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# Peculiarities of students' mental functions development under the influence of different physical activities

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## ABSTRACT

**Aim:** The aim is to study the influence of the training activities of different orientations on the attention development of student specializing in different sports

**Materials and Methods:** The study involved 127 students, who were divided into three groups: group A (n=68) was engaged in speed and power sports, group B (n=59) was engaged in endurance sports, the control group (n=83) included peer students who did not do sports during their studies. The research on students' attention was carried out according to Anfimov's test using a table with letters.

**Results:** It was revealed that speed and power activities increase the integrated indicator of attention (the coefficient of work performance) based only on the speed of viewing characters with unreliable changes in the correctness of the work indicators. Under the influence of endurance training, the coefficient of efficiency is increased based on both an increase in the speed of viewing characters and the correctness of the work indicators. The students of the control group were found to have insignificant changes in the studied indicators of attention.

**Conclusions:** This suggests that endurance training promotes the development of students' attention more effectively. It is set, that specifics of the training process, its orientation equally specifically specialize the peculiarities of the attention development of students.

**KEY WORDS:** attention, physical activity, sports, students

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## INTRODUCTION

It is well known that one of the determining factors of psychological preparation of athletes of various sports in obtaining significant sports results is the achievement of the required level of development of various mental functions, including attention, and properties of the basic nervous processes (strength and functional mobility of the nervous system). The function of attention was defined as the concentration of the subject's activities at a given moment of time on any real or ideal object i. e. item, event, image, thought, etc. The main characteristics of the attention include: 1) concentration (expressed in the degree of concentration on the object), 2) stability (determined by the duration of attention concentration on the object), 3) volume (determined by the number of objects that are "simultaneously" (within 0.1 seconds) and clearly perceived; 4) distribution (characterized by the possibility of simultaneous and successful performance of several different types of activities or actions), 5) switchability (a dynamic characteristic of attention, which determines its ability to quickly switch from one object to another) [1, 2]. This is due to the fact that competitive activity in most sports requires athletes to quickly and accurately assess situations, the ability to focus simultaneously consciousness both on the main object and on several secondary objects at once, as well

as to think and make decisions in the conditions of physical and emotional fatigue. It can be considered that the results of sports activity are largely associated with various mental functions of athletes, among which not the last role is assigned to the basic mental processes (memory, attention, perception and thinking). However, despite the crucial importance of mental functions (in our case, the attention) in the training and competitive activities of most athletes, the question of the specificity of the influence of training loads of different orientation on the dynamics of the formation and development of the athletes' attention is not studied enough. From recent literature sources, we find that the properties of the attention are determined by the basic properties of the main nervous processes (functional mobility of nervous processes and power of nervous processes (brain working capacity) [3, 4]. A strong and movable nervous system creates physiological prerequisites for a larger amount of attention, and a weak one, on the contrary, narrows and limits its capabilities, and therefore individuals with a genetically weak (inert) nervous system perceive a smaller amount of external information, than persons with strong and movable nervous processes. The results of recent researches also indicate that for the effective maintenance of physical activity and the success of studying students, both the individual-typological properties

of the higher areas of the central nervous system and the development of psychomotor functions (in particular, attention and memory) play great importance [5-7]. In this connection, training on the acquisition by athletes of skills and abilities to concentrate the attention in their sports activities is of particular importance.

## AIM

The aim is to study the influence of the training activities of different orientations on the attention development of student specializing in different sports.

## MATERIALS AND METHODS

The study involved 127 students (boys) in the ages between 17 and 20 of the Brovary Higher School of Physical Culture (Kyiv region), who were divided into two experimental groups: group A (n=68) was engaged in speed and power sports (boxing, wrestling, field-and-track athletics), group B (n=59) was engaged in endurance sports (skiing, cycling, swimming), the control group included peer students aged 17-20 (n=83) of the Faculty of Health, Physical Education and Sport of the Boris Grinchenko University of Kyiv (n=43) who did not do sports during their studies.

