



Determination of the informative components of the validity of the reactive maneuverability of the motor potential of a fencer by the «information compression» method

UDC 37.037.1



PhD, Associate Professor **I.Yu. Pugachev**¹

Dr. Hab., Professor **G.N. Ponomarev**²

Dr. Med., Professor **P.V. Rodichkin**²

PhD **F.F. Kostov**²

¹Derzhavin Tambov State University, Tambov

²The Herzen State Pedagogical University of Russia, St. Petersburg

Corresponding author: pugachyov.i@yandex.ru

Abstract

Objective of the study was to determine the integrative latent indicators of the validity of the reactive maneuverability of the fencers' motor potential.

Methods and structure of the study. The respondents were junior fencers aged 18-21, who train at the Children's and Youth Sports School of the Michurinsky district of Tambov (n=12). At the first stage of the work, parameters were studied that directly or indirectly influence the reactive maneuverability of the fencers' motor potential. At the second stage, a two-dimensional biometric analysis was performed using the paired Bravais-Pearson correlation coefficient (r). At the third stage of the work, the degree of significance of the indicators revealed by the two-dimensional mathematical and biometric analysis, which probabilistically affect the reactive maneuverability of the fencers' motor potential, was verified.

Result and conclusions. Integrative indicators of the validity of the latent reactive maneuverability of the fencer's motor potential as an important prognostic feature were established, namely: the search time for the motor unit, the coefficient of accuracy of the motor unit control, the average latent time according to the "tapping test" method, the duration of the potential of the motor unit of the biceps muscle of the shoulder, the speed propagation of excitation along the radial nerve.

Keywords: *fencer's motor potential, reactive maneuverability, biometric analysis, integrative validity indicators, control and forecasting.*

Introduction. A fencer's functional reactivity is a universal phenomenon of his motional readiness potential, a predictor of the effectiveness of a duel. It is no coincidence that in Appendix No. 4 of the Federal Standard of Sports Training (FSST) for the sport of fencing, speed-strength and coordination abilities are marked with the highest ("3") degree of significance in terms of the level of influence [5].

The deep mechanisms of the essence of the manifestation of the reactive maneuverability of fencers are concentrated in a more accelerated transmission of information through the system of neurosecretory synapses due to the mobilization of mediator-receptor connections to the second signaling system of the cerebral cortex and the corresponding more accelerated response of the muscles with the full involvement of the movement control system [6]. Initially, synapses

are involved in this process, transmitting information about the tactics of conducting a duel to the corresponding associative zone of the cerebral cortex, then, after processing the information, neuro-neuronal synapses pass the "baton" to the corresponding muscle cells through neuromuscular synapses, transforming into a universal technical implementation of the conceived idea. At the same time, an important condition for the effectiveness of performing a spontaneously creative tactical action (according to the situation) is the preliminary development of all possible variations in the manifestations of such probabilistic actions in order to save them in the memory of the motor stereotype of motor combinations [6].

An essential role in the sought process of the swordsman's reactive reproduction is also played by the hidden components of the latent reaction time of



psychophysiological parameters, which determine an earlier concentration of mobilization readiness and an advanced (sometimes caused by anticipation and intuition) explosive spurt at the start of a motor action. Latent reaction time is a feature of every fencer, who either initially was a “natural private gifted phenomenon”, or acquired these qualities in the process of painstaking and exhausting work in training.

It should be noted that the functional capacity of indicators of the latent period to the mobilization concentrated action of a fencer is directly related by a linear biometric dependence to his current psycho-emotional state, according to the same mechanism of operation of heart rate parameters [1, 2].

The aim of the study was to determine the integrative latent indicators of the validity of the reactive maneuverability of the fencer’s motor potential, as a predictor phenomenon of the effective start of his attacking or defensive-defensive actions.

Methods and structure of the study. The main methods of hypothetical and empirical scientific knowledge were: “information compression” [3]; theoretical analysis and generalization; logical information processing (analysis, synthesis, comparison, in-

duction, deduction); testing; mathematical-statistical analysis. The procedure for the logical construction of the work algorithm was based on modern didactic principles and organizational and methodological forms of conducting training sessions, psychological, pedagogical and biomedical testing [4].

Results of the study and their discussion. The experiment involved 12 fencers of the Children’s and Youth Sports School of the Michurinsky District of Tambov at the training stage of sports training (4 people from each coach, according to the FSST in the sport “fencing” [5]; 8 people - Candidates for the Master of Sports; 8 people - 1 category), whose age was 19.54 ± 0.93 years.

