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# Professional Culture of the Specialist of the Future

## PSYCHOLOGICAL CORRECTION OF YOUNG SPECIALISTS AND ITS BRAIN CORRELATES

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### *Abstract*

Patterns of the electrical activity of the brain in the ultraslow bandpass were registered by two groups of young students of psychology, practically normal, urban dwellers. The registration, which took about 15 to 20 minutes in each case, was conducted twice, with eyes closed, first prior to passing a course of psychological correction, and second, right after it. The course was two week long, 1.5 hours a day. It comprised listening to either random sounds of nature (control group) or, to familiar music (main group). Two basic trends in dynamics of mean spectral power of signals were demonstrated for members of the main group: if the initial level of ultraslow activity was high, it tended to fall as a result of passing the course; if the initial level was low, it tended to rise. As a result, sort of 'fine tuning' of the activity of the brain took place, which was not the case of the control group. In terms of physiology, the overall functional state of members of the latter tended to pass moderate activation. As to the members of main group, their functional state passed more sophisticated tuning, depending on its initial level. Presence of such tuning, forming part of normal adaptive capacity. was corroborated by data of molecular biological survey.



**Keywords:** Psychological correction, brain, ultraslow activity, adaptation.

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## 1. Introduction

Optimization of the psychophysiological state of the specialist of the future by means of applying procedures of psychological correction forms a highly actual topic of present-day scientific research. Their verification at the level of brain structures and mechanisms seems to be most constructive and expedient. Electrophysiological registration of the dynamics of brain waves provides a relevant approach for the implementation of this approach. Joining the psychological correction with detailed study of underlying brain mechanisms of its effectiveness forms the main topic of the present research.

## 2. Problem Statement

Spectral analysis of quick forms of brain activity, belonging to the realm of electroencephalography, which deals with periodic electric processes ranging from 1.5 to 30 Hertz, in the course of psychological correction of different kinds or, following it, has been quite studied by present time rather extensively. As to the so-called ultraslow activity, that is, electric processes ranging from 0 till 0.5 Hertz, it has been studied by now in an insufficient way. At the same time, ultraslow activity of the brain is currently regarded as being basic for the stabilization of functional state of the organism in general (Aladzhalova, 1979; Bekhtereva, Gogolitsyn, Kropotov, & Medvedev, 1985).

Thus, linking patterns of dynamics of ultraslow electric activity of the brain with different types of psychological correction in normal seems to be a constructive topic for systematic interdisciplinary research.

## 3. Research Questions

Research questions of the present study are the following ones:

**3.1.** Do different types of psychological correction regularly produce different types of brain activity at the level of ultraslow electric processes?

**3.2.** Do optimal types of psychological dynamics, induced by the application of psychocorrection procedures, have brain correlates of their own, at the level of ultraslow activity?

## 4. Purpose of the Study

Purpose of the study consisted in conducting the following procedures:

**4.1** Routine medical testing of 40 young, practically healthy Russian-speaking urban dwellers, aged 23±3 years, which ended with subscription of the routine form of informed consent. All of the respondents were students at bachelor or master programs, intending thus to become specialists in psychology and neighbouring realms (e.g. counceling) (for overview of psychological attitudes of this societal group, see Obukhova & Obukhova, 2015). A sample of blood (5 ml) of each subject was taken, as part of the medical testing, which allowed us to conduct molecular biological analysis, including detection of telomere length (results of this part of the study were already published by us as separate paper);

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**4.2** Psychological testing was conducted in each case, by means of standardized questionnaires. It was focused upon the dynamics of mood, tension, general psychological activation, as well as the level of neuroticization (results of this part of the study also were already published by us as separate paper);

**4.3** Initial registration of the electric activity of the brain in the ultraslow and electroencephalography bandpasses;

**4.4** Passing a two-week course of sound (non-music) therapy, 1.5 hours a day (control group 1); passing a two-week course of music therapy, 1,5 hours a day (group 2), Each of the groups consisted of 20 randomly chosen respondents. Both audiocourses were conducted with the help of sets of sound/music tracks, recommended for the purpose of relaxation by the Federal Ministry of Health of Russia;

**4.5** Routine medical testing of the 40 respondents, blood sample (5 ml) were taken;

**4.6** Another run of the psychological questionnaires was conducted;

**4.7** Final registration of the electric activity of the brain in the ultraslow and electroencephalography bandpasses;

**4.8** Data processing and interpretation of results obtained, as a result of study of psychological dynamics occurring as a result of passing a course in psychological correction, and its brain correlates.

