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Effect of Individual Features of the CNS on Efficiency of Relaxation Biofeedback Training in 9- to 10-Year-Old Children

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Abstract—The possibilities of biofeedback training for improvement of the self-control of the functional state (relaxation) were studied in 9- to 10–year-old children. At the first stage, under conditions of electrophysiological experiment, relaxation shifts were assessed in the cycle quiet wakefulness–relaxation–recovery of the initial state by autonomic (skin resistance) and EEG (spectra and coherence) indices. The children were then trained to control their functional state with a computer game including a feedback loop by skin temperature. After the training cycle, children were repeatedly examined in electrophysiological experiment with the instruction to control their state. Comparative analysis of self-induced relaxation changes before and after a successful training course revealed greater shifts of skin resistance and an increase in the number of distant functional connections (especially, in the intermediate and high-frequency EEG α subbands), with a significantly increased coherence level during relaxation. A correlation was found between the efficiency of self-regulation training and some individual psychophysiological characteristics (simple motor reaction time, autonomic coefficient, resting EEG). Low efficiency of self-control training was observed in younger schoolchildren with a sharply deviant (from the mean group values) reaction time and autonomic coefficient, as well as with EEG manifestations of functional immaturity of the upper brain regulatory structures. The dependence of the EEG changes on the self-regulation strategy is discussed on the basis of obtained evidence and data in the literature.

Progress in science and technology associated with increasing informational and psychoemotional loads calls for methods facilitating better use of human functional resources. This tendency is also traced in the modern school: in parallel with improvement of pedagogic methods, an important problem is to develop and introduce psychophysiological techniques increasing the efficiency of learning [1].

It is common knowledge that learning progress is determined not only by perfect teaching techniques but also by the CNS functional state of the individual being taught. In this connection, the possibility of voluntary control of the functional state, in particular, use of relaxation techniques that optimize the functional state of the CNS and recover and even extend its functional possibilities, is a promising approach.

The practical value of these techniques is beyond question; however, understanding of the neurophysiological mechanisms of relaxation and their age-related features is necessary for successful application of these techniques.

In our earlier electrophysiological works, we studied a rapid relaxation technique, in which rhythmic sound stimulation served to facilitate self-regulation. An increase in EEG coherence in distant (intra- and interhemispheric) lead pairs in different frequency bands characteristic of the relaxation state was found. Such changes in the organization of the bioelectric activity reflect features of the systemic interactions that form and maintain this state [2, 3]. We examined 7- to-10-year-old children and revealed a general tendency toward improvement of self-regulation in each age group. However, the relaxation shifts were variable and subjects with good, moderate, and poor progress were revealed. Poor progress in self-regulation can be determined by constitutional features of the nervous system, for example, increased activation or reactivity of the CNS.

It could be suggested that the efficiency of self-regulation could be increased by additional training. However, in this process, psychological factors should be taken account (in particular, motivation), because regulation of the CNS state in this case should be initiated voluntarily by a subject. A persistent motive can be formed in children only in case of inclusion of the self-regulation task into the context of a game.

In this connection, the computer games with biofeedback (biofeedback) by parameters of the functional state (heart rate, skin temperature), that have been put on the market are promising. In the course of these games, changes in the functional state of a subject (relaxation) are transduced in an increase in the speed of the controlled object via a biofeedback circuit [4–6]. Use of such games provides great scope for self-regulation training.

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Biofeedback is known to be one of the most efficient means of self-regulation training in adults. Games with biofeedback make it possible to use this method in children. Vivid signs of changes in their functional state provide children with a clear idea of self-regulation and its behavioral value and, thus, facilitate formation of a persistent motive for its acquisition.

The aforesaid determined the goal of this work, namely, study of the possibilities of biofeedback in improvement of self-control of the functional state of the CNS (relaxation) in 9- to 10-year-old children and correlation of training efficiency with individual psychophysiological features.

METHODS

Ten 9- to 10-year-old schoolchildren (four boys and six girls) participated in the study. Only children with low and medium self-regulation efficiency according to the results of earlier experiments, were included into the group.

At the first stage, each child was subjected to individual neuropsychological analysis. His or her psychomotor and autonomic functions were analyzed, and the brain functional state was assessed by the characteristics of the resting EEG.

