

**Nervous processes and orthostatic  
reactions features of creative  
specialties students. Monograph**

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NERVOUS PROCESSES AND ORTHOSTATIC  
REACTIONS FEATURES OF CREATIVE  
SPECIALTIES STUDENTS

Monograph

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The future professional activity of students of the Faculty of Arts is characterized by an insufficient level of motor activity of a dynamic nature, combined with a large static load and highly coordinated finger work. Representatives of these specialties have their own psychological characteristics. The monograph reveals the features of the properties of the nervous system and the functional potential of the cardiovascular system of students - future teachers of fine arts and music, and based on the data obtained, recommendations for physical culture and sports have been developed. The Monograph found that future teachers of creative specialties have significantly the least mobility in combination with the highest stability of nervous processes in comparison with representatives of other pedagogical specialties. Significant differences were revealed between the indicators of orthostatic reactions of students of the Faculty of Arts and the faculty where future sports coaches are trained. Orthostatic regulation is much better in students of the Faculty of Physical Culture and Sports. It is necessary to correct the program of physical education of students of creative specialties to increase the interest of students and the correspondence of physical exercises to the characteristics of the nervous system of students of the Faculty of Arts. Future teachers of creative specialties can be recommended to engage in any kind of sport or physical activity, but the most suitable for them are exercises that require the development of endurance in combination with the inclusion of cognitive processes and concentration of attention: walks with observation of nature and the city, exercises to music, exercises with concentration on various natural images, etc.

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# CONTENT

Introduction .....	4
Chapter 1. Functional state pedagogical universities student's peculiarities of various faculties according to orthostatic reactions and psychophysiological capabilities indicators .....	6
Chapter 2. Functional readiness and properties of the nervous system peculiarities of art specialties future teachers .....	21
Chapter 3. Comparative characteristics of the functional state of future art teachers and other pedagogical specialties students.....	34
Conclusions .....	47

## Introduction

Future art teachers are a category of students who combine academic work on learning the basics of pedagogy with a large amount of practical work to improve their professional skills [1]. This is especially characteristic of musicians and representatives of fine arts [2–5]. They get a big load on the muscles of fine motor skills. At the same time, the muscles that support the posture also receive a heavy load, especially the muscles of the spine and lower limbs. The cardiovascular system remains completely neglected, since the professional activities of musicians and representatives of fine arts do not involve loads on the cardiovascular system [4–6]. In order to preserve and strengthen health, future teachers of creative specialties need to strengthen the muscles of the trunk and lower limbs to prevent the development of diseases of the musculoskeletal system. They also need to strengthen the cardiovascular system to increase general endurance, which is a necessary condition for maintaining health [7–10]. But at the same time, the question arises: what exercises are most suitable for representatives of the arts? After all, it is necessary that the exercises were selected taking into account the peculiarities of the functional and psychophysiological state of students, and also contributed not only to physical improvement, but also to professional improvement [11–13].

It should be noted that in general there is a unity of art and sport. After all, at all times, people sought perfection - physical, intellectual, mental... And the advanced people of their time combined different aspects of development in themselves, were distinguished by both high intelligence and the ability to do arts and a high level of mastery of their body [6, 8, 14]. The social foundations of this phenomenon were laid in ancient Greece, during the time of the first Olympics [14]. The idea of integrating sports with art originated in ancient Greece. These provisions are analyzed in detail in the works of Stolyarov [14]. The author cites quotes and sayings of ancient philosophers and modern researchers to illustrate this point of view [14]. Thus, Plato considered the main abilities of a person to be musical (for the development of wisdom) and sports (for the development of the body). At the same time, these abilities should be harmoniously developed [14].

A deep supporter of this idea was the founder of the modern Olympic movement, Pierre de Coubertin [14]. He repeatedly pointed out the need to complement and strengthen the connection between sports and art. He emphasized that art should be adjacent to sports, should be connected with the practice of sports, that sports should be considered as a source and as a reason for art and that there should be an alliance between athletes, artists and spectators [14].

Thus, we observe that people who strive for perfection combine the desire to develop both the body and the perception and creation of works of art. But students of non-sports majors of pedagogical universities pay little attention to physical education and sports. That is why, first of all, it is necessary to interest them in physical exercises. For this, exercises should be selected according to the functional characteristics of students. In order to develop recommendations for physical culture and sports for students of pedagogical universities of the faculties of arts, it is necessary to identify

their psychophysiological features [15, 16] and features of vegetative regulation of the functional state [17–20]. The activity of the autonomic nervous system does not depend on the will of a person. This means that under normal conditions, a person cannot force his heart to beat less frequently or his stomach muscles to stop contracting. However, it is possible to achieve conscious influence on many parameters controlled by the autonomic nervous system with the help of special training methods [15, 16, 20]. The sympathetic nervous system increases metabolism, increases the excitability of most tissues, and mobilizes the body's forces for active activity. The parasympathetic system helps restore spent energy reserves, regulates the body's work during sleep [15, 16, 18]. The autonomic nervous system adapts the work of internal organs to changes in the environment. The autonomic nervous system is also involved in many behavioral acts carried out under the guidance of the brain, influencing both physical and mental activity of a person [19, 20].

That is why the determination of the peculiarities of vegetative regulation of the physical and psychological state based on the performance indicators of the nervous and cardiovascular systems of students of the Faculty of Arts is necessary for the selection of physical exercises that are most suitable for future teachers of creative specialties.

# **Chapter 1. Functional state pedagogical universities student's peculiarities of various faculties according to orthostatic reactions and psychophysiological capabilities indicators**

## **Abstract**

**The purpose of the study:** to determine the characteristics of students of various faculties of pedagogical universities regarding the performance indicators of the nervous and cardiovascular systems based on reaction speed indicators and the orthostatic test.

**Material and methods.** 554 students of H.S. Skovoroda Kharkiv National Pedagogical University of 1-2 courses of various 9 faculties. During psychophysiological testing, a test for the time of a simple visual-motor reaction was used. The following indicators were determined: reaction time, number of errors. Orthostatic reactions were determined by the results of heart rate in the supine position and in the standing position using Polar devices (fitness - watches) and analyzed using the Polar flow applications on the phone and on the computer. The distribution of students into groups according to the characteristics of psychophysiological testing and orthostatic functions was carried out using a hierarchical cluster analysis. The relationship between the faculty of a pedagogical university and the number of students involved in clusters was conducted using the Pearson Chi-square test.

**Results.** Students were divided into 2 groups (clusters) according to psychophysiological functions and orthostatic reactions. The first cluster of students was characterized as "the predominance of the sympathetic department of the autonomic nervous system and the mobility of nervous processes," and the second cluster was characterized as "the predominance of the parasympathetic department of the autonomic nervous system and the strength of nervous processes." It was found that according to the results of the time of simple visual-motor reaction, the students of the first cluster probably differ from the students of the second cluster ( $p < 0.001$ ): in the subjects of the first cluster, the time of simple visual-motor reaction is significantly shorter compared to the students of the second cluster. But according to the number of errors in the test for determining the time of a simple visual-motor reaction, on the contrary, the students of the second cluster had better results ( $p < 0.001$ ). Students of the first cluster have a significantly higher heart rate in the supine position compared to students of the second cluster, as well as a greater difference between the heart rate indicators in the lying and standing positions ( $p < 0.05$ ).

**Conclusions.** The faculty at which students study has a significant effect on the number of subjects with a predominance of the sympathetic (parasympathetic) department of the nervous system and the mobility (strength) of nervous processes according to the results of the Chi-square test and the determination of symmetry measures ( $p < 0.05$ ). The obtained results should be taken into account when conducting physical education classes for students of different faculties, when providing recommendations to students regarding classes in a certain sport (if the student hesitates when choosing a sports specialization), and when planning individual tasks to be conducted online.

## **Introduction**

Graduates of higher education institutions constitute the strategic potential of individual states and the world as a whole (Bejtka, et.all., 2022; Banville, et.all., 2021; Hennig, et.all., 2022). Therefore, preserving and strengthening the health of students in modern socio-economic conditions becomes one of the most important tasks of our time. But research results show that many students do not consider health a priority and are ready to sacrifice it for material benefits or social benefits. In the view of the majority, health does not look like a human-created resource and is not considered as a goal and value of development. This leads to the fact that the state of health of people is paid attention only when violations occur (Choi, et.all., 2021).

In recent decades, the level of morbidity among students has been increasing from year to year (Kozin, et.all., 2022). Diseases of the cardiovascular, nervous systems and musculoskeletal system predominate among the nosological forms (Kozin, et.all., 2022). One of the reasons that negatively affect the state of health is low physical activity, the lack of opportunity for a significant part of teenagers to engage in physical culture and sports on a regular basis at school age, and then during the period of university studies (Borysenko, et. all., 2020). World experience and many years of practice of sports organizations show that the use of physical culture and sports in the formation of a healthy lifestyle is effective and economically beneficial for society (Kim, et.all., 2021; Lamb, et.all., 2021). Physical culture and sports are considered as the most important tool for the development of human potential, as one of the effective means of preserving and strengthening health, increasing work capacity and increasing the duration of an active life (Garcia, et. all., 2021; Kozina, et. all., 2021; Orbaek, et al., 2021).

Mass student sports are a powerful factor of unity, physical and spiritual improvement of each nation, keeping it in an adequate social tone (Lundvall, et.all., 2020; Sakamoto, et.all., 2018; Sebo, et.all., 2022). Thus, the development of sports contributes to the displacement of negative antisocial phenomena from the student environment, the strengthening of corporate spirit, organization, and a sense of responsibility for the result in young people.

This problem especially concerns pedagogical universities, since students - future teachers need not only to have knowledge to strengthen and preserve their health, but also knowledge necessary to transfer to future pupils (Macken, et.all., 2020; Milley, et.all., 2021; Murfay, et.all., 2022). Future teachers need not only to be healthy while studying at the university, but also to maintain health throughout their lives, and especially during their professional activities (Orhan, et.all., 2021; Sakamoto, et.all., 2018). The professional activity of a teacher requires a very good state of health due to the high level of dedication to work, the presence of great emotional stress, the presence of contradictions between the requirements for the physical, intellectual, emotional, and spiritual components of a teacher's professional activity and public recognition of the importance of a teacher's work (Thaqi, et.all., 2021; Tsuda, et.all., 2022; Tudor, et.all., 2020). In addition, the teacher works to create the future, and he must transfer knowledge on strengthening and preserving the health of students. Thus,



the future teacher must be healthy while studying at the university; maintain health throughout life, and especially in professional activities. Also, interaction with children and parents in the process of professional activity requires a good psycho-emotional state. This is ensured by appropriate health status. Interaction with management, work with documentation, preparation for classes, etc. can also be attributed to the problems that await future teachers in their professional activities. And the most important thing for a teacher is the ability to transfer knowledge to students about strengthening and preserving health.