## 5. Research Methods

**5.1.** Brain activity was registered with the help of a 32-channel digital electroencephalograph, produced by Mitsar (St.Petersburg, Russia), from 19 electrodes, fixed at a special helmet, produced by MCS (Zelenograd, Russia), by 10-20 system. Electrode resistance did not exceed 50 kOM

**5.2.** Registration of brain activity and analysis of data obtained was conducted with the help of a special analytic program, elaborated by V.Ponomarev and J.Kropotov at Human Brain Institute, Russian Academy of Sciences in St.Petersburg, Russia, state registration No. 2001610516, of May 08, 2001. The program was applied by permission of the authors. In each case, the registration was done with eyes closed, in an isolated box, and took 15 to 20 minutes**.**

## 6. Findings

**6.1** Statistically relevant shifts in the dynamics of brain rhythms in the ultraslow bandpass were found, as a result of passing a two-week course of sound therapy or, the music one (cf. corresponding conclusions, acquired mainly basing on data on the electroencephalography bandpass dynamics: Altenmüller, Schürmann, Lim, & Parlitz, 2002; Andrade, & Bhattacharya, 2003; Koelsch, 2014). In the case of the sound course, which comprised randomly selected sounds of nature, a general trend towards reduction of the mean spectral power of signals was

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demonstrated. The same tendency, although much less distinct, was demonstrated for the case of music therapy, as well (cf. Zatorre & Salimpoor, 2013).

**6.2**. In order to study this general tendency in full details, a novel approach to data analysis was introduced by us. All the respondents of group 1 were split into two subgroups: subgroup 1a comprised all respondents who had high level of mean spectral power of signal in the ultraslow bandpass before passing the sound course, subgroup 1b – respondents who had low level of signal, also before passing the course. By high level of mean spectral power of signal, we mean values equal to 2.00 and higher; by low level, values smaller than 2.0. Following the same course, group 2 was also split into two subgroups (for results, see Table 1).

**Table 01.** Mean spectral power of signals at the ultraslow bandpass]

| Time / Subgroup | Subgroup 1a | Subgroup 1b | Subgroup 2a | Subgroup 2b |
|---|---|---|---|---|
| Prior | 2.30±0.08 | 1.98±0.08 | 2.28±0.10 | 1.75±0.12 |
| Post | 1.78±0.06 | 1.73±0.05 | 1.79±0.07 | 1.98±0.07 |

Notes: data present mean spectral power of signals from 19 electrodes, adjusted by logarhythmic scale. Prior – mean spectral power before passing a course of psychological correction, post - mean spectral power after passing a course of psychological correction, subgroup 1a – subgroup of respondents who initially had statistically relevant high level of mean spectral power of signals at the ultraslow bandpass, and passed after that a correction course of random sounds; subgroup 1b - initial low level / correction course of random sounds; subgroup 2a - initial high level / correction course of familiar music; subgroup 2b - initial low level / correction course of familiar music.

**6.3.** As shown by Table 1, in the case of both subgroup 1a and subgroup 1b, dynamics of the same kind took place. It consisted in general fall of the spectral power of signal, which was statistically relevant, as a result of passing the music course. An opposite trend was found in the case of the group 2. In the case of subgroup 2a. mean spectral power of the signal fell, just as it was in the case of control group. In the case of subgroup 2b, mean spectral power rose. As a result, the quality of the model became excellent in terms of statistics; the shift from the 'state prior to the music course' (the first row of Table 1) – to the 'state after the music course' (the second row, Table 1) became absolutely statistically relevant.

**6.4.** Interpretation of data of Table 1 is conditioned by the fact that general fall of mean spectral power of signal in the ultraslow bandpass is normally linked to overall activation of the functional state of the organism, while its general increase – to its overall relaxation and retardation. This means that in the case of the control group, passing the audiocourse conditioned overall shift of the functional state towards activation. In the case of the main group 2, two processes took place. If the initial level of ultraslow activity had been high. Activation took place as a result of passing the course, just as in the case of the control group (see data for Subgroup 2a, Table 1). However if the level of signal initially had been too low, an opposite process took place, that is, overall retardation.

**6.5.** Basing on the results of the analysis of Table 1, the basic hypothesis may be formulated. Its essence consists in the statement that in the case of properly conducted music therapy, sort of 'fine tuning' took place, depending on the initial state of the organism. If it had been too

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agitated, certain appeasement took place. If it had been too weak, definite activation took place. In the case of control group, where primitive sound technology was applied, only general relaxation took place, as a result of spending two weeks (1.7 hours a day) in a protected environment (cf. O'Kelly, Fachner, & Tervaniemi, 2016).

**6.6.** In order to corroborate our hypothesis, data of two simultaneously conducted studies are to be taken into account. The psychological survey showed that the psychological state of all our respondents had been normal prior to the course; passing it did not change any index considerably. This means that listening to music for 1.5 hours did not present any stress tour respondents, which is quite normal for present-day young people who spend their days with earphones being constantly stuck into their ears (Spivak, Pustoshkin, Khesina, Zakharchuk, & Spivak, 2016).

