletics), in the number of 20 people. The age of participants was 18 ± 0.5 years.

Two series of experiments were carried out. The subjects were asked to run a distance of 1000 meters twice: the first time without the stressor, the second time with an acoustic stressor. The first part of the experiment was held at the stadium in the form of a control race, with an individual start. The second part of the experiment, where the extreme situation was modeled, was held three days later, it was also carried out individually with each participant only once. As a stressor, an explosion sound was reproduced, the volume of this sound was 130 decibels 0.02 s long at the 900-meter distance mark. Thus, the impact was carried out with a relatively stable state of the athlete's body during intense muscle work in the running process.

Before the experiment, the participants were given the task: by all means to finish the distance (without specifying the planned extreme situation). So, the acoustic effect for them was relatively unexpected.

In the experiment, features of functional motor activity were recorded: the heart rate with the Polar pulse tachometer and the tremor level of the fingers – a tremor meter (patent No. 78655, author Meshcheryakov AV). To monitor the behavioral reaction, video shooting (the last 150 meters of the distance) and anamnesis were carried out (sensations were interviewed during the «explosion», during the subsequent run and after the finish).

Results. Survey data are presented in the table. In the first part of the experiment the participants had stable and comparatively equal heart rate (beats per minute) and tremor (oscillations per minute): the heart rate increased from 86 ± 5 bpm to 180 ± 9 bpm; tremor increased from 20 ± 6 to 42 ± 8 . In the second part of the experiment, the differences in the indices in the subgroups were noted: heart rate and tremor of the fingers were relatively higher after running through the distance with acoustic action in comparison with overcoming the distance without exposure. The sports result decreased by 8-12 seconds.

Analyzing video (slow playback), various reactions of the experiment participants to extreme acoustic effects were noted. As a result of manifestations of

reactions, according to changes in the structure of movements, three types of response were identified, according to which participants were divided into 3 subgroups.

1 subgroup (7 people):

extensor reaction – altered movements of the arms and trunk in the run structure. Under the influence of the stressor, the young men shuddered, jumped upwards on the run with hands up; immediately after that their run was accelerated at the expense of the tempo of movements.

2 subgroup (10 people):

flexor reaction – the change in movement during the impact was characterized by flexion of limbs (arms and legs), as well as torso forward; subjects continued to run, slowing down, looking around.

3 subgroup (3 people):

panic reaction – the subjects stopped abruptly, crouching and covering their heads with their hands, after which they began to look around, refusing to continue running.

Along with specific reactions, visible effects of stress were noted:

- short-term tension of the musculature of the body during the «explosion» – flinch;
- retraction of the neck in the shoulders – flexor motor reaction;
- an external manifestation of fright – mimicry;
- severity of motor-emotional reactions – screaming and «squeezing»;
- a distinct change in the structure of the race according to technical and rhythmic indices.

The study of the motor reactions of the organism under the influence of extreme stressors made it possible for the subjects assigned to different groups to observe the following: after the race, the subjects of the 1 subgroup continued to walk actively, gesture with their hands, and exchange opinions vividly. Subjects 3 subgroups, on the contrary, moved less, their hands were almost not included in the movements, they were mostly on the belt. Subjects 2 subgroups also showed some inhibition and awkward movements.

Table – Subjects' test results

Number of the experiment	Group	Heart Rate before race, bpm	Heart Rate after race, bpm	Tremor before race, vpm	Tremor after race, vpm	The result of the race, min, s
1	general (n=20)	86 ± 5	180 ± 9	20 ± 6	42 ± 8	$2,48 \pm 4$ s
2	1 subgroup (n=7)	86 ± 4	190 ± 3	22 ± 4	58 ± 8	$2,56 \pm 4$ s
	2 subgroup (n=10)	86 ± 5	186 ± 6	22 ± 4	53 ± 6	$3,00 \pm 6$ s
	3 subgroup (n=3)	86 ± 5	180 ± 5	22 ± 4	48 ± 6	did not finish



In the course of the anamnesis of the participants in the experiment, the participants subsequently interacted quite emotionally with the experimenters, expressing the existing subjectively unpleasant feeling that engulfed them at the time of the «explosion», the internal tension, the desire to stop and look around. There was a negative experience of what happened. At the time of the stressor's influence, there was a desire to stop running, to retire from the distance, but then – the need to escape from the place of the «explosion» (the exception was the representatives included in the third group who refused to run). These subjects noted a sense of fright, disorientation, confusion, departure from the «run, at all costs».

Human activity is subject to the laws of the mind, controlling the activities of organs and functional systems, the body as a whole, providing satisfaction of needs. At the same time, the management of activity is subordinated to the meaning – the subject of satisfaction of the need («motive») [6] and to the principles – individually peculiar regulators of the mental and objective activity of the individual [3]. Analyzing the obtained results and trying to transfer them to the professional activity of the pilots, we can assume various psychophysiological and motor reactions of specialists, which can be typified and, accordingly, predicted with the purpose of selecting the most retaining working capacity in complex and unpredictable situations. Pedagogical influence on the expansion of adaptation processes (training) to similar extreme impacts is also important. To further study the performance of the human operator of especially complex systems under stressful influence, there is a plan for organizing new experiments that will allow us to find out the corridor of responses with adequate behavior and maintaining a high level of performing labor operations.

Conclusions:

1. The extreme value of the acoustic stressor is noted as a factor inhibiting the working activity with a sharp sound of an explosive nature.
2. There is an individual-typological motor-psychic reaction to the impact of an extreme acoustic stressor.
3. During the aftereffect of an acoustic stressor, intense muscle activity and communication contribute to relieving tension.
4. Individual-group differences in the manifestation of the reaction are due not only to different excitability (the power of the nervous processes), but also to the level of stability of the target device to stressful effects of extreme intensity.

Literature

1. Altman, Ya.A. About the oppression of the activity of the auditory system in case of prolonged action of rare and frequent rhythmic sound stimulation. Methodological issues of studying noise influence on the body: All-Union. scientific-practical. meeting / Ya.A. Altman. – M., 1963. – P. 61-63.
2. Bugaev, S.A. Influence of superstrong sound stimuli on zonal cerebral circulation in white rats / S.A. Bugaev // Tr. Academy of Medical Sciences of the USSR, 1969. – Part. 12. – P.125-126.
3. Bogen, M.M. Motion Training: Textbook / M.M. Bogen. – Moscow: Physical training and sports, 1985. – 192 p.
4. Zaslavsky, I.E. Acute sound trauma in the locomotive engineer / I.E. Zaslavsky //Magazine of ear, nose and throat diseases. – 1974. – № 1. – P. 112-113.
5. Kitaev-Smyk, L.A. Probabilistic forecasting and individual features of human response in extreme conditions. In the book: Probabilistic forecasting in human activity / Kitaev-Smyk. – M.: Science, 1977. – P. 189-225.
6. Leontiev, A.N. Activity and personality / A.H. Leontiev // Issues of Philosophy. – 1974. – № 4. – P. 87-97.