The scientific base of evidence-based medicine, sports, rehabilitation, physical therapy, health care and analysis of the experience of European universities was applied to this problem. By querying the Web of Science "health care students" 1058 sources were found, of which 48 contained programs on student health care. The programs concern various aspects of students' health: mental (12), reproductive (10), cardio (10), general (16). The analysis of the experience of European universities showed the main directions of student health care: 1 – an individual approach to examinations with the involvement of leading specialists; 2 – availability of "Health Laboratories" and "Health Clubs"; 3 – physical education as one of the leading disciplines in terms of the number of hours with each student choosing a type of sport (motor activity) for classes (Macken, et.all., 2020; Milley, et.all., 2021; Thaqi, et.all., 2021; Tsuda, et al., 2022). But in the analyzed sources, we did not find information about the specifics of the construction of classes for students of different faculties. At present, the issue of developing recommendations has become ripe in society data on sports for students of various pedagogical specialties, as there are data on the presence of features of the nervous and cardiovascular systems in representatives of various professions and specialties. In addition, it is known that playing a certain type of sport and corresponding professions are chosen by people with the appropriate aptitudes, which are reflected in the work of the entire organism, and, first of all, in the work of the nervous and cardiovascular systems (Korobejnikov, et.all., 2012). One of the most common and relatively simple to use for determining the features of the nervous system are psychophysiological indicators based on the registration of reaction speed in various testing modes (Korobejnikov, et.all., 2012; Deary, Deary et.all., 2001). One of the indicators of the work of the cardiovascular system and the regulation of vascular tone are the indicators of the orthostatic test, which are also relatively easy to use (Borysenko, et.all., 2020; Cretu, et.all., 2021; Kozina, et.all., 2020 ). Based on these provisions, the following hypothesis was put forward: students have peculiarities in the work of the nervous and cardiovascular systems, which may be different for students of different faculties of pedagogical universities.

**The purpose** of the study: to determine the characteristics of students of various faculties of pedagogical universities regarding the performance indicators of the nervous and cardiovascular systems based on reaction speed indicators and the orthostatic test.

## **Material and methods**

### Percipients

554 students of H.S. Skovoroda Kharkiv National Pedagogical University of 1-2 courses of various 9 faculties: 60 students of the Faculty of Elementary Education, 52 students of the Faculty of History, 89 of Natural Sciences, 89 of Foreign Philology, 64 of the Faculty of Preschool Education, 136 of the Faculty of Ukrainian Language, 16 of the Faculty of Physical Education and Sports, 16 of the Faculty of Arts , 32 students of the Faculty of Psychology and Sociology. Student testing was conducted in classes on the subject "Health Care Technologies" from 8:00 a.m. to 9:00 a.m. in September - October 2021.

### Procedure

Testing was conducted in each academic group of students separately. From 5 to 20 people were tested at one time. Students were tested as follows. On the first day, students were tested on orthostatic stability. The next day, the students underwent a psychodiagnostic test to determine the speed of reaction in different modes of signal appearance.

### Method of psychophysiological testing

When conducting psychophysiological testing, students were first explained the essence of the tests and the peculiarities of working with the "Psychodiagnostics" program, according to which the testing was conducted, then they made 1-3 attempts to master the tests, and passed the testing. After filling out a special form with the subject's data, a window with the names of the tests appears on the screen. The subject chooses a test that will be used to determine reaction speed. After that, different images appear on the screen. When determining the speed of a simple visual-motor reaction, the subject presses the left mouse button as soon as he sees any image on the screen (Korobejnikov, et.all., 2012).

During psychophysiological testing, a test for the time of a simple visual-motor reaction was used. The following indicators were determined: reaction time, number of errors. The shorter the reaction time, the higher the mobility of nervous processes, which is also related to the activity of the sympathetic division of the autonomic nervous system. The smaller the number of errors, the higher the strength of nervous processes, which is also related to the activity of the parasympathetic division of the autonomic nervous system.

### Orthostatic test

Orthostatic reactions were determined by the results of heart rate in the supine position and in the standing position using Polar devices (fitness - watches) and

analyzed using the Polar flow applications on the phone and on the computer. Testing was carried out as follows. In a special auditorium for massage, students put on fitness watches and lay quietly on their backs on massage tables for 10 minutes to stabilize their heart rate. Then a special mode of orthostatic testing was set on the watch, heart rate was measured in the lying position for 30 seconds. Then the students got up, and heart rate was measured again for 30 seconds. Average heart rate values for 30 s in the lying position and in the standing position were recorded, which were automatically calculated using Polar flow applications in computers and phones. Heart rate values greater than 80 beats·min<sup>-1</sup> were considered indicators of inefficient work of the cardiovascular system. The difference between the heart rate in lying and standing positions of more than 30 beats·min<sup>-1</sup> was regarded as an indicator of difficult adaptation of the body to a change in body position (Borysenko, et.all., 2020; Cretu, et.all., 2021; Kozina, et.all. , 2020).

### Statistical analysis

During the statistical processing of the research results, the normality of the distribution of each sample was first checked using the Kolmogorov-Smirnov test. If the samples obeyed a normal distribution, the comparison of the test results between students of different formed clusters based on the results of the tests on orthostatic and psychophysiological indicators was carried out using the Student's test.

The distribution of students into groups according to the characteristics of psychophysiological testing and orthostatic functions was carried out using a hierarchical cluster analysis. On the basis of the comparison of indicators of psychophysiological functions and orthostatic reactions of students of different clusters according to the Student's method, the formed clusters were characterized:

The number of students in each faculty belonging to each cluster was determined. Students of the two formed clusters were compared according to psychophysiological and orthostatic indicators.

The relationship between the faculty of a pedagogical university and the number of students involved in clusters clusters was conducted using the Pearson Chi-square test.

### Results

First, all samples were tested for normal distribution for all indicators. The test was carried out using the one-sample Kolmogorov-Smirnov test. Table 1, as an example, shows the results of the test results of students of the Faculty of Primary Education according to this criterion. No significant differences were found between the obtained distribution and the normal one ( $p > 0.05$ ). The results of testing all other samples gave a similar result. Thus, a conclusion was made about the possibility of using parametric methods of processing research results.

Table 1

An example of the results regarding the test of the hypothesis of the normality of the distribution according to the Kolmogorov-Smirnov test of students of the faculty of primary education (n=60)

№	Indicators	Hypothesis	Criterion	Asymptotic significance	Decision
1	Time of a simple visual-motor reaction, ms	The distribution is uniform with a low of 206.46 and a high of 392.75	One-sample Kolmogorov-Smirnov test	0.209	The null hypothesis is accepted
2	Errors in the test for the time of a simple visual-motor reaction, number	The distribution is uniform with a minimum of 2.42 and a maximum of 5.853	One-sample Kolmogorov-Smirnov test	0.312	The null hypothesis is accepted
3	Heart rate lying down, beats·min <sup>-1</sup>	The distribution is uniform with a minimum of 58 and a maximum of 76	One-sample Kolmogorov-Smirnov test	0.234	The null hypothesis is accepted
4	Standing heart rate, beats·min <sup>-1</sup>	The distribution is uniform with a minimum of 79 and a maximum of 97	One-sample Kolmogorov-Smirnov test	0.136	The null hypothesis is accepted
5	Standing heart rate - lying heart rate, beats·min <sup>-1</sup>	The distribution is uniform with a minimum of 11 and a maximum of 17	One-sample Kolmogorov-Smirnov test	0.381	The null hypothesis is accepted

Notes. Fixed Lilieforsa. The level of significance is equal to 0.05

In order to determine the individual characteristics and the possibilities of developing a differentiated approach to physical education of students, a cluster analysis of the subjects was conducted based on the indicators of psychophysiological capabilities and autonomic regulation of cardiovascular activity. First, the optimal number of clusters (groups) of students was determined. For this, according to the rules of cluster analysis, the step at which the cluster coefficients begin to grow non-linearly was subtracted from the total number of students whose results were processed (Table 2). This turned out to be step 552. Then, the step at which the coefficients begin to grow non-linearly (552) is subtracted from the total number of subjects (554). As a result of these calculations, we obtained a value of 2, that is, 2 clusters are the optimal number of clusters in this study.

Table 2

The order of agglomeration in the cluster analysis of cases (students) by indicators of psychophysiological functions and orthostatic reactions (n=554)

Stage	Combination of clusters		Coefficients	The stage of the first appearance of the cluster		The next stage
	Student 1	Student 2		Student 1	Student 2	
1	119	121	0	0	0	51

2	251	266	25	0	0	8
3	22	257	132	0	0	34
4	210	225	142	0	0	36
5	264	278	189	0	0	30
6	235	270	195	0	0	54
7	52	113	217	0	0	19
8.....	115	251	257.5	0	2	27
.....552	4	170	68902.839	73	71	75
553	4	172	89525.959	74	69	0

Thus, we got 2 clusters. At the next stage, the belonging of each student to a certain cluster was determined by specifying the number of clusters (2) when dividing the subjects into groups (tables 3, 4). As a result of the distribution of students who passed all the tests, it was determined that 430 people entered the first cluster, and 124 people entered the second cluster.

Table 3

Belonging to clusters of students of pedagogical universities (examples)

Belonging to clusters	Student, conditional number
1	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 15, 16,18, 19, 20. 21, 22, 23, 24, 25, 26 27, 29, 30, 31, 32, 34, 36, 37, 38, 39, 40, 41, 43, 44, 46, 47, 48, 49, 51, 52, 53, 54, 55, 56, 57, 58.....554
2	7, 17, 14, 28, 33, 35, 42, 45, 50, 59.....552

It was found that according to the results of the time of a simple visual-motor reaction, the students of the first cluster probably differ from the students of the second cluster ( $p < 0.001$ ): in the subjects of the first cluster, the time of a simple visual-motor reaction is significantly shorter compared to the students of the second cluster (Table 4) . But according to the number of errors in the test for determining the time of a simple visual-motor reaction, on the contrary, the students of the second cluster had better results ( $p < 0.001$ ) (Table 4). The obtained result is related to the fact that the mobility of the nervous system, which is reflected by the time of a simple visual-motor reaction, often comes into conflict with the strength of the nervous system, which is reflected by the number of errors when performing this test. Significant differences between the test results of students of two clusters were also found for the heart rate indicator in the supine position ( $p < 0.05$ ) (Table 4). Students of the first cluster have a significantly higher heart rate in the supine position compared to students of the second cluster. This indicates a greater influence of the parasympathetic division of the autonomic nervous system on heart rate regulation at rest in students of the second cluster. Students of the first cluster, on the contrary, have a predominance of the sympathetic division of the autonomic nervous system. Based on the obtained data, the first cluster of students was characterized as "the predominance of the sympathetic

department of the autonomic nervous system and the mobility of nervous processes", and the second cluster - "the predominance of the parasympathetic department of the autonomic nervous system and the strength of nervous processes."

