

## EXPERIMENTAL SUBSTANTIATION OF METHODIC OF 11-13 YEARS OLD BOXERS' COORDINATION DEVELOPMENT

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**Abstract.** *Purpose:* experimental substantiation of methodic of junior boxers' coordination training. *Material:* in the research 18 boxers of 11-13 year old age participated. In total, during 4 months 42 trainings were conducted. Total time of coordination load's fulfillment at each training was 15-45 minutes. *Results:* dynamic of results in control tests was statistically confident in the tested parameters of movements. It proves effectiveness of usage the tasks with complex-coordination orientation, accented on impact on sensor-informational and motor systems of movements in junior boxers' trainings. *Conclusions:* coordination training in boxing at initial stage shall include specialized varied means and methods, which would facilitate formation of motor condition and skills' basis. Motor condition and skills are a reserve for further rising of coordination abilities' level of junior sportsmen.

**Key words:** boxers, coordination abilities, sensor, motor systems, vestibular apparatus.

### Introduction

At present successful performance of boxers at international competitions to large extent depends on purposeful and well planned work with reserve, starting from children and juniors. Especially important and valuable stage in many years' training process of preparation of elite sportsman is stage of initial training, which starts at age of 10-11 years [1, 2]. Exactly at this stage the basis of boxing technique is formed in junior boxers as well as the basis of general and special physical fitness.

On modern stage of boxing development scope and intensity of motor loads, realized in probable and sudden situations have significantly increased. It requires quick responses, ability for concentration and re-switching of attention, space-time accuracy and bio-mechanical rationality of movements. All these characteristics are connected by specialists [3-7] with conception of coordination abilities (CA).

High quickness of a boxer, great number of various movements of different complexity create strict conditions of duel conduct, in which it is required to find effective neutralizing or attacking technique in tenth parts of a second [2, 8]. These tasks require high level of all sides of boxer's sport fitness. They also stipulate seeking of new approaches, which would open additional reserves for realization of organism's motor-coordination potentials.

Variety of motor-coordination forms of boxers' functioning during fight requires high mobility of nervous processes and mobilization of sensor-perceptive mechanisms. The most successful in competitions are boxers, who have high level of sensor-perceptive abilities. These abilities are realized under the following perceptions: space time characteristics of movements (own and opponent's), specialized perceptions (sense of distance, sense of time, sense of temp), muscular-motor perceptions at direct contact with opponent. All these leading perceptions shall be closely interconnected and influence on each other [3, 9-11].

Besides, modern boxer shall have high level of motor coordination structure of movements at the account of muscular efforts' differentiation in certain situation [8], accuracy of movements (to external irritator, with responding to moving object), ability to sustain static and dynamic balance with irritation of vestibular apparatus [9, 12].

The most favorable period for development of motor coordination and junior boxers' ability to create new motor program is age of 11-12 years. Just this age range is especially sensitive to purposeful influences of sport trainings [9, 10, 13, 14].

For example, traditional forms of boxing training's organization include functioning in conditions of space-time and alternative indefiniteness. However, these conditions, as a rule, used to be of similar type and stereotype for trainees [8, 9]. In situations of probability adaptation to functioning conditions starts rather quickly. That is why effect in training of junior boxers' coordination abilities is determined not only by complexity of psycho-motor tasks but by their novelty and constant variability.

In this connection (*on the one hand*), it is necessary to rationally vary training conditions in boxing. The, it is necessary to strive for systemically putting of trainees in situation, which would require manifestation of adequacy, quickness, rationality, mobility and improvisation of motor functioning in conditions of time and alternative indefiniteness. *On the other hand*, it is necessary to constantly scope of specialized exercises and change coordination complexity of motor structure. It is possible only at the account of simulation of competition functioning conditions.

In spite of importance and urgency of the problem in modern theory of boxers' sport training methodic of coordination's training is still remaining to be developed insufficiently. There is no clear understanding of coordination abilities' basis, the data about their structure and age specificities of their manifestation are rather divergent; criteria of assessment of coordination abilities have not been worked out; specificities of their development technologies with regard to boxing at initial stage of training have not been determined.

Contradictions of many questions, concerning development of junior boxers' coordination abilities, and absence of their solution condition significance of subject of this work and require further scientific researches.

