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Structure of motoric abilities relevant for boxing success

Benin Murić[1], Izet Kahrović[1], Oliver Radenković[1], Rosario D'Onofrio[2,3]

[1]State University in Novi Pazar, Bio-Medicine Science Department, Study Programme: Sport and Physical Education, Novi Pazar, Serbia.

[2]2Faculty of Medicine and Surgery, Sapienza Universty of Rome

[3]Member of the Multidisciplinary Medical - Scientific Commission, - L.A.M.I.CA - Italy

Abstract. *The research has been conducted in a population of young boxers (15-18 years), being active members of Boxing Clubs elsewhere in Serbia area, with hits aim to determine the structure of motoric abilities relevant for boxing success. The method of twenty motoric tests has been applied where evaluation of motoric abilities of boxers has been performed. Based on the gained results, we can conclude that relevant motoric abilities for boxing success are speed, explosive power, repetitive power and coordination.*

Keywords : *Sport, boxers, Boxing, motoric abilities*.

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Introduction

The success in all sport activities depends upon psychosomatic dimensions of a personality. From the very reason, it is necessary to have more exact orientation in a prompt manner related to accomplishment of top sport results, and then, to select persons whose psychosomatic structure of characteristics is the most appropriate one for a certain sport orientation[1,23].

It is well-known that for top sport results today is necessary to exercise in a huge scope and intensity. In the aim of optimization of sport training, there are researches being permanently performed that contribute to change this process. This is understandable since the accomplishments of a man are limited by their genetic potential. Therefore, knowing dimensions in Boxing is the most significant one. The increased number of researches in motoric area (Guilford, Clark, Semenov, Fleishman, Petz, Meerill, Verkočanski, Kurelić, Momirović, Opavsky), has not succeeded to remove registered weaknesses lately, although positive trends have been noticed[2].

Today, the most often used term is "motoric ability" and it has been reduced in experimental researches onto operationally defined latent dimensions derived from a system of measuring instruments.

Zatsiorsky (1975) defined motoric ability as one of the primary factors of movement. "Motoric ability can be defined as a presence of acquired or innate abilities to perform movement expertly of a general or basic nature, especially within specialised sports or gymnastics technique". They divide motoric ability into two components: motoric ability being mainly consisted of relatively permanent components and it has been changed very slowly under development influence, and motoric readiness being performed under exercising, and whose changes during development process are easier to be noticed and measured. Zatsiorsky (1975) gave the definition where motoric abilities are those aspects of motoric activity being appeared in movement structures and can be described by an equal parameter system, can be measured by an identical measurement system, and where analogue physiological, biochemical, cognitive and connotative mechanisms are[3].

Being defined as such, motoric abilities differ from motoric habits and motoric skills, although motoric abilities manifestation is possible before a concrete motoric act. According to the opinion of majority of theoreticians, movement habits define adoption of certain techniques in sport and they are related to learning process, while motoric abilities are partially inherited, and partially acquired in the training process, before all. With some motoric abilities, genetic factors have higher significance, and with some, a smaller one. However, in all cases, there are possibilities of a certain influence onto their development through specific training methods. The basic motoric abilities represent a base for each learning of movement tasks of a certain technique, and they can be reconsidered to represent the basic value in the entire space of a man's motoric system[3,22].

A classical rational approach to the issue of motoric abilities has consisted mostly in determining motoric factors being defined for latent motoric structures, and the ones are responsible for endless number of manifesting motoric reactions. Such an approach has started under the influence of psychometrical methods applied in the analyse of cognitive abilities, and the one gave results only after World War II, where they allowed formation of cybernetic theories of motoric abilities. A real beginning of a rational analyse of motoric abilities has been connected to researches of Guilford and his associates, and they have been implemented for arm forces of the USA. The issue that has been presented in almost all researches of motoric space has been a weak reliability of measuring instruments. Apart from power tests, all motoric tests have had very low reliability, and thus, their inter-correlations have been near zero. This has been the reason in largely responsible for numerous tries to determine factor structure of motoric space to be unsuccessful, and the existence of motoric dimensions being isolated in some researches has not been confirmed, either [4-6].

Almost all current researches of motoric abilities is possible to put into tries directed towards taxonomy of different motoric, reception-motoric and development tests in a group, where only phenomenology characteristics have been determined. At the same time, there have been very few experimental researches whose aim has been the consequence of such an approach, a real structure of motoric space, and it would be defined based on the systematic research of the segment of psychosomatic status that has not been confirmed [7-10].