Table 4

Indicators of psychophysiological functions and orthostatic reactions of students with a predominance of sympathetic and parasympathetic departments of the autonomic nervous system

Indicators	Cluster <sub>s</sub> *	N	$\bar{x}$	S	m	t	p
Time of a simple visual-motor reaction, ms	1	430	353.59	52.54	6.84	-13.46	0.00
	2	124	567.88	73.90	17.92	-11.17	0.00
Errors in the test for the time of a simple visual-motor reaction, number	1	430	10.94	9.11	2.21	-4.16	0.01
	2	124	1.35	4.99	0.65	-5.69	0.00
Heart rate lying down, beats·min <sup>-1</sup>	1	430	74.61	11.85	1.54	2.11	0.038
	2	124	68.24	6.92	1.68	2.80	0.08
Standing heart rate, beats·min <sup>-1</sup>	1	430	90.80	11.97	1.56	1.61	0.011
	2	124	75.47	12.07	2.93	1.61	0.020
Standing heart rate - lying heart rate, beats·min <sup>-1</sup>	1	430	16.19	10.84	1.41	-0.37	0.043
	2	124	7.24	2.04	1.95	-0.44	0.041

Notes: \* - Clusters: 1 – predominance of the sympathetic division of the autonomic nervous system and the mobility of nervous processes; 2 – predominance of the parasympathetic department of the autonomic nervous system and the strength of nervous processes

The next step of our research was to clarify the question: does the faculty where students study affects the number of students with a predominance of the sympathetic (parasympathetic) departments of the nervous system and the mobility (strength) of nervous processes. Based on the results of processing the test results using the CrossTabs tool, it was found that the expected number of students with a predominance of the sympathetic nervous system and mobility of nervous processes is significantly less than the number obtained at the Faculty of Natural Sciences and the Faculty of Foreign Philology. At all other faculties, the expected number of students is either significantly greater or almost equal to the received number. The faculty at which

students study has a significant effect on the number of subjects with a predominance of the sympathetic (parasympathetic) department of the nervous system and the mobility (strength) of nervous processes according to the results of the Chi-square test ( $p < 0.05$ ) (tables 5, 6, fig. 1).

Table 5

The relative number of students with a predominance of the sympathetic (parasympathetic) departments of the nervous system and the mobility (strength) of nervous processes at various faculties of pedagogical universities

Indicators	Faculty *									Total
	1	2	3	4	5	6	7	8	9	
The number of students of the first cluster at each faculty. %	100	87.5 0	100	55.60	100	75.9 0	33.30	66.7 0	66.7 0	77.6
The number of students of the second cluster at each faculty. %	0	12.5 0	0	44.40	0	24.1 0	66.70	33.3 0	33.3 0	22.4
Total, %	100	100	100	100	100	100	100	100	100	100

Notes: \* - Faculties: 1 - Elementary education; 2 – Historical; 3 - Science, 4 - Foreign philology, 5 - Preschool education, 6 - Ukrainian language, 7 - Physical education, 8 - Arts, 9 - Psychological

\*\* - Clusters: 1 – predominance of the sympathetic division of the autonomic nervous system and the mobility of nervous processes; 2 – predominance of the parasympathetic department of the autonomic nervous system and the strength of nervous processes

Table 6

The influence of the faculty of pedagogical universities on the number of students with a predominance of the sympathetic (parasympathetic) departments of the nervous system and the mobility (strength) of nervous processes

Chi-square criteria	Value	Asymptomatic significance
Pearson's chi-square	12.227a	0.041
Probability relationships	15.068	0.048
Number of allowable observations	76	

Notes. a - For the number of cells, 13 (72.2%) are expected to be less than 5. The minimum expected number is 0.45.

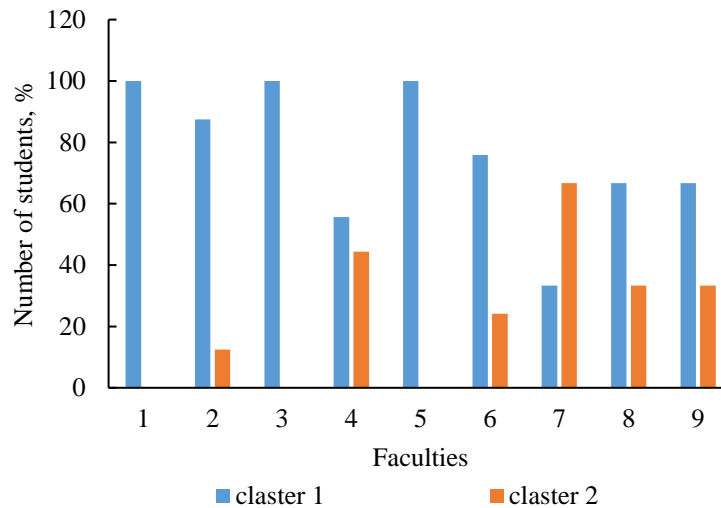


Fig. 1. The number of students (as a percentage of the total number of students in each faculty), with a predominance of the sympathetic (parasympathetic) departments of the nervous system and the mobility (strength) of nervous processes:

\* - the relationship of the faculty with the predominance of the sympathetic (parasympathetic) departments of the nervous system and the mobility (strength) of nervous processes is reliable at  $p < 0.05$

Cluster 1 - students with a predominance of the sympathetic division of the autonomic nervous system and the mobility of nervous processes

Cluster 2 - students with a predominance of the parasympathetic department of the autonomic nervous system and the strength of nervous processes

Faculties: 1 - Elementary education; 2 – Historical; 3 - Science, 4 - Foreign philology, 5 - Preschool education, 6 - Ukrainian language, 7 - Physical education, 8 - Arts, 9 – Psychological

## Discussion

The hypothesis that was put forward in this study was fully confirmed: it was found that students of various faculties of pedagogical universities have peculiarities in the work of the nervous and cardiovascular systems. The data obtained by us in previous studies regarding the presence of psychophysiological and orthostatic features of students of various faculties and the influence of sports on these indicators were confirmed. Thus, in our previous studies (Bejtka, et.al., 2022) it was shown that the reaction speed is best among students of the faculties of elementary education, preschool education, and science. It also reflects the mobility of nervous processes. And the number of errors in the reaction speed test is the lowest among students of the Faculty of Physical Education and Sports.

In the presented study, we obtained similar results. Using cluster analysis, all experimental students were divided into two groups as a result of cluster analysis. The first cluster included students with a significantly shorter reaction time to various indicators, a significantly higher number of errors in the reaction speed test, and higher heart rate values in the orthostatic test. The second cluster, on the contrary, included



students with significantly longer reaction times, significantly fewer errors in the reaction speed test, and significantly lower heart rate values ??in the orthostatic test. The first cluster was called "the predominance of the sympathetic division of the autonomic nervous system and the mobility of nervous processes", since the reaction speed reflects the mobility of nervous processes, and high heart rate values ??in the orthoprobe are one of the indicators that reflect the activity of the sympathetic division of the autonomic nervous system. The second cluster was called "predominance of the parasympathetic department of the autonomic nervous system and the strength of nervous processes", because it included students with significantly longer reaction times, significantly fewer errors in the reaction speed test, and significantly lower heart rate values ??in the orthostatic test.

It was also found that the representatives of the first cluster generally predominate in number among students of pedagogical universities (430 out of 554 experimental students). This can be explained by the fact that the pedagogical specialty generally requires high indicators of the mobility of nervous processes, because the work of a teacher requires a high speed of switching attention (Bejtka, et.all., 2022). And therefore it is no coincidence that students with high mobility of nervous processes intuitively choose a pedagogical university. Mobility of nervous processes is not the only indicator for future teachers. After all, the main thing is that. so that the student likes the future specialty. And that is why a person with any indicators of mobility and strength of nervous processes can become a good teacher. And that is why it is not accidental that among the future teachers there are also representatives with a more inert nervous system, which is compensated by higher values ??of the indicators of the strength of the nervous system. It should also be noted that students with greater mobility of nervous processes have worse orthostatic test scores: they have significantly higher heart rate values ??both in the lying position and in the standing position, and the difference between these indicators is greater compared to the students of the second cluster. This shows, first of all, that the students of the first cluster have a lower level of functional readiness and general endurance, which is reflected in significantly higher values ??of heart rate in the lying position and the difference in heart rate between the lying position and the standing position (Borysenko, et.all., 2020; Cretu, et.all., 2021; Kozina, et.all., 2020). Hence the need to improve the general endurance of the students of the first cluster. But it is necessary to do this by means that correspond to the peculiarities of the nervous system of these students. For this, for example, mobile games can be used, which contribute to the development of endurance in accordance with the peculiarities of the nervous system of students with a predominance of the mobility of nervous processes (Bejtka, et.all., 2022).

The largest number of students of the first cluster was found at the faculty of elementary education (100%), at the faculty of preschool education (100%) and at the faculty of natural sciences (100%). These results also complement our previously obtained data using Duncan's analysis of variance regarding significantly lower values ??of reaction time and significantly more errors when performing a test of reaction speed of students of these faculties.

The largest number of students of the second cluster was found at the Faculty of Physical Education and Sports (66.7%). This is not accidental: because the state of vegetative-vascular regulation depends on the development of general endurance and, accordingly, the functional state of the cardiovascular system. Since playing sports contributes to improving the state of the cardiovascular system, we can note that the results obtained regarding the largest number of students of the second cluster were found precisely at the Faculty of Physical Education and Sports. The results obtained in the conducted research also complement the results of our previous ones studies (Bejtka, et.all., 2022), in which significantly lower heart rate values were found with the help of variance analysis using the Duncan method when transitioning from a lying position to a standing position in students of the Faculty of Physical Education and Sports.

Relatively new knowledge obtained in the presented research is that the mobility of nervous processes is coupled with the activity of the sympathetic division of the autonomic nervous system, and the strength of nervous processes is associated with the activity of the parasympathetic division of the autonomic nervous system. This should be taken into account when conducting physical education classes for students of different faculties, when providing recommendations to students about classes in a certain sport (if the student hesitates when choosing a sports specialization), and when planning individual tasks to be conducted online.

## **Conclusions**

1. Students were divided into 2 groups (clusters) according to psychophysiological functions and orthostatic reactions. The first cluster of students was characterized as "the predominance of the sympathetic department of the autonomic nervous system and the mobility of nervous processes," and the second cluster was characterized as "the predominance of the parasympathetic department of the autonomic nervous system and the strength of nervous processes."

