



Influence of application of special means of development of equilibrium and precision-target movements on the level and structure of psychophysiological indicators, physical and technical readiness of archers

Artiuh V.V.¹, Kozina Zh.L.¹, Koval V.O.², Safronov D.V.², Fomin S.V.³, Novikov Yu.O.³

¹H.S. Skovoroda Kharkiv National Pedagogical University

²V.N. Karazin Kharkiv National University

³Kharkiv National Technical University of Agriculture named after Petr Vasilenko

DOI: <http://doi.org/10.5281/zenodo.2536441>

Abstract

Objective: to determine the impact of special precision-target exercises on the level and structure of psycho-physiological indicators, physical and technical readiness of archers at the initial stage of preparation. Material and methods. The study involved 22 beginner athletes, boys and girls aged 18-20 years. The subjects were divided into two groups (control and experimental) of 11 people each. Results. It was shown that shooters of the experimental group reliably improved the indicators of archery due to the development of precision-targeted skills. Revealed a significant improvement in the results of physical and technical readiness of the athletes of the experimental group "tension of the tityvka on the left hand", $p < 0.01$; "Tension tityvka on the right hand", $p < 0.01$; "The sum of hits from 600 points", $p < 0.001$; "Flexion-extension of the arms in a prone position", $p < 0.01$; Squats, $p < 0.05$. The control group is also characterized by a significant improvement in the results of testing in terms of technical and physical fitness, but with a lower level of significance: "tension on the left arm," $p < 0.05$; "Tension tityvka on the right hand", $p < 0.05$; "The sum of hits from 600 points", $p < 0.01$; "Flexing-extension of the arms in a prone position", $p < 0.05$. The presence of significant differences between the control and experimental groups in terms of technical readiness was revealed ("tightening the tityvka on the right hand", $p < 0.05$ and "sum of hits from 600 points", $p < 0.05$). It was shown that after the experiment, the number of reliable relationships between indicators of psycho-physiological functions and indicators of technical and physical fitness in the experimental group increased from 5 to 10. In the control group, the number of reliable relationships between these indicators remained at the experimental level (5 relationships "relationships"). Conclusions. The application of the experimental methodology for the development of precision-target movements has a positive effect on the level of technical and physical training. athletes, as well as on the structure of the complex preparedness of athletes.

Key words: archery; precision-oriented exercises; shooting; callisthenics; power.

Анотація

Артюх В.В., Козіна Ж.Л., Коваль В.О., Сафронів Д.В., Фомін С.В., Новіков Ю.А. Вплив застосування спеціальних засобів розвитку рівноваги та точно-цільових рухів на рівень та структуру психофізіологічних показників, фізичної та технічної підготовленості лучників.

Мета: визначення впливу спеціальних точно-цільових вправ на рівень та структуру психофізіологічних показників, фізичної та технічної підготовленості лучників на початковому етапі підготовки. Матеріал і методи. У дослідженні прийняло участь 22 спортсменів-початківців юнаків та дівчат у віці 18-20 років. Випробувані були розділені на дві групи (контрольну і експериментальну) по 11 осіб в кожній. Результати. Показано, що у випробуваних експериментальної групи достовірно поліпшились показники техніки стрільби з лука за рахунок розвитку точно-цільових навичок. Виявлено достовірне поліпшення результатів фізичної та технічної підготовленості спортсменів експериментальної групи: «натяг титівки на ліву руку», $p < 0,01$; «натяг титівки на праву руку», $p < 0,01$; «сума влучень з 600 очок», $p < 0,001$; «згинання-розгинання рук в упорі лежачі», $p < 0,01$; «присідання», $p < 0,05$. Для контрольної групи також характерно достовірне поліпшення результатів тестування за рівнем технічної та фізичної підготовленості, але при меншому рівні значущості: «натяг титівки на ліву руку», $p < 0,05$; «натяг титівки на праву руку», $p < 0,05$; «сума влучень з 600 очок», $p < 0,01$; «згинання-розгинання рук в упорі лежачі», $p < 0,05$. Виявлено наявність достовірних розходжень між контрольною та експериментальною групами за показниками технічної підготовленості («натягування титівки на праву руку», $p < 0,05$ та «сума влучень з 600 очок», $p < 0,05$). Показано, що після проведення експерименту кількість достовірних взаємозв'язків між показниками психофізіологічних функцій та показниками технічної та фізичної підготовленості в експериментальній групі підвищилась з 5 до 10. В контрольній групі кількість достовірних взаємозв'язків між даними показниками так і залишилась на доекспериментальному рівні (5 взаємозв'язків). Висновки. Застосування експериментальної методики розвитку точно-цільових рухів позитивно вплинуло на рівень технічної та фізичної підготовленості спортсменів, а також на структуру комплексної підготовленості спортсменів.

Ключові слова: стрільба з лука; точно-цільові вправи; стрільба; фізична підготовка; сила.

Анотация

Артюх В.В., Козина Ж.Л., Коваль В.О. Влияние применения специальных средств развития равновесия и точно-целевых движений на уровень и структуру психофизиологических показателей, физической и технической подготовленности лучников.

