
PSYCHOPHYSIOLOGICAL REACTION TO MUSICAL ACCOMPANIMENT AS AN INHIBITOR OF PERFORMING COMPLEX TASKS

Anton Kurapov¹, Oleksandra Balashevych²

¹ PhD (Psychology), Assist. Prof., Taras Shevchenko National University of Kyiv (Kyiv, Ukraine)

ORCID ID: <https://orcid.org/0000-0002-1286-9788>

² Student, Taras Shevchenko National University of Kyiv (Kyiv, Ukraine)

ORCID ID: <https://orcid.org/0000-0002-4865-3487>

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We present the model of using the GSR and PPG polygraph sensors for the empirical study of the influence of musical accompaniment on the respondents' psychophysiological response while performing complex tasks. The results show that respondents in general tend to perform better in solving complex problems if they listen to music. process is accompanied with their favourite musical compositions. The presence of musical accompaniment results in significantly lower area of the galvanic-skin reaction readings and the amplitude of photoplethysmogram. Obtained results in general are in accordance to the current trends in scientific literature. The authors believe that the obtained results will aid in understanding the impact of listening to music while performing complex tasks on psychophysiological indicators, as well as the impact of listening to music on the quality of complex tasks.

Keywords: complex tasks, psychophysiological reactions, music, musical accompaniment, polygraph, skin-galvanic reaction, photoplethysmogram.

Problem Statement. In recent decades, the amount of sound information that surrounds people has increased significantly. People listen to music almost every day, even if they are not aware of it: many of them stay in the constant musical environment while doing some work with a continual sound background. Therefore, it is very important to study how musical accompaniment affects not only the emotional sphere and well-being, but also the cognition and the ability to solve certain problems. Currently, there are many case studies, including cross-disciplinary, learning the impact of music on the human psyche from different points of view. In particular, the study of musical accompaniment impact on non-musical activities (Hallam, 2011; Pavlyugina, 2012); neuronal basics of listening to music (Starcheus, 2007; Reybrouck et al., 2021), the influence of music on human cognitive functions (Gotsdiner, 1993;

Nekipelov et al., 2005; Pogonysheva et al., 2015; Mironova, 2020).

Psychophysiology is one of the areas of psychology which studies the phenomena related to physiology. Despite the fact that each person has individual psychological and physiological reactions to music and noise, the latest research of the influence of noise on the psychophysiological parameters and working capacity (Nekipelov, 2005; Pogonysheva et al., 2015) has shown some tendencies of increasing the response time if staying in noise for a relatively long period. Thus, these psychophysiological researches can contribute to other branches of psychology, such as psychology of labour, in studying certain human reactions to various stimuli, which, in turn, can help to improve the concentration of attention, well-being, emotions, etc.

Address for correspondence, e-mail: editpsychas@gmail.com
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The purpose of this study is to determine the features of psychophysiological reactions to musical accompaniment during the performance of complex tasks. Particular attention was paid to the differences in quality of tasks' performance for people who listened to music while performing a task and those, who did not listen to it. The study was conducted as a classical experiment involving the control and experimental groups.

Literature Review. Rapid technological development has played an important role in the possibility of music listening at any time in everyday life. The transition to digital technology of music recording and playback allows listeners to choose between music of different types and genres. Such dynamics is likely to lead to significant changes in human interaction with music (Baym, 2015). It is undeniable that the amount of music in human life has increased significantly, thus it is important to study music influence on emotional state and other psychological aspects.

Listening to music recently has become a kind of experience used by neurobiologists and psychologists to study cognitive, affective, and other functional changes. The research mostly focuses on studying of listener's perceptual and cognitive changes after music listening, linking these changes with neuroplasticity, or changes in neural connections – as the result of adaptation to new environmental requirements.