2. It was found that according to the results of the time of simple visual-motor reaction, the students of the first cluster probably differ from the students of the second cluster ( $p < 0.001$ ): in the subjects of the first cluster, the time of simple visual-motor reaction is significantly shorter compared to the students of the second cluster. But according to the number of errors in the test for determining the time of a simple visual-motor reaction, on the contrary, the students of the second cluster had better results ( $p < 0.001$ ). Students of the first cluster have a significantly higher heart rate in the supine position compared to students of the second cluster, as well as a greater difference between the heart rate indicators in the lying and standing positions ( $p < 0.05$ ).

3. The faculty at which students study has a significant effect on the number of subjects with a predominance of the sympathetic (parasympathetic) department of the nervous system and the mobility (strength) of nervous processes according to the results of the Chi-square test and the determination of symmetry measures ( $p < 0.05$ ).

4. The obtained results should be taken into account when conducting physical education classes for students of different faculties, when providing recommendations to students regarding classes in a certain sport (if the student hesitates when choosing a sports specialization), and when planning individual tasks to be conducted online.

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## **Chapter 2. Functional readiness and properties of the nervous system peculiarities of art specialties future teachers**

### **Abstract**

**Background and purpose.** The future professional work of students of the Faculty of Arts is characterized by an insufficient level of physical activity of a dynamic nature in combination with a large static load and highly coordinated finger work. Representatives of these specialties have their own psychological characteristics. Purpose: to reveal the peculiarities of the properties of the nervous system and the functional potential of the cardiovascular system of students - future teachers of fine arts and music and, based on the obtained data, to develop recommendations for physical education and sports.

**Material and methods.** Students of H.S. Skovoroda Kharkiv National Pedagogical University took part in the study. The total number of students was 812. 24 of them were students of the Faculty of Arts. Future specialists in physical education and sports took part in the number of 25 people. 763 students were representatives of other faculties. Properties of the nervous system were determined using psychophysiological testing. During psychophysiological testing, the reaction time and the number of errors were determined for each test. The indicators of the orthostatic test were used as indicators of functional readiness. In the orthostatic test, the heart rate was measured in the lying position and in the standing position and the difference between these indicators. Statistical analysis involved comparing students of the Faculty of Arts with students of other faculties using parametric methods, since all samples corresponded to a normal distribution.

**Results.** Future teachers of creative specialties have reliably the least mobility in combination with the highest stability of nervous processes in comparison with representatives of other pedagogical specialties. Reliable differences were found between the indicators of orthostatic reactions of students of the Faculty of Arts and the faculty where future sports coaches are trained. Orthostatic regulation is significantly better in students of the Faculty of Physical Education and Sports.

**Conclusions.** It is necessary to adjust the program of physical education of students of creative specialties to increase the interest of students and to match physical exercises to the features of the nervous system of students of the Faculty of Arts. Future teachers of creative specialties can be recommended to engage in any kind of sport or motor activity, but the most suitable for them are exercises that require the development of endurance in combination with the inclusion of cognitive processes and concentration: walks with observation of nature and the city, exercises performed to music, exercises with a concentration on various natural images, etc.

## Introduction

The formation of a healthy lifestyle of future teachers is of great importance for society [1–4]. As the great teacher of the 20th century, Maria Montessori [5], pointed out, the future teacher must, first of all, be attractive to children. At the first stage, attractiveness for children is determined by the appearance of the teacher. And in order to have a good appearance, you need to have good health [6]. In addition, future teachers must overcome all the difficulties of studying at the university. Also, their future work is associated with psychological and physical stress [1, 2]. After all, they will need to effectively interact with children, with parents, with the leadership of the school and education in general, prepare for classes, have time to work with documentation and pay attention to their own family. And most importantly, teachers bring knowledge to future generations. And they also need to convey knowledge about a healthy lifestyle to their students and form in them the skills and abilities to strengthen and preserve health. Only in this way can a healthy nation be formed.

Specialists in creative specialties occupy a special place among future teachers. In general, pedagogy requires creativity. But in society, creative specialties include music, visual arts, and dance. We will look at health-saving technologies for musicians and artists. Their professional work is characterized by an insufficient level of physical activity of a dynamic nature in combination with a large static load and highly coordinated work of the fingers [7–10]. Representatives of these specialties have their own psychological characteristics. First of all, they have developed creative thinking with imaginative perception and activation of the right hemisphere of the brain [9]. This is of great importance for the creation of world-class masterpieces, but it provides certain characteristics. This is reflected in the fact that they can, for example, be engaged in a creative project all the time. At the same time, they can forget about anything, even about food and sleep. And all the more they forget about doing physical exercises, which is a necessary condition for a healthy lifestyle [7, 10]. That is why it is necessary for them to choose physical exercises and technologies of physical education in such a way that they are organically combined with art classes and very appealing to future specialists in creative specialties. And this is not accidental. After all, art seeks constant creative improvement.

It should be noted that people at all times sought the unity of physical, intellectual and physical development. So, the great mathematician, philosopher, humanist Pythagoras was the champion of the Olympics in Greece in fist fighting and an innovator in music [8, 10]. And the famous swordsman Miyamoto Musashi [11] pointed out that a real warrior should get acquainted with every kind of art and learn the ways of all professions. This is not accidental, because the possession of a wide range of movements affects the coherence of the work of the central nervous system [12-14]. That is why athletes need to study the basics of art, and future specialists in creative specialties need to improve their control of their bodies through physical exercises.

The physiological basis of the unity of sport and art is that all levels of the central nervous system participate in the process of controlling movements and forming skills [12–13]. Therefore, with the development of the perception of beauty and harmony, be it sports movements or works of art, the coherence of the work of the central nervous system is improved. It helps to achieve excellence in all activities. In this connection, art and sport are a single entity.

In our previous studies [15], we established by analyzing specific examples that sport and art have many common features. Both sports and art require motor activity. In sports, these are movements of large muscles, in art - movements of small muscles. Sports and art require a perfect mastery of movements that exceeds generally accepted averages. Ideal technique determines the most rational movements, which are perceived as beautiful. Perception of art develops creativity, non-standard thinking. So, there is a connection between sports and art that promotes the manifestation of mastery. It is not by chance that many famous actors, musicians, and artists combine art and sports

Let's consider the need to combine art and sports on the example of training musicians. In order to successfully study at a music school, it is necessary to study for 2 hours every day, and in the process of improvement - for 4-6 hours or more [7-10]. Classes are accompanied by large static loads on the spine, pelvic muscles and lower limbs with high dynamic loads on the muscles of the shoulder girdle. Performances at competitions and concerts also require a high level of endurance and mental stability. Many types of musical art require a high level of physical training. For example, to achieve a good sound on wind instruments, it is necessary to develop the strength of the respiratory muscles. Unfortunately, many young talents do not realize their potential due to insufficient level of health. Therefore, physical exercises are necessary for musicians as an integral means of their professional training. And their teachers should promote sports.

These provisions also apply to all other creative specialties. That is why it is necessary to choose such classes in physical culture and sports, which would be organically combined with the main type of activity, and help to improve in the chosen art form.

To solve the tasks, it is necessary to determine the peculiarities of the functioning of the nervous system of future specialists in creative specialties. The most accessible way of determining the features of the nervous system is based on psychophysiological indicators: reaction speed in different testing conditions and the number of errors when passing these tests [13, 14]. These indicators reflect the mobility and stability of nervous processes. It is also important to determine the functional features of the cardiovascular system and the regulation of vascular tone [16–19]. This is necessary to determine the impact of lack of physical activity on orthostatic regulation. Orthostatic regulation is a necessary condition for the quality work of a specialist in creative specialties, who, due to the peculiarities of their work, need to spend a lot of time in a standing position.

In our research, the following hypothesis was put forward: students - future teachers of creative specialties have peculiarities of psychophysiological functions and



orthostatic reactions in comparison with students of other specialties of pedagogical universities.

**Purpose:** to reveal the peculiarities of the properties of the nervous system and the functional potential of the cardiovascular system of students - future teachers of fine arts and music and, based on the obtained data, to develop recommendations for physical education and sports.

## **Material and methods**

### Participants

Students of H.S. Skovoroda Kharkiv National Pedagogical University took part in the study. The total number of students was 812. 24 of them were students of the Faculty of Arts. Future specialists in physical education and sports took part in the number of 25 people. Also, 88 future specialists - teachers of junior grades, 76 - future teachers of history, 130 - future teachers of mathematics, physics, biology disciplines took part in the study. Future foreign language specialists took part in the number of 131 students. 93 representatives of preschool education, 198 future Ukrainian language teachers, and 25 future sports coaches also took part in the study. 47 participants of the experiment were representatives of psychological and sociological specialties.

### Procedure

The testing procedure was similar to that described in our previous studies [1, 2]

The method of determining the properties of the nervous system

The determination of the peculiarities of the work of the nervous system was carried out according to the author's psychophysiological testing program [1, 2, 13, 14]. We determined the speed of a simple reaction when you need to press the left mouse button on any picture that appears on the computer screen. The number of errors was also determined in this test. The speed of reaction and the number of errors in the test for a complex discrimination reaction were also determined. The choice of two elements from three options was assumed. Different pictures appeared alternately on the computer screen. If the picture had an image of a geometric shape, you had to press the left mouse button. If an image from the animal world appeared on the computer screen, you had to press the right mouse button. All other images were to be skipped without clicking. When determining the properties of the nervous system, we used the following provisions: the faster the student reacts to the object, the higher the mobility of the nervous system; the fewer mistakes he makes, the greater the stability of his nervous system [1, 2, 13, 14].

## Determination of functional capabilities of the cardiovascular system and regulation of orthostatic functions

To determine the functional capabilities of the cardiovascular system, we used the heart rate indicator in the supine position. The lower this indicator was (up to 48-44 beats per minute), the more economically the heart works [6, 16, 19]. We also determined the frequency of heart contractions after the transition from a lying position to a standing position. The smaller this value was, the more developed the mechanism of vascular tone regulation when changing the position [6, 17, 19].

### Statistical analysis

First of all, we checked the samples for normal distribution according to standard methods [1, 2]. In our case, all samples obeyed a normal distribution ( $p > 0.05$ ), and therefore we used parametric methods of processing the results (Student's test). We compared the results of the tests based on psychophysiological indicators and on indicators of orthostatic reactions of students of the Faculty of Arts and students of all other faculties of the Pedagogical University. We also compared students of the Faculty of Arts and students of the Faculty of Physical Education and Sports to identify the impact of sports on selected indicators.