Neuropsychological examination was performed by the modified Luria technique. With regard to the specific aims of this work (investigation of the voluntary regulation of the functional state), the neuropsychological analysis was predominantly directed at the study of voluntary regulation of activity (VRA). Eight parameters reflecting deviant features of the VRA were taken into account. The expression of each of these parameters was assessed by the results of a number of neuropsychological testings of a subject, and the corresponding individual coefficient was derived. The total coefficient K of immaturity of the VRA was calculated [7].

Psychomotor functions were assessed by the time of visuomotor reactions. Computer versions of the techniques of measurement of the simple visuomotor reaction (SMR) and the reaction of choice (CR) from two alternatives were used. Visual stimuli were presented in random order with an interval of 2–5 s.

The eight-color Luscher test was used for analysis of autonomic functions, with the results processed by the method of Yu.I. Filimonenko *et al.* [8] with calculation of the so-called autonomic coefficient (AC). An AC value higher than unity indicates an ergotropic mode of functioning of the autonomic nervous system (predominance of the sympathetic system). A trophotropic character of autonomic functions is indicated by an AC value lower than unity (predominance of the parasympathetic system).

The functional state of the brain was assessed using structural analysis of the resting EEG [9].

In the course of electrophysiological experiment, the EEG was recorded in different functional states of the CNS (quiet wakefulness–relaxation–recovery of the initial state). To form the relaxation state, a subject was asked to dispose him- or herself to a situation of rest and relax using the most simple psychophysiological techniques, i.e., quiet respiration and muscle relaxation in the phase of expiration.

A rhythmic relaxation phonogram with rate of 6 Hz [10] was used to facilitate formation of the relaxation state.

Monopolar EEGs were recorded in the occipital (O_1 and O_2), parietal (P_3 and P_4), temporo-parieto-occipital (*TPOs* and *TPOd*), central (C_3 and C_4), and frontal (F_3 and F_4) leads. Not less than five 5-s EEG segments recorded in the experimental situations were analyzed. The spectral power density (SPD) and intra- and interhemispheric coherence function (COH) were calculated in the frequency band of 5–13 Hz.

During the EEG experiment, the skin resistance (SR), reflecting changes in the level of sympathetic activation [11], was monitored.

After the EEG experiment, each subject participated in the behavioral training with the use of computer biofeedback game “Canoe Race” (developed at the Novosibirsk Institute of Cybernetics, Siberian Division, Russian Academy of Sciences). Skin temperature (a sensor was fixed on the tip of the index finger) served as the controlling parameter in the biofeedback circuit. The game plot was a canoe race according to the Olympic system from the first thirty-second part of a final to the final. A subject could control his or her canoeist speed by changing his or her own state: the deeper the relaxation, the higher the speed. To form the relaxation state, a subject was suggested to use the same psychotechnical devices: quiet respiration and muscle relaxation in the expiration phase.

A characteristic feature of the game algorithm is noteworthy. It was constracted in such a way that, in a subsequent heat a rival was assigned a mean speed reached by a subject in the previous heat. This algorithm demanded acquisition of controlled relaxation skills.

The duration of a single training session was not more than 20 min; a subject was presented with three to five sessions depending on the training progress.

After the biofeedback training, a repeated EEG examination was carried out.

RESULTS

Analysis of Results of the Preliminary Examination

Neuropsychological analysis. The tested group could be divided into three subgroups according to VRA maturity. The first subgroup ($1.0 \le K < 1.2$) included four children with good VRA (subjects O., B., Nch., and G.). Deviant signs in this subgroup were poorly expressed and there were no deviations in four to six parameters. High voluntary activity, stable task performance with a specified program, and well-developed control over activity were characteristic of these children.

The second subgroup (1.2 ≤ K < 1.4) included three children with moderate level of VRA development (subjects M., Nb., and P.). In this subgroup, subjects strongly varied in the state of individual parameters, but the majority of coefficients testified to moderate deviations in the VRA. Strong deviations in this subgroup were observed only in one or, at a maximum, two parameters.

The third subgroup (1.4 ≤ K < 1.6) consisted of three children (subjects T., S., and K.). In this subgroup, high coefficients were observed for parameters such as impulsiveness (two subjects), problems in performance of complex programs (two subjects), and instability of a program (two subjects). In the other subgroups, these characteristics were expressed moderately or weakly. Moreover, only in the third group were marked problems in the self-control of activity observed. Each subject had strong deviations in three or four parameters.

