



## Determining the style of conducting a fight of qualified boxers based on neurodynamic indicators using multivariate analysis methods

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DOI: <https://doi.org/10.34142/HSR.2019.05.02.09>

### Abstract

**Purpose:** to justify the use of psychophysiological indicators to determine the style of conducting a fight in boxing.

**Material and methods.** The study involved 27 qualified boxers of the middle weight category of 22-25 years. Athletes were tested on psychophysiological indicators. Initially, the determination of the psychophysiological capabilities of athletes was carried out. Then, using a cluster analysis of psychophysiological indicators, the athletes were divided into groups and the features of the styles of conducting a duel between the athletes of each group were analyzed using an expert assessment of their technical and tactical actions. Next, a distinction was made between the psychophysiological indicators of the athletes of the formed groups, i.e. different fighting styles.

**Results.** Cluster analysis of indicators of psychophysiological testing showed the presence of 3 groups of athletes. An expert evaluation of the boxing match styles included in each group showed that the first group included boxers of the counterattack style, "Sluggers", the second group included athletes of the attacking style, "Swarmers (in-fighter, crowder)", the third group included athletes of the counterattack and defensive styles, "The out-boxers (out-fighter, boxers)". Boxers - "Sluggers" have higher mobility of nervous processes in comparison with representatives of other styles. Boxers - "pace" are distinguished by significantly higher neurodynamic endurance. "Attackers" - "Swarmers (in-fighter, crowder)" are distinguished by a higher strength of the nervous system, determined by the number of errors in the test for the speed of a complex reaction in the feedback mode.

**Conclusions.** Psychophysiological and neurodynamic indicators are informative for determining the inclinations of boxers to a particular style of conducting a duel. This provision can be applied at all stages of training athletes to quickly and effectively determine propensities for a particular style of conducting a duel based on innate neurodynamic and psychophysiological characteristics.

**Key words:** boxing; a cluster; style; duel; neurodynamics; psychophysiological indicators.

### Анотація

Сафронов Д.В., Козін В.Ю., Козіна Ж.Л., Басенко А.В., Рябенков І.О., Храпов С.Б. Визначення стилю ведення поєдинку кваліфікованих боксерів на основі нейродинамічних показників за допомогою методів багатовимірної аналізу.

**Мета роботи** — обґрунтування застосування психофізіологічних показників для визначення стилю ведення поєдинку в боксі.

**Матеріал і методи.** У дослідженні взяли участь 27 кваліфікованих боксерів середньої вагової категорії 22-25 років. Було проведено тестування спортсменів по психофізіологічних показників. Спочатку було проведено визначення психофізіологічних можливостей спортсменів. Далі за допомогою кластерного аналізу психофізіологічних показників було здійснено розподіл спортсменів по групах і проведено аналіз особливостей стилів ведення поєдинку спортсменів кожної групи за допомогою експертної оцінки їх техніко-тактичних дій. Далі було проведено визначення відмінностей між психофізіологічними показниками спортсменів утворилися груп, тобто різних стилів ведення поєдинку.

**Результати.** Кластерний аналіз показників психофізіологічного тестування показав наявність 3-х груп спортсменів. Експертна оцінка стилів ведення поєдинку боксерів, які увійшли в кожну групу, показала, що в першу групу увійшли боксери контратакуючого стилю, «ігровики», до другої групи увійшли спортсмени атакуючого стилю, «силовики», в третю групу увійшли спортсмени контратакуючого і захисного стилів, «темповики». У боксерів - «ігровиків» вище рухливість нервових процесів у порівнянні з представниками інших стилів. Боксери - «темповики» відрізняються достовірно вищою нейродинамічною витривалістю. «Атакуючі» - «силовики» відрізняються більш високою силою нервової системи, яка визначається за кількістю помилок в тесті на швидкість складної реакції в режимі зворотного зв'язку.

**Висновки.** Психофізіологічні і нейродинамічні показники є інформативними для визначення схильностей боксерів до певного стилю ведення поєдинку. Дане положення може застосовуватися на всіх етапах підготовки спортсменів для швидкого і ефективного визначення схильностей до певного стилю ведення поєдинку на основі вроджених нейродинамічних та психофізіологічних характеристик.

**Ключові слова:** бокс; кластер; стиль; поєдинок; нейродинамика; психофізіологічні показники.

### Анотация

Сафронов Д.В., Козин В.Ю., Козина Ж.Л., Басенко А.В., Рябенков И.О., Храпов С.Б. Определение стиля ведения поединка квалифицированных боксеров на основе нейродинамических показателей с помощью методов многомерного анализа

**Цель работы** — обосновать применение психофизиологических показателей для определения стиля ведения поединка в боксе.

**Материал и методы.** В исследовании приняли участие 27 квалифицированных боксеров средней весовой категории 22-25 лет. Было проведено тестирование спортсменов по психофизиологическим показателям. Вначале было проведено определение психофизиологических возможностей спортсменов. Далее с помощью кластерного анализа психофизиологических показателей было осуществлено распределение спортсменов по группам и проведен анализ особенностей стилей ведения поединка спортсменов каждой группы с помощью экспертной оценки их технико-тактических действий. Далее было проведено определение различий между психофизиологическими показателями спортсменов образовавшихся групп, т.е. разных стилей ведения поединка.

