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MODERN METHODS FOR ASSESSING THE COMPLEXITY OF MOTOR ACTIVITY AND ITS QUALITATIVE PERFORMANCE

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Purpose: a single method justification for assessing the complexity of motor activity and quality of its performance.

Materials and methods: the carried out researches used empirical materials of dissertation works and research in the field of sports and physical culture, in which various methods for qualitative assessment of performed movements and definition of its complexity category were used.

Results: general provisions, which are the basis of motor activity formation, its objectification in subsequent periods of physical development, principles of ranking the complexity of motor activity construction, criteria of constructing the individual algorithm of training and formation of optimal group compatibility in game types of motor activity organization, are established**.**

Conclusions: introduction of the unified system of certification and systematization of physical development of the population of Ukraine will allow maintaining the sufficiently complete and meaningful information about the labor potential of the country and to distribute more expedient its provision of state needs.

Keywords: biomechanical analysis, complexity assessment of motor activity, rank of training, motor talent.

Introduction

The problem of objectivity for assessing the performance of competitive exercises is inherent for any kinds of sport and professional work. Its solution is possible on the basis of strict theoretical validity of construction of complex-coordinated motor activity and available level of development of consistently complicated kinematics of movements during many years of training.

The natural form of development and movement learning begins with the postnatal period. Their consistent objectification at each stage has its own characteristics. Accounting these features is necessary for the construction of an individual passport of physical development and the level of readiness available for a particular person. The uneven flow of physical development leads to the release of puberty and sensational periods, in which it's essential to take into account the availability of physical activity both in its structural complexity and volume.

The scheme of age periodization, adopted at the VII All-Union Conference on Age Morphology, Physiology and Biochemistry in 1965, is most often used in domestic medical and biological research. It is represented by the following time periods: newborn 1-10 days; infant age 10 days-1 year; earlier childhood 1-3 years; first childhood 4-7 years; second childhood 8-12 years (boys), 8-11 years (girls); adolescence 13-16 years (boys), 12-15 years (girls); youth age 17-21 years (boys), 16-20 years (girls); I mature age 22-35 years (male), 21-35 years (female); II mature age 36-60 years (male), 36-55 years (female); advanced age 61-74 years (men), 56-74 years (women); senile age 75-90 years; centenarians - 90 years [1, 2].

This chronological periodization has its distribution density by body weight growth indicators and its formation into individual systematic constitution. This provision defines leading, normally and low developing individuals. They have body proportions corresponding to normal chronological development by their constitution. Regarding the category of normal structure of development, there is a category of deviating individuals by the ratio of mass growth and its formation. These deviations are manifested in the changed proportions of bio-kinematic links of body, which determines the peculiarities of their movement dynamics and energy consumption for providing these locomotions [3].

The statistical principle of morphofunctional organization of the developing organism taking into account physiological features ensuring mass growth and its formation of the given scheme of age periodization allows distributing into seven levels of its rank improvement [4]. This provision has a mathematical basis based on the general principles of self-organization of developing systems [5]. The foundation of this provision is based on the developed construction methods of sign semantic spaces in KhSAPC with the introduced in them a single comparison measure of mutual conditions of relations of mass-forming masses of the flowing organogenesis [6].

The purpose of the research is a single method justification for assessing the complexity of motor activity and quality of its performance.

Material and methods of the research

Materials and methods of research: analysis and generalization of empirical data, clinical anthropometry, biomechanical methods for assessing the motion construction, method of orderly presentation of empirical data of sign semantic spaces with introduced in them a single measure of sigmal measurements of compared signs, speed video shooting, and computer processing of obtained video material.

Results of the research

There are average indicators of chronologically normally developing individuals in each of the age periodization of age morphology, physiology and

biochemistry. Such indicators are characteristic of a particular population. Within the population norm of chronological age, one can talk about a regional chronological norm, which consists of a set of individual norms. There is a coincidence between the chronological average norm and the individual norm in each of the defined norms.