Analysis of psychomotor and autonomic functions. Analysis of the latent period of the visuomotor reactions revealed a marked variety of individual values. Thus, the SMR time varied within the range of 229–359 ms, and the CR time varied in the range of 350–513 ms.

The correlation between the SMR and CR times was not high (r = 0.6). As seen from the table, where the subjects are ranged by the SMR time, the relationship between these two values is nonlinear. It is interesting that the lowest values of the CR time were characteristic of the medium values of the SMR time, whereas the longest CR latencies corresponded both to low and high values of the SMR time.

According to data available in the literature, the SMR time reflects the excitability of the sensorimotor system [12], which is rather closely related with the level of general nonspecific activation of the CNS [13]. The difference between the values of the SMR and CR time, defined by some authors as the time of the central delay [14], reflects the time of information processing in the central unit of the functional system of sensorimotor reactions. Thus, the data obtained about the relationship between the SMR and CR times confirmed the idea of the existence of an activation level optimal for information processing and diagnostic value of simultaneous measurement of these indices [15]. Noteworthy in this case is that three of the four children (subjects Nch, B., and O.) whose VRA was developed best were characterized an the SMR time close to its mean group value.

Analysis of the state of the autonomic functions by the Luscher color test revealed substantial interindividual variability of the AC in the range from 0.64 to 2. The AC values of the majority of children examined (subjects S., O., B., T., Nch., and K.) were within the limits of 1.0–1.5.

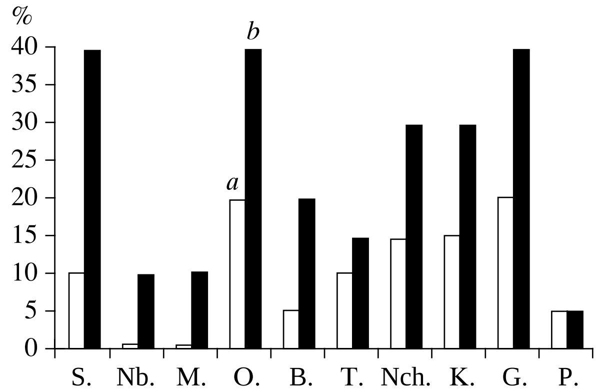

Fig. 1. Relaxation-related changes in skin resistance (%) in the course of electrophysiological experiments (*a*) before and (*b*) after computer training. Abscissa: subjects.

Structural analysis of the resting EEG. Structural analysis of native electroencephalograms showed that seven of the ten examined children (subjects K., O., Nch., B., P., G., and M.) were characterized by a well-developed α rhythm with the modal frequency in the range of 9–11 Hz and an occipital focus. A polymodal α rhythm in the band of 8–11 Hz was recorded in three children. In this case, in one child, the α rhythm was fragmentary (subject S.), and, in two children (subjects T. and Nb.), it was irregular and sharpened. In six of ten subjects, the α rhythm was driven by rhythmic flickering in the band of 4–12 Hz; in the remaining four children, the driving reaction was observed in the band of 7–12 Hz. Thus, in accordance with criteria proposed by I.P. Lukashevich *et al.* [16], the state of the cortical structures of the examined children can be assessed as normal for their age.

In the EEGs of all the children, generalized bilaterally synchronous oscillations of the θ band were episodically recorded, which is rather characteristic of this age [16]. In addition to these waves, generalized bi- or

Individual values of psychomotor reaction time and autonomic index in the examined children

Subject	Simple motor reaction, ms	Choice reaction, ms	Autonomic coefficient
S.	229	503	1.2
Nb.	255	501	1.7
M.	264	429	2.0
O.	283	440	1.5
B.	283	350	1.5
T.	286	378	0.8
Nch.	311	430	1.0
K.	336	495	1.1
G.	347	514	0.9
P.	359	513	0.6

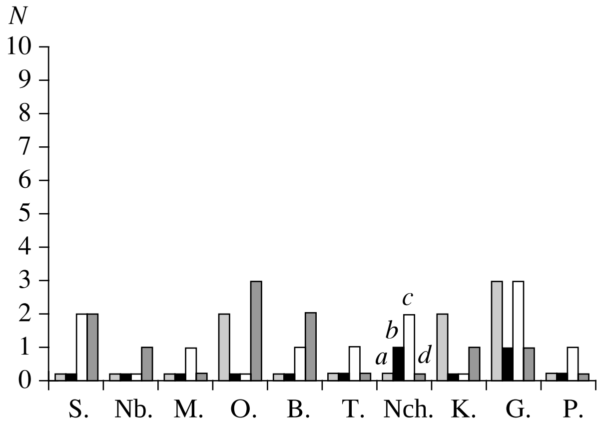

Fig. 2. Individual frequency distributions ((*a*) 5–7 Hz; (*b*) 7–9 Hz; (*c*) 9–11 Hz; (*d*) 11–13 Hz) of significant changes in EEG coherence between distant lead pairs before the training cycle. Abscissa: subjects.