**Purpose, tasks of the work, material and methods**

*The purpose of the work* is experimental substantiation of methodic of coordination abilities' training of junior, 11-13 years old age, boxers.

*The tasks of the research:* to determine effectiveness of the worked out author's methodic of boxers' coordination abilities' training by means of different motor coordination orientation.

*The methods and organization of the research:* analysis and generalization of scientific and methodic literature; pedagogic observation; testing of coordination abilities with the help of control tests [4, 10, 13], which have high values of reliability and informative.

The battery of control tests included:

**1. Repeated jumps with maximal rotation to right and left sides on coordination meter of V. Starosta** – for determination of CA level and tiredness in motor and information parts of motor system's structure.

**2. Forward rolls with 180° turn** – for vestibular stability. The tested were offered to fulfill a series of forward rolls with following 180° turn (forward roll - 180° turn, forward roll and so on). The test was fulfilled up to first signs of giddiness and absence of ability to fulfill roll in straight line (it was assessed and failure in informational part of motor system's structure). The time of fulfillment of control exercise was measured in seconds.

**3. Romberg's test (balance on one foot) and Yarotskiy's test (rotation by head)** – for determination of static coordination and vestibular stability.

**4. «Shuttle run»** – for determination of ability for re-construction of motor actions. The tested were offered to run 9 meters, then return to start line. The run 6 meters and turn to start line. Then run 3 meters and turn back. The time of fulfillment was measured in seconds.

**5. «Run around obstacles»** – determination of orientation in space. At site of 10 meters length, at marks 2,5 m and 7.5 m high poles were installed. The tested were offered to run from start line to finish, running the 1<sup>st</sup> pole from the right, 2<sup>nd</sup> – from the left, 3<sup>rd</sup> – from the right. In second attempt they were offered to run the 1<sup>st</sup> pole from the left, 2<sup>nd</sup> – from the right and 3<sup>rd</sup> - from the left. Before fulfillment of every control attempt the tested were given one trial start. The time of fulfillment was measured in seconds.

Besides control tests for determination of tiredness in information part of motor system's structure we used in training two more tests: 1 – finger-nose coordination (dynamic coordination); 2 – testing of walking by methodic of V.G. Strelets. Both tests were fulfilled freely, individually during all training and usually after tasks with complex coordination load.

Pedagogic experiment was conducted on the base of Brest SCJSOR №1 from January to April 2014 at time of trainings. In experiment 18 junior boxers of 11-13 yrs. Age participated. All they were practically healthy.

Results of control tests before and after experiment were processed with methods of mathematical statistics. There were determined: mean arithmetic ( $\bar{x}$ ); standard mean-square deviation ( $\sigma$ ); average-statistical errors ( $m$ ); t-criterion of Stjudent for dependent samples. Mathematical processing of statistical parameters was realized with the help of computer program Statistika 6.0.

**Results of the research**

The principle in experimental program of coordination abilities' development was the fact that structure of motor functioning system consisted of informational and motor parts. Informational part of the structure included coordination of nervous and sensor systems' functioning. The motor part was complex of coordination abilities' manifestation.

Trainings of coordination orientation in experimental group were realized on the basis of physical load distribution with prevalence of complex-coordination exercises and increased attention to informational and motor parts of motor system's structure. The program of author's methodic of CA training was included in preparatory and main parts of training that was 60% of total time. In total, during 4 months in experimental group 42 trainings were conducted.

In first complex of exercises (oriented on development of upper and lower limbs' coordination) we used different asymmetric and symmetric movements with different trajectories, exercises for static and dynamic balance, various jump exercises, game exercises with objects or without them (see table 1).

Table 1

*Approximate complex of exercises for coordination of movements for warming up part of training during 1<sup>st</sup> and 2<sup>nd</sup> months)*

№	Description of exercises
1	Initial position (i.p.) – main stance (m.s.). 1-left foot standing ahead on toe, right arm directed aside, left – on waist; head is turned to the left (to the right); transfer body mass on left foot, right one – direct backward on toe, drop arms. 2. Right leg directed forward on toe, left arm directed leftward, right hand – on waist; turn head rightward and transfer body mass on right foot; drop arms. 3. Turn around; at the end of turn clap with hands over head, have a look at hands. 4. i.p. Dozing – 3-4 times.