The individual norm reflects the peculiarities of biological development and is characterized by biological age with morphofunctional characteristics of the course of metabolic processes and somatotype constitution. In characteristic semantic spaces the individual norm is characterized by a vector coming from the origin of coordinates and connecting it to the location of the individual norm in the characteristic semantic space. Thus, the individual norm is characterized by the vector length and the angle of its deviation from the line of chronological norm of development.

Nine zones in the direction of deviation from the norm of chronological development and three levels of deviation are allocated in this semantic space, in accordance with the normal law of distribution density of the controlled contingent that is shown in Fig.1

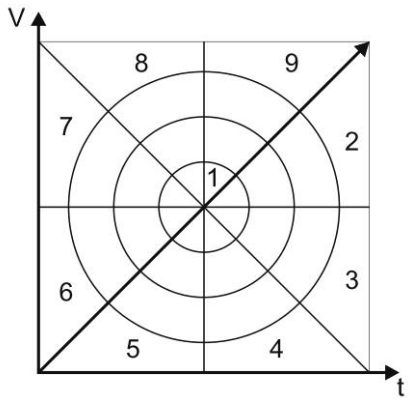

Fig.1. Type classification of individual norms

“Body size is time of its achievement” in the sign semantic space (description in the text).

In fact, this characteristic is represented by a three-dimensional space divided into three coordinate planes, which reflect the distribution of masses in three directions: body length, body width and anteroposterior (thickness) body. In a deeper

classification of body structure, which is extremely important for the evaluation of body motion kinematics, clinical anthropometry was used according to the method of M.M. Breitman in her modified version, developed in KhSAPC [7] and presented as the logarithmic spiral, where the norm is the circle, in which each of 15 measured parts of the body are arranged in order of their weight value.

Only linear dimensions of length of the considered body parts are given in the Figure 2. In reality, a complete representation is presented in a three-dimensional "unit" cube or "unit" sphere.

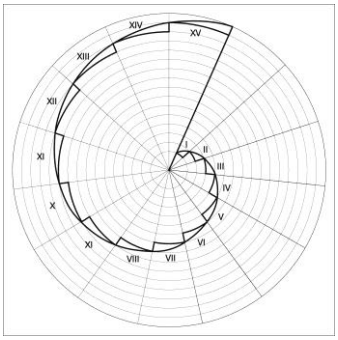

Fig.2. Human anthropometric parameters in the polar coordinate system

The "muscle" type of physique presented by M.M. Breitman is taken as an example.

Similarly, the share of physical qualities in construction of the performed movements is presented (Fig. 3 (c, b, a)

It is necessary to have standard tests for the evaluation of motor qualities and standard arsenals characteristic and accessible motor activities in each of the age periods in all cases in order to carry out this type of certification. This is due to the fact that a more complex combination of movements' construction is formed with narrower specialization of their use on the basis of the previous learned arsenal of movements by making them possible. If we compare the structure of improvement and development of narrow professional motor activity as some meta-language, this process corresponds to the full complication of the development of language movement from household forms of motor activity to their substantive orientation types of sports specialization with the subsequent narrowly directed specialization of

meta-language, reaching the highest level of its manifestation, expressed in the pedestal of the Olympic Champion or the World Champion.

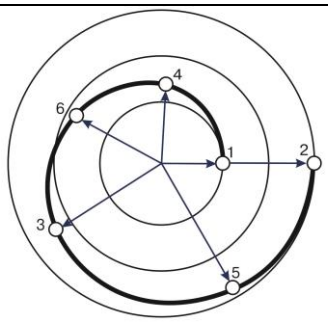	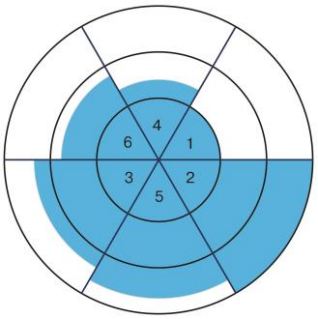	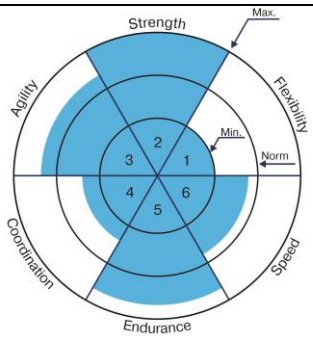
c	B	a
Distribution of consecutive physical qualities in the logarithmic helix. The value of min and max is located on the same radius of the vector. Their location defines a single turn of the logarithmic helix. The location of the rest is determined by their rotation until the moment of logarithmic spiral touches.	Distribution of these qualities in the order in which they are changed.	Average circle reflects average norm of motor properties in the used standard tests.

