SCIENTIFIC LIFE

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Modern psychophysiology and brain mechanisms of creativity

In the article it is presented the review of materials of the XIV World psychophysiological congress organized by the International Organization of Psychophysiology (IOP) and which took place in St Petersburg on September, the 8-13th, 2008. It is presented brief information about IOP. There are examined tendencies of development of modern psychophysiology. The special attention is devoted to research of brain mechanisms of creation and creativity.

Key words: *psychophysiology, the International Organization of Psychophysiology, the brain hemispheres, frequency ranges, alpha-band, cognitive processes, brain organization of creativity, creative inspiration.*

The official year of modern psychophysiology birth is considered to be 1982 when in Montreal took place the first International psychophysiological congress. On this constituent congress psychophysiology was defined as "a science of physiological mechanisms of processes and statuses, individual distinctions" [1], there was organized the International Organization of Psychophysiology (IOP), which got support and accreditation in UNO. Since 1983 the IOP publishes the international magazine – "International Journal of Psychophysiology". This official magazine of IOP obtained a high recognition of the international scientific community. It is unique and highly prestigious international forum which integrates the scientific works of various fields of modern psychophysiology. At present IOP communicates with 2 122 institutes worldwide, its members are the leaders of psychophysiology from 49 countries [12].

One of the major purposes of IOP is to promote development and strengthening of psychophysiology, association of psychophysiologists and integration of interdisciplinary psychophysiology in leading fundamental and applied medical, behavioural neuroscince. For realization of this purpose since 1982 the official congresses of the International organization of psychophysiology are regularly spent one time in two years in various countries.

On the 8th of September – the 13th of September, 2008 the XIV World congress on psychophysiology "The Olympics of the Brain" took place in St Petersburg. In work of the congress there have participated more than 500 scientists from 60 countries of the world. To Petersburg there have also arrived native psychophisiologists working

worldwide. At the congress the Russian young scientists whose high level was noted by experts made their reports [5].

Working language of the congress was English. Theses of reports were published in "International Journal of Psychophysiology" (Volume 69, №3, 2008) [2].

For many years the president of the congress is professor Konstantin Mangina (the USA, Canada). The chairman of the International organizing committee is the director of Institute of brain of person of the Russian Academy of Science, corresponding member of Russian Academy of Science Svyatoslav Vsevolodovich Medvedev (St Petersburg). "The brain, as we known, is the most difficult object in the Universe, and despite all reasonable efforts, techniques, technologies, yet we cannot understand up to the end how it works, admits S.V. Medvedev, but nevertheless each research approaches us to this purpose" [4].

At the XIV psychophysiological congress there were read plenary lectures, 42 symposiums, 3 stand sections were spent. The great interest of scientific community has been attracted by the research of the known Russian scientist, member-correspondent of the Russian Academy of Science, Konstantin Anokhin, who in the plenary lecture "Steady traces of memory in the constantly changing brain: reality or illusion?" has told about own experiments on studying of memory mechanisms which were on a joint of physiology and genetics; he has analyzed the basic results of other researchers work in this field, presented hypothesis still demanding check. K. Anokhin, for example, revealed that there were mechanisms which allow "to delete" something from the memory, because of what the person can even forget any life episode [3].

"For the system approach new technologies are required, considers the professor Scott Mackeig from University of California in San Diego, today neuropsychophisiologists in researching of delicate mental processes use mainly the electroencephalography, the magnetic resonance and the positron emissive tomography; in all cases examinees are offered to solve tasks, on quick wits for example; they do it in artificial situation, and the result received at this case, can be strongly deformed" [2; 137]. In the plenary lecture "Associating the brain, thinking and behaviour" he spoke about development of new technologies which would allow to research personal thought processes in natural conditions, when a person moves, hears sounds surrounding him, sees various subjects, etc. He has shown on a slide the examinee on whose head there was "the hat" with electrodes, and behind the back there was the small bag. By means of this device in a mode of real time and "real life" parameters of the brain work were registered [4].

Interest of psychophysiologists was also caused by the plenary lecture of professor Alexey Ivanitsky "the Science of the brain on a way to the decision of the consciousness problem", who examined the possible mechanisms of subjective events, brain functions of consciousness and unconsciousness and compared features of brain functioning and an artificial intellect [2; 136].