Research methods: theoretical analysis and synthesis of scientific and methodical literature, pedagogical testing, statistical analysis. The theoretical analysis and synthesis of scientific and methodical literature allowed to determine the problem field of the research, get a general idea of the degree of development of the research problem. 14 sources on the topic of the article from the scientometric databases Web of Science Core Collection, Scopus and others were analyzed. The testing of students' attention was carried out according to Anfimov's correction test using a table with letters (40 lines of 50 letters in each of them). It was suggested to all investigated to alternately find the letters "K" and "X" in each line of this table. Duration of work is 2 minutes. Testing was conducted with each subject individually. The following indicators characterizing the attention were determined: the number of characters viewed (A, units); the number of letters correctly crossed out (B, units); the number of mistakes made during the whole period of operation (units); also focus (concentration) of attention that was estimated by its components such as the speed of viewing characters, the coefficients of correctness and efficiency of work. The speed of viewing characters was determined by the formula  $S_v = A / 120$ , where:  $S_v$  – the speed of viewing characters; c.u., A – the number of characters that the student was able to look at two minutes, units; 120 – duration of work, s. The coefficient of correctness (success) of work was determined by the formula  $C_c = B / A$ , where:  $C_c$  – the coefficient of correctness of work, c.u.; B – the number of correctly crossed out characters, units; A – the number of characters that the student was able to look at for two minutes, units. The coefficient of performance was determined by the formula  $C_p = S_v \cdot C_c$ , where:  $C_p$  – coefficient of performance, c.u.;  $S_v$  – the speed of viewing characters, c.u.;  $C_c$  – the coefficient of correctness of work, c.u.

The evaluation of the research results was performed according to a comparative analysis of the first and second

(one year) examination stages of the examinees according to the following scheme: separately for each sport, separately by groups of students and the comparative analysis of the experimental groups with a control group.

The research of the attention was conducted in an isolated room in the first half of the day (from 9 to 12), no earlier than two hours after meals. One or two days before the research, the students was asked to reduce physical exertion in terms of volume and intensity by 50%, not to use tonic and soothing pharmacological preparations, and on the day of testing – strong tea or coffee. Statistical analysis was applied to correctly process the data and identify the difference between the indicators under study. The reliability of the difference between the students' indicators was determined by means of Student's t-test. The statistical significance for all statistical tests was set at  $p < 0.05$ . All statistical analyses were performed with the SPSS software, version 21, adapted to medical and biological researches.

Each student participated in the study on voluntary basis. In the process of conducting the research, we followed the directives of the European Society No. 86/609 and the legislation of the Helsinki Declaration of 2013 on human participation in biomedical research. All individuals were healthy at the time of the examination.

## RESULTS

The nature of changes in the indicators of attention of student engaged in speed and strength sports (group A) according to the first (I) and second (II) stages of the research are given in Table 1. From the data of this table it is clear that all students of this group have the same type of changes in the attention indicators, namely: 1) the total number of viewed characters and the number of correctly crossed letters increased significantly ( $p < 0.001$ ) for all the time of work; 2) however, the number of mistakes made increased significantly (at a 0.1% level of statistical significance); 3) accordingly, a probably ( $p < 0.001$ ) increase in work efficiency (according to the registration of the  $C_p$  indicator) was performed due to a significant increase in the speed of viewing the characters ( $p < 0.001$ ) with an insignificant nature of changes in the coefficient of correctness of work ( $p > 0.05$ ). It is worth noting that despite the unreliability of changes in the  $C_c$  indicator ( $p > 0.05$ ), there is a clear downward trend in its absolute values.

As can be seen from the Table 2, athletes of endurance sports (cyclists, skiers, swimmers) recorded a statistically significant improvement in the dynamics above the incurred indicators ( $p < 0.05-0.001$ ). However, a significant increase in the  $C_p$  indicator is performed equally both by improving the average values of the  $S_v$  and the  $C_c$  indicators.

The absolute values of the average indicators of the attention of students not involved in sports (control group) characterize the data in Table 3. As expected no significant differences were found in the dynamics of changes in the indicators of attention ( $p > 0.05$ ).

A comparative analysis of the longitudinal (according to the first and second stages of the research) changes in the indicators of the attention of student-athletes of speed and



**Table 1.** Indicators of the attention of student engaged in speed and strength sports (group A) according to the first (I) and second (II) stages of the research (n=68), Mean±SD