### Results

We found reliable differences in the results of the tests of students of the Faculty of Arts and all other faculties of the pedagogical university in only two indicators of psychophysiological functions: the time of a simple visual-motor reaction and the number of errors in the test for the time of a complex reaction to the selection of different images. Students of the Faculty of Arts have a significantly longer latent time of a simple visual-motor reaction ( $p < 0.05$ ) and a significantly lower number of errors in the complex reaction time test (Table 1, Figs. 1, 2).

Table 1. Indicators of properties of the nervous system and functional capabilities of the cardiovascular system of students of the Faculty of Arts in comparison with students of other faculties

Indicators	Faculties*	N	$\bar{x}$	S	m	t	p
Reaction time without selecting images, ms	1	788	391.280	105.333	6.434	-2.218	0.027
	2	24	509.500	141.262	70.631		
Errors in the reaction time test without selecting images,, number	1	788	2.338	5.673	0.347	0.207	0.836
	2	24	1.750	1.500	0.750		
Complex reaction time for choosing two	1	788	515.059	140.775	8.816	0.107	0.915
	2	24	507.500	66.083	33.042		

options out of three, ms							
Errors in the test for the time of a complex reaction to the choice of two options out of three, number	1	763**	7.954	11.066	0.841	6.382	0.000
	2	24	1.250	1.258	0.629		
Heart rate lying down, beats·min <sup>-1</sup>	1	763**	72.130	10.544	0.967	-0.354	0.724
	2	24	74.000	2.828	1.414		
Standing heart rate, beats·min <sup>-1</sup>	1	763**	89.540	12.817	1.175	-0.924	0.357
	2	24	95.500	5.508	2.754		
The difference between the heart rate standing and the heart rate lying down, beats·min <sup>-1</sup>	1	763**	17.310	11.032	1.011	-0.754	0.452
	2	24	21.500	5.745	2.872		

Notes. \* 1 – all faculties that were studied; 2 - Faculty of Arts. \*\* Data from the faculty of physical education and sports were not included in the processing of the results in the tests for the number of errors in the test of a complex reaction to the choice of two options out of three and in the orthostatic test, since the students of this faculty showed the lowest values of the measured indicators

The speed of reaction characterizes the mobility of the nervous system. An increase in reaction time indicates a decrease in the mobility of nervous processes. Therefore, it can be noted that the students of the Faculty of Arts have a less mobile nervous system in comparison with students of other faculties. Also, the smaller number of errors in the reaction time test for choosing 2 elements out of 3 indicates greater stability of the nervous system of students of the Faculty of Arts in comparison with other faculties of the Pedagogical University.

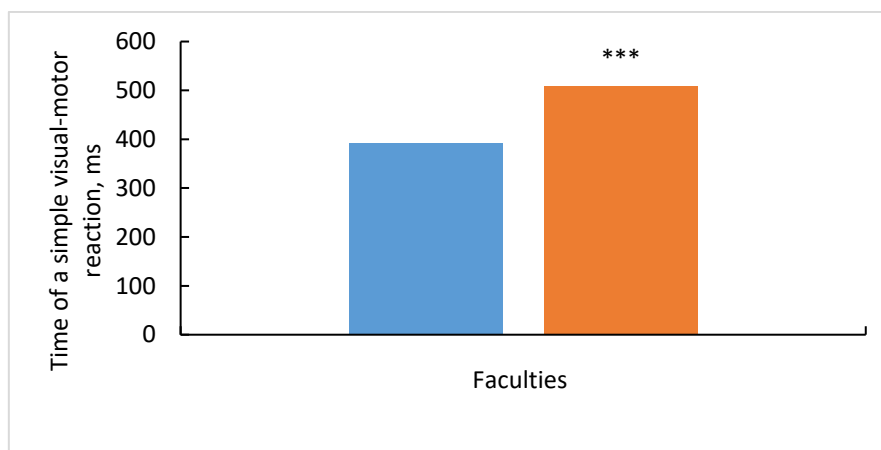


Fig. 1. The value of the time of a simple visual-motor reaction in students of the Faculty of Arts in comparison with students of other faculties:

\*\*\* - differences are significant at  $p < 0.001$

■ - all faculties; ■ - Faculty of Arts

It should be noted that in the processing of the results in the tests on the number of errors in the test of a complex reaction to the choice of two options out of three and in the orthostatic test, the data of the Faculty of Physical Education and Sports were not included. As we found in our previous studies [2], students of this faculty showed the lowest values of the measured indicators. We excluded them from the analysis in order to discover whether students in the Faculty of Arts differed from those in other non-sporting faculties. The same applies to the comparison of the results of orthostatic reactions (Table 1, Fig. 2).

According to all other indicators, no significant differences were found between the test results of students of the Faculty of Arts and students of all other faculties of the Pedagogical University ( $p > 0.05$ ) (Table 1).

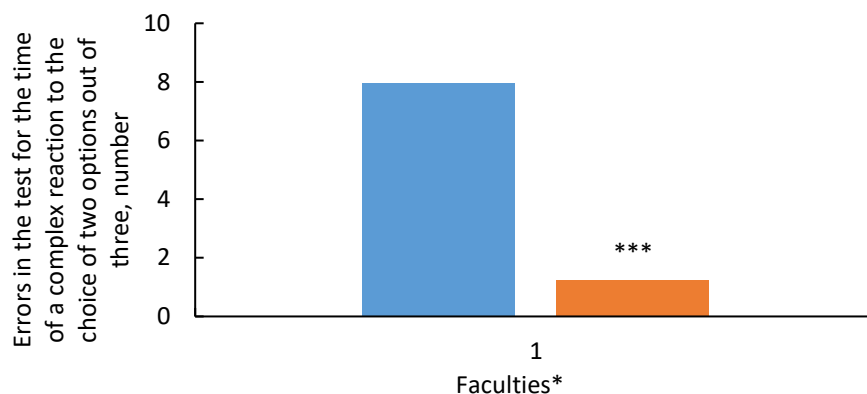


Fig. 2. The number of errors in the test for the time of a complex reaction to the choice of two options out of three among students of the Faculty of Arts in comparison with students of other faculties:

\* the data of the Faculty of Physical Education and Sports were not included in the processing of the results, since the students of this faculty showed the least number of errors in this test

\*\*\* - differences are significant at  $p < 0.001$

■ - all faculties; ■ - Faculty of Arts

To determine the influence of sports on the indicators of psychophysiological functions and orthostatic reactions, we compared these indicators among students of the faculties of arts and physical education and sports. The presence of reliable discrepancies was found only for the indicators of orthostatic reactions (Table 1, Fig. 3). The frequency of heart contractions in the lying position is significantly higher in students of the Faculty of Arts compared to students of the Faculty of Physical Education and Sports. This indicator is equal to 62 bpm for students of the Faculty of Physical Education and Sports and 74 bpm for students of the Faculty of Arts ( $p < 0.05$ ) (Table 1, Fig. 3).

Table 2. Indicators of properties of the nervous system and functional capabilities of the cardiovascular system of students of the faculties of arts and physical education and sports

Indicators	Faculties*	N	$\bar{x}$	S	m	t	p
Reaction time without selecting images, ms	1	25	403.750	152.450	76.225	-1.018	0.348
	2	24	509.500	141.262	70.631		
Errors in the reaction time test without selecting images,, number	1	25	4.750	8.221	4.110	-0.434	0.680
	2	24	8.250	13.889	6.945		
Complex reaction time for choosing two options out of three, ms	1	25	519.750	72.006	36.003	0.251	0.810
	2	24	507.500	66.083	33.042		
Errors in the test for the time of a complex reaction to the choice of two options out of three, number	1	25	2.000	0.817	0.408	1.000	0.356
	2	24	1.250	1.258	0.629		
Heart rate lying down, beats·min <sup>-1</sup>	1	25	62.250	6.652	3.326	-3.251	0.017
	2	24	74.000	2.828	1.414		
Standing heart rate, beats·min <sup>-1</sup>	1	25	73.750	7.042	3.521	-4.866	0.003
	2	24	95.500	5.508	2.754		
The difference between the heart rate standing and the heart rate lying down, beats·min <sup>-1</sup>	1	25	11.500	3.786	1.893	-2.907	0.027
	2	24	21.500	5.745	2.872		

Note: \* 1 – Faculty of Physical Education and Sports, 2 – Faculty of Arts

The same applies to the heart rate indicator in a standing position: this value is significantly higher in students of the Faculty of Arts compared to students of the Faculty of Physical Education and Sports ( $p < 0.01$ ). The difference between heart rate in the standing position and in the lying position is also significantly higher in students of the Faculty of Arts compared to students of the Faculty of Physical Education and Sports ( $p < 0.05$ ) (Table 1, Fig. 3).

The obtained data indicate that sports have a positive effect on the functional state of the cardiovascular system and the regulation of vascular tone.

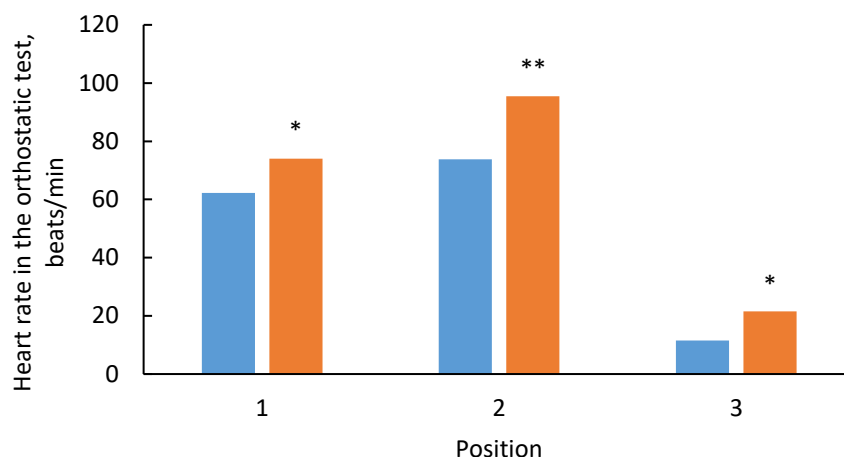


Fig. 3. The value of heart rate in the orthostatic test of students of the Faculty of Arts in comparison with the Faculty of Physical Education and Sports: 1 – in the lying position, 2 – in the standing position, 3 – the difference in heart rate between the standing position and the lying position

\* - differences are significant at  $p < 0.05$

\*\* - differences are significant at  $p < 0.01$



- Faculty of Physical Education and Sports;



- Faculty of Arts

## Discussion

The hypothesis, which was put forward in this study, was confirmed regarding the existence of peculiarities of the work of the nervous system according to the indicators of psychophysiological functions of future teachers of creative specialties. It was found that their reaction speed is lower compared to representatives of other specialties. This indicates that the future specialists of creative specialties have lower mobility of nervous processes. At the same time, students of the faculty of arts have a significantly lower number of errors in the test for determining the reaction time of choosing 2 elements out of 3 compared to students of all other studied students - future teachers.