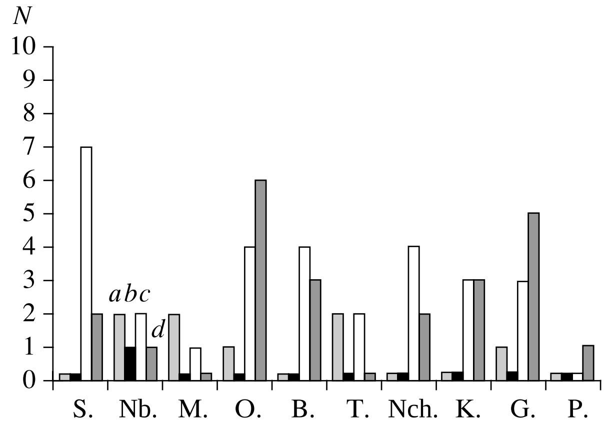

Fig. 3. Individual frequency distributions ((*a*) 5–7 Hz; (*b*) 7–9 Hz; (*c*) 9–11 Hz; (*d*) 11–13 Hz) of significant changes in EEG coherence between distant lead pairs after the training cycle. Designations are as in Fig. 2.

three-phase oscillations of the α band were recorded in five children, which may be related to increased involvement of diencephalic (in particular, hypothalamic) structures [17]. Such changes can reflect the prepuberty-related changes in neuroendocrine regulation [18].

In parallel to generalized activity, bilateral bursts of slow-wave activity in the anterior or posterior cortical areas (involvement of the upper or lower brainstem structures, respectively) were recorded in five children (subjects K., Nb., O., S., and T.), which is interpreted as a sign of immaturity of the brain regulatory structures [19].

Electrophysiological Examination

Analysis of success in biofeedback training. Three groups of children could be distinguished by the degree of training progress. A subgroup of “successful” children (subjects S., O., and G.) managed to finish the game (to win the final heat) already during the third session. In distinction, “unsuccessful” children (subjects Nb., M., T., and P.) were not able to rise up higher than one-eighth of the final even after five training sessions. Subjects B., Nch., and K. occupied the intermediate position: by the end of training they rose up to the semifinal and even to the final.

Analysis of changes in autonomic indices. Changes in skin resistance in the course of the first relaxation trial (before the biofeedback training) are presented in Fig. 1a. As seen from the figure, the examined children were characterized by different relaxation shifts: only in four of the ten subjects did the increase in skin resistance during relaxation reach 15–20%.

After training, the relaxation shifts according to skin resistance indices substantially increased in the majority of subjects (Fig. 1b). In three cases (subjects Nb., M., and T.), the computer training yielded only, weak effect, and, in one case (subject P.), there was no effect at all.

Analysis of changes in the EEG parameters. As in our earlier studies [2, 3], comparison of EEG changes during the first (before the training) and second (after the training) relaxation trials revealed a greater informative value of the COH parameters as compared to the SPD.

Taking into account our studies and data in the literature on the EEG coherence between distant points as the most regular reflection of relaxation changes in the CNS functional state [2, 3, 20], in our analysis, we gave considerable attention to relations between the precentral and postcentral areas and interhemispheric COH.

During the first relaxation trial, a significant increase in COH level between one or several distant lead pairs was observed in virtually all subjects (Fig. 2). Notably, the relatively more pronounced changes (an increase in COH simultaneously in several distant lead pairs in one frequency band) were observed in children with higher relaxation shifts according to the skin resistance (subjects O. and G.).

After the training (Fig. 3), in the majority of subjects, the relaxation was accompanied by a significant increase in COH in a greater number of distant lead pairs than in the first trial. The most pronounced COH shifts were observed for the rhythmic components of the α band (medium- and high-frequency subbands). Many distant cortical lead pairs with COH increased in a single frequency subrange had a certain spatial structure with a focus in the anterior areas (Fig. 4).