**Результаты.** Кластерный анализ показателей психофизиологического тестирования показал наличие 3-х групп спортсменов. Экспертная оценка стилей ведения поединка боксеров, вошедших в каждую группу, показала, что в первую группу вошли боксеры контратакующего стиля, «игровики», во вторую группу вошли спортсмены атакующего стиля, «силовики», в третью группу вошли спортсмены контратакующего и защитного стилей, «темповики». У боксеров - «игровиков» выше подвижность нервных процессов по сравнению с представителями других стилей. Боксеры - «темповики» отличаются достоверно более высокой нейродинамической выносливостью.

«Атакующие» - «силовики» отличаются более высокой силой нервной системы, определяемой по количеству ошибок в тесте на скорость сложной реакции в режиме обратной связи.

**Выводы.** Психофизиологические и нейродинамические показатели являются информативными для определения склонностей боксеров к определенному стилю ведению поединка. Данное положение может применяться на всех этапах подготовки спортсменов для быстрого и эффективного определения склонностей к определенному стилю ведения поединка на основе врожденных нейродинамических и психофизиологических характеристик.

**Ключевые слова:** бокс; кластер; стиль; поединок; нейродинамика; психофизиологические показатели.

## Introduction

At the present stage of boxing development, the style of conducting a duel is a characteristic feature of every professional boxer [1, 2, 3]. So, there are boxers who are distinguished by great power assertiveness in a duel. They are distinguished by a large impact force, the desire for forceful suppression of the enemy. Such boxers include Mike Tyson, Vitali Klitschko, George Foreman, David Tua and other attacking “swarmers” [4, 5, 6]. Some boxers fight, constantly varying their actions, using a lot of feints, strike at the most unexpected moments, for example, counterattacking “sluggers” Roy Jones, Mohammed Ali, Floyd Mayweather [2, 7, 8]. There are boxers who “exhaust” the opponent at a high pace for many rounds, and win when the opponent is no longer able to withstand the imposed pace. These are counterattack “out-boxers” Manny Pacquiao, Joe Fraser and others [9, 10, 11]. The most successful option is the ability to combine different styles, and in different battles to show different manners of conducting a duel. However, nevertheless, the most characteristic features of the movements of athletes remain unchanged, which gives reason to talk about the prevailing style.

Determining the inclination of a boxer to a certain style of conducting a duel is an urgent task, since the merging of activities, as a rule, manifests itself at the stage of maximizing the athlete's capabilities, however, to increase the efficiency of training boxers, determining the inclination of athletes to a certain style of conducting a duel is of great importance at all stages of preparation. For this, it is necessary to use informative indicators that are sufficiently accessible in definition, do not require a

long time period for their development and are relatively unchanged in ontogenesis [12, 13, 14]. For this purpose, psychophysiological indicators can be used, but their application requires in-depth theoretical and experimental justification [15, 16, 17].

The doctrine of the styles of activity and, in particular, of the styles of struggle, has its roots in antiquity [1, 2, 18]. To date, the nature of the origin of various styles is not fully understood. There are hypotheses that indicate that the styles occurred as a result of separate training of individual groups of people [19, 20, 21]. There are also historical facts that testify to the origin of fighting styles as an imitation of the movements and survival strategies of various animals [22, 23]. In this case, copying was carried out both external movements and internal states. Martial arts descended from the “crane style”, as well as various fighting styles within the same martial art, have survived to our time (Fig. 1).

A number of Wushu styles are known, united by the general name Xiang Xinquan - “styles of image and form” or “styles of imitation of form”. They are based on imitation of the movements and habits of animals. In Xiangqian, the state of naturalness, spontaneous emancipation (zìjān) is achieved through complete self-identification with the chosen object, not only external, but most importantly, internal. Man, mastering the “form and image” of the tiger, snake, dragon, achieved the natural emancipation and natural power of the animal in its “pristine state” [24]. Imitation of animal movements has been known in China for a long time. In early totem dances, the ancestors of the Chinese imitated the manner of fighting the animal.