At the first stage of the work, the parameters that directly or indirectly probabilistically affect the reactive maneuverability of their propulsion potential were studied. The parameters of psychophysiological functions were assessed using the computer “Psychophysiological Complex -PFC 01”. Subtle physiological mechanisms of motor activity and bioelectrogenesis of the neuromotor apparatus were measured using a Hungarian-made MG-440 electromyograph. The test results are presented in a summary table.

The results of testing the parameters of fencers, directly or indirectly probabilistically influencing the reactive maneuverability of their motor potential (n=12)

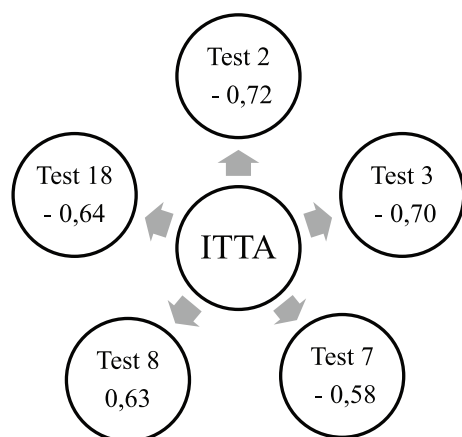
No.	Control test	Test results ($\bar{X} \pm m$)
Indicators of psychophysiological functions		
1.	Number of errors in the «Complex sensorimotor reaction» technique (number)	0,7±0,2
2.	Mean latent time of the technique «Complex sensorimotor reaction» (ms)	537,4±19,1
3.	Mean motor time of the technique «Complex sensorimotor reaction» (ms)	234,5±17,8
4.	The performance of the «Tapping test» technique (number of reactions)	329,2±1,9
5.	Average time of one reaction of the technique «Tapping test» (ms)	148,3±6,4
6.	Average latent time of the «Tapping test» technique (ms)	2,6±0,3
Subtle physiological mechanisms of motor activity		
7.	Motor unit search time (MU) (s)	32,4±3,1
8.	Coefficient of regularity of work MU (%)	80,2±3,6
9.	Control Accuracy Ratio MU (%)	78,7±2,0
Биоэлектрогенез нейромоторного аппарата		
10.	Potential duration (DP) MU of hand muscles (ms)	9,24±0,07
11.	DP MU muscles of the forearm (ms)	10,21±0,08
12.	DP MU biceps brachii (ms)	10,83±0,08
13.	DP MU triceps brachii (ms)	12,22±0,06
14.	Potential amplitude (AP) MU of hand muscles (µV)	1541,9±29,1
15.	AP MU of forearm muscles (µV)	814,4±7,2
16.	AP MU biceps brachii (µV)	374,5±3,3
17.	AP MU triceps brachii (µV)	962,6±12,8
18.	The speed of propagation of excitation along the radial nerve (ms)	55,5±1,5



It can be seen from the data in the table that all the studied indicators of the fencers are within the limits of the physiological and psychophysiological norm; the variability of the scatter of values corresponds to the bell-shaped distribution of test results that fit within ± 3 . This gave us a reason to apply further mathematical-biometric tools.

In order to further specify the degree of significance of individual indicators in the issue under study, we carried out a two-dimensional biometric analysis using the paired Bravais-Pearson correlation coefficient (r). The matrix of intercorrelations included an integral indicator of tactical and technical actions (ITTA) of athletes, assessed on a conditional nine-point scale by experienced specialists. Concordance coefficients (W) with a confidence interval of 92.0-94.3% corresponded to the values of 0.79-0.89. This confirmed the reliability of the experts' opinions.

The most significant intercorrelations are shown in the figure.



Correlation galaxy of the integral indicator of tactical and technical actions of fencers with probabilistic parameters of reactive maneuverability of their motor potential

Note: test numbers correspond to the serial number of the table.

Thus, a strong and negative degree of relationship was found between: the integral indicator of tactical and technical actions (ITTA) and the average latent time of the "Complex sensorimotor reaction" technique ($r=-0.72$); ITTA and mean motor time of the "Complex sensorimotor reaction" technique ($r=-0.70$). A positive and medium degree of relationship was established between the ITTA and the coefficient of the regularity of the work of the MU ($r=0.63$). A negative and medium degree of relationship was established between ITTA and the speed of propagation of excitation along the radial nerve ($r=-0.64$), as well as

between ITTA and the search time for MU ($r=-0.58$).