Цель: определение влияния специальных точностных-целевых упражнений на уровень и структуру психофизиологических показателей, физической и технической подготовленности спортсменов на начальном этапе подготовки. Материал и методы. В исследовании приняло участие 22 начинающих спортсменов юношей и девушек в возрасте 18-20 лет. Испытуемые были разделены на две группы (контрольную и экспериментальную) по 11 человек в каждой. Результаты. Показано, что у испытуемых экспериментальной группы достоверно улучшились показатели техники стрельбы из лука за счет развития точностных-целевых навыков. Виявлено достоверное улучшение результатов физической и технической подготовленности спортсменов экспериментальной группы «натяжение титивки на левую руку», $p < 0,01$; «Натяжение титивки на правую руку», $p < 0,01$; «Сумма попаданий из 600 очков», $p < 0,001$; «Сгибание-разгибание рук в упоре лежа», $p < 0,01$; «Приседания», $p < 0,05$. Для контрольной группы также характерно достоверное улучшение результатов тестирования по уровню технической и физической подготовленности, но при меньшем уровне значимости: «натяжение титивки на левую руку», $p < 0,05$; «Натяжение титивки на правую руку», $p < 0,05$; «Сумма попаданий из 600 очков», $p < 0,01$; «Сгибание-разгибание рук в упоре лежа», $p < 0,05$. Виявлено наличие достоверных различий между контрольной и экспериментальной группами по показателям технической подготовленности («натягивания титивки на правую руку», $p < 0,05$ и «сумма попаданий из 600 очков», $p < 0,05$). Показано, что после проведения эксперимента количество достоверных взаимосвязей между показателями психофизиологических функций и показателями технической и физической подготовленности в экспериментальной группе повысилась с 5 до 10. В контрольной группе количество достоверных взаимосвязей между данными показателями так и осталась на доэкспериментальном уровне (5 взаимосвязей). Выводы. Применение экспериментальной методики развития точностных-целевых движений положительно повлияло на уровень технической и физической подготовленности спортсменов, а также на структуру комплексной подготовленности спортсменов.

Ключевые слова: стрельба из лука; точностных-целевые упражнения; стрельба; физическая подготовка; сила.



Introduction

Archery (archery) - art and sports, which consists in the ability to shoot arrows (Camus, 2017; Clark, 2016). The arts of archery arose in the late Paleolithic or early Mesolithic era (Arnade, 2018; Ditcham, 2017; Pontzer, et al., 2017; Sensfelder, 2017; Silverman, 2016). The oldest finds related to archery are dated from the eighth to ninth century BC. Historically, archery was used for hunting and fighting (Gunn, 2018; Haemers, 2017; Jaser, 2017; Nicholas, 2017; Stabel, 2017; Toichkin, 2016). The bow was used for this purpose almost everywhere (Ranglack, et al., 2017). The only region where archery was not known until the 19th century is Australia and Oceania. In large combat, the bow was last used at the beginning of the 19th century (Arnade, 2018; Baguet, 2017; Ellis, 2016). Archery is an Olympic sport. Archery is included in the program of the Summer Olympics since 1900.

Archery is actively developing at the momentary stage (Park, 2016; Park et al., 2016; Tarigan, et al., 2018). Together with the development of archery as a sport, a technique for teaching archery techniques is developed (Choi, and Ok, 2016). For this purpose, in today's world sports science, studies are conducted to determine the biomechanical and physiological parameters of firing (Ariffin et al., 2018; Reddy et al., 2016; Simsek, 2018; Spratford and Campbell, 2017; Suppiah, 2017; Taha, et al., 2017), simulation of shooting techniques (Richards, 2018), factors of fatigue in archery (Lankford, and Higginson, 2016), the time parameters of a shot are investigated for revealing of factors damaging the achievement of high sports result (Callaway, et al., 2017), the cognitive mechanisms of archery (Gonzalez, et al., 2017), the possibilities of athletes of dosamona the lift of technical actions and the training process (Tanet.al., 2016), as well as the possibilities of using an archery as a means of stress (Aysan, 2016).

Thus, modern scientific research reveals the importance of forming the right technique in archery. But the question remains unclear about the development of special techniques for the development of precise movements of athletes-archers. The training mainly applies directly to archery without special exercises for the development of target accuracy. It should be noted that in other precise-target species there are methodological developments for the development of accuracy.

The purpose of the study: the determination of the effect of special precision-target exercises on the level and structure of psychophysiological indicators, physical and technical preparedness of archers at the initial stage of training.

Material and methods

Participants

The study was attended by 22 sportsmen-novice boys and girls aged 18-20 years. The survey group was represented by the NGO "Poltava Regional Archery Federation". All students agreed to participate in the experiment.

Organization of research

The research was conducted in accordance with the implementation of the plan of the NGO "Poltava Regional Archery Federation" for the training of athletes archers with the use of exercises with precision-specific sports.

The subjects were divided into two groups (control and experimental) for 11 people in each. Distribution was made by accident. In the beginning and at the end of the experiment, athletes were tested. Before the beginning of the experiment, the groups did not differ significantly in their psychophysiological indices (according to Horbova and Schulte tests), according to the indicators of physical fitness (Push-up and squatting) and on indicators of technical readiness (time of tensile of the right and left hand, accuracy hits in the target) (Table 1).