Fig. 3. Partial manifestation of physical qualities in construction of the executed movements of the corresponding standard tests

The mathematic of this process is described by exponential dependence. It can be expressed in the coordinate system where ordinate is represented by a scale “level of achievement” or “available complexity” and “rank of achievement”. Such a scale is formed by the normal law of density distribution of probable availability of task complexity execution, which includes force of expression of the performed actions, their duration and multi-componence of content simultaneously or sequentially performed actions. The sigmal distribution of task complexity has six complicated zones corresponding to the verbal description: imitation or copying (plagiarism); eclecticism or collecting; compilation or combination, association; skill-knowledge of various options for solving the problem; creativity-ability to create new; creation or motor genius - unreachable creation.

Six zones have seven boundary sections from the initial public or zero level of complexity and the limit seventh rank of creation. In a summarized table expression of this representation the motor task performance can be represented as a rectangular matrix in which each column contains elements of equal complexity relating to the considered kind of sport.

Each row contains elements of all seven complexity categories distributed in the sequence of the column sequence number.

The column number determines the element complexity in the row.

The element, which is present in each cell, has its own number, in which the first digit indicates the line number ($a_{1,1}; a_{1,2}; a_{1,3} ... a_{1,n-1}; a_{n,n}$).

The element complexity in a string grows by logarithmic dependence and consists of the following components:

1. Complexity (number of elements) is the part (S)

2. Severity (effort quantification) is the part (F)

3. Duration is the part (t).

These are making difficulty of the performed work in overcoming each of seven ranks. The measure of climbing difficulty is represented by the sum of quantitative indicators of elements of overcome difficulties A=(S+F+t). The complexity premium is determined by accuracy measure, which is expressed in inverse proportion to the mean square deviation $\delta : h = \frac{1}{\delta\sqrt{2}}$. The term “accuracy measure” is derived from measurement error theory [9,10,11].

The generalized Fig. 4 representing the meaningful content of the overcome complexity way to the limit of available rise to the top of the seventh rank ascent.