At the third stage of the work, we verified the degree of significance of the indices revealed by the two-dimensional mathematical and biometric analysis, which probabilistically affect the reactive maneuverability of the fencers' motor potential. For this purpose, a multivariate analysis was applied to compare the values of private (PCC) and multiple correlation (R) between the results of the ITTA rating of participants in the process and eighteen sought-for biostructure values. The essence of the biometric technology was that if, after leveling the particular value of the parameter, the previous value of R decreases significantly, then the indicator under study is the "most significant". The linear regression equation was determined using the standard SPSS program.

It was clarified that the most informative in terms of the degree of differentiation are the following parameters: MU search time, MU control accuracy coefficient, average latent time according to the "tapping test" method, duration of the MU potential of the biceps muscle of the shoulder, speed of propagation of excitation along the radial nerve. In addition, the multiple correlation coefficients of the relationship of these structures with two parameters of the ITTA (the second parameter of the ITTA reflected the performance rating in the past macrocycle competitions) were: $R=0.85$; $R=0.83$; $R=0.76$; $R=0.74$; $R=0.73$. The above parameters reflect the conceptual basis of the latent component of the reactive maneuverability of the fencer's motor potential.

Conclusions. Thus, the stage-by-stage implementation of one-dimensional, two-dimensional and multidimensional biometric analyzes within the framework of the toolkit of the "information compression" principle revealed integrative indicators of the validity of the latent reactive maneuverability of the fencer's motor potential, namely: the search time for a motor unit, the coefficient of accuracy of motor unit control, the average latent time according to the method "tapping test", the duration of the potential of the motor unit of the biceps muscle of the shoulder, the speed of propagation of excitation along the radial nerve, which is an important prognostic sign.

References

1. Izard K.E. Psikhologiya emotsiy [Psychology of emotions]. K.E. Izard [transl.]. St. Petersburg: Piter publ., 1999. 464 p.
2. Kostov F.F., Ponomarev G.N., Rodichkin P.V. Korrektsiya fizicheskoy rabotosposobnosti zani-



- mayushchikhsya fizicheskoy kulturoy i sportom [Correction of physical performance of those involved in physical culture and sports]. St. Petersburg: SPbGETU «LETI» publ., 2022. 219 p.
3. Pugachev I.Yu. Avtorskiy printsip «szhatiya informatsii» kak innovatsionnaya tekhnologiya v sisteme sportivnoy podgotovki [The author's principle of "information compression" as an innovative technology in the system of sports training]. Innovatsionnyye tekhnologii v sisteme sportivnoy podgotovki, massovoy fizicheskoy kultury i sporta [Innovative technologies in the system of sports training, mass physical culture and sports]. Proceedings national scientific-practical conference with international participation. St. Petersburg: FGBU «SPb NIIFK» publ., 2019. pp. 116-119.
 4. Pugachev I.Yu., Korablev Yu.Yu., Osmanov E.M. Prioritetnyye napravleniya primeneniya didakticheskikh printsipov obucheniya v vysshey shkole pedagogiki fizicheskogo vospitaniya [Priority directions of application of didactic principles of teaching in the higher school of pedagogy of physical education]. Vestnik Tambovskogo universiteta. Seriya: Gumanitarnyye nauki. 2017. Vol. 22. No. 1 (165). pp. 39-62.
 5. Prikaz Ministerstva sporta Rossiyskoy Federatsii ot 19.01.2018 g. №40 «Ob utverzhdenii federalnogo standarta sportivnoy podgotovki po vidu sporta «fekhtovaniye» [Order of the Ministry of Sports of the Russian Federation of January 19, 2018 No. 40 "On approval of the federal standard for sports training in the sport of fencing"] [Electronic resource]. Available at: <https://minsport.gov.ru/2018/Prikaz40ot19012018.pdf> (date of access: 11.23.2022).
 6. Rodichkin P.V., Golubev V.N. Nekotoryye aspekty adaptatsii dvigatelnoy sistemy sportsmenov vysokogo klassa k myshechnoy deyatelnosti razlichnoy napravlenosti [Some aspects of the adaptation of the motor system of high-class athletes to muscular activity of various directions]. Vestnik Baltiyskoy pedagogicheskoy akademii. 2002. No. 47. p. 71.