The technique with the use of special precision-purpose exercises was used in the experimental group. The experimental group was engaged in a standard program, but the time for common practice was shortened, and additional exercises were included in the training, such as firing from the balance of the boarding gun with an additional optical gun. Balance board is a tool that allows you to develop a sense of balance, improve your body's appearance, it has as a simple swing for two only has a smaller size (basically this simulator is used for rehabilitation (Molnar, Zelei, & Insperger, 2018), and only then the balance board found itself in the sport).

Shooting from the balance board includes 3 stages of preparation 1-stage - this is the ability to find the balance on the balance board and keep it as long as possible, the 2-stage - is the ability of the gun standing on the board of the board caught an absolute balance and shoot with ngo, this gives the archers strong resistance in the legs and the back of the 3rd stage is the ability to shoot while standing on the balance of the board caught an absolute balance and shoot with it, but before that, after the shot, do not lose this balance and hit precisely the goal at short distances.

Shooting with an additional optical target is required in order for the shooter to learn 2 aspects of



the technique: 1- Keep the bow even and do not cling it in different directions, as usually on these additional sights e level and their task is to keep the bow aim and shoot when the level in the middle; 2 - hold the bow when stretching it so that the sight is always at the center of your target at any level and positioned anywhere on the sew.

The control group trained according to the generally accepted method for archers. Experiment lasted 2 months.

Investigation of the level of attention in the method of Horbova "Red-black table"

Goal.

Estimation of switching and distribution of attention. Can be used to survey people of all ages.

The study is conducted using special tables, in which randomly located 25 red and 24 black numbers. The tester must first find the black numbers in ascending order, then the red numbers in descending order. Immediately after the first task, the numbers in the table are mixed, and the subject begins to perform the second task. It consists in alternating the search for black numbers in the growing and red in descending order.

Data Processing.

The time taken for each series and the error are taken into account. The time of execution of the second task is not equal to the time of execution of the first task, because part of the time goes to switching the attention and operational content of the just mentioned numbers. The difference between two time indices will be the time of switching attention (ERV) from one row of numbers to another. The less this difference, the less the number of errors, the better the switching attention. Types of errors: skipping a number, repeating one number twice, choosing the wrong color number.

After completion, the results of the first and second tests, as well as ERW are displayed on the screen and automatically entered in the database.

Research of mental performance according to the method of "Table Schulte"

Goal.

Determination of stability of attention and dynamics of efficiency. Used to survey people of all ages. The tested in turn offers five tables, on which randomly numbers are from 1 to 25. The searcher looks for, shows and names the numbers in the order of their growth. The sample is repeated with five different tables.

The main indicator is the time of execution. According to the results of each table, a depletion curve (fatigue) can be constructed, which reflects the stability of attention and performance in dynamics.

With this test, you can also calculate indicators such as performance (EP), degree of exercise (BP), mental resistance (PU).

$$ER = \frac{T1 + T2 + T3 + T4 + T5}{5}$$

where T1 - time of work with the first table; T2 - from the second; TK - from the third; T4 - from the fourth; T5 - from the fifth.

The degree of development (BP) is calculated by the formula:

$$BP = \frac{T1}{ER}$$

The result is less than 1,0 - the indicator of good training, respectively, the higher the given figure, the more the subject needs time to prepare for the main work. Mental endurance (endurance) is calculated by the formula:

$$PU = \frac{T4}{ER}$$

Indicator of the result (PP) of less than 1,0 says good mental stability and, accordingly, the higher the given indicator, the worse the psychological stability of the researched before performing a given job. After completion, test results are automatically entered into the database.

Statistical analysis.

The digital material obtained during the study was processed using traditional methods of mathematical statistics. For each indicator, the arithmetic mean value X, the mean square deviation S (standard deviation), and the validity of the differences between the parameters of the initial and final results, as well as between the control and experimental groups according to the t-student criterion with the corresponding level of significance (p) were determined.

A correlation analysis of the test parameters was also conducted for the experiment and after the experiment (the results of the control and experimental groups were processed separately for each group).

In mathematical treatment of the primary materials of this study, in addition to calculating primary statistics, a correlation analysis of the test indicators was conducted. Mathematical processing of data was carried out using Microsoft Excell's Data Analysis SPSS research programs. Differences were considered to be reliable at a significance level of p < 0.05.



Results

According to the results of the experiment,

the control and experimental group did not differ significantly from each other ($p < 0,05$) (Table 1).