Listening to music for hours and even minutes can lead to changes in brain function. In the context of predictive coding theory, which states that our brain is constantly modeling and updating the mental model of the environment, listening to music is an active process of anticipation, and this process is continuous with any influence of new sounds (Reybrouck, 2021). When a person starts dancing to the beat of music, for example, not only do their motor skills change, but so do their heart rate, breathing, and even their feelings. This is associated with the work of the basal ganglia, which plays an important role in the programming and planning of movements, as well as in the development of automatisms. Movement, emotion, and rhythm are so intertwined in the brain that even a change in tempo will affect the assessment of emotional content (Kurapov, 2021). Not only performance, but also listening to music is a complex process in terms of the brain functions, which

greatly affects emotional and cognitive state of a person: that is why music is quite commonly used for psychotherapy.

Methodology. The objective of this research is to verify the following hypotheses:

- 1) Listening to music during the performance of complex tasks affects a person's skin galvanic response and cardiovascular activity.
- 2) Listening to music affects the quality of performance of complex tasks.

The research methodology consists of two parts: hardware-based methods for measuring psychophysiological reactions, in this case using the GSR and PPG polygraph sensors, and a questionnaire. It should be noted that not all polygraph sensors should be put on, but only those that measure the skin galvanic response, as well as cardiovascular contractions. The questionnaire, in turn, includes questions of socio-demographic nature (age, gender of the respondent), subjective evaluation questions, the respondent's ability to do certain work with music, to be focused on completed tasks, as well as respondent's self-assessment at the time of the research and in everyday life. For example, the extent to which the respondent considers himself as calm or anxious, open or closed, full of energy or tired, active or weak. In this part of the questionnaire, the open-ended question also asks the respondent to indicate his/her musical genre preferences, musical education (if any), skills of playing musical instruments. The next part of the questionnaire includes 20 test questions, which are drawn up to assess and measure the respondent's ability to do various tasks. Although these tasks are not aimed at measuring intelligence as such, this particular study tests both verbal and nonverbal intelligence.

Conceptual research model. The research has form of a classic experiment involving an experimental and control group. For the experimental group, the study was conducted as follows: the respondent signs the consent to undergo the study, and then the instruction is read out. After reading the instructions, polygraph sensors are connected to the respondent. Then the respondent selects his/her favorite musical compositions and proceeds to complete the test task. For the control group, the procedure was the same except without the ambient music.

Results. To determine the statistical methods that

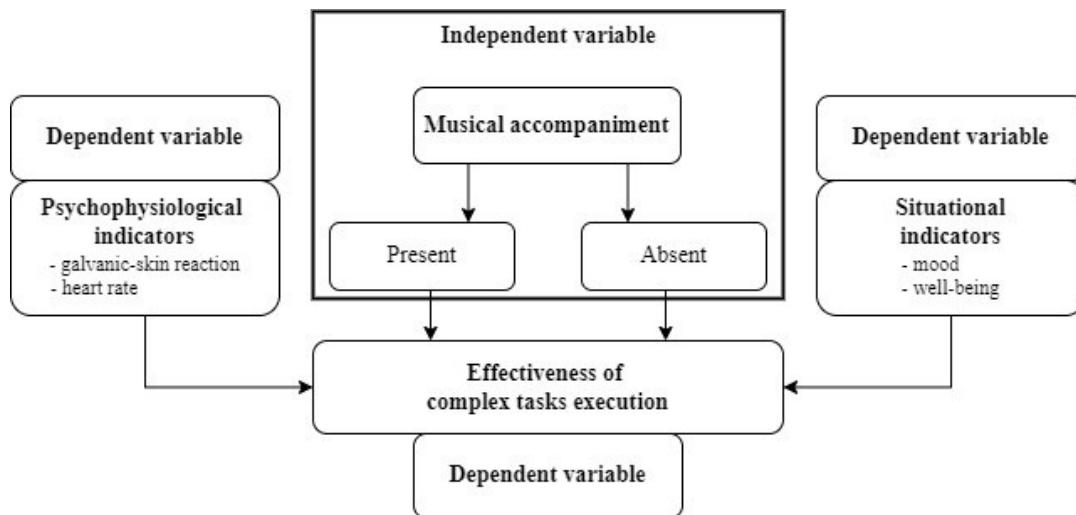


Fig. 1. Conceptual Research Model

Table 1

Analysis results for total score in the test, the area of the CGR and the amplitude of the PPG.