This indicates that future specialists in creative specialties have a higher stability of the nervous system compared to other future teachers [2, 13, 14]. Exceptions are made only by students of the Faculty of Physical Education and Sports. Their number of errors is the lowest among all the experimental students [1]. And this shows that the students of the Faculty of Physical Education and Sports have the greatest stability and strength of the nervous system. Among students of the faculty of arts, the number of errors in the choice reaction test is unreliably different from this indicator of students of the faculty of physical education and sports.

And therefore, we can conclude that students - future teachers of creative specialties are distinguished by low mobility of nervous processes combined with great stability of the nervous system. We can explain this fact by the fact that the specificity of the work of representatives of visual arts and music requires long-term concentration on the canvas they create, or on learning a certain piece of music, which can last several

hours every day. Thus, the peculiarities of the nervous system of students of the Faculty of Arts are the ability to concentrate for a long time when it is necessary to do something without mistakes and not to switch attention to other matters. This is due to such properties of the nervous system as high stability (strength) and low mobility of nervous processes [1, 2, 13, 14]. We do not consider here the question of whether these features of the nervous system of future teachers of creative specialties are hereditary or whether they are formed in the process of creative activity.

It is known that the properties of nervous systems are largely hereditary, but can be developed in a certain range [13, 14]. We can note that creative specialties are intuitively chosen by people who have hereditary prerequisites from the side of the properties of the nervous system. And the question arises: what physical exercises are most suitable for future specialists in creative specialties? We believe that the most rational will be exercises that also require a long-term moderate load. At the same time, physical exercises should bring satisfaction to future teachers of creative specialties. Walks and trips deserve special attention [20, 21]. After all, they correspond to the peculiarities of their nervous system, that is, they also require great stability. In addition, these exercises develop endurance, and, accordingly, the cardiovascular system - the main factor of health. During walks, you can observe the beauty of nature or the city. It is most suitable for representatives of creative specialties as appreciators of beauty. It should also be noted that in almost all types of sports and motor activity there are representatives with any properties of the nervous system. After all, the nervous system is capable of adaptation. That is why future teachers of creative specialties can engage in various types of aerobics [22], active and sports games, cycle sports, etc. [23]. Thus, future teachers of creative specialties can be recommended to engage in any kind of sport or motor activity, but the most suitable for them are exercises that require the development of endurance in combination with the inclusion of cognitive processes and concentration: walks with observation of nature and the city, exercises performed under music, exercises with concentration on various natural images, etc.

## **Conclusions**

1. Future teachers of creative specialties have reliably the lowest mobility in combination with the highest stability of nervous processes in comparison with representatives of other pedagogical specialties. These features of the nervous system of future teachers of creative specialties can be hereditary or formed in the process of creative activity. They determine the application of physical exercises, which are most suitable for future specialists in creative specialties.

2. Significant differences between the indicators of orthostatic reactions of students of the Faculty of Arts and the Faculty of Physical Education and Sports were revealed. Orthostatic regulation is significantly better in students of the Faculty of Physical Education and Sports.

3. It is necessary to adjust the program of physical education of students of creative specialties to increase the interest of students and to match physical exercises

to the peculiarities of the nervous system of students of the Faculty of Arts. Future teachers of creative specialties can be recommended to engage in any kind of sport or motor activity, but the most suitable for them are exercises that require the development of endurance in combination with the inclusion of cognitive processes and concentration: walks with observation of nature and the city, exercises performed to music, exercises with a concentration on various natural images, etc.

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## **Chapter 3. Comparative characteristics of the functional state of future art teachers and other pedagogical specialties students**

### **Abstract**

**Purpose:** to reveal the autonomic regulation peculiarities of the functional state based on indicators of the nervous and cardiovascular systems work of future fine arts and music teachers for the development of recommendations for the use of physical exercises.

### **Material and methods**

812 students of pedagogical institutions of higher education of Ukraine took part in the study. During psychophysiological testing, the following indicators were determined for each test: reaction time, number of errors. The shorter the reaction time, the higher the mobility of nervous processes. The lower the number of errors in the reaction test of choosing two elements out of three, the higher the stability of nervous processes. Orthostatic reactions were determined by the results of heart rate in the lying position and in the standing position. Parametric processing methods (Student's method for comparing average values) and hierarchical cluster analysis were used.

### **Results**

Two groups of students - future teachers were identified: with a predominance of the sympathetic department of the autonomic nervous system and with a predominance of the parasympathetic department of the autonomic nervous system. The largest number of students with predominance of the parasympathetic department of the autonomic nervous system was found among students – future teachers of creative specialties (faculty of arts). Students of the Faculty of Arts have significantly longer latency time of visual-motor reaction compared to representatives of other faculties. This indicates a lower mobility of nervous processes of students of the Faculty of Arts in comparison with students of other faculties. Along with this, future art teachers have significantly fewer errors in the test for choosing 2 elements out of 3. This indicates greater stability of nervous processes in future teachers – representatives of art compared to other future teachers.

### **Conclusions**

Students – future teachers of creative specialties (faculty of arts) have the more stability and less mobility nervous system in combination with the autonomic nervous system parasympathetic department predominance. That is why endurance exercises that do not require frequent switching of attention are suitable for them. Such exercises include walking, slow running, swimming et. all. Exercises should be performed for at least one hour. They will also be suitable for exercises with the activation of visual perception.

## Introduction

Future art teachers are a category of students who combine academic work on learning the basics of pedagogy with a large amount of practical work to improve their professional skills [1]. This is especially characteristic of musicians and representatives of fine arts [2–5]. They get a big load on the muscles of fine motor skills. At the same time, the muscles that support the posture also receive a heavy load, especially the muscles of the spine and lower limbs. The cardiovascular system remains completely neglected, since the professional activities of musicians and representatives of fine arts do not involve loads on the cardiovascular system [4–6]. In order to preserve and strengthen health, future teachers of creative specialties need to strengthen the muscles of the trunk and lower limbs to prevent the development of diseases of the musculoskeletal system. They also need to strengthen the cardiovascular system to increase general endurance, which is a necessary condition for maintaining health [7–10]. But at the same time, the question arises: what exercises are most suitable for representatives of the arts? After all, it is necessary that the exercises were selected taking into account the peculiarities of the functional and psychophysiological state of students, and also contributed not only to physical improvement, but also to professional improvement [11–13].

It should be noted that in general there is a unity of art and sport. After all, at all times, people sought perfection - physical, intellectual, mental... And the advanced people of their time combined different aspects of development in themselves, were distinguished by both high intelligence and the ability to do arts and a high level of mastery of their body [6, 8, 14]. The social foundations of this phenomenon were laid in ancient Greece, during the time of the first Olympics [14]. The idea of integrating sports with art originated in ancient Greece. These provisions are analyzed in detail in the works of Stolyarov [14]. The author cites quotes and sayings of ancient philosophers and modern researchers to illustrate this point of view [14]. Thus, Plato considered the main abilities of a person to be musical (for the development of wisdom) and sports (for the development of the body). At the same time, these abilities should be harmoniously developed [14].

A deep supporter of this idea was the founder of the modern Olympic movement, Pierre de Coubertin [14]. He repeatedly pointed out the need to complement and strengthen the connection between sports and art. He emphasized that art should be adjacent to sports, should be connected with the practice of sports, that sports should be considered as a source and as a reason for art and that there should be an alliance between athletes, artists and spectators [14].

Thus, we observe that people who strive for perfection combine the desire to develop both the body and the perception and creation of works of art. But students of non-sports majors of pedagogical universities pay little attention to physical education and sports. That is why, first of all, it is necessary to interest them in physical exercises. For this, exercises should be selected according to the functional characteristics of students. In order to develop recommendations for physical culture and sports for students of pedagogical universities of the faculties of arts, it is necessary to identify

their psychophysiological features [15, 16] and features of vegetative regulation of the functional state [17–20]. The activity of the autonomic nervous system does not depend on the will of a person. This means that under normal conditions, a person cannot force his heart to beat less frequently or his stomach muscles to stop contracting. However, it is possible to achieve conscious influence on many parameters controlled by the autonomic nervous system with the help of special training methods [15, 16, 20]. The sympathetic nervous system increases metabolism, increases the excitability of most tissues, and mobilizes the body's forces for active activity. The parasympathetic system helps restore spent energy reserves, regulates the body's work during sleep [15, 16, 18]. The autonomic nervous system adapts the work of internal organs to changes in the environment. The autonomic nervous system is also involved in many behavioral acts carried out under the guidance of the brain, influencing both physical and mental activity of a person [19, 20].

That is why the determination of the peculiarities of vegetative regulation of the physical and psychological state based on the performance indicators of the nervous and cardiovascular systems of students of the Faculty of Arts is necessary for the selection of physical exercises that are most suitable for future teachers of creative specialties.

**Purpose:** to reveal the peculiarities of vegetative regulation of the functional state based on indicators of the work of the nervous and cardiovascular systems of future teachers of fine arts and music for the development of recommendations for the use of physical exercises.

## **Material and methods**

### **Participants**

812 students of pedagogical institutions of higher education of Ukraine took part in the study: 88 students of the faculty of elementary education, 76 students of history, 130 of natural sciences, 131 of foreign philology, 93 of the faculty of preschool education, 198 of Ukrainian language, 25 of the faculty of physical education and sports, 24 students from the Faculty of Arts, 47 students from the Faculty of Psychology and Sociology.

### **Determination of properties of the nervous system by psychophysiological tests**

The determination of the features of the nervous system was carried out according to the Psychodiagnostics program. The program [1, 16] provides determination of the speed of a simple visual-motor reaction, determination of the reaction speed of choosing two elements from three. The program works as follows. Various images appear on the screen. When determining the speed of a simple visual-motor reaction, the subject presses the left mouse button as soon as he sees any image on the screen. When determining the reaction speed of choosing two elements out of

three, the subject reacts to images of geometric figures by pressing the left mouse button and to images of animals by pressing the right mouse button. The subject does not react to all other images.

During psychophysiological testing, the following indicators were determined for each test: reaction time, number of errors. The shorter the reaction time, the higher the mobility of nervous processes, which is also related to the activity of the sympathetic division of the autonomic nervous system. The smaller the number of errors in the reaction test of choosing two elements out of three, the higher the strength and stability of nervous processes, which is also associated with the activity of the parasympathetic department of the autonomic nervous system [13, 14, 15].