Table 1

Indicators of psychophysiological functions, of physical and technical preparedness of archers of control (n=11) and experimental (n=11) groups for experiment

Title of tests	Group	Statistical Indicators					
		N	\bar{x}	S	m	t	p
Method "Schulte Table, Efficiency of Work", c.u.	K	11	35,83	6,94	2,09	-0,58	>0,05
	E	11	37,40	5,69	1,72		
Method «Table of Schulte, speed of inclusion in work», c.u.	K	11	1,03	0,04	0,01	0,15	>0,05
	E	11	1,02	0,04	0,01		
Method "Schulte Table, Mental Stability", c.u.	K	11	1,06	0,17	0,05	0,54	>0,05
	E	11	1,02	0,16	0,05		
Method "Red-black table of Gorbov", mistakes when working on the table number 1	K	11	3,27	2,90	0,87	-0,52	>0,05
	E	11	3,91	2,88	0,87		
Technique "Red-black table of Gorbov", errors at work on the table number 2	K	11	7,36	6,74	2,03	-0,45	>0,05
	E	11	8,64	6,53	1,97		
Method "Red-black table of Gorbov", switching attention, c.u.	K	11	69,91	11,39	15,49	-0,48	>0,05
	E	11	70,36	11,71	15,59		
Tension of an onion to the left hand, s	K	11	33,55	6,49	1,96	0,03	>0,05
	E	11	33,45	7,13	2,15		
Tension on the right hand, s	K	11	51,09	9,43	2,84	-1,23	>0,05
	E	11	56,55	11,37	3,43		
The sum of hits from 600 points	K	11	247,36	27,03	8,15	-0,40	>0,05
	E	11	251,64	23,59	7,11		
Push-up for 1 minute, quantity	K	11	16,36	2,84	0,86	0,35	>0,05
	E	11	15,91	3,21	0,97		
Squat for 1 minute, quantity	K	11	39,00	11,97	3,61	0,99	>0,05
	E	11	34,55	8,95	2,70		

Note: K is a control group; E is an experimental group

The lack of significant differences between the control and the experimental group prior to the experiment gave rise to a pedagogical experiment.

Repeated testing after 2 months, during which the applied experimental methods of targeted and precise movements, showed the presence of significant differences between control and experimental group on indicators of technical training ("stretching titivky on the right hand", $p < 0,05$ and "amount of hits 600 points ", $p < 0,05$) (Table 2).

Thus, the results of the test showed that the experienced experimental group significantly improved the performance of archery techniques due to the development of precision-oriented skills.

In-group comparison on the test indicators showed a significant improvement in the results of the physical and technical preparedness of the athletes of the experimental group: "the tension of the ticket on the left hand", $p < 0,01$; "Tension of the ticket on the right hand", $p < 0,01$; "The sum of hits from 600 points", $p < 0,001$; "Push-up," $p < 0,01$; "Squatting", $p < 0,05$ (Table 3).

For the control group, there is also a significant improvement in the test results by the level of technical and physical preparedness, but with a lower level of significance: "the tension of the ticket on the left hand", $p < 0,05$; "Tension of the ticket on the right hand", $p < 0,05$; "Sum of hits from 600 points", $p < 0,01$; "Push-up", $p < 0,05$ (Table 4).



Table 2

Indicators of psychophysiological functions, physical and technical preparedness of the archers of the control (n=11) and experimental (n=11) groups after the experiment

Title of tests	Group	Statistical Indicators					
		N	\bar{x}	S	m	t	p
Method "Schulte Table, Efficiency of Work", c.u.	K	11	34.88	7.65	2.31	0.35	>0,05
	E	11	33.78	7.27	2.19		
Method «Table of Schulte, speed of inclusion in work», c.u.	K	11	1.04	0.06	0.02	0.41	>0,05
	E	11	1.03	0.05	0.01		
Method "Schulte Table, Mental Stability", c.u.	K	11	1.08	0.15	0.05	1.09	>0,05
	E	11	1.01	0.15	0.04		
Method "Red-black table of Gorbov", mistakes when working on the table number 1	K	11	4.18	2.93	0.88	0.91	>0,05
	E	11	3.09	2.66	0.80		
Technique "Red-black table of Gorbov", errors at work on the table number 2	K	11	7.18	6.26	1.89	-0.58	>0,05
	E	11	8.82	6.95	2.10		
Method "Red-black table of Gorbov", switching attention, c.u.	K	11	67.18	48.61	14.66	-0.68	>0,05
	E	11	81.82	52.26	15.76		
Tension of an onion to the left hand, s	K	11	40.73	7.79	2.35	-1.26	>0,05
	E	11	45.45	9.68	2.92		
Tension on the right hand, s	K	11	61.45	11.37	3.43	-2.54	<0,05
	E	11	74.73	13.09	3.95		
The sum of hits from 600 points	K	11	298.18	33.38	10.06	-3.02	<0,01
	E	11	340.27	31.96	9.64		
Push-up for 1 minute, quantity	K	11	20.00	3.26	0.98	-1.00	>0,05
	E	11	21.64	4.37	1.32		
Squat for 1 minute, quantity	K	11	47.00	14.23	4.29	0.10	>0,05
	E	11	46.45	11.40	3.44		

Note: K is a control group; E is an experimental group

Table 3

Indicators of psychophysiological functions, physical and technical preparedness of archers of the experimental (n=11) group before and after the experiment