Based on numerous researches, it is still possible to gain insight into the type of applied instruments and their metric characteristics, and this can serve as a base for construction of new ones, or adaptation of the existing ones, so as to make optimal their metric characteristics. The factors determined in the current, classically oriented researches, can be a base for dimensioning and choice of measuring instruments in the researches whose aim has been determining of the structure of the entire motoric space [11-13].

It should be emphasized that there are numerous studies that examined the motor skills of boxers [14-17]. However, no study has examined through factor analysis which motor skills are necessary for boxing success. Therefore, the aim of the study was to determine the structure of motoric abilities relevant for boxing success.

Method

The research sample has been taken from the population that could be defined as boxers' population from Boxing Clubs of Serbia, age between 15 to 18 years. Starting from the established subject and research aim, an optimal number of sample subjects have been taken so as the research had been conducted in concrete, and the results would have been exact ones. The very sample has consisted to 100 boxers, members of Boxing Clubs of Serbia, and this has been an optimal number for the planned research. The examinees have had to fulfil the following conditions:

- The examinees' age has been defined based on chronological age, so as the research included examinees of 15 to 18 years;

- Not to have organic or somatic diseases;

-To be active members of a Boxing Club;

For the evaluation of motoric abilities, 20 motoric tests have been used , being chosen per structural model of, being defined as a structural movement mechanism (MSK), functional synergy and tonus regulation mechanism (SRT), intensity excitation regulation mechanism (RIE) and excitation duration regulation mechanism [2].

Results and Discussion

The approach to the analyse of motoric abilities and determination of manifesting and latent motoric dimensions from the earliest researches has been significantly improved. The classical approach to the issue of motoric abilities has consisted in determining motoric factors being defined as latent motoric structures that have been responsible for different manifestations. During determining of motoric abilities structure and tries to gain to reliable information on motoric abilities, standard motoric tests have been used and applied in current researches.

Table 1. The matrices of main components of motoric variables

Variable	Components				
	FAC1	FAC2	FAC3	FAC4	h^2
MONT	-,681	,454	,146	,322	,795
MTAR	,722	,053	,267	-,286	,677
MTAN	,795	-,017	,059	-,100	,645
MKOP	-,776	,351	,009	,310	,821
MBNR	,749	-,238	,380	-,193	,800
MDP	,686	-,113	,080	,274	,564
MPSG	,627	-,224	,281	-,383	,669
MIP	-,123	,621	-,094	-,149	,432
MPIK	,574	-,310	,250	,332	,599
MGHC	,370	-,089	,520	,542	,709
MSD	,592	,618	-,028	,088	,740
M20m	-,740	-,350	,040	-,117	,685
MBML	,544	,700	,141	,040	,808
MSV	,664	,568	-,034	-,055	,767
MDŠ	,268	,848	,006	-,047	,793
MIZG	,548	-,378	-,194	,340	,596
MZGP	,741	-,058	-,219	,125	,616
MPTR	,801	-,036	-,197	,056	,685
MDNL	,594	-,083	-,545	,175	,688
MINP	,387	-,107	-,663	-,018	,601

Table 2. The matrices of motoric variables structure and scope

Variable	Components			
	OBL1	OBL2	OBL3	OBL4
MONT	-,754	,227	,347	,137
MTAR	,750	,284	,113	,034
MTAN	,550	,244	-,189	,137
MKOP	-,817	,094	,234	,050
MBNR	,817	,019	,137	,229
MPSG	,885	-,017	,148	-,033
MIP	-,164	,549	,097	-,313
MPIK	,197	-,089	-,113	,632
MGHC	-,069	,070	,189	,880
MSD	,023	,792	-,165	,126
M20m	-,156	-,584	,280	-,225
MBML	,087	,858	,047	,139
MSV	,211	,762	-,157	,013
MDŠ	-,082	,902	,062	-,103
MIZG	,013	-,174	-,553	,424
MZGP	,206	,189	-,524	,207
MPTR	,306	,227	-,497	,164
MDNL	-,047	,111	-,814	,060
MINP	-,015	,009	-,797	-,231

Table 3. Inter-correlation of OBLIMIN factors

Components	OBL1	OBL2	OBL3	OBL4
OBL1	1,000	,180	-,421	,435
OBL2	,180	1,000	-,113	,091
OBL3	-,421	-,113	1,000	-,224
OBL4	,435	,091	-,224	1,000

The interpretation of correlations of certain tests from a measuring instrument set for evaluation of motoric abilities has been based on primary hypothetic latent dimensions.

The matrices of inter-correlation have been taken as a starting matrix for extraction of latent variables by the method of main components, while their number has been determined by Guttman-Kaiser criterion. The method of main components has been primary determined by entropy emitted the entire quantity of information. The maximal entropy shall be emitted by the system part that has been connected to characteristic roots being less or more equal to one.