Indicators	I	II	t	p
Boxers				
The number of students	(n=23)	(n=23)		
The number of characters viewed, units	69.2±1.96	88.5±1.64	4.58	<0.001
The number of correct answers, units	57.0±1.82	68.7±1.57	4.87	<0.001
The number of mistakes, units	12.1±1.35	19.7±1.29	4.07	<0.001
The speed of viewing characters, c.u.	0.57±0.016	0.73±0.013	7.76	<0.001
The coefficient of correctness of work, c.u.	0.81±0.022	0.77±0.019	1.38	>0.05
The coefficient of performance, c.u.	0.45±0.019	0.55±0.017	3.92	<0.001
Wrestlers				
The number of students	(n=21)	(n=21)		
The number of characters viewed, units	70.4±1.88	87.7±1.73	6.77	<0.001
The number of correct answers, units	56.7±1.69	67.3±1.58	4.58	<0.001
The number of mistakes, units	13.6±1.75	20.3±1.50	2.91	<0.01
The speed of viewing characters, c.u.	0.58±0.015	0.72±0.013	7.06	<0.001
The coefficient of correctness of work, c.u.	0.80±0.023	0.76±0.021	1.28	>0.05
The coefficient of performance, c.u.	0.46±0.018	0.54±0.016	3.32	<0.01
Athletes				
The number of students	(n=24)	(n=24)		
The number of characters viewed, units	69.8±2.06	88.2±1.91	6.55	<0.001
The number of correct answers, units	51.8±1.78	62.0±1.53	4.35	<0.001
The number of mistakes, units	17.5±1.94	26.2±1.68	3.39	<0.01
The speed of viewing characters, c.u.	0.57±0.017	0.72±0.018	6.06	<0.001
The coefficient of correctness of work, c.u.	0.73±0.027	0.69±0.025	1.09	>0.05
The coefficient of performance, c.u.	0.41±0.020	0.49±0.016	3.12	<0.01

Legend: Mean: arithmetical average; SD: standard deviation; t: t-test value, p: the significance of the difference between the indicators of the first and the second stages of the research.

**Table 2.** Indicators of the attention of student engaged in endurance sports (group B) according to the first (I) and second (II) stages of the research (n=59), Mean±SD

Indicators	I	II	t	p
Cyclists				
The number of students	(n=23)	(n=23)		
The number of characters viewed, units	63.7±1.48	76.4±1.39	6.26	<0.001
The number of correct answers, units	56.8±1.54	73.6±1.44	7.97	<0.001
The number of mistakes, units	6.9±1.37	2.7±1.26	2.26	<0.05
The speed of viewing characters, c.u.	0.52±0.019	0.62±0.014	4.24	<0.001
The coefficient of correctness of work, c.u.	0.88±0.022	0.95±0.018	2.46	<0.05
The coefficient of performance, c.u.	0.45±0.020	0.58±0.017	4.95	<0.001
Skiers				
The number of students	(n=16)	(n=16)		
The number of characters viewed, units	61.7±1.57	72.3±1.52	4.85	<0.001
The number of correct answers, units	55.0±1.58	69.7±1.45	6.85	<0.001
The number of mistakes, units	6.6±1.26	2.6±1.20	2.30	<0.05
The speed of viewing characters, c.u.	0.50±0.021	0.59±0.019	3.18	<0.01
The coefficient of correctness of work, c.u.	0.88±0.022	0.96±0.018	2.81	<0.05
The coefficient of performance, c.u.	0.43±0.023	0.57±0.020	4.59	<0.001
Swimmers				
The number of students	(n=20)	(n=20)		
The number of characters viewed, units	62.5±1.98	80.4±1.64	6.96	<0.001
The number of correct answers, units	56.0±1.94	77.2±1.67	8.28	<0.001
The number of mistakes, units	6.4±1.32	2.6±1.21	2.12	<0.05
The speed of viewing characters, c.u.	0.52±0.019	0.66±0.020	5.08	<0.001
The coefficient of correctness of work, c.u.	0.89±0.024	0.96±0.019	2.29	<0.05
The coefficient of performance, c.u.	0.46±0.029	0.62±0.027	4.04	<0.001

Legend: Mean: arithmetical average; SD: standard deviation; t: t-test value, p: the significance of the difference between the indicators of the first and the second stages of the research



**Table 3.** Indicators of the attention of student not engaged in sports (control group) according to the first (I) and second (II) stages of the research (n=83), Mean±SD

Indicators	I	II	t	p
The number of students	(n=83)	(n=83)		
The number of characters viewed, units	64.4±2.17	69.8±1.94	1.86	>0.05
The number of correct answers, units	55.9±1.82	61.6±1.88	1.80	>0.05
The number of mistakes, units	8.5±1.71	8.2±1.49	0.13	>0.05
The speed of viewing characters, c.u.	0.53±0.021	0.57±0.017	1.48	>0.05
The coefficient of correctness of work, c.u.	0.87±0.019	0.88±0.016	0.40	>0.05
The coefficient of performance, c.u.	0.46±0.022	0.50±0.019	1.38	>0.05

Legend: Mean: arithmetical average; SD: standard deviation; t: t-test value, p: the significance of the difference between the indicators of the first and the second stages of the research.