Title of tests	Group	Statistical Indicators					
		N	\bar{x}	S	m	t	p
1	2	3	4	5	6	7	8
Method "Schulte Table, Efficiency of Work", c.u.	BE	11	37.40	5.69	1.72	1.30	>0,05
	AE	11	33.78	7.27	2.19		
Method «Table of Schulte, speed of inclusion in work», c.u.	BE	11	1.02	0.04	0.01	-0.61	>0,05
	AE	11	1.03	0.05	0.01		
Method "Schulte Table, Mental Stability", c.u.	BE	11	1.02	0.16	0.05	0.16	>0,05
	AE	11	1.01	0.15	0.04		
Method "Red-black table of Gorbov", mistakes when working on the table N1	BE	11	3.91	2.88	0.87	0.69	>0,05
	AE	11	3.09	2.66	0.80		
Technique "Red-black table of Gorbov", errors at work on the table N2	BE	11	8.64	6.53	1.97	-0.06	>0,05
	AE	11	8.82	6.95	2.10		
Method "Red-black table of Gorbov", switching attention, c.u.	BE	11	80.36	51.71	15.59	-0.07	>0,05
	AE	11	81.82	52.26	15.76		
Tension of an onion to the left hand, s	BE	11	33.45	7.13	2.15	-3.31	<0,01
	AE	11	45.45	9.68	2.92		



1	2	3	4	5	6	7	8
Tension on the right hand, s	BE	11	56.55	11.37	3.43	-3.48	<0,01
	AE	11	74.73	13.09	3.95		
The sum of hits from 600 points	BE	11	251.64	23.59	7.11	-7.40	<0,001
	AE	11	340.27	31.96	9.64		
Push-up for 1 minute, quantity	BE	11	15.91	3.21	0.97	-3.51	<0,01
	AE	11	21.64	4.37	1.32		
Squat for 1 minute, quantity	BE	11	34.55	8.95	2.70	-2.73	<0,05
	AE	11	46.45	11.40	3.44		

Note: BE - before the experiment; AE - after the experiment

Table 4

Indicators of psychophysiological functions, physical and technical readiness of control (n=11) group archers before and after the experiment

Title of tests	Group	Statistical Indicators					
		N	\bar{x}	S	m	t	p
Method "Schulte Table, Efficiency of Work", c.u.	1	11	35.83	6.94	2.09	0.30	>0,05
	3	11	34.88	7.65	2.31		
Method «Table of Schulte, speed of inclusion in work», c.u.	1	11	1.03	0.04	0.01	-0.79	>0,05
	3	11	1.04	0.06	0.02		
Method "Schulte Table, Mental Stability", c.u.	1	11	1.06	0.17	0.05	-0.30	>0,05
	3	11	1.08	0.15	0.05		
Method "Red-black table of Gorbov", mistakes when working on the table number 1	1	11	3.27	2.90	0.87	-0.73	>0,05
	3	11	4.18	2.93	0.88		
Technique "Red-black table of Gorbov", errors at work on the table number 2	1	11	7.36	6.74	2.03	0.07	>0,05
	3	11	7.18	6.26	1.89		
Method "Red-black table of Gorbov", switching attention, c.u.	1	11	69.91	51.39	15.49	0.13	>0,05
	3	11	67.18	48.61	14.66		
Tension of an onion to the left hand, s	1	11	33.55	6.49	1.96	-2.35	<0,05
	3	11	40.73	7.79	2.35		
Tension on the right hand, s	1	11	51.09	9.43	2.84	-2.33	<0,05
	3	11	61.45	11.37	3.43		
The sum of hits from 600 points	1	11	247.36	27.03	8.15	-3.92	<0,01
	3	11	298.18	33.38	10.06		
Push-up for 1 minute, quantity	1	11	16.36	2.84	0.86	-2.79	<0,05
	3	11	20.00	3.26	0.98		
Squat for 1 minute, quantity	1	11	39.00	11.97	3.61	-1.43	>0,05
	3	11	47.00	14.23	4.29		

Note: BE - before the experiment; AE - after the experiment

Thus, in the experimental group, the improvement of the physical and technical readiness rates is more pronounced than in the control group.

It should be noted that improvements in psycho-physiological parameters were not observed either in the experimental group or in the control group (Table 3, 4). This can be explained by the fact

that psychophysiological indicators are hereditary characteristics and difficult to develop. Especially since the experiment lasted only 2 months.

However, to determine the level of structuring of indicators of preparedness, to identify the relationship between the indicators of psychophysiological functions and indicators of physical



and technical preparedness, a correlation analysis of the test parameters of the athletes of the control and experimental groups before and after the experiment was conducted. Before the experiment, the number of reliable relationships between psychophysiological indicators and indicators of physical and technical preparedness in both the control and experimental groups is 5-6 interconnections.

After the experiment, the number of reliable relationships between the indicators of psychophysiological functions and the indicators of technical and physical preparedness in the experimental group increased from 5 to 10. In the control group, the number of reliable relationships between these indicators remained at the pre-experimental level (5 interactions) (Table 5).