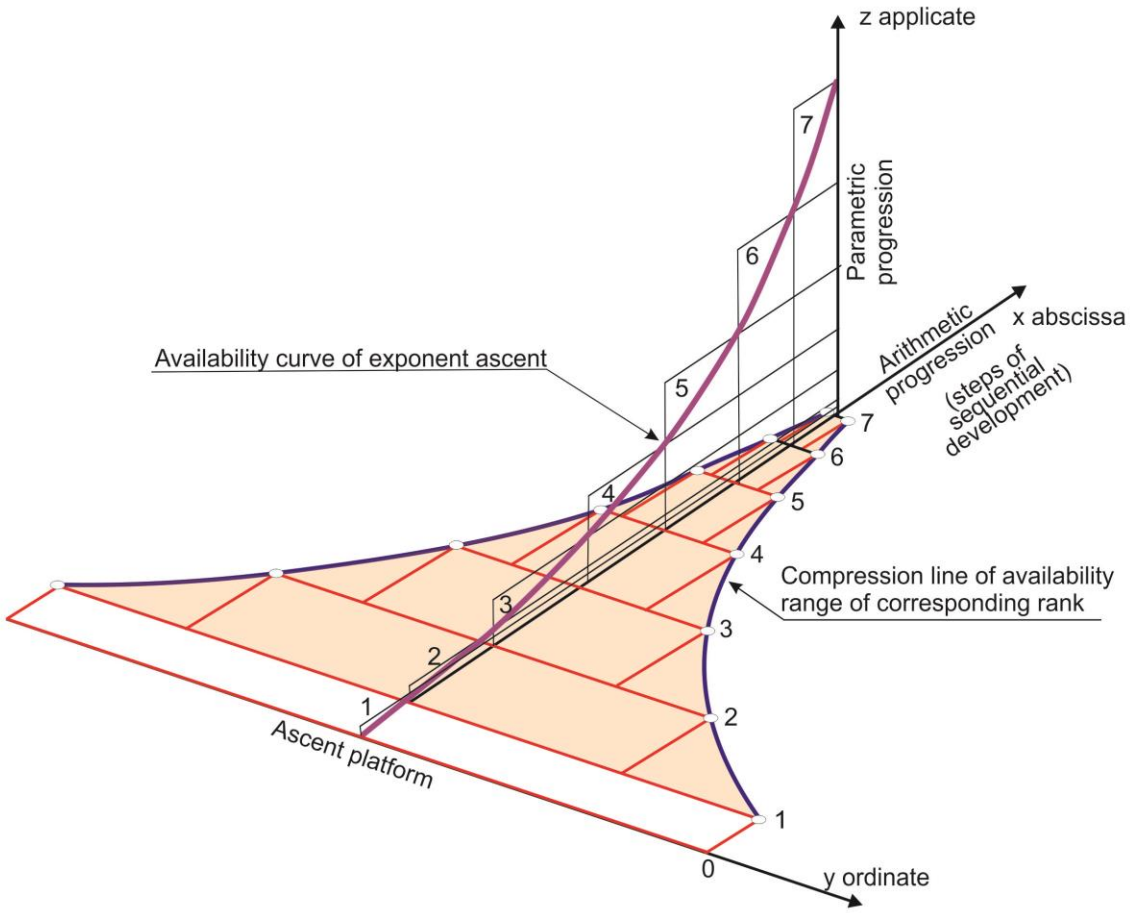

Fig. 4. Representation of meaningful content of the overcome complexity way to the limit of available rise to the top of the seventh rank ascent.

The construction details of the generalized three-dimensional representation of the increasing complexity of specialized motor activity are presented in Fig. 5.