For more than 25 years the psychophysiology has suffered considerable changes. It is possible to judge the basic directions of these transformations by names of numer-

ous symposiums of the congress. Among large symposiums there are "From neuron to system" (chairmen A. M. Chernorizov, U. I.Alexandrov, Russia), "Genetics, the brain and behaviour" (chairman O.V. Sysoyeva, Russia) which participants have shown opportunities of association of various disciplines – physiology, molecular biology and genetics, for studying mental processes. Names of such symposiums as "Psychophysiology of vision" (chairman U.E .Shelepin, Russia), "the Brain organization of cognitive functions in ontogenesis" (chairman M.M. Bezrukih, Russia), "Modern directions in psychophysiology of the person and individual distinctions" (chairman Viifredo de Pascalis, Italy), "Oscillations, anticipation and processes of memory" (chairman N. N. Danilova, Russia), reflect spheres of modern psychophysiology which have become already classical. During these symposiums there were widely discussed electrophysiological correlations of cognitive processes, there were discussed the questions of interhemispheric features of color and space perception, interaction of hemispheres in conditions of binocular perception. Great attention was devoted to researches of electrophysiological correlations of processes of visual attention, search, training, to problems of transition from local to global analysis [9].

The special symposium "the Brain asymmetry and strategies of reaction" (chairman Murat Ozgoren, Turkey) was devoted to problems of functional asymmetry of hemispheres, where there were also discussed the questions of influence of attention on the character of asymmetry, of interhemispheric specificity of reaction strategy, of neuro bases of thinking and behaviour.

Alongside with the fields traditional for psychophysiology there are also actively formed and rapidly developed the areas of new competences presented at such symposiums as "Military psychophysiology" (chairman V. N. Sysoyev, Russia), "Psychoneuroimmunology" (chairman I. D. Stolyarov, Russia), "Psychophysiological and clinical aspects EEG and SSP at pharmacological influences" (chairman professor V.B. Strelets, Russia), "Consciousness and self-consciousness in psychophysiological measurements" (chairman Jan Kaiser, Poland), "EEG networks by failure to mention" (chairman Andrew C.N. Chen, China), "Interface "a brain-computer" (chairman professor A. A. Frolov, Russia), "Lie detector based on definition of P-300 potential" (chairman Bruno Verschuere, Belgium), etc.

At the symposium "Clinical psychophysiology of cognitive disturbances and memory disorders" (chairman Helen Beuzeron-Mangina, Canada) great attention was devoted to discussion of the methods of functional brain disorders correction. Created by the permanent president of the International organization of psychophysiology (IOP) Konstantin Mangina, the test is widely applied by scientists of other countries to diagnostics of various disorders, inability to training, age brain changes, etc. Scientists from Italy, Canada, Turkey presented the results of research of brain activity at performance of Mangina's test by healthy examinees and examinees with disorders of attention, executed with use of the functional magnetic resonant tomography [5].

During the symposium "Spatial and time ranges of manifestation of mentally specific and mentally nonspecific brain activations" (chairman S.G. Danko, Russia) there

was the question: "What can we study combining application of the methods of EEG and magnetic resonant tomography". On the basis of correlation of these methods there were presented neurophysiological features of the generalized tonic activation of brain as a whole and local phase activations, determining a character of attention. There were distinguished brain predictors preparing cognitive activity of attention (alerting attention). There were analyzed the reasons of distinctions in results of research of the general level of cortical activation.

At the symposium "Neurophysiology of complex cognitive processes" (Chairman N. V. Volf, Russia) there were discussed distinctions of neurophysiological mechanisms of verbal and nonverbal intellectual activity, and also sexual distinctions as a physiological basis of various strategies of processing of information, memorizing, divergent thinking. New data on interrelation of intellectual and brain efficiency are presented.

In the subject of the XIV World congress there was reflected a precise tendency of psychophysiology of last several years: today many researchers try "to fix" the supreme functions which are peculiar only to the human brain, processes of thinking and creativity, by means of various techniques and devices [7]. The special symposium "the Creative brain" has been devoted to studying of mechanisms of creativity: new directions of researches of creativity" (chairman A. Dietrich, Lebanon) in which there participated researchers from the USA, Germany, Austria and Russia. During the symposium there were analyzed the works directed on searches of the brain functional status specific to creative process. There were discussed the most informative for diagnostics of this status frequency ranges of EEG, reflection in EEG-correlations of the emotional factor of creative process. The special attention was devoted to methodical approaches to neurophysiological research of creative process on each of its stages, especially during the moment of a new idea birth, creative inspiration.