Table 5

Correlation matrix of testing testers of experimental groups after conducting experiment (n=11)

Testing Indicators	1	2	3	4	5	6	7	8	9	10	11
1	1.00										
2	0.00	1.00									
3	0.21	-0.28	1.00								
4	-0.36	-0.44	0.09	1.00							
5	-0.19	0.31	0.09	0.19	1.00						
6	-0.10	0.06	0.27	0.37	0.90*	1.00					
7	-0.10	0.35	-0.22	-0.35	0.03	-0.19	1.00				
8	-0.08	0.44	-0.15	-0.50*	0.00	-0.25	0.92	1.00			
9	0.15	0.12	-0.55*	-0.07	0.24	0.06	0.14	0.26	1.00		
10	-0.56*	-0.04	-0.07	0.11	0.50*	0.44*	0.36	0.15	-0.17	1.00	
11	-0.22	-0.55*	0.16	0.52	0.56*	0.65*	-0.12	-0.30	0.06	0.60*	1.00

Notes:

- 1 - Method "Schulte Table, Efficiency of Work", c.u.
 - 2 - Method «Table of Schulte, speed of inclusion in work», c.u.
 - 3 - Method "Schulte Table, Mental Stability", c.u.
 - 4 - Method "Red-black table of Gorbov", mistakes when working on the table number 1
 - 5 - Technique "Red-black table of Gorbov", errors at work on the table number 2
 - 6 - Method "Red-black table of Gorbov", switching attention, c.u.
 - 7 - Tension of an onion to the left hand, s
 - 8 - Tension on the right hand, s
 - 9 - The sum of hits from 600 points
 - 10 - Push-up for 1 minute, quantity
 - 11 - Squat for 1 minute, quantity
- * - the coefficients of correlation are reliable at $p < 0,05$

Discussion

The obtained data show that in the experimental group the harmony of the functioning of the nervous system from the point of view of motion management has increased, as the number of correlation interactions between the psychophysiological indicators and the level of physical and technical preparedness of athletes has increased. This confirms the results we have received earlier that when the athlete's level of fitness increases, the level of self-organization of the system increases, which is an athlete or team (Kozina et al., 2016). These results confirm the theory of self-organizing systems to enhance their structuring as they evolve (Kozina et al., 1998, 2009, 2015, 2017,

Sobko et al., 2014). The level of structuring of the system reflects the coherence of the work of its various systems, which indirectly reflects the existence of correlation relationships between different indicators of preparedness and work of different systems of the organism.

The obtained data also confirm the results of research on the development of precision-target movements in other sports (Korobejnikov et al., 2012, Kozina, et al., 2016). The results obtained in previous studies (Kozina et al., 2016) showed that target precision is a complex quality that depends on many factors and the work of different body systems. Precision-target precision is manifested comprehensively, that is, the development of



precision-target movements in one kind of activity accelerates the development of precision-target movements in another type of activity (Kozina et al., 2016). That is why the use of special precision-target exercises proposed in our experiment as additional means for the development of accuracy of archers has allowed to significantly affect the target performance of athletes. The obtained data confirm and extend the results on the effectiveness of the integrated development of target accuracy. But in the field of archery such studies have not yet been carried out, and therefore the results are new in terms of improving the technique of development of target precision shooters at the initial stage of training.

In addition, the findings confirmed the results of authors' research on the importance of physical fitness for the implementation of precise actions. In the experimental group, the increase in physical fitness indicators is more pronounced than in the control group. This is also confirmed by the results of other authors' research (Ariffin et al., 2018; Reddy et al., 2016; Simsek, 2018; Suppiah, 2017; Taha et al., 2017) on the importance of physical fitness for the formation of sports movement techniques.

Conclusions

1. The application of the experimental methodology for the development of precision-target movements positively influenced the level of technical and physical preparedness of athletes, as well as the structure of the complex preparedness of athletes.

2. It is shown that in experimental group experimental data on archery technique improved significantly due to the development of precision-

target skills. Really improved results of physical and technical preparedness of athletes of the experimental group: "tension of the ticket on the left hand", $p < 0.01$; "Tension of the ticket on the right hand", $p < 0.01$; "The sum of hits from 600 points", $p < 0,001$; "Flexion-extensions of hands in the emphasis lying," $p < 0.01$; "Squatting", $p < 0,05$. For the control group, there is also a significant improvement in the test results by the level of technical and physical preparedness, but with a lower level of significance: "the tension of the ticket on the left hand", $p < 0,05$; "Tension of the ticket on the right hand", $p < 0,05$; "Sum of hits from 600 points", $p < 0.01$; " Push-up," $p < 0,05$. The existence of reliable differences between the control and experimental groups according to the technical readiness indicators ("tightening of the ticket to the right hand", $p < 0,05$ and "the amount of hits from 600 points", $p < 0,05$) was revealed.

3. It was shown that after the experiment, the number of reliable interconnections between the indicators of psychophysiological functions and the indicators of technical and physical preparedness in the experimental group increased from 5 to 10. In the control group, the number of reliable interactions between these indicators remained at the pre-experimental level (5 interconnections).

In the future, it is planned to explore the possibility of using exercises from other sports to improve the special physical and technical training of athletes.

Conflict of interest. The authors state that there is no conflict of interest.

