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Research paper

Development of a Universal Correctional Psycho-Acoustic Method for Optimizing the Human Functional State

K.A. Nazarova[1*], N.E. Milchakova[2]

[1,2] *MIREA - Russian Technological University, Moscow, Russia*

Abstract

The purpose of this article is to substantiate the developed complex of musical means of influencing functional state of a person, presented in the form of "Simulator for Active Music Therapy" (SAMT) methodology. This is a new psychocorrectional tool used for the development of conditioned reflex, cause-effect relationships, higher mental functions and the formation of functional comfort. From point of view of the system-structural approach, the theoretical and methodological foundations of correctional method are presented, and also modern conceptual approaches to the study of musical psychophysiology are considered.

Keywords: Development, Psycho-Acoustic Method, Functional State, Psychology, Optimizing

1. Introduction

Emotional regulation of human life reflects the process of internal work of the body and is one of the main tasks in the areas of ergonomics, psychophysiology and psychology of work [1,2]. Insufficient study of the emotional sphere of functional state, as well as leveling the role of emotions in the regulation of human activity, is the reason for absolutization of the logical aspect in a system-structural study of life activity, when considering which crucial importance of the emotional structure as a segment of thinking that often prevails over the logical structure of world perception is ignored [3, 4].

It is impossible to deny the fact that lack of constant development of sanogenic thinking leads to an exclusively external (objective) straightforward management of cognitive (mental) activity, and, as a result, violates psychosomatic health, and affects quality of human development of the cognitive-cognitive sphere [5].

While modern popular psychology increasingly offers ways to suppress emotions as a method of cultivating a successful competitive personality in oneself, one should not forget that emotion regulation is a process of awareness and realization of subjective biologically based experiences [6], their transformation from the destructive to the constructive field of thinking, which contributes to the productive implementation of vital and personal processes [7], and also contributes to the formation of an optimal comfortable psychosomatic condition that the terms of the psychology of work and ergonomics, is a major factor in the formation of functional comfort [8, 9]. Analysis of the individual characteristics of emotional sphere, analysis of the structural and dynamic properties of personality and the level of influence of musical means of expressiveness on the functional state of a person, taking into account the type of higher nervous activity, allowed us to identify the main predictors of an individual response to a sound stimulus and form a stable model of perception of musical means of expressiveness by different personality types [10, 11, 12]. The obtained theoretical-methodological and experimentally structured knowledge formed the basis of SAMT methodology, which is presented in this study as a musical-acoustic projected auditory tool for optimizing the functional state of a person taking into account psycho-physiological and socio-ergonomic factors [13].

Object of study: the impact of a complex of designed musical means of expression (melody, harmony, rhythm) on the functional state of a person, taking into account the individual-typological properties of the individual.

Subject of research: the development and testing of a set of musical means of expression (melody, harmony, rhythm), structurally and dynamically correlated with the individual-typological properties of the individual.

The hypothesis of the study: the projected set of musical means of expression, presented in the form of structurally and dynamically differentiable musical criteria: melody, harmony, rhythm is theoretically and methodologically justified ordered set of musical characteristics that provide a sustainable effect of optimizing the functional state of a person.

2. Materials and research methods

The task of this technique is to find the most convenient in use and effective, affordable means of optimizing a person's state, capable of ensuring the development of higher mental functions, cause-effect relationships, sanogenic (creative) thinking and, ultimately, influencing the formation of functional comfort. personality.

To achieve these objectives, the work was built in several stages:

1. Identification of the main descriptive criteria for means of musical expression, differentiated by the predominant type of higher nervous activity.
2. Creation of a complex of musical means of expression of various structural-dynamic content, hypothetically optimal for a certain type of higher nervous activity. The design of a stimulus sound material, presented in the form of patterns of melodies, tempo-rhythmic structures and harmonics, is carried out on the basis of the obtained results when identifying descriptive criteria of musical expressiveness differentiated by the predominant type of higher nervous activity.