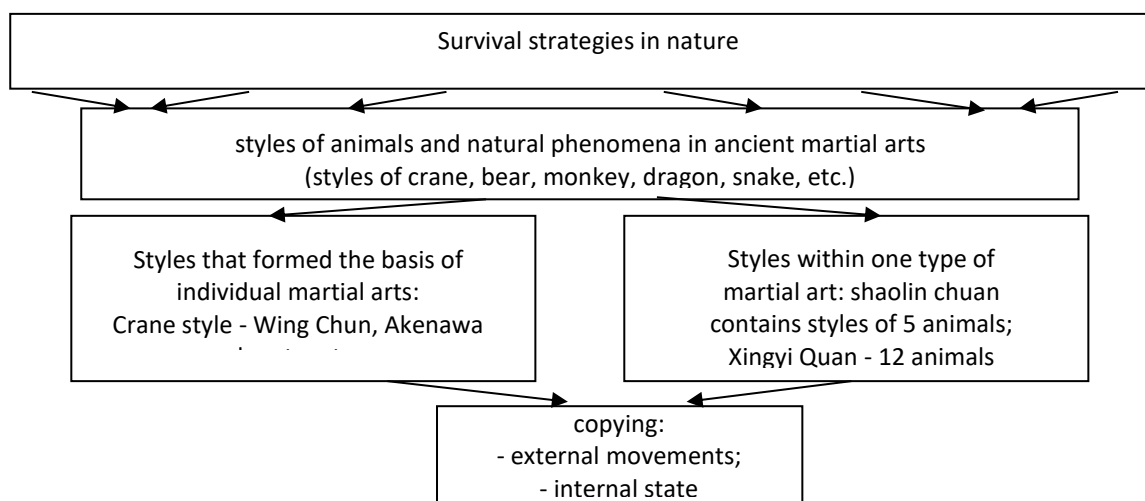


Fig. 1. Survival strategies in nature as a psychophysiological basis for the formation of a fighting style



For example, in the first centuries of our era, at the imperial court, monkey and crane dances were arranged. At the beginning of the 2nd century AD the Huainan Tzu treatise described the exercises “clambering bear”, “bird stretched out in flight”, “washing wild duck”, “jumping monkey”, “staring owl”, “looking tiger”, united under the name “game of six animals” (lucy ) [24, 25]. A little later, the famous healer, Taoist Hua Tuo (141–208) created the “Game of Five Animals” (Wuxi) complex [26], based on the movements of a bear, tiger, deer, monkey and bird, arguing that this “can cure everyone.” However, all these exercises related more to the systems of psychophysical regulation and did not represent martial art in the full sense of the word. But it was they who laid down the basic principles of xiangxiuan styles.

In the modern European tradition, there are several classifications of boxing combat styles, none of which, in our opinion, is universal due to the mixing of different categories of concepts. For example, the classic international classification of styles in boxing mixes categories such as the distance between rivals and the nature of the punches. This classification distinguishes between outsiders, punchers, infighters, sluggers [1, 2]. In the domestic classification, mixing of different categories, such as attack and defense, the predominance of various physical qualities, and the breadth of the technical arsenal also often occurs [1, 2]. In this regard, we have systematized the categories of different classifications of boxing combat styles, the scheme of which is presented on this slide. According to the predominance of attack or defense actions, styles are divided into attacking, counterattack, defensive. By the predominance of physical qualities, boxers are divided into “Swarmer (in-fighters, crowders)” and “The out-boxers (out-fighters, boxers)”, and “Sluggers” are distinguished, which, on the one hand, are distinguished by the development of coordination abilities or dexterity, and, on the other hand, possession of a wide technical arsenal. Very often there is a combination of the manifestation of any physical qualities and the predominance of attacking or counterattacking actions. For example, “Swarmers (in-fighters, crowders)” are most often attackers at the same time, and “Sluggers” are counterattacks, “The out-boxers (out-fighter, boxers)” are also most often counterattacks or defenders. It is logical to assume that the physiological basis for the formation of styles is relatively unchanged genetically determined functions, for example, neodynamic processes and psychophysiological capabilities, and the registration of these indicators in the training process will help determine at the stage of basic

training the boxer’s inclination towards the future style of the fight.

**The purpose of the work** was to justify the use of psychophysiological indicators to determine the style of conducting a duel in boxing.

## Material and methods

### *Participants*

The study involved 27 qualified boxers of the middle weight category of 22–25 years. Athletes were tested on psychophysiological indicators. Testing was conducted from 10-00 to 11-00. Athletes were tested in the same conditions for all.

### *Experimental protocol*

The following parameters characteristic of the psychophysiological status, typological features of the nervous system, indicators of the nervous system efficiency, and attention indicators [27, 28] were set by using the Psychodiagnostics computer software:

- A set of indices for the time of a simple visual-motor reaction (mean of 30 attempts (ms), standard deviation (ms), number of errors); duration of exposure (signal): 900 ms.

- A set of indicators of a complex visual-motor reaction of selecting 1 element from 3 and selecting 2 elements from 3 (mean value of 30 attempts (ms), standard deviation (ms), number of errors); duration of exposure (signal): 900 ms.