Having applied GK criterion, four characteristic roots have been announced to be significant, therefore, manifesting space of motoric abilities has been reduced to the same number of latent

dimensions. The first main component (Table 1) with its characteristic root of 7.82 explains 39.12% from the entire explained variability, being 68.44%.

Since it is the first main component, the percentage of the explained variability completely satisfies, and with this percentage of variable, it has been possible for the first main component to be named a general motoric factor. The largest projections onto the first main component have the tests of coordination (MONT, MTAP, MTAN, MKOP, MBNR), a balancing test (MPSG), a precision one (MPIK), a speed (M20m), an explosive power (MSV), a repetitive power (MDNL, MPTR, MZBP) and force (MIZG).

Although the other main components cannot be given a special kinesiology reality, as it has been the case with the first main component, by their inspection, those generators of variability could be discovered that according to their position of significance, have been responsible for the variability of the analysed space.

The largest projections with the second main component has a test for estimation of power of a dynamometry of a hand (MDŠ), explosive power of throwing of a medicine ball from a laying position (MBML), a long jump (MSD) and flexibility of a flax bat (MIP). The second main component explains 15.71% of the entire variability and can be reconsidered a factor of general power.

The third main component has been determined by the force test of a body, holding of legs in transfer (MINP), thus, it represents a single factor of this test. It has been characteristic with its root 1.55 and it explains 7.75% of variants of the entire variability.

The fourth main component has been determined by a precision test of shooting of a horizontal target (MGHC). This main component with its characteristic root of 1.17 explains 5.84% of variant of the entire variability. It can be interpreted as a single factor of a shooting precision.

To gain a parsimony structure, the initial coordination system has been rotated into an oblique angle Oblimin solution, where the same number of latent variables has been kept. The applied Oblimin rotation has brought to the sum of quadrant of factor coefficient for the same variable has to be different after rotation from the sum before it. From the very reason, there are two types of coordinates in the oblique angle in the frame of reference, and the ones have been different in factor analyse, and they derive from different projections of vector tests, after applied Oblimin rotation, the matrix of a scope has been gained and it contained parallel vector projections of certain variables (Table 2), and inter-correlation factor matrix (Table 3).

The first latent dimension of the largest projection has with the evaluation tests structure movement mechanism: drumming of legs and arms (MBNP), coordination with a bat (MKOP), turning on the floor (MONT), hand tapping (MTAR) and leg tapping (MTAN). Since it is the instrument whose variability depends upon space and time accuracy and movement accuracy, but also upon movement performance with constant amplitude, this latent dimension can be defined as a mechanism for movement structure, i.e. a coordination factor.

The largest projections onto the second Oblimin factor have tests where regulation intensity excitation mechanism has been evaluated: dynamometry of a hand (MDŠ), throwing of a

medicine ball from a laying position (MBML), a high jump (MSV), a long jump (MSD) and running of 20 meters (M20m). Obviously, this is a very complex mechanism being characteristic for young selected boxers. For performance of motoric tasks of explosive power, the energetic component has a dominant significance. This latent motoric dimension can be defined as a regulation of intensity excitation mechanism.

The largest projections onto the third Oblimin factor have tests for evaluation of force and repetitive power: increasing of legs while laying, (MDNL), increasing of legs while transferring (MINP), increasing while swinging(MIZG), swinging by a low bending (MZGP) and a body increase test while laying (MPTR). The efficient performance of these tests depends upon either of a long keeping of isometric muscle contraction in a certain position, or long dynamic contraction where eccentric and concentric contractions replace one after the other. A physiologically significant source of energy for long muscle work is glycogen in the oxidative conditions of a process. Since projections of tests, this factor can be defined as a regulation duration excitation mechanism.

The fourth Oblimin factor has been explained by the regulation tonus test and synergic regulation: precision tests of a horizontal target (MGHC) and darts (MPIK), and also a test of a deep bending over a bench (MDP). Precision, as a basic motoric ability, has been connected with the accuracy of evaluation of space and time parameters of the given system. It is well-known that precision as an extremely sensitive ability depends upon emotional state. In current researches, within numerous authors, it has been emphasised a high negative correlation with neurosis and dissociative syndrome. The mutual base at first completely different motoric movements (precision and flexibility) lies in muscle synergism, since for successful performance of either motoric task, a muscle co-activation has been a responsible one, and also synergic action of muscles being placed on both sides of passive elements of a locomotors apparatus. This factor can be undoubtly defined as a regulation and tonus regulation mechanism. The inter-correlation factor matrices (Table 3) shows that gained correlations of first, third and fourth factor have been statistically significant, and this leads to a conclusion that axis factors are not mutually distant, i.e. that cosinus of an angle that both cover is a higher one.