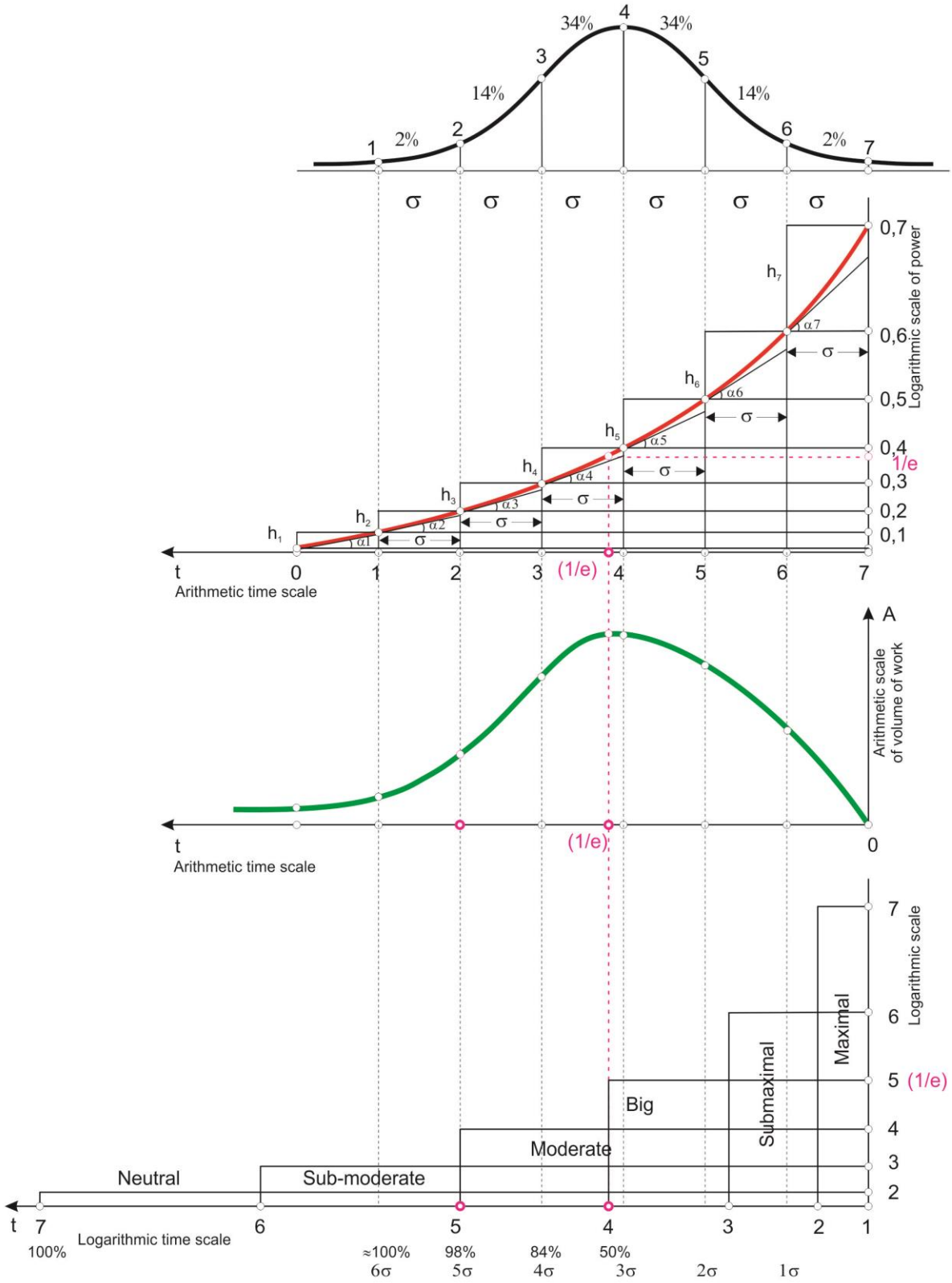

Fig. 5. Components of the growing complexity of specialized motor activity: a) logarithmic scale of power representation $tg\alpha_i = \frac{h_i}{\delta}$ $h_i = tg\alpha \cdot \delta$; $S_i = \frac{\delta \cdot h_i}{2} = A$; $N = \frac{A}{t}$; $N = \frac{\delta \cdot h_i}{2} : t = \frac{\delta \cdot h_i}{2 \cdot t}$. h_i - geometrical progression; t - arithmetic progression

The obtained analytical descriptions of the complexity assessment of motor activity and qualitative performance taking into account the premium for the category of complexity were made for the development of the automated system ensuring objectivity of judging, first of all, in sports, in which the result of performance is estimated in points.

The method of remote assessment in real time is based on high-speed shooting and its computer processing, which is an integral part of such system, isn't presented in this article, because it has a deep coverage in previous publications published in Slobozhanskiy herald of science and sport [7,8].

Conclusions / Discussion

The presented system of complexity assessment of motor activity and its qualitative implementation taking into account allowances for complexity and measure of accuracy can be used in almost any sphere of sports and professional activity. Its introduction into practice allows developing a unified system of individual certification and systematization of physical development and level of physical preparation of the controlled contingent.

In the practice of sport this approach makes it possible to identify the most exposed individuals to the exact specificity of motor activity due to the corresponding phylogenetic talent. The development of a unified system of certification and systematization of physical development and level of physical preparation should be carried out at all stages of age periodization which is used in the practice of medical and biological research.

Prospects for further research in this direction. The further development of this direction will be connected with practical implementation of a full-scale complex of remote assessment in real time of the current functional state according to the observed kinematics of movements of the controlled individual with the complexity assessment of motor activity and quality of its performance, and also allowances for the rank of complexity and accuracy of the final result.

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