DISCUSSION

It was shown by us earlier that when rhythmic stimulation with a frequency of 6 Hz was used for relaxation in 9- to 10-year-old schoolchildren with pronounced relaxation-related shifts in skin resistance, the distant coherence increased to a relatively greater extent in the band of 5–7 Hz [21]. After the biofeedback training, the relaxation-related changes in COH distinctly predominated in the α band.

In our viewpoint, the explanation for this discrepancy should be sought in different psychophysiological mechanisms of regulation of the functional state in these cases.

It can be suggested that, in the case of rhythmic stimulation, relaxation is provided by a "sensory dominant" formed by focusing of attention on an external signal. This dominant can mediate the control of the external state performed by the rhythmic stimulation (a theoretical basis for this assumption has been given in [22]). By means of the sensory dominant, the regulatory system of the brain uses the external rhythm for synchronization of bioelectric activity, which is reflected in a decrease in activation at the level of behavior and in an increase in the EEG coherence in the frequency band close to the stimulation frequency. In a certain sense, this mechanism can be called "passive" relaxation.

As is known from the literature, relaxation-related changes in bioelectric activity in the α band are characteristic of traditional methods of relaxation without the use of external stimulation, for example, neuromuscular relaxation or meditation, at the first stage of which neuromuscular relaxation also takes place [23–25]. In these cases, a decrease in the muscle tone leads in the physiological relaxation mechanisms, initiating relaxation through a decrease in the activation influence of the motor system on the hypothalamus and limbicoreticular complex, i.e., structures highly involved in the control of cortical activation [13]. Muscle relaxation was also used by the subjects during the biofeedback training as the state-controlling action. Thus, as distinct from the rhythmic stimulation, this mechanism of relaxation was to a greater extent based on the "active work" of a subject in order to form the corresponding functional system (according to P.K. Anokhin) with the biofeedback loop. This method of self-regulation can be called "active" relaxation.

In this connection, the similarity of changes in EEG parameters under conditions of application of classical relaxation techniques and after the biofeedback training during the second relaxation trial is not surprising: in both cases, cortical synchronization in the frequency of the dominant EEG α rhythm takes place.

It can be concluded from the aforesaid that the increase in self-regulation efficiency after the biofeedback training in the examined children was reached by the strategy of "active" relaxation.

In view of the differences revealed in the results of biofeedback training, it is of interest to compare the individual psychophysiological, neurophysiological, and electrophysiological features of the examined children with posttraining improvements their self-regulation.

A weak behavioral (i.e., success in the game) and electrophysiological (corresponding changes in EEG parameters) effect of the biofeedback training (or the absence of an effect) was characteristic of subjects Nb., M., T., and P., and, therefore, analysis of their individual features was of special interest.

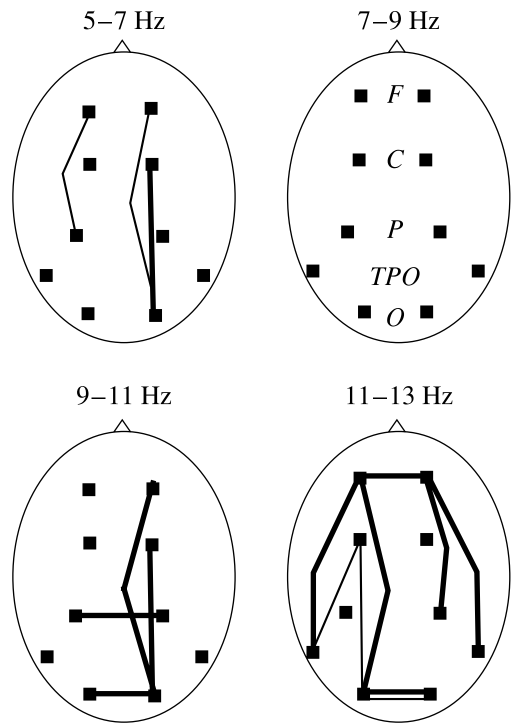

Fig. 4. Relaxation-related changes (increase) in the pattern of "significant" values of distant coherence functions in the studied frequency ranges before (thin lines) and after (thick lines) the training course in subject O.