**Table 4.** Indicators of the attention of student engaged in speed and strength sports (group A) and endurance sports (group B) according to the first (I) and second (II) stages of the research (n=127), Mean±SD

Indicators	I	II	t	p
Group A				
The number of students	(n=68)	(n=68)		
The number of characters viewed, units	69.8±1.92	88.1±1.71	7.12	<0.001
The number of correct answers, units	55.1±1.74	66.0±1.53	4.70	<0.001
The number of mistakes, units	14.4±1.63	22.1±1.44	3.54	<0.001
The speed of viewing characters, c.u.	0.57±0.013	0.72±0.011	8.81	<0.001
The coefficient of correctness of work, c.u.	0.78±0.020	0.74±0.019	1.45	>0.05
The coefficient of performance, c.u.	0.44±0.015	0.53±0.014	4.39	<0.001
Group B				
The number of students	(n=59)	(n=59)		
The number of characters viewed, units	62.6±1.62	76.4±1.47	6.31	<0.001
The number of correct answers, units	55.9±1.61	73.5±1.48	8.05	<0.001
The number of mistakes, units	6.6±1.27	2.6±1.20	2.29	<0.05
The speed of viewing characters, c.u.	0.51±0.017	0.62±0.015	4.85	<0.001
The coefficient of correctness of work, c.u.	0.88±0.019	0.96±0.015	3.31	<0.01
The coefficient of performance, c.u.	0.45±0.021	0.59±0.018	5.06	<0.001

Legend: Mean: arithmetical average; SD: standard deviation; t: t-test value, p: the significance of the difference between the indicators of the first and the second stages of the research.

**Table 5.** Comparative analysis of changes in the concentration of attention – the speed of viewing characters by student of group A, group B and control group according to the first (I) and the second (II) stages of the research (n=210), Mean±SD, c.u.

Stages	Group A [1]	Group B [2]	Control group [3]	t; [p1–p2]	t; [p1–p3]	t; [p2–p3]
I	(n=68) 0.57±0.013	(n=59) 0.51±0.017	(n=83) 0.53±0.021	2.80; <0.01	1.62; >0.05	0.74; >0.05
II	(n=68) 0.72±0.011	(n=59) 0.62±0.015	(n=83) 0.57±0.017	5.38; <0.001	7.41; <0.001	2.21; <0.05

Legend: Mean: arithmetical average; SD: standard deviation; t: t-test value, p: the significance of the difference between the indicators of studied groups.

**Table 6.** Comparative analysis of changes in the concentration of attention – the coefficient of the correctness of the work of student of group A, group B and control group according to the first (I) and the second (II) stages of the research (n=210), Mean±SD, c.u.

Stages	Group A [1]	Group B [2]	Control group [3]	t; [P1–P2]	t; [P1–P3]	t; [P2–P3]
I	(n=68) 0.78±0.020	(n=59) 0.88±0.019	(n=83) 0.87±0.019	3.63; <0.001	3.26; <0.01	0.37; >0.05
II	(n=68) 0.74±0.019	(n=59) 0.96±0.015	(n=83) 0.88±0.016	9.09; <0.001	5.64; <0.001	3.65; <0.001

Legend: Mean: arithmetical average; SD: standard deviation; t: t-test value, p: the significance of the difference between the indicators of studied groups.

**Table 7.** Comparative analysis of changes in the concentration – the coefficient of performance of student of group A, group B and control group according to the first (I) and the second (II) stages of the research (n=210), Mean±SD, c.u.

Stages	Group A [1]	Group B [2]	Control group [3]	t; [P1–P2]	t; [P1–P3]	t; [P2–P3]
I	(n=68) 0.44±0.015	(n=59) 0.45±0.021	(n=83) 0.46±0.022	0.39; >0.05	0.75; >0.05	0.33; >0.05
II	(n=68) 0.53±0.014	(n=59) 0.59±0.018	(n=83) 0.50±0.019	2.63; <0.05	1.27; >0.05	3.44; <0.01

Legend: Mean: arithmetical average; SD: standard deviation; t: t-test value, p: the significance of the difference between the indicators of studied groups.

strength sports and endurance sports are given in Table 4. From the data of this table it is seen that in athletes of group A, despite the probable ( $p < 0.001$ ) improvement in most average attention values, a significant ( $p < 0.001$ ) increase in the number of mistakes is recorded with an unreliable nature of changes in Cc ( $p > 0.05$ ). While the students of group B, on the contrary, there is a statistically significant ( $p < 0.05-0.001$ ) improvement in all the above indicators.