Group of scientists of Institute of brain of person of the Russian Academy of Science have presented results of the researches begun under direction of N.P. Bekhtereva in which there was studied the dependence of the brain correlations of creative thinking from a level of creative abilities, from success of the problem decision and its character (verbal, nonverbal), from development of professional skills. They distinguished "flexible" and "rigid" parts of brain providing of the creative problem decision. Followers and colleagues of N.P. Bekhtereva researched the areas of the brain which are responsible for creative process, interaction of creativity and emotions, creativity and the so-called detector of errors [3]. The brain mechanism of optimization of cogitative activity or the detector of errors have been discovered by N.P. Bekhtereva and it is based on the fact that "in the brain there is a system which traces, whether you do everything correctly, h. e. gives typical decisions of questions" [8]. In these researches it was used the polymethodical approach, enabling to compare the results of EEG researches and the research spent by means of the positron emission tomography (PET). The received data have allowed to note the important role not only of the right (as it is more often considered), but also of the left hemisphere in realization of creative process.

The role of alpha-band (8-13 hertz) in realization of creative activity was noted in the report of O. M. Bazanova (Novosibirsk). Each time, having coped with a creative task, the brain of the person signals that it is executed by a stream of electric activity on alpha-frequency. O. M. Bazanova noted the growth of alpha-band among gifted musicians during music performance. And among nonprofessionals alpha-band's amplitude, on the contrary, was decreased [6].

The opportunity of development of width of alpha-band range by means of special training leading to increase of creativity, was shown by Andreas Fink, the scientist from institute of psychology of the Austrian city Grasse [2; 178].

Owing to new methods the scientists had an opportunity to find out, how the success of the brain's work depends on its genetics, its structure, structure of molecules in tissues. American researcher Rex Jung has presented in the report a new way of measurement of creativity of the person [8]. In his opinion, it is possible to recognize the brain of the person disposed to creative thinking by characteristic structural attributes. Among creative persons in the forward part of the brain zone convolutions the maintenance of the one of the widespread amino acids, n-acetylaspartate, is reduced, the forward temporal lobes are thicker and, on the contrary, the calloused body is reduced. "There are optimum combinations of the brain tissues and activation of some of its areas, determining personal disposition to creativity", has informed in the report Rex Jung [2; 179].

German scientist Jan Vessel with colleagues carried out the research of mimic muscles of the person during performance of creative tasks. Having compared mimicry of two groups of examinees, of those who, eventually, has guessed how to execute the task, and those who has not executed it, the scientists have found out the surprising result. The signal about a guess could be seen on the faces of participants of experiment before it has been found. Similarity of the satisfied smile flashed among those who have come to result though the brain work parameters yet did not specify it by alpha-band splash [6].

Instead of N.P. Bekhtereva's planned plenary lecture there has been organized the memorial symposium where her colleagues and followers have participated. The text of lecture has been presented to participants in the form of the brochure "Utility of psychophysiology for long cognitive life" in which it was spoken about the fact that brain's active work can influence a status of the organism as a whole and even prolong the person's life. Last years N.P. Bekhtereva lots of time devoted to research of an explanation of mechanisms owing which the brain can operate the organism of person [10]. "Structures of the brain which are additionally activated at the creative problem decision have the direct relation with various aspects of memory, behaviour and speech, orientation in time and space, manifestations of personality, Natalia Bekhtereva writes, at the same time they also influence the physiological processes providing the important functions. Opportunities of some of these structures include providing of emotions, regulation of independent nervous system, breath, heart rhythm, etc." [11]. "I believe that it is precisely the involving of the person in creative process with all

reorganizations accompanying his brain and organism that leads to surprising statistically justified situation, when "the clever lives longer". The brain comes to life, and the organism comes to life. Existing connections between cells and structures of the brain become more active; new connections and, most likely, new cells, neurons are formed. Not denying huge benefit and necessity of physical trainings, proper nourishment, I consider that today, taking into account tendencies of the modern world, it would be important to emphasize expediency of the directed activation of the brain creative potential" [2; 135].

The phenomenon of creative inspiration which attracts so fixed attention of modern psychophysiologists, would not be itself, if it did not add us new puzzles still expecting the decision. The XXI century is called the century of human brain. The modern science knows already much about it, but even more secrets it has to discover.

The XV World congress of psychophysiology would take place on the 30th of September – the 4th of October, 2010 in Budapest.

The Literature

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