Turning back to the table, it is noteworthy that there is a pronounced correlation (r = –0.66) between the SMR time (the level of sensorimotor activation) and the AC (the level of activation of the autonomic nervous system). Both of these indices in some way characterize the level of general nonspecific activation of the nervous system. In this aspect, it is interesting that three subjects from these four can be classified as "extreme" types, i.e., with either an increased or a substantially decreased level of general nonspecific activation of the nervous system. The influence of autonomic functions on self-regulation efficiency is apparent: extreme activity both of the sympathetic and of the parasympathetic system narrows the range of variations of the controlled parameter (skin temperature), thus making self-regulation difficult.

Of note is the practical value of combined analysis of the indices. Thus, subject S, whose SMR time was the lowest but whose AC was close to its mean group value, showed one of the best results during biofeedback training.

According to their neurophysiological characteristics, subjects Nb., M., and P. belonged to the medium group (K between 1.2 and 1.4), and only subject T. had one of the lowest VRA indices.

The observed correlations of success in biofeedback training with neuropsychological characteristics are attributable to the fact that neuropsychologically defined VRA is a category that embraces the ability of self-regulation studied here but also includes other functions. The VRA implies mature functions of voluntary control according to given programs and the ability to form these programs. The programming function of the CNS is of principal significance, whereas self-regulation efficiency was estimated by a child's ability to voluntary change his or her functional state (to decrease the level of psychophysiological activation).

Despite a notable discrepancy between the neurophysiological mechanisms of the VRA and voluntary regulation of the functional state of the CNS, it should be mentioned that success both in VRA and self-regulation largely depends on voluntary attention, age-related features of which are determined by maturity of the frontothalamic system [26]. The significance of this factor was confirmed in this study: two of the subjects with poor training progress (Nb. and T.) were characterized by EEG signs of upper brainstem origin testifying to immaturity of the frontothalamic system [16]. It is interesting, however, that the SMR time and the AC in subject T. were close to the mean group values.

Thus, different factors can be responsible for poor progress in biofeedback training. In this study, we have shown the significance of two of them, i.e., the level of general nonspecific activation of the nervous system and the maturity of the frontothalamic regulation of cortical activation.

CONCLUSIONS

(1) In the majority of cases, training with bifeedback can improve self-regulation of the CNS functional state in 9- to 10-year-old children, which is manifested in greater relaxation shifts of both the autonomic and EEG indices.

(2) After successful training, the relaxation-related EEG changes consist in an increase in the number of distant lead pairs with a significantly increased COH level, in particular, in the medium- and high-frequency α subbands.

(3) Low efficiency of self-regulation training in younger schoolchildren is coincident with immaturity of the upperbrainstem regulatory structures and strong imbalance of autonomic activation.