- A set of indicators of a complex visual-motor reaction of selecting 2 elements out of 3 in the feedback mode, i.e. as the response time changes, the signal delivery time changes. The short version is carried out in the feedback mode, when the duration of exposure changes automatically depending on the response of the subject: after a correct answer, the duration of the next signal is reduced by 20 ms, and after a wrong one, it increases by the same amount. The range of the signal exposure change during the subject’s operation is 20–900 ms, with a pause between exposures of 200 ms. The correct answer is to press the left (right) mouse button during the display of a certain exposure (image) or during a pause after the current exposure. In this test, the time to reach the minimum exposure of the signal and the time of the minimum exposure of the signal reflect the functional mobility of the nervous processes; the number of errors reflects the strength of the nervous processes (the lower these parameters, the higher the mobility and strength of the nervous system). The duration of the initial exposure is 900 ms; the amount of change in the duration of the signals with correct



or erroneous responses is 20 ms; pause between the presentation of signals lasts 200 ms; the number of signals is 50. The indicators are fixed: the average value of the latent period (ms), root-mean-square deviation (ms), number of mistakes, time of test execution (s), minimum exposure time (ms), time of exposure to the minimum exposure (s).

In determining the typological characteristics of the nervous system, we were guided by the provision that the higher the rate of exit to the minimum signal exposure, the shorter the time of the minimum signal exposure in the feedback mode, the higher the mobility of the nervous processes. The fewer errors when performing the test in the feedback mode, the higher the strength of the nervous system [13, 14, 15].

The indicators of mental working capacity were also determined in accordance with the Schulte test. In this test, the subject is provided with  $5 \times 5$  tables of 25 digits (from 1 to 25) arranged in a random order. The task is to mark the numbers from 1 to 25. After passing the first table, the second with a different order of digits immediately appears, and so on. In total, the subject passes 5 tables. The reported outcomes were: the time of work on each of the 5 tables (min), the efficiency of work as the arithmetic average of the time of operation on 5 tables (min), the performance of the nervous system as an individual time of work on the 4<sup>th</sup> and 1<sup>st</sup> tables, and the workability of the nervous system as an individual work time for the 2<sup>nd</sup> and 1<sup>st</sup> tables.

The ability to concentrate was studied with the proofreading (correction) method (Bourdon test) [13, 14, 15]. Switching attention was also determined by the Gorbov test "Red-black table" [18].

#### *Statistical analysis*

In connection with the tasks to justify the informativeness of psychophysiological indicators as the basis for the formation of the style of conducting a duel in boxing, we limited ourselves to conducting a hierarchical cluster analysis of indicators of psychophysiological testing.

At the first stage of this series of studies, the psychophysiological capabilities of athletes were determined [18, 27, 28]. Then, using a cluster analysis of psychophysiological indicators, the athletes were divided into groups and the features of the styles of conducting a duel between the athletes of each group were analyzed using an expert assessment of their technical and tactical actions. As a result, each group of boxers was given a name according to the styles of the match. After that, a determination was made of the differences between the psychophysiological indicators of the athletes of

the formed groups, i.e. different styles of conducting a duel, and a characteristic of boxers of each style of conducting a duel according to the psychophysiological capabilities and special performance has been compiled.

#### **Results**

A hierarchical cluster analysis of indicators of psychophysiological testing was used to clarify the styles of conducting a boxing match [18, 27, 28]. In hierarchical cluster analysis, each particular case first forms its own separate cluster. At each step, two separate clusters that are closest in structure to each other are combined into one cluster. The stages of clustering are presented in table 1. From this table, as well as from the dendrogram (Fig. 2), it can be seen that at the first step, boxers No. 22 and 23 were combined into one cluster.

From this it follows that these boxers are close in their structure of psychophysiological capabilities, which must be taken into account when conducting training.

At the next stage of cluster analysis, they are joined by athletes No. 21, 26, 1, 20, etc.

In order to find out which number of clusters is optimal, subtract the number of the step at which the cluster coefficients begin to increase nonlinearly from the number of athletes analyzed. In our case, this is step No. 24 (Table 1). Therefore, the optimal number of clusters is  $27 - 24 = 3$ .

So, we got 3 clusters, i.e. 3 groups of boxing athletes. In boxing, this meets the three main styles of conducting a duel. Figure 2 shows the affiliation of each player to a specific cluster.

Thus, a cluster analysis of indicators of psychophysiological testing showed the presence of 3 groups of athletes. An expert evaluation of the boxing match styles included in each group showed that the first group included boxers of the counterattack style, "Sluggers", the second group included athletes of the attacking style, "Swarms (in-fighters, crowders)", the third group included athletes of the counterattack and defensive styles, "The out-boxers (out-fighter, boxers)". Since only psychophysiological indicators participated in the cluster analysis, and the athletes were divided into three groups, which turned out to be actually groups of boxers of different styles of conducting a duel, we can conclude that the hypothesis about the predominant influence of psychophysiological capabilities on the formation of a style of conducting a duel in boxing is confirmed.