2	I.p. – m.s. 1 – turn torso rightward with right leg forward, on toe; left hand – behind head, right hand – on waist, bend forward. 2- i.p.. 3 – turn torso leftward; left leg put forward on toe; right hand – behind head, left hand – on waist; bend to the left. 4 – take position of swimmer’s start and turn in jump around; hands – upward, have a look at hands. 5 – Direct arms by arches inside- outside. 6 – i.p. Dozing – 3-4 times.
3	I.p. – right arm directed forward-upward; left arm – downward-backward. 1 – jump, part feet, change arms’ position. 2 – jump, close feet, change arms’ position. Dozing – 3-4 times.
4	I.p. – m.s. 1 – jump on right foot, left one directed backward with arms – forward. 2 – jump on left foot with right one – backward and arms – aside. 3- jump on both feet with rmas directed backward by arch trajectory. 4- forward roll. 5 – high jump, hands upward – aside. 6 – i.p. Dozing – 3-4 times.
5	I.p. – m.s. 1 – step with left leg; by arch trajectory one and half forward turns by right arm. 2 – step with right leg and by arch trajectory one and half forward turns by left arm. 3 – jump with feet apart and clap behind back; jump – feet closed and arms aside with hands upward. 4 – i.p. Dozing – 4-5 times.

In second complex of exercises at the beginning of warming up part we offered main typical kinds of exercises for vestibular stability (rotations, bends, turns, acrobatic) with changing of their coordination complexity and load. Besides, we used outdoor games or relay races oriented on development of boxers’ sensor system (see table 2).

Table 2

*Approximate complex of exercises for coordination of movements and vestibular stability (for warming up part of training during 3<sup>rd</sup> and 4<sup>th</sup> months)*

№	Description of exercises
1	2
1	<i>Walking with rotation of head (dozing – by 10"-20")</i> Walking with back forward and rotation of head; walking with twisting of pelvis rightward-leftward; usual run; run by cross step (right side – left side forward); run with back forward; run with rotation around own axis; run with “throwing” of arms and legs freely forward, backward, rightward, leftward; run with shins backward, with “juggling” with ball; run with change of direction by command; “snake” run with change of direction; run with high jumps and rotations by coach’s signal; run on “bumps”; usual run with rotation of head; minced run with simultaneous rotation of closed arms.
2	<b><i>Walking exercise (dozing 10"-20"):</i></b> Walk with lunges and twisting to forward leg; walk with rotation of torso; walk in bent position with twisting to forward leg; walk with rotation of hands and head simultaneously; walk with alternate and simultaneous rotation of arms in elbow joints; walk with arms rotation in shoulders in different directions (right – forward circle, left – backward circle); walk “pump” with rotation around own axis; walk with straight blows and twisting to forward leg (with face – forward, with back – forward).
3	<b><i>Exercises at the spot (for static balance) (dozing 10"-20")</i></b> I.p. – standing on right foot, left leg is raised (angle 90°) arms directed aside, simultaneous rotation of hands and foot, in shoulder and hip joints. Standing on right foot, left leg is raised higher knee level. Move leg by figure eight trajectory. I.p. – stance on right foot, left leg is directed backward-upward arms are aside (position “Robin”). I.p. – stance on right foot, left leg is raised and bent in knee (angle 90°). Torso is bent forward. Imitation of flight with arms.
4	<b><i>Exercises in pairs (for sense of balance) (dozing 20"-30")</i></b> On gymnastic bench: rhythmic pushes with one or both arms with fakes. On gymnastic bench - rhythmic pushes with both arms simultaneously in chest, shoulder, diaphragm with jumps on one or two legs. Pushes with one or both arms in squatting position.
5	<b><i>Special warming up exercise for coordination of movements (dozing 30"-1')</i></b> : By signal clap of coach boxer, standing in combat stance apply certain defensive or attacking technique depending on signal. By instructor’s

<p>signal (one clap) boxer makes one blow, by 2 claps he uses certain defense. Moving in combat stance boxers play “tag”. Moving in combat stance boxers “tamp” tennis balls on floor. Moving in combat stance boxers throw big or small balls with left or right arms. Moving in combat stance near wall boxers go away from balls, thrown to them by partners.</p>
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In main part of training we selected specific exercises, permitting to concord movements as well as to reconstruct skill depending on varied conditions. This methodic is given in the following algorithm: 1 – space orientation (sense of “blow distance”); 2 – accuracy of space parameters of movements; 3 – accuracy of time parameters of movements (sense of time) (see table 3).