REFERENCES

1. Roberts, T.B., Multistate Education: Metacognitive Implications of the Mindbody Psychologies, *J. Transpersonal Psychol.*, 1989, vol. 21, no. 1, p. 23.
2. Gorev, A.S., Dynamics of the Alpha-Band Frequency Components in the Encephalogram of 9- to 10-Year-Old Children during Relaxation, *Fiziol. Chel.*, 1996, vol. 22, no. 5, p. 45.
3. Gorev, A.S., Dynamics of the Alpha-Band Frequency Components in the EEG of 7- to 8-Year-Old Children during Relaxation, *Fiziol. Chel.*, 1998, vol. 24, no. 1, p. 21.
4. Sokhadze, E.M., Shtark, M.B., and Shul'man, E.I., Biological Feedback in Scientific Researches and Clinical Practice, *Byull. SO AMN SSSR*, 1985, no. 5, p. 78.
5. Dzhafarova, O.A., Novozhilova, L.A., and Svorovskaya, N.G., A Prognosis of BIOFEEDBACK Training Course Efficiency, *Bioupravlenie-2. Teoriya i praktika* (Biological Control-2. Theory and Practice), Novosibirsk, 1993, p. 43.
6. Dzhafarova, O.A., Donskaya, O.G., Izarova, I.O., and Putilov, A.A., A Method of Game Biological Control and Heart Rate Regulation, *Byull. SO AMN SSSR*, 1999, no. 1 (91), p. 62.
7. Semenova, O.A., Machinskaya, R.I., Akhutina T.V., and Krupskaya, E.V., Brain Mechanisms of Voluntary Regulation of Activity and Acquisition of the Skill of Writing in 7- to 8-Year-Old Children, *Fiziol. Chel.*, 2001, vol. 27, no. 4, p. 23.
8. Filimonenko, Yu.I., Rapid Technique for Assessment of Self-Training Efficiency and Prognosis of Success in Human Activity, *Eksperimental'naya i prikladnaya psikhologiya. Vypusk 11. Lichnost' i Deyatel'nost* (Experimental and Applied Psychology'. Issue 11. Personality and Activity), Leningrad. Gos. Univ., 1982, p. 52.
9. Lukashevich, I.P., Machinskaya, R.I., and Fishman, M.N., Diagnostics of the Functional Brain State in Younger Schoolchildren with Learning Problems, *Fiziol. Chel.*, 1994, vol. 20, no. 5, p. 34.
10. Gorev, A.S., Regulation of the Functional State of the CNS in Younger Schoolchildren Using Rhythmic Sound Stimulation with the Frequency of 6 and 9 Hz, *Fiziol. Chel.*, 2001, vol. 27, no. 5, p. 35.
11. Lidberg, L. and Wallin, B.B., Sympathetic Skin Nerve Discharges in Relation to Amplitude of Skin Resistance Responses, *Psychophysiology*, 1981, vol. 18, no. 3, p. 268.
12. Boiko, E.I., *Vremya reaktsii* (The Reaction Time), Moscow: Meditsina, 1964.
13. Gellhorn, E. and Loofbourrow, J.N., *Emotions and Emotional Disorders. A Neurophysiological Study*, New York: Harper & Row, 1963. Translated under the title *Emotsii i emotsional'nye rasstroistva*, Moscow: Mir, 1966.
14. Beteleva, T.G., *Neirofiziologicheskie mekhanizmy zritel'nogo vospriyatiya* (Neurophysiological Mechanisms of Visual Perception), Moscow: Nauka, 1983.
15. Kiselev, S.Yu., Development of Sensorimotor Reactions in Preschool Children, *Cand. Sci. (Psychol.) Dissertation*, Moscow, 2001.
16. Lukashevich, I.P., Machinskaya, R.I., and Fishman, M.N., The Role of the Regulatory Brainstem Regions in Functional Maturation of the Cortex in 7- to 8-Year-Old Children, *Fiziol. Chel.*, 1996, vol. 22, no. 1, p. 63.
17. Latash, L.P., *Gipotalamus, prisposobitel'naya aktivnost' i elektroentsefalogramma* (Hypothalamus, Adaptive

Activity, and Electroencephalogram), Moscow: Nauka, 1968.

18. *Fiziologiya podrostka* (Physiology of an Adolescent), Farber, D.A., Ed., Moscow: Prosveshchenie, 1988.
19. Machinskaya, R.I., Bezrukikh, M.M., and Sugrobova, G.A., Differential Influence of the Functional Maturity of the Cortex and Regulatory Brain Structures on Indices of Cognitive Performance in 7- to 8-Year-Old Children, *Fiziol. Chel.*, 1999, vol. 25, no. 5, p. 14.
20. Sarmanov, V.Ya., Relationships between Psychic and Neurophysiological Phenomena and Biological Feedback, *Fiziol. Chel.*, 1982, vol. 8, no. 5, p. 846.
21. Gorev, A.S., Dynamics of the EEG Parameters in Younger Schoolchildren during Change in the Functional State (Relaxation) under the Action of Rhythmical Stimulation, *Fiziol. Chel.*, 2000, vol. 26, no. 2, p. 37.
22. Pervushin, Yu.V., Resonance Mechanisms of Changes in Biological States, *Biofizika*, 1991, vol. 36, no. 3, p. 534.
23. Farrow, J.T., *Physiological Changes Associated with Transcendental Consciousness: The State of Least Excitation of Consciousness*, Weggis, 1975.
24. Hirai, T., *Psychophysiology of Zen*, Tokio: Jgaki Shoin, 1974.
25. Pavlova, L.P. and Romanenko, A.F., *Sistemnyi podkhod k psikhofiziologicheskomu izucheniyu mozga cheloveka* (System Approach to Psychophysiological Study of the Human Brain), Leningrad: Nauka, 1988.
26. Machinskaya, R.I., Formation of Neurophysiological Mechanisms of Voluntary Selective Attention in Younger Schoolchildren, *Doctoral (Biol.) Dissertation*, Moscow, 2001.