3. Testing of the designed complex of musical means of expressiveness in the laboratory using a complex psychophysiological method of fixing the results obtained. Processing of the obtained results and selection of the most valid patterns of musical means of expressiveness, ensuring a stable effect on the functional state of a person, taking into account individual typological characteristics.

The projected SAMT methodology is based on modern neurocognitive studies based on the basis of the developments of VNIITE (department of ergonomics and psychophysiology) in the field of psychoacoustic design and functional states; Center for Applied Neuroeconomics and Behavioral Research; Russian-German Center of the European Academy of Natural Sciences [14, 20].

To identify the features of the impact of musical means of expression on the functional state of a person, the following empirical methods were used: laboratory and ascertaining experiments, survey methods, psychological testing, expert assessment method; psychophysiological methods: electroencephalography, registration of vegetative parameters: galvanic skin response, photoplethysmogram, electrocardiogram, respiratory recursion.

When processing results, the following methods were used: a descriptive analysis of EEG; coherent analysis; topographic mapping; comparative analysis of the reliability of indicators, identified using the parametric student's t-test; Spearman's correlation analysis; cluster analysis; and multivariate analysis of variance with repeated measurements. Data processing was performed using Logic 10.0, ANOVA / MANOVA, Statistics 22.0, analysis of brain electrical activity, heart rate analysis, and cumulative analysis by Medic LTD.

As is known, the type of higher nervous activity is a stable set of psycho-physiological personality characteristics associated with emotional excitability [16]. The general scientific proposition that the basic properties of the nervous system are the balance, strength and mobility of the nervous system, as well as the theoretical and methodological analysis of the existing fundamental psychophysiological personality typologies and their comparative analysis, revealed the main descriptive criteria for musical expressiveness most suitable for each type higher nervous activity. The study and systematization of the peculiarities of the influence of harmony, rhythmics and melodies of music on the functional state of a person made it possible to identify ways to optimize the psychoemotional state (to cause a stable fixed effect) [9]. The total sample of the sample was 1400 respondents, which were differentiated according to the following criteria: the prevailing type of higher nervous activity, the level of musical education, gender, age, level of general education.

The creation of a musical stimulus methodological material was carried out at a professional recording studio by professional musicians and music psychologists.

To identify the psychophysiological predictors of perception of subjectively preferred / non-preferred musical means of expressiveness, a complex psychophysiological experiment was conducted on a sample of 46 people aged from 16 to 46 years.

The system of musical means of influencing the functional state of a person in this method is presented as a projected ordered set of interrelated musical characteristics that provide in a set stable effects of changes in the functional state of a person recorded using psychophysiological indicators.

3. Results and discussion of results

The test results aimed at identifying the main descriptive signs of musical expressiveness, differentiated by type of higher nervous activity, confirmed validity of the designed sound stimulus material representing the SAMT Method. The hypothesis of this study was based on the fact that the structure and dynamics of musical means of expressiveness correlate with a certain type of higher nervous activity in strength, balance and mobility, sampling frequency of the information component, its mobility, method of perception, processing of information and output signal. The reliability of the results is confirmed by the volume of the general population and the level of statistical significance ($p < 0.05$), as well as a representative sample of respondents in a further psychophysiological study.

On the basis of the obtained results, expert group identified the most appropriate designed musical patterns by the following criteria: melody, rhythmics, harmony, differentiated according to the sign of the prevailing type of higher nervous activity. Musical patterns formed the basis of the SAMT methodology, presented in the form of a musical sampler consisting of mutually compatible musical means of expressiveness according to the criteria: melody, harmony, rhythmics. It is proved that, depending on the individual-typological characteristics of the individual, a person will be subjectively comfortable with certain musical means of expression, expressing a certain emotion, consistently reflected in the presented musical patterns [9, 10]. All musical patterns are synchronized with each other and will create a common musical sound, regardless of the choice of the pattern.

Thus, Man constructs for himself a unique musical composition, formed according to his own subjective individual typological preferences.