Table 1

Agglomeration order in the cluster analysis of indicators of psychophysiological testing of boxers (n = 27)

Step, №	Cluster of boxers (according to conventional numbers)		Coefficients
	Cluster 1	Cluster 2	
1	22	23	0.65
2	21	26	0.68
3	1	20	0.82
4	5	6	0.85
5	18	25	0.90
6	19	21	0.97
7	18	22	1.07
8	7	16	1.21
9	4	11	1.30
10	9	18	1.46
11	4	17	1.52
12	8	9	1.55
13	8	19	1.76
14	1	7	1.86
15	1	27	2.02
16	14	15	2.86
17	1	8	2.92
18	24	28	3.15
19	4	5	3.61
20	10	13	4.16
21	1	24	4.88
22	4	12	5.20
23	1	2	5.29
<b>24</b>	10	14	<b>10.84</b>
25	1	4	11.06
26	1	10	65.31
27	1	3	92.67

For a more thorough verification of this hypothesis, a comparison was made of the formed groups of boxers by their psychophysiological capabilities. It was revealed that “counterattacking” - “Sluggers” significantly differ from other groups of boxers in a higher speed of simple and complex reaction, and the speed of a complex reaction for boxers - “Sluggers” is significantly higher both in the optimal mode of operation and in the feedback mode (Tabl. 2). They also have a higher output rate for minimum signal exposure, less time for minimum signal exposure (Tabl. 2). Thus, boxers - “Sluggers” have higher mobility of nervous processes in comparison with representatives of other styles. Boxers - “Sluggers” also differ from boxers of other styles with a significantly higher switchability of attention, concentration of attention. Boxers - “The out-boxers (out-fighter boxers)” are distinguished by a significantly higher neurodynamic endurance (mental stability), determined by the Schulte test, and

by high workability (Tables 2, 3). It can be assumed that the higher mental performance of athletes does not allow them to realize an attacking power style, and they apply other qualities that are more developed for them, forming a counterattack or defensive style, and become “the out-boxers (fighter boxers)”.

This is confirmed by the identification of significant differences between groups of boxers in terms of speed, strength and mobility of nervous processes. “Counterattacks” - “Sluggers” are distinguished by a higher reaction rate, speed of work, and attentiveness when completing tasks (Tables 2, 3).

“Attackers” - “Swarmer” (in-fighters, crowdsmen)” are distinguished by a higher strength of the nervous system, determined by the number of errors in the test for the speed of a complex reaction in the feedback mode (Tables 2, 3).

