# OPERATIONAL EVALUATION OF ATHLETE'S MENTAL CONDITION

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***Abstract:*** *Modern sport is characterized by the importance of accounting for all its main components, which include athlete's mental conditioning. However, prompt assessment of the sportsman's mental condition lacks necessary tools and methods, which makes it difficult for a coach to effectively manage the process of athletic instruction. According to psychologists, an informative way to determine the human mental condition is its assessment by eye movements. The purpose of our study was to identify a possibility of using the parameters of eye micromotion (using a relative index – coefficient of variation of eye micromotion) and determining its variation ranges to assess the athlete's mental condition. Riflemen were involved as test subjects (n=36). Required indicators were recorded using a special photoelectron device and the corresponding method of its application. The relative index used – coefficient of variation ($C_{vm}$) of eye micromotion was used for the quantitative evaluation of recorded parameters. Analysis and generalization of results, discrimination test and correlation analysis were also used. The results of the study have showed that the values of the coefficient of variation of athletes' eye micromotion are related to their qualification. Conditions of the contest most affected the athletes of lower qualification. This was indicated by the differences in $C_{vm}$ between low (category III) and high-qualification athletes (master of sports) in special (0.21) and training conditions (0.21) and even more noticeable differences in this coefficient for the control (0.42) and competitive (0.50) shooting. The graph shows changes in this coefficient and visual discrimination performance of the test subjects during the contest day and during a competitive shooting exercise, which made it possible to interpret $C_{vm}$ as an operational indicator for assessing the mental condition, and discrimination ability as one of the indicators of the athlete's mental condition.*

***Keywords:*** *athlete, mental condition, operational evaluation, eye micromotion, coefficient of variation, discrimination ability, bullet shooting.*

## INTRODUCTION

Athlete's preparedness for the training and, particularly, competitive load (specific start) plays an important role in its success (attainment of the desired result). One of the main components of this preparedness is the athlete's mental condition [12, 18], which needs prompt and objective evaluation. The importance of prompt evaluation of this condition is explained by a variety of tasks that a coach or an expert (psychologist) faces when training athletes [4, 13, 15, 18, 24], right up to mental

condition correction [22] and specification of the current and pre-start condition [14, 19]. It is highly recommended that the psychologist stays with the team virtually all the time to gain trust of the athletes. However, in sport practice, such methods as questionnaires, interviews, indirect indicators (excessive sweat, red spots, nervousness of athletes) are used to evaluate this condition with low operational efficiency [14, 18, 24] and low information value of the results obtained, which is very inconvenient to the coach and which makes it very hard for the coach to be objective in the possible correction of the training load. Traditional psychologists suggested evaluating this human mental condition by eye movements [9,10] for objective assessment. A photoelectric method [4, 7, 20] was proposed to record these movements. This method may be implemented using a special device [2]. This method has the following benefits: simple recording procedure, no need to reprocess results, easy-to-use equipment, possibility to attain the required measurement accuracy. However, there is still very few studies intended to make use of the devices implementing this method in sport practice and to examine the indicators that are recorded using corresponding facilities and that ensure qualified interpretation of results obtained (indicators of athlete's eye micromotion) [3, 6, 16]. Results of some studies allow to conclude that human psychological peculiarities may be described using psychophysiological indicators, such as discrimination ability [5, 11]. In the end, it is not quite clear, whether the above indicators should be defined in terms of psychology or psychophysiology. All this evidences the relevance of the study at hand. Study **objective**: identifying a possibility of using the parameters of eye micromotion (using a relative index – coefficient of variation of eye micromotion) to evaluate mental condition and determining its degree of changes in athletes before, during and after contests.

## METHODS

Thirty-six riflemen of different qualification levels were involved as test subjects. Required indicators were recorded using a special photoelectron device and the corresponding method of its application. The relative index used – coefficient of variation ($C_{vm}$) of eye micromotion was used for the quantitative evaluation of the recorded parameters [23]. Analysis and generalization of results, discrimination test and correlation analysis were also used. Parameters were recorded over 10 training days 15-20 minutes before the first practice and discrimination ability was measured under a different schedule over 2 days. The chosen device application method implied athlete's visual fixation of a point situated at a distance of 1.5 meters to the test subject's eye for 10 seconds, during which the range of involuntary eye jumps of the athletes aged from 17 to 22 was recorded. The device in use settles the methodical task of two-axis recording of athlete's eye movement parameters when staring at the point. This device was chosen thanks to its capability to record eye micromotions with the required accuracy [2]. The following conditions were met to correctly measure athlete's eye micromotion parameters; 1) such element of the device as unified contact lens (UCL) for each test subject was strictly the size of his eyeball; 2) device calibration was compulsory prior to each measurement for each test subject. Although these conditions were met, it should be noted that the recording of required parameters took 30-35 seconds on the average for each test subject. Another indicator used in the study – discrimination ability (DA) – was measured in static conditions and implied definition of