Таблица 3

*Approximate complex of exercises for coordination of movements and vestibular stability (for main part of training)*

№	Description of exercises
1	2
<b>Special warming up exercises for quickness and coordination of movements (dozing by 1')</b>	
1	<i>Instructor imitates jabs and disciples quickly and variably defend (bent back, bent aside and so on).</i>
2	Instructor imitates jabs and disciples instantly defend and response by single counter blow (straight). Преподаватель
3	Standing in front of group in combat stance, instructor open different parts of body. Trainees instantly and rationally imitate appropriate jabs.
<b>Exercises, to be fulfilled at distance higher than combat</b>	
4	Distance between boxers – 2-3 steps. One boxer imitates different single or double blows; his opponent takes appropriate defense and imitates counter attack (jab) (dozing by 2 x 1')
<b>Exercise in combat with shadow</b>	
5	By instructor's signal temp of different actions increases (dozing by 4 x 15')
<b>Exercise at combat distances</b>	
6	Boxers move in front each other. One of them strives to break distance. By instructors command “stop” both boxers stop and distance is checked.
7	Boxers move in front of each other at different distances. One of boxers opens glove for a moment. It is a signal for opponent's attack. Opponent can attack only if glove is in open position at blow distance. Attacks can be quite different (dozing by 2 x 1').
8	Boxer intentionally opens different parts of body. Partner selectively responds by jab or combination of blows and takes defense against possible counter blows (dozing by 2 x 1').
<b>Exercises on apparatuses (bags) (dozing by 1').</b>	
9	By signal clap (command) of instructor boxer makes single jab at head level; by two claps – one jab at head and one – at torso levels; three claps – series of two jabs (one at head level and second at torso level). By clap of instructor boxer defend against imaginative blow, by two claps – boxer makes defense and counter blow По хлопку преподавателя боксер делает защиту от воображаемого удара, по двум хлопкам – боксер jab; by three claps – boxer defends against imaginative blow, makes single blow and again defends.
<b>Exercises on boxing paws (dozing by 2 x 1')</b>	
1	Boxer responds to certain position of paws by single blow.
1	
1	Boxer makes blows on paws, when they are at certain distance (middle, far, close).
2	

The listed above means of coordination orientation are based on different special and general motor actions, permitting to expand the basis of motor skills (motor experience) for activation of certain perceptive functions and specialized perceptions of the trainees.

Total time of fulfillment of coordination load in every training was 15 – 45 minutes. Increase of scope of load was realized at the account of increasing of every exercise's repetitions in one series, quantity of series and quantity of different exercises in series with preservation of equal quantity of repetitions.

In process of trainings there were the following regulators of increasing of coordination tasks' intensity: increase of coordination complexity on the base of increasing of variability of exercises; increasing of requirements to accuracy, quickness, purposefulness and stability of techniques' fulfillment simultaneously; fulfillment of coordination exercises in conditions of time deficit; change of means and parameters of movements' fulfillment; change of conditions in the process of fulfillment of motor tasks; reduction of pauses between tasks and series of coordination exercises; against the background of tiredness. Duration of coordination work in certain task varied in average from parts of a second to several minutes.

Duration of rest intervals was set depending on tasks of coordination training and was in the whole from 30 to 45 seconds to 2-3 minutes. It permitted to restore organism's workability for effective fulfillment of the next task. Character of rest between coordination exercises was passive or active. In the process of active rest we used exercises for relaxation and stretching.

The main principle of the author's approach of CA development shall be not achievement of certain adaptation to loads but constant expansion of its limits with varying of different general and special motor-coordination actions. Opening of coordination potentials of junior boxers creates efficient basis for coordinated actions with application of modern combat techniques, for activation of motor intellect, increasing of space and time accuracy of movements, vestibular stability and quickness of responses. In this connection it is logical to assume that the offered methodic shall increase reserve level of informational and motor components of junior boxers' coordination abilities.