Taking into account the fact that changes in the integral indicator of concentration - the coefficient of performance (Cp) among students of various training orientations are performed differently (in one case, mainly due to an increase in Sv, in the other – both due to the Cc indicator and Sv) we had the opportunity to conduct a comparative analysis of the above indicators between students of groups A and B and students of the control group. As shown in Table 5, the speed of viewing characters (Sv) (according to the data of the second stage of the research) remains significantly higher among students-athletes than among students-non-athletes ( $p < 0.05-0.001$ ), whereas among the two groups of athletes, as expected, significantly high values of the Sv indicator are registered in students of group A in comparison with their peers – students of group B ( $p < 0.001$ ).

As can be seen from the data Table 6, the coefficient of correctness of work (Cc) remains significantly higher (according to the data of the second stage of the research) in students of group B compared with students of group A and students of the control group ( $p < 0.001$  in both cases). Students who do not play sports have the best Cc values ( $p < 0.001$ ), compared with students engaged in speed and strength sports (group A).

And finally, Table 7 shows that the coefficient of performance (Cp) is significantly higher in group B than in group A ( $p < 0.05$ ) and students not engaged in sports ( $p < 0.01$ ). Whereas, between the students of group A and the students of the control group, no significant differences were found in the indicator of Cp ( $p > 0.05$ ).

## DISCUSSION

Based on the results of a long-term research of the attention among student-athletes from one of the specialized sports institutions we come to the conclusion that, despite the attention, we have previously investigated the functions of visual memory and logical thinking, is characterized by an expressed genetic heredity and is poorly subjected to correction by means of physical education and sports, we believe that the direction of the training process is specifically

the specializing features of the development of this function [8, 9]. So, we find that athletes engaged in speed and strength sports (boxing, wrestling, athletics: sprint, hurdling, jumping, shot put and throwing the disc) along with improvement (in dynamics) of most of the attention indicators (except for the number mistakes), the growth of the integral indicator of this function – the coefficient of performance is due to the significant ( $p < 0.001$ ) increase of the speed of viewing characters indicator with statistically unreliable ( $p > 0.05$ ) nature of changes in the indicator of correctness of work. Then, as under the influence of endurance training, on the contrary, the athletes register improvement in absolutely highest of all of the above indicators, and the increase in the coefficient of performance is due to an increase in the indicator of speed of viewing characters ( $p < 0.001$ ), and the indicator of the correctness of the work ( $p < 0.01$ ). The fact that athletes with the same type of orientation of the training process did not find significant differences in the indicators of the mentioned mental function ( $p > 0.05$ ), which is unconditional evidence of the specific influence of physical exertion on organism functions people of different ages and professional employment [10, 11]. In control group of students who were not involved in sports, there were no significant differences in the changes in the indicators of this mental function ( $p > 0.05$ ). A comparative analysis of changes in the functions of concentration of attention indicators in the three groups of students indicates that the above-mentioned integral indicator of this function (coefficient of work performance) is significantly higher among endurance sports student compared to speed and strength sports students ( $p < 0.05$ ) and students not involved in sports ( $p < 0.01$ ). No significant differences were found in the values of the coefficient of work performance ( $p > 0.05$ ). The results obtained complement and extend the findings of many studies [12-15].

## CONCLUSIONS

It is set, that specifics of the training process, its orientation equally specifically specialize the peculiarities of the development of the attention of students-athletes 17-20 years of specialized sports institutions. It was revealed that speed and power activities increase the integrated indicator of attention (the coefficient of work performance) based only on the speed of viewing characters with unreliable changes in the correctness of the work indicators. Under the influence of endurance training, the coefficient of efficiency is increased based on both an increase in the speed of viewing characters and the correctness of the

work indicators. This suggests that endurance training promotes the development of students' attention more effectively. The students of the control group were found to have insignificant changes in the studied indicators of attention.

#### PROSPECTS FOR FURTHER RESEARCH

The influence of physical activities on the indicators of time perception of students specializing in different sports is supposed to be studied.

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#### CONFLICT OF INTEREST

The Authors declare no conflict of interest.

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