the minimum width of a dark band between two white sheets at 50 m visible to the athlete. DA values were equal to the inverse value of the marked width of the visible band and the unit of measurements was $cm^{-1}$. The mean value of 3 attempts with binocular tracking was defined.

**RESULTS**

Before recording eye micromotions, the fact that these motions were characterized by higher variety in terms of the direction of jumps, drifts and their ranges was considered. However, analysis of preliminary results has shown that involuntary jumps (saccades) [10, 16], or to be more precise, their amplitudes or variation ranges in relative terms are of the most interest to the study. The relative value – coefficient of variation ($C_{vm}$) of eye micromotion was proposed as a numerical characteristic of these changes [23]. This value is represented with the following expression:

$$C_{vm} = \frac{2\,(A_{max} - A_{75\,u})}{A_{75\,u} + A_{75\,l}} \qquad (1)$$

where $A_{max}$ is the maximum values of jump amplitudes (saccades);

$A_{75\,u}$ is the 75% level for the values of upper amplitude limits;

$A_{75\,l}$ is the 75% level for the values of lower amplitude limits;

Calculation results of coefficients of variation of eye micromotion represented graphically have enabled visual representation of the dependence of this coefficient on riflemen's qualification levels in various training and competitive conditions (figure 1). It follows from figure 1 that competitive environment affects low-qualification athletes (categories III and I) the most, which is probably due to their poor psychological stability and high anxiety before each start. For example, this is evidenced by a minor difference in $C_{vm}$ values ($\Delta$=0.07±0.01) in category III athletes in training and special conditions and sharper changes in this coefficient for the control (by 0.27±0.03) and competitive (by 0.50±0.07) shooting.