By results of control tests of junior boxers it is possible to find out general trends of changes of coordination potentials. The conducted by us research resulted in the following:

1) Before experiment in test "jumps with maximal rotation rightward/leftward (from 15 attempts): only results of second attempt ( $287.0 \pm 18.41$ ) were statistically significant ( $t=2.92$ ;  $P<0.05$ ) and exceeded indicators of the first attempt ( $262.5 \pm 15.21$ ). In further attempts there were no statistically significant differences ( $P>0.05$ ).

2) After experiment in test "jumps with maximal rotation rightward/leftward (from 15 attempts) we found a number of differences:

– results of second attempt with rightward rotation ( $278.50 \pm 13.19$ ) were statistically significant ( $t=4.30$ ;  $P<0.01$ ) and exceeded results of the first attempt ( $267.50 \pm 13.71$ ).

– in third attempt with leftward rotation ( $290.50 \pm 12.28$ ) statistically significant ( $t=2.71$ ;  $P<0.05$ ) trend to increasing of results, comparing with the second attempt ( $278.50 \pm 13.19$ ) preserved. This trend was observed also in fourth attempt ( $304.00 \pm 11.85$ ), results of which substantially ( $t=3.48$ ;  $P<0.01$ ) exceeded indicators of the previous one.

– further, in up to the eighth attempt there were no substantial changes of the regarded indicator ( $P>0.05$ ). However, in 9 ( $235.00 \pm 17.58$ ), 10 ( $242.50 \pm 18.68$ ) and 11 ( $246.50 \pm 18.97$ ) attempts we observed statistically significant changes ( $t=2.75-3.95$ ;  $P<0.05-0.01$ ).

When fulfilling repeated jump with maximal leftward/rightward rotations the tested had only 15 attempts. At 16<sup>th</sup> attempt there happened informational failure (i.e. wrong choice of rotation side). Full tiredness in 16<sup>th</sup> attempt was determined by us as presence of certain physiological limits of tiredness (intrinsic for junior, 11-13 yrs. age, boxers). Analysis of dynamic of mistakes in choice of rotation side permitted to determine that before experiment the first mistake happened already in 6<sup>th</sup> attempt. After experiment failure happened only in 12<sup>th</sup> attempt.

Comparison of the received data permitted to detect that before and after experiment percentage of mistakes in 12<sup>th</sup> attempt was 10%; in 13<sup>th</sup> attempt – before experiment – 40% and after experiment – 10%; in 14<sup>th</sup> attempt, before experiment – 60% and after – 50%; in 15<sup>th</sup> attempt, before experiment – 80% and after – 70%.

Results of the conducted analysis witness about trend of CA improvement after experiment (see table 5).

Table 5

*Results of control tests before and after experiment*

№	Description of tested parameters	Statistical characteristics				t\P
		Before experiment		After experiment		
		$\bar{x}$	m	$\bar{x}$	m	
1	Push by two legs with leftward rotation (the best attempts) °	297.50°	17,53	322,50°	13,67	3,18/ P<0,05
2	Forward roll with rotation by 180°, sec.	20.50	2,20	25,60	2,19	6,78/ P <0,05
3	Romberg's test (on right leg)	15.10	2,97	16,10	2,63	1,54/ P >0,05
4	Romberg's test (on left leg)	10.80	1,91	12,60	1,81	3,67/ P <0,05

№	Description of tested parameters	Statistical characteristics				
		Before experiment		After experiment		tP
		$\bar{x}$	m	$\bar{x}$	m	
5	Yarotskiy's test (rightward)	53.70	15.08	57,00	11,89	1,29/ P >0,05
6	Yarotskiy's test (leftward)	52.10	15.66	67,00	14,70	2,29/ P <0,05
7	Shuttle run (3,6,9 m), sec.	13.03	0.20	12,32	0,28	2,12/ P <0,05
8	Running around poles (from right side), sec.	3.10	0.07	2,91	0,05	2,27/ P <0,05
9	Running around poles (from left side), sec.	3.22	0.06	3,01	0,05	2,53/ P <0,05

Comparative analysis of Romberg's test results and Yarotskie's test results (rotation by head) showed improvement of results only in leftward rotation. At left limb there were registered substantial differences ( $P < 0.05$ ) from indicators of right side (and limb). This fact is conditioned by the fact that before experiment in functional state of vestibular analyzer there was present functional asymmetry with prevalence of right limb. However, after purposeful pedagogic influences of coordination orientation to symmetrizing of movements we found reserve potential of junior boxers in left limb. It permitted to increase the level of vestibular stability.