Features	p	V	Rank Difference
Overall test score	0,000	13,500	11,48
GSR area	0,007	36,000	-8,1
PPG amplitude	0,000	18,000	-10,80

should be applied to process the obtained experimental results the distributions of the measured variables were analyzed. It was identified that according to the Kolmogorov-Smirnov criterion, the distributions differ from the normal one ($p < 0,005$), so further analysis was carried out using non-parametric methods. According to the obtained results (Table 1) respondents who listened to music while performing the task have better results when performing the complex task (difference in ranks = 11,48), and also have lower indicators in terms of the amplitude of the photoplethysmogram (difference in ranks = -10,8). The conducted studies also made it possible to uncover the existence of a relationship between the amplitude of the PPG and the results of complex tasks: a strong negative correlation ($r = -0,627$; $p = 0,000$) was observed between these values.

The sum of points for the test has a strong negative rank correlation with concentration according to the respondent's self-report at the time of the study ($r = -0,815$; $p = 0,000$), and a moderate positive rank correlation with the level of anxiety ($r = 0,551$; $p = 0,003$). An average negative rank correlation was obtained between the amplitude of the GSR ($r = -0,505$; $p = 0,007$) and the overall test result, the

area of the GSR ($r = -0,696$; $p = 0,000$) and the amplitude of the PPG ($r = -0,627$; $p = 0,000$). The results indicate a statistically significant difference between the ranks of the experimental and control groups according for the following variables: total score for the test, the area of the GSR and the amplitude of the PPG (Table 1). The experimental group, on average, has higher ranks for the performance of the test task, as well as lower ranks for the area of the GSR and the amplitude of the PPG. Also, the analysis of ranks showed that the experimental group has a lower rank of concentration of respondents.

To analyze the homogeneity of the sample for the sum of points (Fig. 2) and the amplitude of PPG (Fig. 3), an Xbar R chart was constructed by combining consecutive measurements into subgroups of 5 respondents. The average values (upper parts of the graphs) and ranges of values (lower parts of the graphs) for each subgroup are completely within the control interval, which means that the addition of new measurements does not greatly change the overall picture of the experiment and the averages are not significantly biased by outliers.