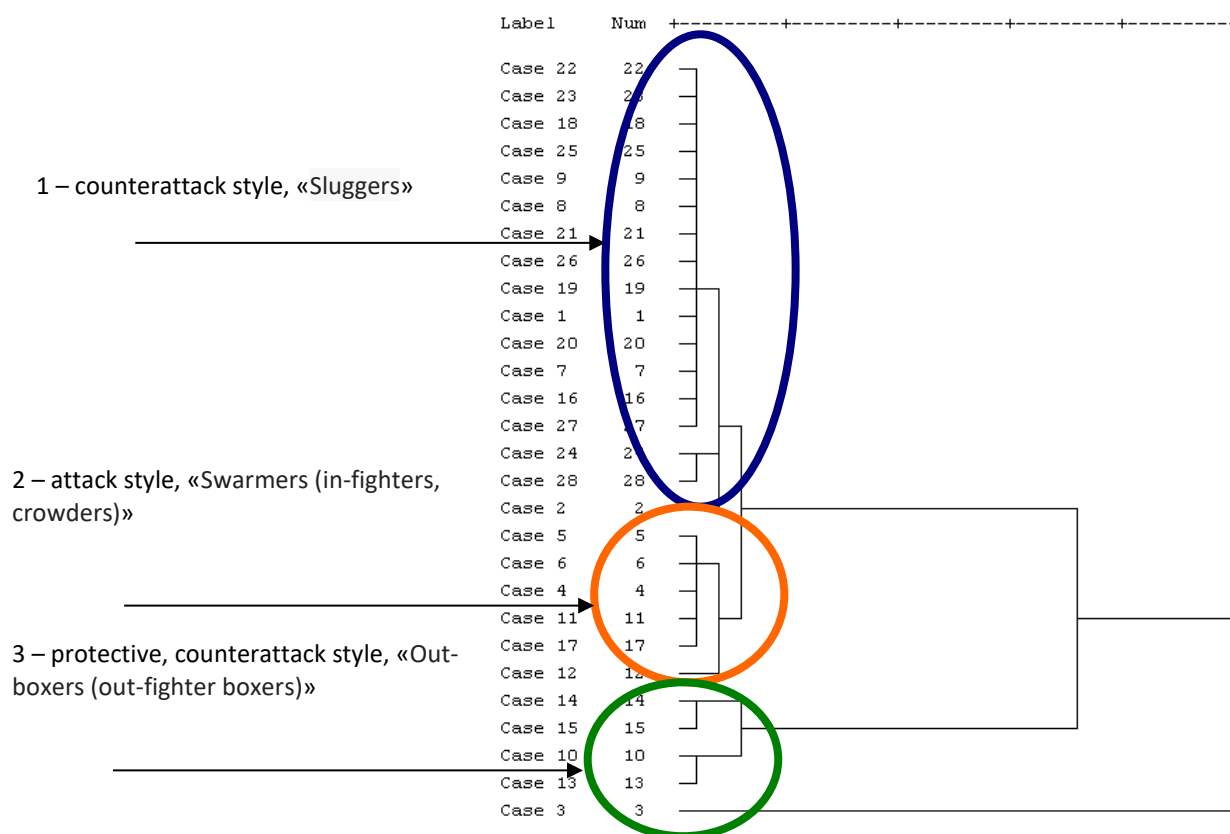


Fig. 2. The distribution of boxers into groups using cluster analysis of psychophysiological indicators (dendrogram) (n=27)

Table 2

Neurodynamic indicators of boxers with different fighting styles (n=27)

Indicators	Groups	n	$\bar{x}$	S	m	t	p
Time of simple visual-motor reaction (ms)	1 sluggers	15	208,38	14,75	3,81	t <sub>1-2</sub>	<0,001
	2 out-boxers	6	254,19	11,43	4,67	t <sub>1-3</sub>	<0,01
	3 swarmers	6	266,23	28,92	11,81	t <sub>2-3</sub>	>0,05
Time of simple reaction on sound stimulus (ms)	1 sluggers	15	263,75	24,77	6,40	t <sub>1-2</sub>	<0,05
	2 out-boxers	6	301,32	26,6	10,86	t <sub>1-3</sub>	<0,001
	3 swarmers	6	394,41	29,33	11,97	t <sub>2-3</sub>	<0,001
Time of reaction of choice of 2 elements from 3 (ms)	1 sluggers	15	333,38	16,64	4,30	t <sub>1-2</sub>	<0,001
	2 out-boxers	6	459,05	14,93	6,10	t <sub>1-3</sub>	<0,001
	3 swarmers	6	478,56	16,01	6,54	t <sub>2-3</sub>	<0,05
Time of response selection in the feedback mode (ms)	1 sluggers	15	470,89	18,99	4,90	t <sub>1-2</sub>	<0,05
	2 out-boxers	6	487,68	14,08	5,75	t <sub>1-3</sub>	>0,05
	3 swarmers	6	492,00	25,19	10,28	t <sub>2-3</sub>	>0,05
Error in feedback test (quantity)	1 sluggers	15	22,94	2,38	0,61	t <sub>1-2</sub>	<0,05
	2 out-boxers	6	19,59	2,42	0,99	t <sub>1-3</sub>	<0,01
	3 swarmers	6	19,06	2,27	0,93	t <sub>2-3</sub>	>0,05
Time to reach of Minimum Exposure in feedback test, s	1 sluggers	15	59,2	5,56	1,44	t <sub>1-2</sub>	>0,05
	2 out-boxers	6	62,3	2,66	1,09	t <sub>1-3</sub>	<0,001
	3 swarmers	6	77,8	2,57	1,05	t <sub>2-3</sub>	<0,01
Time of minimum signal exposure in the feedback mode (ms)	1 sluggers	15	320,4	29,74	7,68	t <sub>1-2</sub>	>0,05
	2 out-boxers	6	340,6	25,21	10,29	t <sub>1-3</sub>	<0,001
	3 swarmers	6	380,2	28,36	11,58	t <sub>2-3</sub>	<0,05



Table 3

Psychophysiological indicators of boxers with different fighting styles (n=27)