The offered methodic of CA development on the base of competition functioning's simulation rendered substantial influence on the tested indicators, Dynamic of changes of control tests' results (roll with turn) and Romberg's, Yarotskiy's tests, tests "Shuttle run" and "Running around poles" showed statistically significant ( $P < 0.05$ ) improvement of the tested parameters. It again proves effectiveness of the worked out by us methodic of CA training in junior boxers with application of complex-coordination loads and increased impact on sensor-informational and motor systems of movements.

#### Discussion

Analysis of literature and author's own researches' results showed that this work confirms researches of specialists [15-18] in field of coordination training of junior boxers. At present there is a few scientific researches in the field of variation of means and methods of coordination orientation in boxing. With it, many authors [15-18] touch on development of separate parameters of boxers' coordination training and do not regard process of junior boxers' training from the point of complex character of variation approach. Up to the present research variation approach in coordination training of junior boxers has been being regarded only as a specific question [19-21], without creation of theoretical essence, principles, algorithms and specific methods of training's optimization. From this point of view our research is a new one and is significant for theory and practice of sport training in boxing and other kinds of sports, That is why this work is a new direction, in which principle of variation approach transforms into system with own structure and algorithm.

We have confirmed the data of specialists [15-20] about the fact that in age range from 11 to 13 years, there exists high development of sensor-informational and motor components of CA under influence of purposeful coordination exercises of different variation orientation. This phenomenon is conditioned by the fact that in this age inhibitive influences of cortex and sub-cortex structures increase, close to adult type cortex – sub cortex relations form with leading role of cortex [22]. Accordingly, interconnection between different cortex centers increases, mainly at the account of neurons' branches growth in horizontal direction. It creates morphological functional basis for brain functions' development and installation of inter-systems' connections.

According to a number of researches [15-21], permanent creation of new inter-system links in neuro-physiological mechanisms of junior boxers' organisms ensures variation of complex processes of movements' coordination. In its turn, it conditions high tension of functions of central nervous system in general as well as motor apparatus. In this connection, presence of high level coordination is determined by different correlation of inherited features, physiological construction and highly developed psycho-physiological qualities, which are sustained by special coordination training.

#### Conclusions:

1. Coordination training in boxing shall include specialized means and methods of variable orientation, which would permit to form the basis of motor conditions and skills. Thus additional reserves are created for further growth of coordination abilities.

2. In the age of 11-13 years old junior boxers manifest intensive development of informational and motor components of coordination abilities: ability for according and co-submission of separate movements in single, holistic complex-coordinated motor functioning. The detected age peculiarities of CA substantiate main approaches to training of above named abilities and permit to effectively and rationally control training process at initial stage of junior boxers' training.

3. In programs with coordination orientation it is necessary to rationally combine variety of trainings' construction and control over load. It permits to ensure higher level of development of coordination potentials' components of junior boxers. In this connection the necessary conditions of CA development in junior boxers are: establishing of optimal structural-functional connections between training and competition functioning; application of special exercises in varied conditions (probable and sudden situations); simulation of situations with alternate indefiniteness, connected with demand in varying of responsive actions; shortening of time for solution of psycho-motor task in certain sequence (situation – attack- defense – plot of boxing duel – the solved task). Just such approach will permit for junior boxers to realize effectively technical-tactic actions in boxing duel.

Thus, the data of experiment permitted to determine that under influence of system of special motor-coordination tasks there happen improvement of synchronizing of organism's motor, physiological and vegetative functions (achievement of their optimal concordance). It results in mobilization of reserve potentials and finds additional ways for further improvement of training methodic for junior boxers.

*The prospects of further researches* imply working out and implementation of exercises of conjugated orientation: motor coordination tasks accented on boxers' technical tactic actions.

#### Conflict of interests

Author declares absence of any conflict of interests.

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