References

1. Ariffin, M. S., Rambely, A. S., & Ariff, N. M. (2018). Wrist Muscle Activity of Khatrah Approach in Mameluke Technique Using Traditional Bow Archery. In K. Ibrahim, M. M. Hanafiah, M. H. H. Jumali, N. Ibrahim, & S. A. Hasbullah (Eds.), *2017 Ukm Fst Postgraduate Colloquium* (Vol. 1940).
2. Arnade, P. (2018). Archery and Crossbow Guilds in Medieval Flanders, 1300-1500. *American Historical Review*, *123*(1), 308-309. doi:10.1093/ahr/123.1.308
3. Aysan, H. A. (2016). The Effects of Archery as a Sports Branch on Coping with Stress. *Studies on Ethno-Medicine*, *10*(1), 39-43.
4. Baguet, J. Y. (2017). Archery and Crossbow Guilds in Medieval Flanders 1300-1500. *Urban History*, *44*(2), 344-345. doi:10.1017/s0963926817000116
5. Callaway, A. J., Wiedlack, J., & Heller, M. (2017). Identification of temporal factors related to shot performance for indoor recurve archery. *Journal of Sports Sciences*, *35*(12), 1142-1147. doi:10.1080/02640414.2016.1211730
6. Camus, R. M. (2017). Comparison by Metaphor: Archery in Confucius and Aristotle. *Dao-a Journal of Comparative Philosophy*, *16*(2), 165-185. doi:10.1007/s11712-017-9545-y
7. Choi, S., & Ok, G. (2016). The Role of Gukgung in the Success of South Korean Archery. *International Journal of the History of Sport*, *33*(9), 990-1007. doi:10.1080/09523367.2016.1237507
8. Clark, G. A. (2016). *Philosophy as Practice Zen and Archery* (Vol. 72).
9. Ditcham, B. G. H. (2017). Archery and Crossbow Guilds in Medieval Flanders, 1300-1500. *Sixteenth Century Journal*, *48*(2), 485-487.
10. Ellis, J. (2016). Archery and Social Memory in Sixteenth-Century London. *Huntington Library Quarterly*, *79*(1), 21-40. doi:10.1353/hlq.2016.0006
11. Gonzalez, C. C., Causer, J., Grey, M. J., Humphreys, G. W., Miall, R. C., & Williams, A. M. (2017).



- Exploring the quiet eye in archery using field- and laboratory-based tasks. *Experimental Brain Research*, 235(9), 2843-2855. doi:10.1007/s00221-017-4988-2
12. Gunn, S. (2018). Archery and Crossbow Guilds in Medieval Flanders, 1300-1500. *English Historical Review*, 133(563), 929-931. doi:10.1093/ehr/cey157
 13. Haemers, J. (2017). Archery and Crossbow Guilds in Medieval Flanders, 1300-1500. *Renaissance Quarterly*, 70(2), 742-743. doi:10.1086/693255
 14. Jacobs, D. B., & Park, J. L. (2017). Winning the team event at major international archery competitions. *Proceedings of the Institution of Mechanical Engineers Part P-Journal of Sports Engineering and Technology*, 231(4), 355-361. doi:10.1177/1754337117719777
 15. Jaser, C. (2017). Archery and Crossbow Guilds in Medieval Flanders. 1300-1500. *Zeitschrift Fur Historische Forschung*, 44(4), 737-739.
 16. Kim, H. S., Oh, S. H., & Park, Y. H. (2016). Development of Gesture Recognition-Based STEAM Educational Games Focused on Korean Traditional Archery. In C. Stephanidis (Ed.), *Hci International 2016 - Posters' Extended Abstracts, Pt Ii* (Vol. 618, pp. 107-111).
 17. Korobejnikov, G.V., Korobejnikova, L.G., Kozina, Zh.L. (2012). *Evaluation and correction of physiological states in sports*, Kharkiv, KNPU. In *Ukrainian*
 18. Kozina, Z., Barybina, L., Mishchenko, D., Tsikunov A., & Kozin A. (2011). The program "Psychodiagnostics" as a means of determining psycho-physiological characteristics and functional state in the physical education of students. *Physical education of students*, 3, 56-59.
 19. Kozina, Z., Kozin, V. (1998). Birth of a child (Methods of physical and psychological preparation of pregnant women for natural childbirth) Kharkiv, 78 p. In Russian
 20. Kozina, Z., Kozin, V. (2009). Little wizards. Cheerful children's gymnastics in verses, Kharkov, 72 p. In Russian
 21. Kozina, Z., Prusik, K., Görner, K., Sobko, I., Repko, O., Bazilyuk, T., et al. (2017). Comparative characteristics of psychophysiological indicators in the representatives of cyclic and game sports. *JPES*, (17)2, 648 – 655.
 22. Kozina, Z.L. (2005). Basic scientific and methodological approaches to the process of individualizing the training of athletes (by the example of basketball). *Fizicheskoe vospitanie studentov tvorcheskikh spetsialnostey*, 5, 8-20
 23. Kozina, Z., Repko, O., Kozin, S., Kostyrko, A., Yermakova, T., & Goncharenko, V. (2016). Motor skills formation technique in 6 to 7-year-old children based on their psychological and physical features (rock climbing as an example). *Journal of Physical Education and Sport*, 16(3), 866-874. doi:10.7752/jpes.2016.03137
 24. Kozina, Zh.L., & Kozin, V.Yu., (2009). Chudo prirody. Dinamicheskaya gimnastika i plavanie dlya samyih malenkih [Nature miracle. Dynamic gymnastics and swimming for the youngest]. Kharkiv. 32 p.
 25. Kozina, Z. L., Krzysztof, P., & Katarzyna, P. (2015). The concept of individual approach in sport. *Pedagogics Psychology Medical-Biological Problems of Physical Training and Sports*, 19(3), 28-37. doi:10.15561/18189172.2015.0305
 26. Kozina, Z., Grin, L., Yefimov A. (2010). The application of the system of aims, means and methods of individualization of training athletes in team sports in the structural elements of the annual training cycle. *Fizicheskoe vospitanie studentov*, 4, 45-52.
 27. Krzysztof, P., Katarzyna, P., Iermakov, S., Kozina, Z. (2010). Indexes of physical development, physical preparedness and functional state of polish students. *Pedagogy, Psychology and medical and biological problems of physical education and sport*, 12 (1), 113-122.
 28. Lankford, D. E., & Higginson, B. (2016). The Effect Of Fatigue And Elevated Heart Rate On Archery Shot Performance. *Medicine and Science in Sports and Exercise*, 48(5), 858-858. doi:10.1249/01.mss.0000487571.81523.18
 29. Molnar, C. A., Zelei, A., & Insperger, T. (2018). Human balancing on rolling balance board in the frontal plane. *Ifac Papersonline*, 51(14), 300-305. doi:10.1016/j.ifacol.2018.07.240
 30. Nicholas, D. (2017). Archery and Crossbow Guilds in Medieval Flanders, 1300-1500. *History*, 102(350), 300-302. doi:10.1111/1468-229x.12384
 31. Park, J. L. (2016). Winning major international target archery competitions. *Proceedings of the Institution of Mechanical Engineers Part P-Journal of Sports Engineering and Technology*, 230(3), 186-194. doi:10.1177/1754337115590277
 32. Sobko, I.N., Kozina, Zh.L., Iermakov, S.S., Muszkieta, Radosław, Prusik, Krzysztof, Cieślicka, Mirosława, & Stankiewicz, Błażej (2014). Comparative characteristics of the physical and technical preparedness of the women's national team of Ukraine and Lithuania basketball (hearing impaired) before and after training to Deaflympic Games. *Pedagogics, Psychology, Medical-Biological Problems Of Physical Training And Sports*, 18(10), 45-51. doi:10.5281/zenodo.10490