Indicators	Groups	n	$\bar{x}$	S	m	t	p	
Work performance in the Schulte test (cu)	1 sluggers	15	66,29	5,46	2,23	t <sub>2-3</sub>	3,35	<0,01
	2 out-boxers	6	32,87	2,91	0,75	t <sub>1-2</sub>	-17,33	<0,001
	3 swarmers	6	77,40	6,02	2,46	t <sub>1-3</sub>	-14,21	<0,001
The degree of involvement in the work on the Schulte test (cu)	1 sluggers	15	0,96	0,02	0,01	t <sub>1-2</sub>	-2,29	<0,05
	2 out-boxers	6	1,11	0,16	0,07	t <sub>1-3</sub>	2,07	>0,05
	3 swarmers	6	0,90	0,07	0,02	t <sub>2-3</sub>	2,95	<0,05
Mental resistance according to the Schulte test (cu)	1 sluggers	15	0,88	0,08	0,03	t <sub>1-3</sub>	16,71	<0,001
	2 out-boxers	6	1,33	0,1	0,03	t <sub>1-2</sub>	10,81	<0,001
	3 swarmers	6	0,78	0,05	0,02	t <sub>2-3</sub>	2,60	<0,05
The number of errors in the Bourdon test (cu)	1 sluggers	15	15,93	0,19	0,05	t <sub>1-2</sub>	3,54	<0,05
	2 out-boxers	6	11,82	2,84	1,16	t <sub>1-3</sub>	4,59	<0,01
	3 swarmers	6	12,36	1,90	0,78	t <sub>2-3</sub>	-0,39	>0,05
Concentration of attention on the Bourdon test (cu)	1 sluggers	15	635,23	25,89	6,68	t <sub>1-2</sub>	25,26	<0,001
	2 out-boxers	6	241,83	34,45	14,06	t <sub>1-3</sub>	30,38	<0,001
	3 swarmers	6	291,64	22,35	9,12	t <sub>2-3</sub>	-2,97	<0,05
Switching attention to the Bourdon test (cu)	1 sluggers	15	37,74	2,04	0,83	t <sub>1-3</sub>	-6,23	<0,001
	2 out-boxers	6	23,73	3,42	1,40	t <sub>2-3</sub>	8,62	<0,001
	3 swarmers	6	14,14	2,50	0,65	t <sub>1-2</sub>	-22,40	<0,001
Attention switching indicator on the Gorbov test "Red-black table (cu)	1 sluggers	15	106,67	9,00	2,32	t <sub>1-2</sub>	-5,61	<0,001
	2 out-boxers	6	140,00	13,40	5,47	t <sub>1-3</sub>	-2,05	>0,05
	3 swarmers	6	119,45	14,21	5,80	t <sub>2-3</sub>	2,58	<0,05

## Discussion

In this study, the hypothesis of the informativeness of psychophysiological and neurodynamic indicators was confirmed to determine the propensity for a certain style of conducting a duel in boxing. The confirmation of this hypothesis is due to the coincidence of the groups of athletes formed using the cluster analysis tested on neurodynamic and psychophysiological indicators, with the opinion of experts regarding the similarity of boxers within each group in terms of the style of the fight. The informational content of neurodynamic and psychophysiological indicators is also confirmed by the presence of significant differences between boxers with different styles of conducting a duel according to neurodynamic and psychophysiological indicators. From this point of view, our results complement the results of studies presented in [1, 2, 18]. It should be noted that differences in the psychophysiological capabilities of boxers with different styles of combat are the physiological basis for the formation and manifestation of an individual

style of activity. Thus, higher reaction rate indicators among boxers - "counterattacks, sluggers" determine the formation of a style of conducting a duel that requires a quick response to a changing environment, quick decision making. In addition, the style of boxers "sluggers" involves performing precise actions in a rapidly changing environment. The physiological prerequisites for the formation and manifestation of this style of action are such psychophysiological indicators as the speed of work, i.e. the number of correctly completed tasks per unit of time with an unpredictable nature and time of the appearance of the signal, and work efficiency (Tab. 2, 3).

It should be noted that boxers - "swarmers" compensate for the insufficient reaction speed, speed and accuracy of work with higher stability of work with fewer errors (Tab. 2, 3), i.e. they can do better than others with respect to identical actions. It follows that for such athletes, the best option for realizing their physiological inclinations is to achieve mastery in actions that do not require high variability of actions and consist in the manifestation of a high

level of strength in relatively similar actions, which is realized in the style of boxers - "attacking swarmers". Thus, physiological inclinations are realized in specific abilities, manifested in the formation of a certain style of activity, in our case, the style of conducting a duel in boxing. Similar provisions explain the higher mental performance of boxers - "out-boxers" (Tab. 2, 3). From this point of view, the results obtained are new.

It is known that each person has different "sets" of abilities. An individual-unique combination of abilities is formed throughout life and determines the uniqueness of a person. The success of the activity is also ensured by the presence of one or another combination of abilities that works for the result. In an activity, some abilities can be replaced by others - similar in manifestations, but differing in origin. The success of one and the same activity can be provided by different abilities, therefore the absence of one ability can be compensated by the presence of another or even a whole complex.

Therefore, the individual uniqueness of the complex of individual abilities that ensure the successful implementation of activities is commonly called the "individual style of activity". In modern psychology, more often they began to talk about competencies, as integrative qualities (abilities), which are aimed at achieving a result. We can say that competencies are abilities through the eyes of employers. In fact, the employer does not care what the internal composition of the abilities that ensure the fulfillment of the task, the fact of its implementation is important for them. Therefore, competencies are even called by the task: "the ability to perform such and such a task". And due to what internal resources it will be implemented - this is the problem of the one who performs this work.