Laboratory psychophysiological research was based on the following scenario: prior to the registration of biological indicators, the subject was asked to listen to four types of patterns of melody, harmony and rhythmics, differing structurally and dynamically, and correlating with four types of higher nervous activity. Then, from the selected patterns for each criterion of the proposed means of musical expression, a general sound of harmony, melody and rhythm, most preferred by the subject, creating together a full-fledged musical composition was created. Further, the subject was asked to create a composition of patterns that did not fit his subjective choice and caused an indifferent or rejecting reaction, in order to compare the subjective and objective recorded indicators of the two compositions.

When calculating the Pearson correlation coefficient, which characterizes the linear relationship between the two variables, we compared the subjective assessment of the subjects for all functional tests with vegetative indicators. As a result of processing by the functional test “listening to subjectively selected patterns” and calculating the correlation coefficient, the following became clear: 38 people have a positive correlation in electrocardiogram (82% of subjects), which confirms the fact that the subjective predisposition to music has a positive effect on the functional state of a person.

In terms of the galvanic skin response, which characterizes irritation and emotional response, a positive correlation when listening to subjectively preferred patterns could be seen in 28 people (60% of subjects). In 40% of the subjects, an increase in negative emotional reactions was observed when listening to subjectively unpleasant patterns, due to the inappropriate type of speed and strength of the stimulus.

Taking into account the identified trends in topographic mapping, as well as the presence of subjective and objective physiological factors, assessed comprehensively in this study, a dispersion analysis of intergroup differences on the scales was carried out: subjectively preferred patterns — subjectively non-preferred patterns to identify possible patterns between different dependent samples.

On the basis of the obtained results and statistical reliability, it can be concluded that when listening to patterns positively correlated with the subjective choice of respondents, brain activity is most pronounced in areas responsible for the logical and emotional memory formation and phonological processing of hearing, as well as in areas that regulate person's mood. In the theta-2 and alpha-1 ranges, the activity of evoked potentials in the area of leads P3, P4, which are responsible for cognitive knowledge and verbal memorization of information, dominates. The activity is expressed in the alpha-1, alpha-2 frequency ranges in leads F7, F8, which are responsible for the cognitive as well as endogenous

mood regulation, emotional expression, verbal perception and processing of the verbal signal.
The findings suggest that the systemic response of the body when interacting with SAMT, provide adequate mobilization of the psycho-physiological processes of the body, contributing to the optimal functional state of an active person and the development of a state of functional comfort. Synchronous activation of the affective and cognitive components of the psyche contributes to the development of sanogenic thinking and the regulation of emotional states of a person.

4. Findings

It is demonstrated that the developed complex of musical means of influence, presented in the form of the "Simulator for Active Music Therapy" (SAMT) methodology, is a powerful way to influence the functional state of a person and can be used to develop conditioned reflex, cause-effect relationships, higher mental functions and the formation of functional comfort. A study in the field of musical preferences of modern man revealed that the most significant criteria in the evaluation of music for all personality typologies are: melody, rhythm, harmony. Regularities were found in the evaluation of musical criteria depending on the psychopersonality.
The simulator is a universal practical means of application and allows you to diagnose the structural and dynamic qualities of the person, as well as correct the functional state. Satisfactory indicators of criteria for assessing the quality of the technique are presented, and the reliability of the correlation analysis of psychophysiological parameters is shown.