Артюх В.В.

Poltvaarcheryfederation@gmail.com
Харківський національний педагогічний університет
імені Г.С. Сковороди;
вул.Алчевских 29, Харьков, 61002, Украина.

Козина Ж.Л.

<http://orcid.org/0000-0001-5588-4825>
zhanneta.kozina@gmail.com
Харьковский национальный педагогический
университет имени Г.С. Сковороды;
ул.Алчевских 29, Харьков, 61002, Украина.

Коваль В.О.

<https://orcid.org/0000-0003-1265-9753>
vikkoval85@gmail.com
Харківський національний університет імені
В.Н.Каразіна
61022, Харків, майдан Свободи, 4

Сафронов Д.В.

<https://orcid.org/0000-0002-9608-8670>
safronovdani70@gmail.com
Кандидат медицинских наук
Харьковский национальный университет имени В.Н.
Каразина
г.л. Свободы, 4, Харьков, 61022, Украина

Фомін С.В.;

<https://orcid.org/0000-0002-5090-242X>;
Харьковский национальный технический университет
сельского хозяйства имени Петра Василенка;
Харьков, просп. Московский, 45, г. Харьков, 61002,
Украина

Новіков Ю.О.;

<https://orcid.org/0000-0002-5090-242X>;
sporthntusg2013@ukr.net
Харьковский национальный технический университет
сельского хозяйства имени Петра Василенка;
Харьков, просп. Московский, 45, г. Харьков, 61002,
Украина

Artiuh V.V.

Poltvaarcheryfederation@gmail.com
H.S. Skovoroda Kharkiv National Pedagogical
University
Altshevskih str. 29, Kharkov, 61002, Ukraine

Kozina Zh.L.

<http://orcid.org/0000-0001-55884825>
zhanneta.kozina@gmail.com
H.S. Skovoroda Kharkiv National Pedagogical
University
Altshevskih str. 29, Kharkov, 61002, Ukraine

Koval V.O.

<https://orcid.org/0000-0003-1265-9753>
vikkoval85@gmail.com
V.N. Karazin Kharkiv National University
4 Svobody Sq., Kharkiv, 61022, Ukraine

Safronov D.V.

<https://orcid.org/0000-0002-9608-8670>
safronovdani70@gmail.com
V. N. Karazin Kharkiv National University
Svobody sq., 4, Kharkov, 61022 Ukraine

Fomin S.V.;

<https://orcid.org/0000-0002-5090-242X>;
sporthntusg2013@ukr.net;
Kharkiv National Technical University of Agriculture
named after Petr Vasilenko;
ave. Moscow, 45, Kharkov, 61002, Ukraine

Novikov Yu.O.;

<https://orcid.org/0000-0002-5090-242X>;
sporthntusg2013@ukr.net;
Kharkiv National Technical University of Agriculture
named after Petr Vasilenko;
ave. Moscow, 45, Kharkov, 61002, Ukraine

Принята в редакцию: 10.11.2018

Received: 10.11.2018