Psychophysiological differences of boxers with different styles of conducting a duel are the basis for differences in the indicators of the special performance of boxers (Tab. 1-3, Fig. 3).

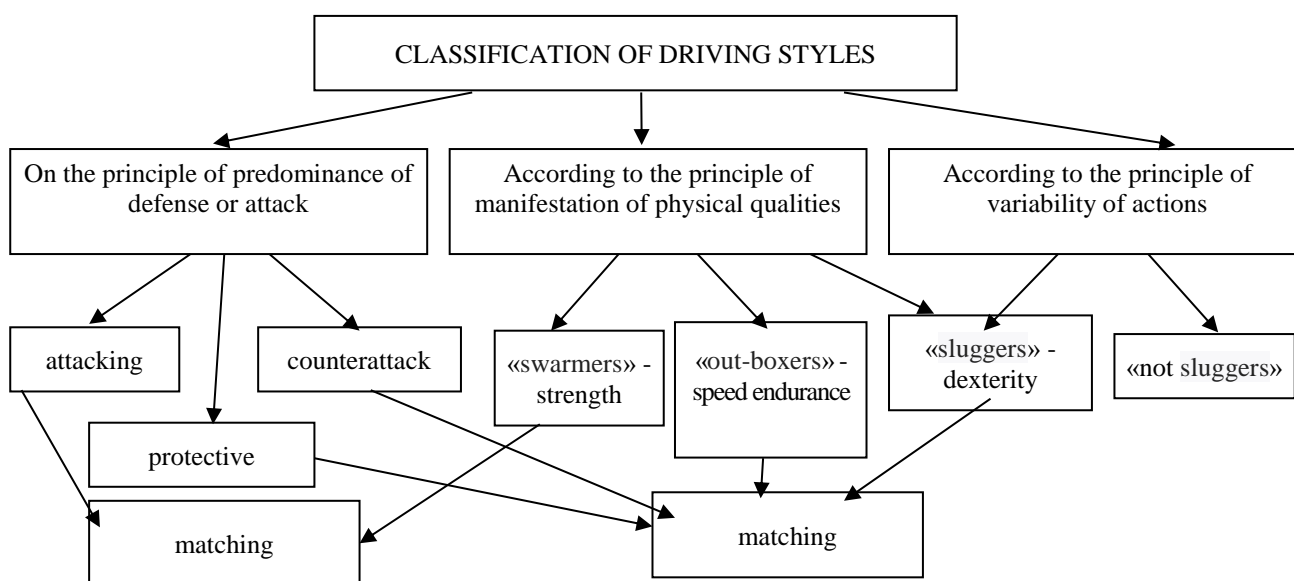


Fig. 3. Systematization of classifications of boxing combat styles according to various category criteria

Very often there is a combination of the manifestation of any physical qualities and the predominance of attacking or counterattacking actions. For example, "swarmers" are most often attackers at the same time, and "sluggers" are counterattacks, "out-boxers" are also most often counterattacks or defenders. It is logical to assume that the physiological basis for the formation of styles is relatively unchanged genetically determined functions, for example, neodynamic processes and psychophysiological capabilities, and the registration of these indicators in the training process will help determine at the stage of basic training the boxer's inclination towards the future style of the fight.

## Conclusions

1. Cluster analysis of indicators of psychophysiological testing showed the presence of 3 groups of athletes. An expert evaluation of the boxing match styles included in each group showed that the first group included boxers of the counterattack style, "sluggers", the second group included athletes of the attacking style, "swarmers", the third group included athletes of the counterattack and defensive styles, "out-boxers".

2. Boxers - "sluggers" have higher mobility of nervous processes in comparison with representatives of other styles. Boxers - "sluggers" also differ from boxers of other styles with a





significantly higher switchability of attention, concentration of attention.

3. Boxers - "out-boxers" are distinguished by significantly higher neurodynamic endurance (mental stability), as determined by the Schulte test, and are highly developed. "Counterattacking" - "sluggers" are distinguished by a higher reaction rate, speed of work, and attentiveness when completing tasks.

4. "Attackers" - "swarmers" are distinguished by a higher strength of the nervous system, determined by the number of errors in the test for the speed of a complex reaction in the feedback mode.

5. Psychophysiological and neurodynamic indicators are informative for determining the inclinations of boxers to a certain style of conducting a duel. This provision can be applied at all stages of training athletes to quickly and effectively determine propensities for a particular style of conducting a

duel based on innate neurodynamic and psychophysiological characteristics.

### Acknowledgements

The study was conducted in accordance with the research work of Ministry of Education and Science of Ukraine for 2019–2020 «Theoretical and methodological foundations of technology development for the restoration of musculoskeletal system and functional state and prevention of injuries and representatives of different age groups in physical culture and sports» (№ 0119U100634).

### Conflict of interest

Authors state no conflict of interest.

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Received: 15.05.2019

Принята в редакцію 15.05.2019