#### Determination of the functional state by the orthostatic test

Orthostatic reactions were determined by the results of heart rate in the lying position and in the standing position. Heart rate values in the supine position greater than 80 beats·min<sup>-1</sup> were considered indicators of inefficient work of the cardiovascular system. The difference between the heart rate in lying and standing positions of more than 30 beats·min<sup>-1</sup> was considered as an indicator of difficult adaptation of the body to a change in body position [1, 21].

#### Statistical analysis

During the statistical processing of the research results, the normality of the distribution of each sample was first checked using the Kolmogorov-Smirnov test. Since the samples obeyed a normal distribution, parametric processing methods (Student's method for comparing mean values) and hierarchical cluster analysis were used.

### **Results**

Based on the comparison of indicators of psychophysiological functions and orthostatic reactions of students of different clusters according to Student's method, the formed clusters were characterized: 1 cluster - students with a predominance of the sympathetic department of the autonomic nervous system and the mobility of nervous processes; 2 - students with predominance of the sympathetic division of the autonomic nervous system and stability of nervous processes [1].

It should be noted that the second cluster (predominance of the parasympathetic department of the autonomic nervous system and stability of the nervous system) included the largest number of students of the Faculty of Arts (Fig. 1). In second place are students of the Faculty of Physical Education and Sports.

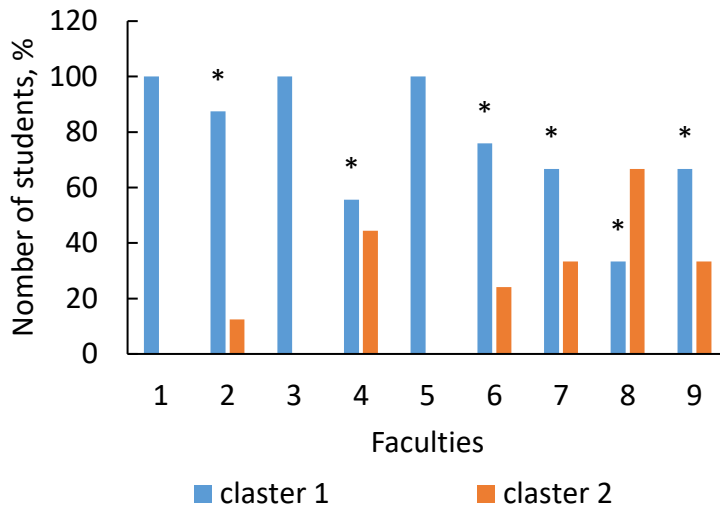


Fig. 1. The number of students (as a percentage of the total number of students at the faculty), with a predominance of the sympathetic (parasympathetic) departments of the nervous system and the mobility (strength) of nervous processes:

Cluster 1 - Predominance of the sympathetic division of the autonomic nervous system

Cluster 2 - Predominance of the parasympathetic division of the autonomic nervous system

\* - the relationship of the faculty with the predominance of the sympathetic (parasympathetic) departments of the nervous system and the mobility (strength) of nervous processes is reliable at  $p < 0.05$

Faculties:

- 1 - Primary education
- 2 - Historical
- 3 - Natural
- 4 - Foreign philology
- 5 - Preschool education
- 6 - Ukrainian-speaking
- 7 - Physical education
- 8 - Arts
- 9 - Psychological
- 10 - Total number

We can explain the obtained fact by the fact that students - representatives of fine arts and music are more prone to long-term work that requires a lot of concentration. This can be related to both genetic predispositions and formation during art studies.

Students of the Faculty of Arts have significantly longer latency of visual-motor reaction compared to representatives of other faculties (Fig. 2). This indicates a lower mobility of nervous processes of students of the Faculty of Arts in comparison with students of other faculties.

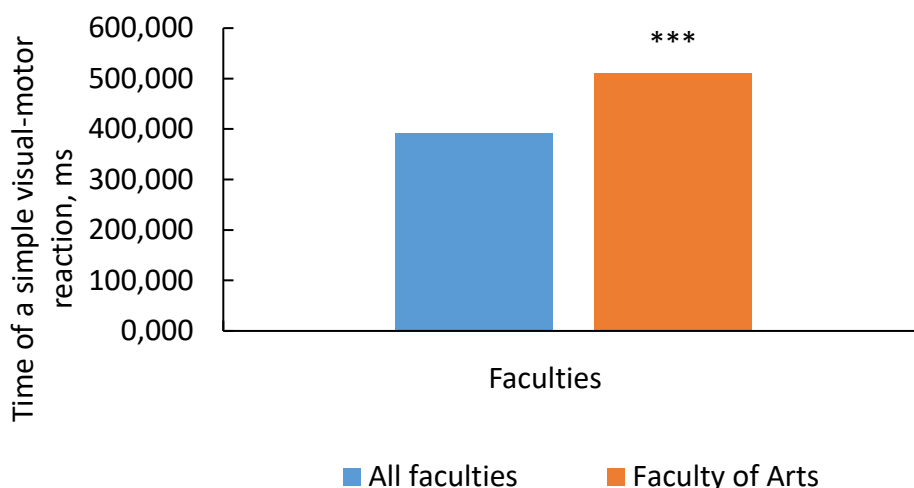


Fig. 2. The value of the time of a simple visual-motor reaction in students of the Faculty of Arts in comparison with students of other faculties (Elementary Education, History, Natural Sciences, Foreign Philology, Preschool Education, Ukrainian Language, Physical Education, Psychology)

\*\*\* - differences are significant at  $p < 0.001$

At the same time, future art teachers have significantly fewer errors in the test for choosing 2 elements out of 3 (Fig. 3). This indicates greater stability of nervous processes in future teachers - representatives of art compared to other future teachers.

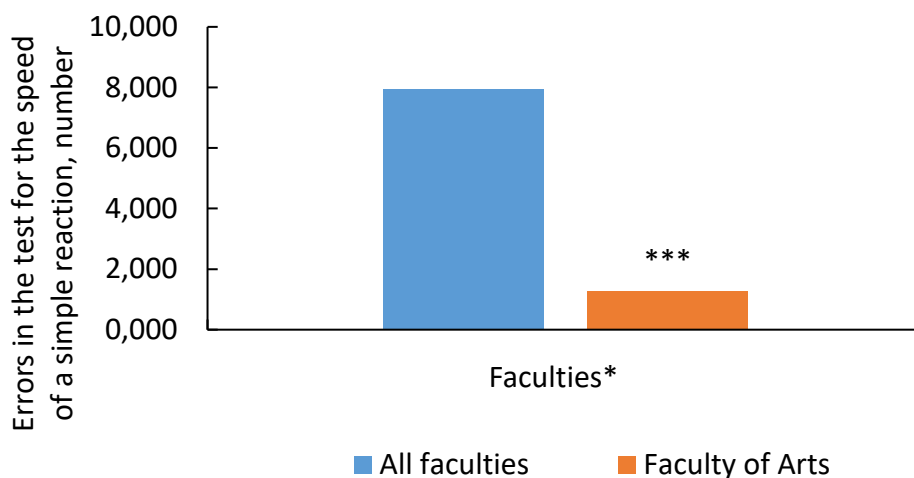


Fig. 3. The number of errors in the reaction time test for choosing 2 elements out of 3 among students of the Faculty of Arts in comparison with students of other faculties (Elementary Education, History, Natural Sciences, Foreign Philology, Preschool Education, Ukrainian Language, Psychology)

\*Data from the Faculty of Physical Education and Sports were not included in the processing of the results, as the students of this faculty showed the least number of errors in this test

\*\*\* - differences are significant at  $p < 0.001$



We also obtained reliable differences in the value of the indicator "Time of simple visual-motor reaction, ms" for the representatives of the two clusters (Fig. 4). It was found that this indicator is significantly higher in representatives of the second cluster "Predominance of the parasympathetic department of the autonomic nervous system." This indicates that students with a predominance of the parasympathetic department of the autonomic nervous system have lower mobility of nervous processes compared to representatives of the first cluster.

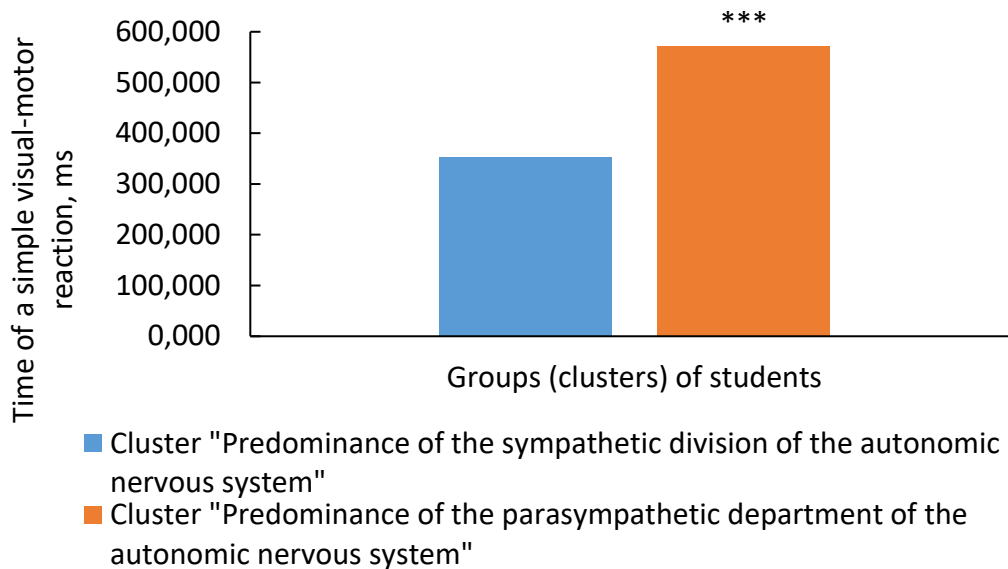


Fig. 4. The value of the time of a simple visual-motor reaction in students with a predominance of the sympathetic (parasympathetic) departments of the nervous system and the mobility (strength) of nervous processes of various faculties of a pedagogical university:

\*\*\* - differences are significant at  $p < 0.001$

But the number of errors, on the contrary, is significantly lower among representatives of the second cluster "Predominance of the parasympathetic department of the autonomic nervous system" (Fig. 5). This indicates greater stability of the nervous system in students of this cluster.