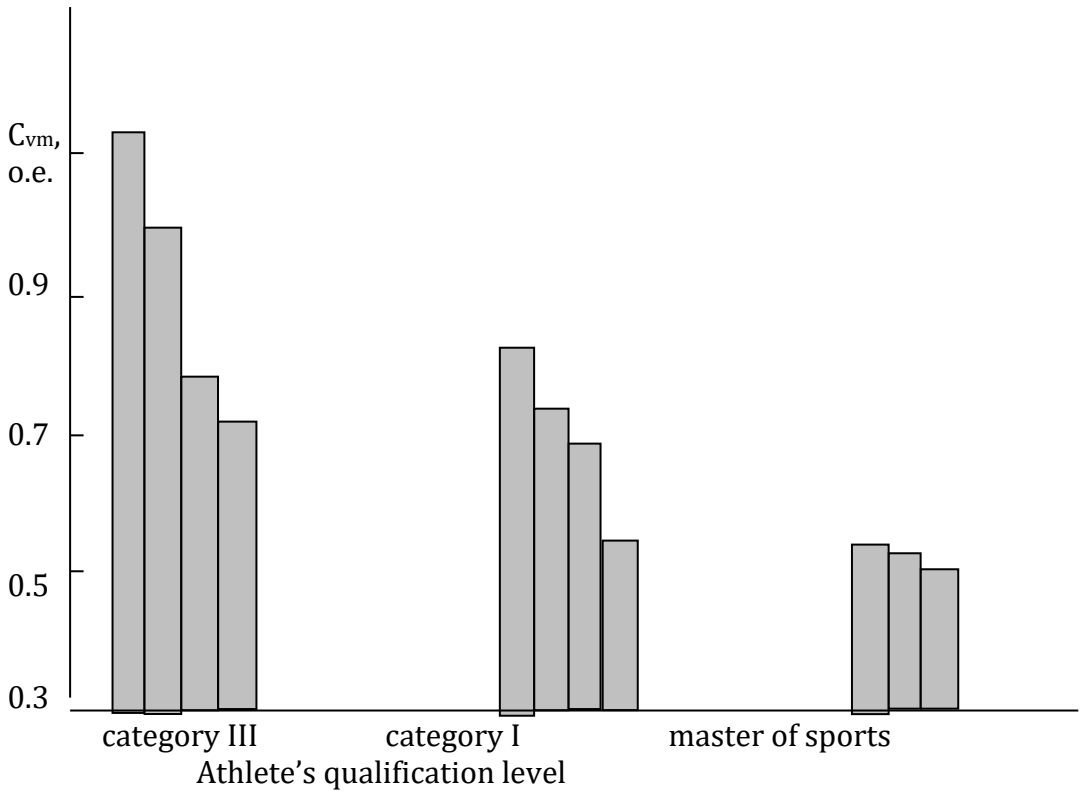


Fig. 1. Diagrams of coefficient of variation of eye micromotions of riflemen 1 hour before different types of shooting practice

- contests,
- control,
- special conditions,
- training

At the same time, increase in $C_{vm}$ in this category of athletes during shooting with a rifle secured in a special shooting bed (special conditions) (by 0.07±0.01, as was already noted) was virtually the same as the level of change in this coefficient in masters of sport under similar conditions (Δ=0.06±0.01). Numerically, the values of this coefficient for the first group of riflemen were at the level of 0.72±0.09 and at 0.43±0.06 for the second group of athletes. Increase in the athletes' qualification level was accompanied by normalized eye micromotions through the decrease in their maximum ranges, which affected the decrease in $C_{vm}$ between training and competitive conditions (in particular, by 0.37±0.05 in III category riflemen and by 0.12±0.02 in masters of sport). The results obtained suggest that eye movement activity of the test subjects expressed with $C_{vm}$ depends on: a) athlete's qualification; b) individual peculiarities of his mentality; c) sport task he faces. It became obvious during the study that, during the contest day and directly during the competitive exercise, $C_{vm}$ changes were different in different athletes (figure 2).

For the convenience of comparison of athletes' psychological and psychophysiological indicators, the same figure shows the discrimination ability (DA) curve. X axis shows the time before and after a shooting exercise. Required measurements were made in the conditions of control training before and after MV-9 (60 shots from the lying position) shooting exercise (category I, n=12). Influence of competitive conditions (in particular, control shooting) on involuntary eye movement activity, i.e. $C_{vm}$ of the rifleman was observed already one day before the start. Significant increase (up to 0.60±0.11) of this parameter was observed 1-1.5 hour before the shooting. In fact, $C_{vm}$ jump was observed 15-20 minutes before the exercise and reached its peak (0.67±0.09) during proof shoots (during 10-15 minutes after the start of the exercise).