Based on the boxing structure analyse, it has been logical for motoric abilities, speed and explosive power to be reconsidered the most necessary ones for boxing success. Without the ones, and very expressive motoric abilities, it is impossible to gain even middle level results. Different forms of speed (reaction speed, action speed and movement speed), allow boxers to react promptly onto an opponent's actions, efficient application of defence techniques, fast performance of certain hits, performance a number of hits in a series, fast movement in a boxing ring, and efficient usage of a counter attack. A high level of explosive power, especially of arms and shoulders' area, can have dangerous and difficult hits to the opponent, and thus, in a hit, solve a boxing fight [14]. The explosive power of legs is also significant for boxers since it allows faster movement towards the opponent or away from the one [17, 18].

During a boxing fight, a boxer must synchronise the work of legs (movement) with the work of arms (hitting, blocking, stopping and similar), move his direction of movements very fast,

realise fast his close motoric structures, and realise complex motoric structures by moving the entire body in the space, since he needs a high coordination level. One of the characteristics of a qualitative boxer is his ability to change the direction of his movements and his ability of fast combining of different movements, and this tells on someone's agility to influence in largely onto boxing success [19]. Legs' coordination is the ability that allows establishment of a balanced position and its maintenance in the fighting conditions, a faster access to the opponent, more efficient and powerful hitting, the use of a number of hits, combination of different movements, a good approach towards the opponent, a successful ending of a fight, a successful finting and others [20].

The necessity of a fast performance of all basic structures in boxing, being also poly-structural ones, demands from a boxer a significant level of coordination being defined as "a speed of performance of complex motoric tasks". Since boxing fights in a ring are being characterised by a continuous hitting and movement, it can be concluded that a certain influence onto boxing success has body coordination, although not as previously mentioned forms of coordination [21]. Therefore, gained results of factor analyse confirm or justify its application in this research. Hence, factor analyse can be treated as a confirmative method, in this case.

Conclusion

The research has been conducted with the aim to confirm the structure of motoric dimensions within athletes being active boxers.

Based on the gained results (Table 1) that emphasise the first mail component, the percentage of the explained variability is completely satisfactory, and with this variability variant, it is possible to name the first main component to be genral motoric factor. The largest projections onto the first main component had had coordination tests (MONT, MTAP, MTAN, MKOP, MBNR), the balance test (MPSG), precision test (MPIK), speed (M20m), explosive power (MSV), repetitive power (MDNL, MPTR, MZBP) and force (MIZG). The greatest projections with the second main component had had the test of evaluation of dynamometry hand power (MDŠ), explosive power of throwing a medicine ball from a laying position (MBML) and long jump (MSD) and flexibility of a flax bat (MIP).

The third main component processed by the body test of leg increase while transferring (MINP), thus it represents the single factor of this test. The fourth main component has been determined by the precision test, shooting of the horizontal target (MGHC). It can be interpreted as the precision shooting factor. After having applied Oblimin rotation, the matrices of the scope have been gained and contained parallel vector projections of certain variables (Table 2), and inter-correlation factor matrices (Table 3).

The first latent dimension of the greatest projection has had the structure movement mechanism being applied in evaluation: drumming of legs and arms (MBNP), coordination with the bat (MKOP), turning on the floor (MONT), hand tapping (MTAR) and leg tapping (MTAN). Since these are the instruments whose variability depends upon space and time movement accuracy, but also of movement performance by the constant amplitude, this latent dimension can be defined as movement structure mechanism, the coordination factor.

The largest projections onto the second Oblimin factor have had tests that evaluated regulation intensity excitation mechanism. Obviously, it has been a complex mechanism being characteristic for young selected boxers. For performance of motoric tasks of the type of explosive power, energetic component has a dominant influence. This latent motoric dimension can be defined as regulation intensity excitation mechanism.

The largest projections onto the third Oblimin factor have the evaluation power tests and repetitive power. Since test projections, this factor can be defined as regulation intensity excitation mechanism. The fourth Oblimin factor explains tests for estimation of regulation tonus mechanism and synergic regulation. This factor can undoubtly be defined as synergic regulation mechanism and tonus regulation. The matrices of inter-correlation factor (Table 3) shows that gained correlations of first, third and fourth factor have been statistically significant, and this leads to the conclusion that factor axis are not distant mutually, i.e. cosynus angle the ones mutually cover is a higher one.

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