Discussion. The presented research confirmed the

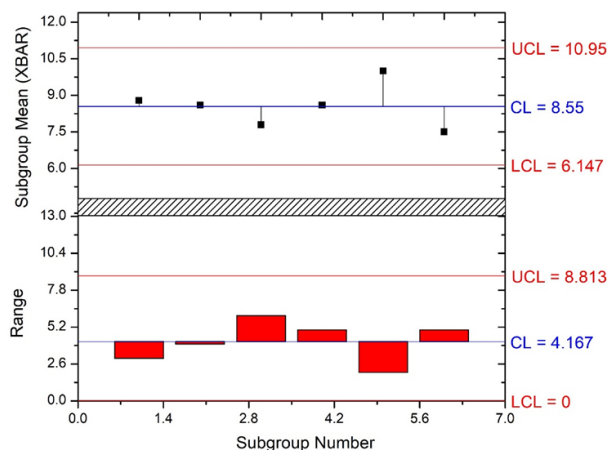


Fig. 2. Xbar R chart for total scores for a test

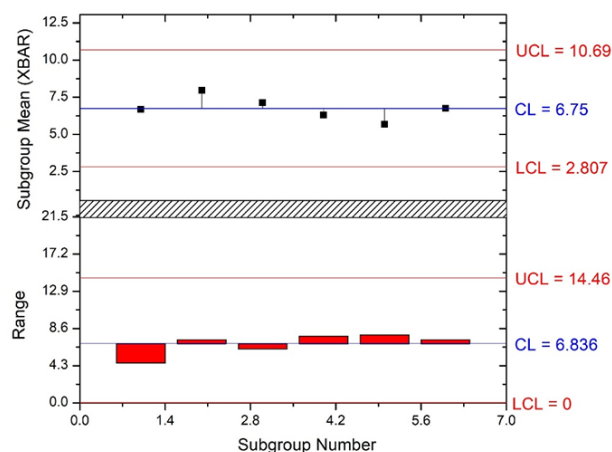


Fig. 3. Xbar R chart for FPG amplitude

general trends described in the world scientific literature (Hallam et al., 2011; Pavlyugina et al., 2012; Reybrouck et al., 2021; Kurapov et al., 2021), namely that music affects speed and quality of performing complex tasks, psychophysiological parameters and level of concentration of attention. The conducted research showed that music has a significant effect on people when performing complex tasks. On average, respondents who were able to listen to their favorite music performed better on the total test score, and are also more relaxed, according to self-assessment test. It was found that people who had a musical education are less sensitive to the influence of music, because music and the performance of certain tasks while listening to it are more familiar to them. A noticeable correlation of the indicators that can be revealed on the polygraph, performing the task and listening to music while performing the task in the experimental group was revealed: indicators of the skin-

galvanic reaction and cardiovascular rhythm are on average reduced compared to the control group. It was recorded that calmer respondents coped better with the performance of the test task.

Some respondents rated their concentration as high, because they could feel responsible and very anxious, which is why, based on the results, such respondents received lower points for the test. Respondents of the experimental group, that is, those who listened to music, were less anxious. It can be assumed that the subjects who listened to music believed that it could distract them, so in the self-report about the current state they answered that they had a low level of concentration, but as our study showed, music helps in performing complex tasks, hence such respondents showed better test results.

The ability to play a musical instrument is a complex phenomenon that includes not only the mechanical

performance of certain actions with the instrument, but also various types of memory, the ability to quickly navigate, internal feelings of tempo, rhythm ect are involved in this process. Therefore, people with a musical education may perform better when performing certain tasks to music, and music can be expected to have a calming effect on them that can be tracked by polygraph.

Conclusions. The study presents the model of using the GSR and PPG polygraph sensors for empirical research of psychophysiological response features to musical accompaniment as an inhibitor of complex tasks performance. According to the conducted experiment people tend to perform better in solving complex problems if the process is accompanied with their favourite musical compositions. At the same time the presence of musical accompaniment results in significantly lower area of the galvanic-skin reaction readings and the amplitude of photoplethysmogram. A strong negative correlation was revealed between the amplitude of the PPG and the performance in complex tasks. An extraordinary relation of the presence of the musical education on the magnitude of the aforementioned effect was uncovered: people with such education tend to experience a lower impact of music on their performance.

The presented research confirmed the general tendencies described in the world scientific literature. The authors believe that the acquired results will aid in understanding the impact of listening to music while performing complex tasks on psychophysiological indicators, as well as the impact of listening to music on the quality of complex tasks. The obtained results can be compared with modern theoretical and experimental views of the scientific community on the role and nature of music influence on the cognition and psychophysiology.

References :

- Baym, N. K. (2015). *Personal connections in the digital age*. John Wiley & Sons.
- Gotsdiner, A. L. (1993). *Muzykal'naya psihologiya*. Mezhdunarodnaya akademiya pedagogicheskikh nauk. Moskva.
- Hallam, S., Cross, I., & Thaut, M. (Eds.). (2011). *Oxford handbook of music psychology*. Oxford University Press.
- Kurapov A., Balashevych A., & Tsurikova H. (2021). *Complex sound's*

pitch and tempo perception: psychological and instructional features. *Bulletin of Taras Shevchenko National University of Kyiv* (2), 38-41.

- Mironova, A. A. (2020). *Opasnost' vozdeystviya shuma na psihofiziologicheskoe sostoyanie i trudospobnost' cheloveka*. *Mezhdunarodnyj studencheskij nauchnyj vestnik*, (6), 1-1.
- Nekipelov, M. N., Nekipelova, O. O., SHishelova, T. N., & Maslova, E. S. (2005). *Vliyanie shuma na opponentnye psihofiziologicheskie sistemy pamyati cheloveka*. *Uspekhi sovremennogo estestvoznaniya*, (9).
- Pavlyugina, R. A., Karamysheva, N. N., Sakharov, D. S., & Davydov, V. I. (2012). *Influence of music on the solution of mathematical logical tasks*. *Human Physiology*, 38(4), 354-360.
- Pogonysheva, I. A., Pogonyshv, D. A., & Krylova, A. A. (2015). *Vliyanie shuma na psihofiziologicheskie parametry i rabotospobnost' organizma cheloveka*. *Vestnik Nizhnevarovskogo gosudarstvennogo universiteta*, (1), 87-93.
- Reybrouck, M., Vuust, P., & Brattico, E. (2021). *Neural Correlates of Music Listening: Does the Music Matter?*. *Brain Sciences*, 11 (12), 1553.
- Starcheus, M. S. (2007). *Tajny i mify emocional'no-psihologicheskogo vozdeystviya muzyki na cheloveka*.