**6.7.** As to results of the molecular biological study, they were much more interesting: telomere length rose in the case of main group 2, and fell in the case of control group 1; both results were statistically relevant. This means that subconscious influence of music, regarded by means of the molecular biological analysis, was much stronger than the conscious one, registered by psychological tests, "Fine tuning' took place in the case of the music course, most probably resulting in definite prolongation of the future life span of our respondents; the opposite trend took place in the case of the primitive sound therapy (Spivak, Urazova, Zakharchuk, & Spivak, 2018; cf. Zharinov & Anisimov, 2014). Structures providing this kind of 'fine tuning' could form essential part of the adaptive ability in general (for physiological outlook, see Sudakov, 2019; for evolutionary parallels, cf. McDermott, & Hauser, 2005). Their analysis forms the next objective of our research.

## 7. Conclusion

**7.1.** Psychological correction tends to influence ultraslow activity of the brain of normal young people in a most profound way;

**7.2.** Especially designed music technology brings about complex changes in the organization of ultraslow activity that could be tentatively characterized as 'fine tuning'. If initial level of mean power of signal is somewhat too low, it tends to rise as a result of passing the course. If the initial level is too high, the opposite process tends to take place. In both cases, general optimization of the functional state of the organism most possibly takes place;

**7.3.** In the case of control group, where a primitive sound technology was applied, no 'fine tuning' took place. The general trend consisted in overall fall in the spectral power of signal, which in its turn tended to condition moderate activation of the general functional state of the organism;

**7.4**. As shown by the results of a parallel molecular biological survey, telomere length rose by members of the main group 2, who passed a music course, which meant that their adaptive ability improved considerably (although, most probably, temporarily), as a result of passing the course. The opposite trend was demonstrated for members of the control group.

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## References

Aladzhalova, N. A. (1979). *Psikhofizicheskie aspekty sverkhmedlennoi aktivnosti golovnogo mozga* [Psychophysiological aspects of ultraslow activity of human brain]. Moscow: Nauka.

Altenmüller, E., Schürmann, K., Lim, V., & Parlitz, D. (2002). Hits to the left, flops to the right: different emotions during listening to music are reflected in cortical lateralisation patterns *Neuropsychologia, 40*(13), 2242–2256. https://doi.org/10.1016/S0028-3932(02)00107-0

Andrade, P., & Bhattacharya, J. (2003). Brain tuned to music. *Journal of the Royal Society of Medicine, 96*(6), 284–287. https://doi.org/10.1177/014107680309600607

Bekhtereva, N. P., Gogolitsyn, J. L., Kropotov, J. D., & Medvedev, S. V. (1985) *Neirofiziologicheskie mekhanizmy myshlenia: otrazhenie myslitelnoi deiatelnosti v impulsnoi aktivnosti neironov [Neurophysiological mechanisms of thought: reflection of thinking activity in impulse neuron activity]*. Leningrad: Nauka.

Koelsch, S. (2014). Towards a neural basis of music-evoked emotions. *Trends in Cognitive Science, 14*(3), 131–137. https://doi.org/10.1016/j.tics.2010.01.002

McDermott, J., & Hauser, M. (2005). Probing the Evolutionary Origins of Music Perception. *The neurosciences and music II: from perception to performance. New York Academy of Sciences, 1060* (1), 6-16. https://doi.org/10.1196/annals.1360.002

Obukhova, J. V., & Obukhova, S. G. (2015). Osobennosti kharakhteristik i smysloobrazuiushchikh motivov samorealizatsii studencheskoi molodezhi [Peculiarities of characteristics and sense-forming motives of self-realization of student youth]. *Rossiiskii psikhologicheskii zhurnal, 12*(4), 21-30.

O'Kelly, J., Fachner, J., & Tervaniemi, M. (2016, November 22). Editorial: Dialogues in music therapy and music neuroscience: collaborative understanding driving clinical advances. *Frontiers in Human Neuroscience*. https://doi.org/10.3389/fnhum.2016.00585

Spivak, D. L., Pustoshkin, E. A., Khesina, A. A., Zakharchuk, A. G., & Spivak, I. M. (2016). Psychological effects of perception of traditional / non-traditional music and their brain correlates. Article 1: Psychological effects. *International Journal of Cultural Research, 1*(22), 142-155.

Spivak, I. M., Urazova, A. S., Zakharchuk, A. G., & Spivak, D. L. (2018). Perception of Traditional / Non-traditional Music and its Influence upon Life Expectancy: Preliminary Report/ Article 1: Telomere Length. *International Journal of Cultural Research, 30*(1), 198-208. https://doi.org/10.24411/2079-1100-2018-00021

Sudakov, S. K. (2019). Fiziologicheskie motivy predvidenia budushego rezultata tselenapravlennogo povedenia [Physiological mechanisms of anticipation of result of futurebehaviour]. *I.M. Sechenov Russian physiological journal, 105*(1), 36–42. https://doi.org/10.1134/S0869813919010084

Zatorre, R., & Salimpoor, V. (2013). From Perception to Pleasure: Music and its Neural Substrates. Proceedings of the National Academy of Science of the USA, *110* (suppl.2), 10430–10437. https://doi.org//10.1073/pnas.1301228110

Zharinov, G. M., & Anisimov, V. M. (2014). Muzyka i dolgoletie [Music and longevity]. *Successes of gerontology, 27*(2), 284-290. [in Rus]