References

[1] Andrew, Thatchera; Paul, H.P. Yeowb. Human factors for a sustainable future. Applied Ergonomics. - 2016. - Vol. 57. - P. 1-7.
[2] Thomas, Franke; Nadine, Rauh; Josef F. Krems. Drivers in the range of critical conditions. Applied Ergonomics. - 2016. - Vol. 57. - p. 28-35.
[3] Wang, Tianyue; Yan, Jianhao; Li, Shumei. Increased insular patients: a resting-state fMRI study. EUROPEAN RADIOLOGY. - 2017. - Vol. 9. - p. 3703-3709.
[4] Tyng, Chai M .; Amin, Hafeez U .; Saad, Mohamad N.M. The Influences of Emotion on Learning and Memory. FRONTIERS IN PSYCHOLOGY. - 2017. - Vol.8. - P. 47-51.
[5] Zegan, Georgeta; Dascalu, Cristina Gena; Enache, Angela Mariana. Psychosocial Factors in Acquiring Sanogenous Behaviors in Preschoolers. INTERNATIONAL CONFERENCE PSIWORLD. - 2014. - Bucharest Univ Faculty PsycholEducSci, Bucharest, ROMANIA.
[6] Mareckova, K .; Holsen, L .; Admon, R. Neural-hormonal responses to negative affective stimuli: Impact of dysphoric mood and sex. JOURNAL OF AFFECTIVE DISORDERS. - 2017. - Vol. 222. - p. 88-97.
[7] Untersuchungen zur Lehre von der Gestalt: I.Prinzipielle Bemerkungen. "Psychol. Forsch" - 1922. - Vol.l. - P.47–58.
[8] K.A. Nazarova. The influence of the subjective assessment of the perception of music on the functional state of a person. Acmeology. - 2013. - Vol. 2 (46). - pp. 69-73.
[9] K.A. Nazarova. The system of musical means of optimizing the functional state of a person: a psycho-physiological aspect. VNIITE: dissertation of the candidate of psychological sciences: 19.00.03. - 2013. - pp. 23-148.
[10] Stavrova Olga; Meckel Andrea. The effect of trait empathy on emotional contagion through art. MOTIVATION AND EMOTION. - 2017. - Vol. 4. - P. 492-509.
[11] Randall, William M .; Rickard, Nikki Sue. Reasons for personal music listening: A mobile experience sampling study of emotional outcomes. PSYCHOLOGY OF MUSIC. - 2017. - Vol. 4. - P. 479-495.
[12] Slevc, L. Robert; Pillary, Aniruddh, D. Steele Koelsch. PHYSICS OF LIFE REVIEWS. - 2011. - Vol. 8. - P. 110-111.
[13] Nazarova K., Sapozhnikov M., Milchakova N. "DEVELOPMENT AND TESTING OF A UNIVERSAL PSYCHO-ACOUSTIC METHODOLOGY OF HUMAN FUNCTIONAL STATE CORRE". Journal of Statistics Sources Index (ESCI): http: //ipscience.thomsonreuters.com/cgi-bin/jrnlst/jlresults.cgi? PC = MASTER & ISSN = 2146- 5193
[14] Nazarova K.A., Miroshnik E.V., Chaynova L.D. Psychological development of musical tools to optimize the functional state of a person. PSYCHOLOGICAL JOURNAL. - 2016. - Vol. 37 (2). Pp. 105-111.
[15] Pearce, Marcus; Rohrmeier, Martin. Music Cognition and the Cognitive Sciences. TOPICS IN COGNITIVE SCIENCE. - 2012. - Vol. 4 (4). - p. 468-484.
[16] B.M. Heat Problems of individual differences. M. - 1961. S. 48-49.
[17] Sihvonen, Aleksi J .; Saerkaemoe, Teppo; Leo, Vera. Music-based interventions in neurological rehabilitation. LANCET NEUROLOGY. - 2017. - Vol. 16 (8). - P. 648-660.
[18] Mahendran, Rathi; Rawtaer, Iris; Fam, Johnson. It is a study of a randomized controlled trial. TRIALS. - 2017. - Vol. 18. P. 324.
[19] Pang, Yajing; Cui, Qian; Duan, Xujun. Extraversion modulates functional connectivity hubs of resting-state brain networks. JOURNAL OF NEUROPSYCHOLOGY. - 2017. - Vol.11 (3). - P. 347-361.
[20] Sokolova M.L. Modern problems of the direction "Technology of artistic processing of materials." // Russian technological journal. - 2017. - Vol. 5, No. 1 (15) - p. 50-56.