Anton Kurapov

PhD (Psychology), Assist. Prof., Taras Shevchenko National University of Kyiv (Kyiv, Ukraine)

Oleksandra Balashevych

Student, Taras Shevchenko National University of Kyiv (Kyiv, Ukraine)

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ABSTRACT

The research presents a model for using the GSR and PPG polygraph sensors for empirical research of psychophysiological response features to musical accompaniment as an inhibitor of the performance of complex tasks. According to the findings of the experiment that was carried out, when people are asked to solve difficult problems while listening to their preferred musical compositions, they tend to perform significantly better. While this is occurring, the area of the galvanic-skin reaction readings and the amplitude of the photoplethysmogram are significantly reduced as a consequence of the presence of musical ac-

companiment. The amplitude of the PPG was found to have a strong negative correlation with the performance in complex tasks, as was revealed by the findings. An extraordinary relation between the presence of musical education and the magnitude of the aforementioned effect was discovered: people with such education tend to experience a lower impact of music on their performance. This finding was made possible by the discovery of an extraordinary relation between the presence of musical education and the magnitude of the aforementioned effect.

The research that was presented provided support for the general tendencies that are outlined in the global scientific literature. The acquired results will benefit in understanding the impact of listening to music while performing complex tasks on psychophysiological indicators, as well as the impact of listening to music on the quality of complex tasks. In addition, the authors believe that the results will aid in understanding the impact of listening to music on the quality of complex tasks.

Keywords: complex tasks, psychophysiological reactions, music, musical accompaniment, polygraph, skin-galvanic reaction, photoplethysmogram.

Антон Олександрович Курапов

Кандидат психологічних наук, асистент кафедри психології, Київський національний університет імені Тараса Шевченка (м. Київ, Україна)

Олександра Костянтинівна Балашевич

Студент факультету психології, Київський національний університет імені Тараса Шевченка (м. Київ, Україна)

ОСОБЛИВОСТІ ПСИХОФІЗІОЛОГІЧНОЇ РЕАКЦІЇ НА МУЗИЧНИЙ СУПРОВІД ЯК ІНГІБІТОРА ВИКОНАННЯ КОМПЛЕКСНИХ ЗАДАЧ

АНОТАЦІЯ

У роботі представлено модель застосування датчиків ФПГ та ШГР поліграфу для емпіричного дослідження особливостей психофізіологічної реакції на музичний супровід як інгібітор виконання комплексних завдань. Згідно з результатами проведеного експерименту, коли людей просять вирішити складні задачі, під час прослуховування улюблених музичних композицій респонденти, як правило, виконують їх значно краще. При цьому площа показників шкірно-гальванічної реак-

ції та амплітуда фотоплетизмограми значно зменшуються за наявності музичного супроводу. Амплітуда ФПГ має сильну негативну кореляцію з продуктивністю при виконанні комплексних завдань. Проведені дослідження дозволили встановити сильний зв'язок між наявністю музичної освіти та величиною зазначеного ефекту: люди з такою освітою, як правило, відчувають менший вплив музики на їх здатність виконання комплексних завдань.

Представлене дослідження підтвердило загальні тенденції, які окреслюються у світовій науковій літературі. Отримані результати поглиблюють розуміння впливу прослуховування музики під час виконання комплексних завдань на психофізіологічні показники, а також впливу прослуховування музики на якість виконання комплексних завдань. Крім того, отримані результати ілюструють вплив прослуховування музики на якість виконання складних завдань.

Ключові слова: комплексні задачі, психофізіологічні реакції, музика, музичний супровід, поліграф, шкірно-гальванічна реакція, фотоплетизмограма.

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