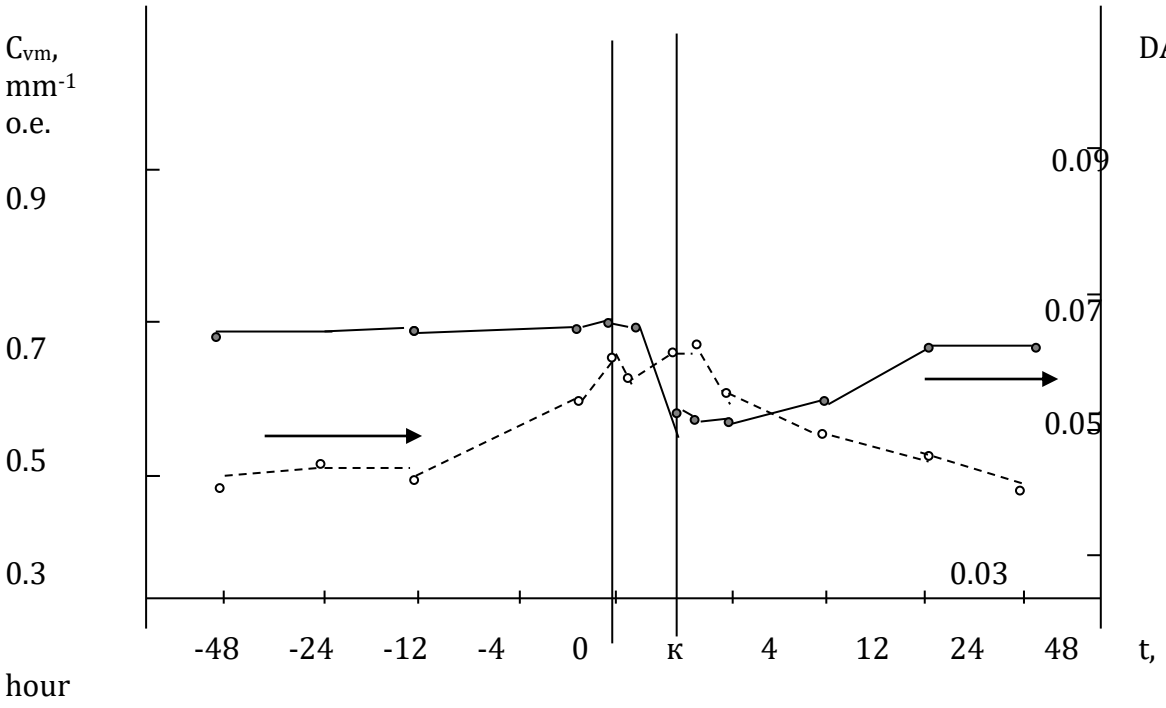


Fig. 2. Changes in the coefficient of variation of rifleman's eye micromotion and discrimination ability before and after control shooting (MV-9 exercise, category I, n = 12)

0 – start of the shooting exercise;
К – end of the shooting exercise

Athlete's performance of the physical actions required for shooting decreased this coefficient a little (to 0.61±0.08). During the shooting exercise, preparation and individual shots (of after bad or, on the contrary, after a series of very good shots), acute fluctuations of $C_{vm}$ were observed in virtually all the athletes (11 out of 12 test subjects). This is not shown on the graph due to the chaotic nature of these jumps during shooting. Numerically, the ranges of these fluctuations (in the form of jumps) reached 0.88-0.92, which may be explained by the current shooting delivery (mainly, errors) and individual psychological traits (attitude to this type of practice). On the average, the level of the

indicator under study was nearly the same as before the start in the group of the test subjects, with only standard deviation increased (±δ), i.e., 0.67±0.17. Minor increase in $C_{vm}$ at the end of the exercise is perhaps explained by the fact that the athletes were concerned with their performance, which is officially announced 15-20 minutes after the end of the exercise in bullet shooting. The listed changes in the indicator under study suggested that they actually described current changes in the rifleman's mental condition, which allowed to conclude that the coefficient of variation of eye micromotions ($C_{vm}$) could be considered as an operational indicator of the athlete's mental condition. Unlike the coefficient proposed, discrimination ability of the test subjects was virtually the same (0.063±0.011 $mm^{-1}$) 2 days before the contests. A minor improvement in this psychophysiological indicator (by 1.05%) was observed 15-20 minutes before the competitive exercise. However, 15-20 minutes after the start of the shooting, DA returned to the baseline. By the end of the shooting exercise, it reduced to 0.052±0.019 $mm^{-1}$ (or by 17.5%). The decrease in this parameter (by 0.003 $mm^{-1}$ only) was observed during 10-30 minutes after the end of the control shooting. Athletes' discrimination ability almost fully restored to pre-contest values in 24-28 hours. DA was under-restored by 1.8%.

Another result of the study performed was specification of dependence between athlete's involuntary and voluntary eye movement activity when preparing and shooting. During preparation, the athlete engages voluntary eye movement activity. Its analysis revealed the presence of visual and kinematic images of a sport situation (VKISS) and for riflemen – visual and kinematic images of targeting (VKIT): forms of this activity manifestation [7]. The results of the study did not reveal any specific interdependence between these indicators due to their major variations. For example, $C_{vm}$ values in the range of 0.35-0.40 were observed both in category III rifleman and master of sports. However, in the former, it described the lower and, in the latter, – the upper level of variations of this coefficient. At the same time, the results obtained suggested that interdependence of $C_{vm}$ and VKIT is reverse. Thus, it was ascertained that $C_{vm}$ was strongly affected by rifleman's mental and physiological condition and his ability to manage these conditions. Changes in discrimination ability have shown that it may be preconditioned by vision physiology; visual fatigue of the test subject (during and after shooting); recovery in the post-load time.

## CONCLUSION

1. Coefficient of variation of eye micromotion may be used for the operational evaluation of the athlete's mental condition.
2. The coefficient of variation of eye micromotions is affected by the athlete's qualification and the tasks he faces in training settings.
3. Full recovery of the athlete's mental condition (by the example of riflemen) is attained approximately 36-40 hours after the competitive exercise.
4. Visual discrimination performance is mainly used as the indicator of the rifleman's psychophysiological characteristic and it has complex interrelation with the coefficient of variation of eye micromotions, the specification of which requires a special study.

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