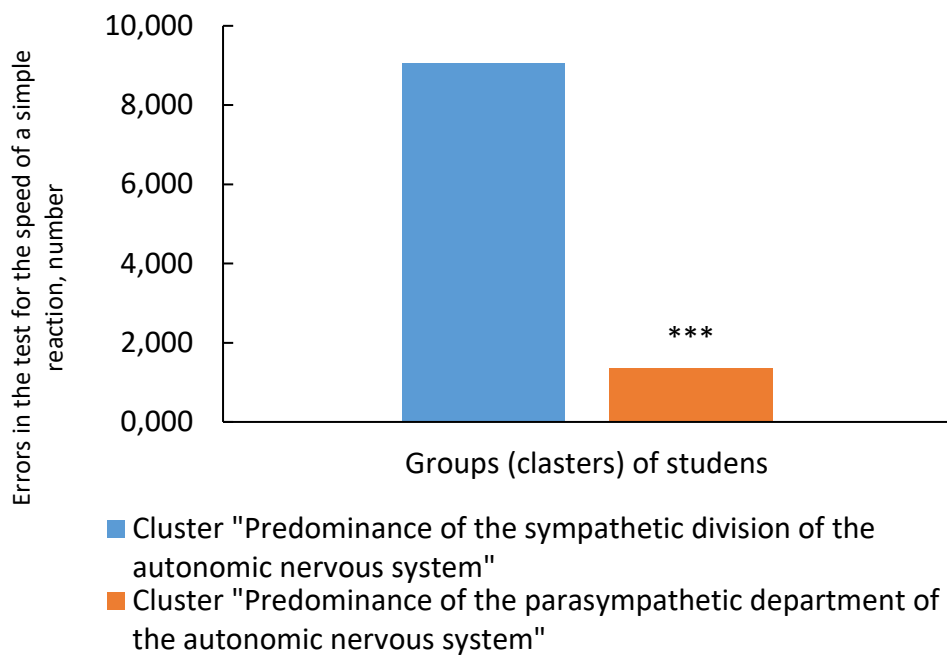


Fig. 5. The number of errors in the test for the time of a simple visual-motor reaction in students with a predominance of the sympathetic (parasympathetic) departments of the nervous system and the mobility (strength) of nervous processes of various faculties of a pedagogical university:

\*\*\* - differences are significant at  $p < 0.001$

Significantly lower heart rate values in the lying position were also found for students - representatives of the second cluster (Fig. 6). This may indicate a higher level of general endurance of students of the second cluster, as well as the presence of features of autonomic regulation of cardiac activity, which promotes activation of the parasympathetic division of the autonomic nervous system at rest.

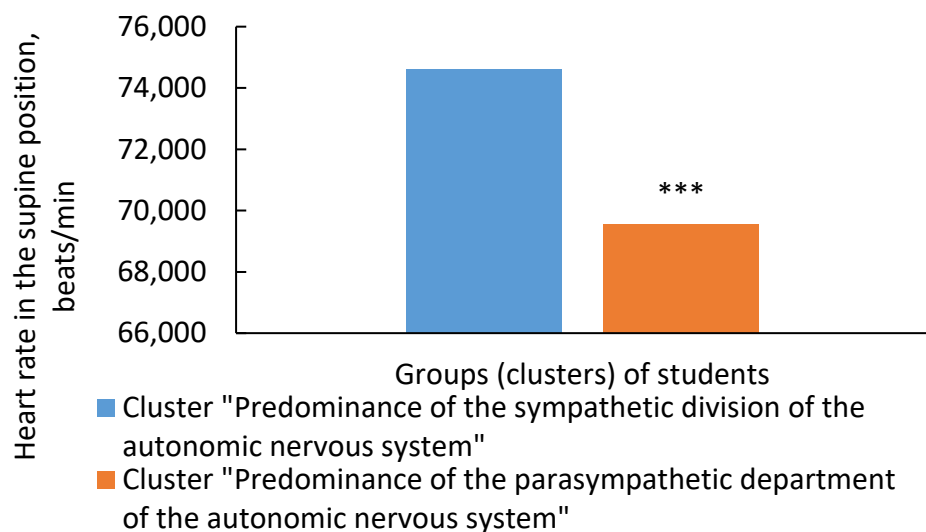


Fig. 6. The value of heart rate in the supine position in students with a predominance of the sympathetic (parasympathetic) departments of the nervous system and the mobility (strength) of nervous processes of various faculties of the pedagogical university:

\*\*\* - differences are significant at  $p < 0.001$

## Discussion

It should be noted that in our previous studies [1], we found the predominance of the parasympathetic division of the autonomic nervous system at rest in students of the Faculty of Physical Education and Sports. We can explain this by a higher level of training, which leads to the economization of the body's work at rest. In the study presented in the presented work, we obtained results that indicate the predominance of the parasympathetic division of the autonomic nervous system also among students of the Faculty of Arts. We can explain this fact by the presence of hereditary features that determine the properties of the nervous system of students who choose the path of artistic activity. Based on the obtained data, it can be noted that from the point of view of hereditary features of the nervous system of students of the Faculty of Arts, these students have more stability of the nervous system and less mobility in combination with the predominance of the parasympathetic department of the autonomic nervous system. That is why endurance exercises that do not require frequent switching of attention are suitable for them. Such exercises include walking, slow running, swimming. Exercises should be performed for at least one hour. They will also be suitable for exercises with the activation of visual perception. For example, our previous works presented sets of exercises that combine Western and Eastern approaches to physical culture [6, 8].

Based on the above, students were given the following recommendations. Every day for 2 hours, walk outside in the city or in the park [22, 23] (where you like it most) for 1 hour and take pictures of everything you like. Measure the pulse 3 times during the journey, record the results. At home, choose 3-5 of the most successful pictures. Record the results of heart rate measurement and take photos.

We also recommend future teachers of creative specialties to do special gymnastics in verses 2-3 times a week for the development of creative abilities and physical fitness [6, 8, 24]. When performing each exercise, imagine as much as possible what is being said in the line of the poem that corresponds to the exercise. Make drawings or create (choose) music for the complex as a whole or for each exercise separately. This recommendation stems from the concept of the unity of sport and art.

The study confirmed the opinion of Stolyarov [14], who attaches particular importance to the analysis of the issue of the integration of sports and art. His works justify the necessity and show the real possibility of integrating sports and art as two elements of modern culture, summarize and systematize the practical experience accumulated in this field. Stolarov presented a specific program of integration of sports and art [14].

Currently, in addition to the need to integrate sports and art, one more aspect of the human personality can be highlighted - intelligence, one of the manifestations of which is science. In ancient times, science and art were equated. As shown above, Plato considered music to be a manifestation of wisdom [14]. However, at present, science can be separated into a separate aspect due to its enormous influence on society and individual human development.

Thus, the goal of the work was achieved. Data on the unity of sport and art have been confirmed. Peculiarities of vegetative regulation of functions, properties of the nervous system and orthostatic reactions of future teachers of creative specialties were revealed.

## **Conclusions**

1. Two groups of students - future teachers were identified: with a predominance of the sympathetic department of the autonomic nervous system and with a predominance of the parasympathetic department of the autonomic nervous system. The largest number of students with predominance of the parasympathetic department of the autonomic nervous system was found among students - future teachers of creative specialties (faculty of arts).

2. Students of the Faculty of Arts have significantly longer latency time of visual-motor reaction compared to representatives of other faculties. This indicates a lower mobility of nervous processes of students of the Faculty of Arts in comparison with students of other faculties. Along with this, future art teachers have significantly fewer errors in the test for choosing 2 elements out of 3. This indicates greater stability of nervous processes in future teachers - representatives of art compared to other future teachers.

3. Significantly lower heart rate values in the supine position were also found for students with a predominance of the parasympathetic department of the autonomic nervous system, among whom the largest number are students of the Faculty of Arts. This may indicate a higher level of general endurance of these students, as well as the presence of features of the autonomic regulation of cardiac activity, which contributes to the activation of the parasympathetic department of the autonomic nervous system at rest.

4. Students - future teachers of creative specialties (faculty of arts) have more stability of the nervous system and less mobility in combination with the predominance of the parasympathetic department of the autonomic nervous system. That is why endurance exercises that do not require frequent switching of attention are suitable for them. Such exercises include walking, slow running, swimming. Exercises should be performed for at least one hour. They will also be suitable for exercises with the activation of visual perception.

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## Conclusions

1. Future teachers of creative specialties have reliably the lowest mobility in combination with the highest stability of nervous processes in comparison with representatives of other pedagogical specialties. These features of the nervous system of future teachers of creative specialties can be hereditary or formed in the process of creative activity. They determine the application of physical exercises, which are most suitable for future specialists in creative specialties.

2. Significant differences between the indicators of orthostatic reactions of students of the Faculty of Arts and the Faculty of Physical Education and Sports were revealed. Orthostatic regulation is significantly better in students of the Faculty of Physical Education and Sports.

3. It is necessary to adjust the program of physical education of students of creative specialties to increase the interest of students and to match physical exercises to the peculiarities of the nervous system of students of the Faculty of Arts. Future teachers of creative specialties can be recommended to engage in any kind of sport or motor activity, but the most suitable for them are exercises that require the development of endurance in combination with the inclusion of cognitive processes and concentration: walks with observation of nature and the city, exercises performed to music, exercises with a concentration on various natural images, etc.

4. Two groups of students - future teachers were identified: with a predominance of the sympathetic department of the autonomic nervous system and with a predominance of the parasympathetic department of the autonomic nervous system. The largest number of students with predominance of the parasympathetic department of the autonomic nervous system was found among students - future teachers of creative specialties (faculty of arts).

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them. Such exercises include walking, slow running, swimming. Exercises should be performed for at least one hour. They will also be suitable for exercises with the activation of visual perception.

8. Students were divided into 2 groups (clusters) according to psychophysiological functions and orthostatic reactions. The first cluster of students was characterized as "the predominance of the sympathetic department of the autonomic nervous system and the mobility of nervous processes," and the second cluster was characterized as "the predominance of the parasympathetic department of the autonomic nervous system and the strength of nervous processes."

9. It was found that according to the results of the time of simple visual-motor reaction, the students of the first cluster probably differ from the students of the second cluster ( $p < 0.001$ ): in the subjects of the first cluster, the time of simple visual-motor reaction is significantly shorter compared to the students of the second cluster. But according to the number of errors in the test for determining the time of a simple visual-motor reaction, on the contrary, the students of the second cluster had better results ( $p < 0.001$ ). Students of the first cluster have a significantly higher heart rate in the supine position compared to students of the second cluster, as well as a greater difference between the heart rate indicators in the lying and standing positions ( $p < 0.05$ ).

10. The faculty at which students study has a significant effect on the number of subjects with a predominance of the sympathetic (parasympathetic) department of the nervous system and the mobility (strength) of nervous processes according to the results of the Chi-square test and the determination of symmetry measures ( $p < 0.05$ ).

11. The obtained results should be taken into account when conducting physical education classes for students of different faculties, when providing recommendations to students regarding classes in a certain sport (if the student hesitates when choosing a sports specialization), and when planning individual tasks to be conducted online.



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