ORIGINAL ARTICLE

Psychophysiological states and motivation in elite judokas

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

Georgiy Korobeynikov[1ABCDE], Karine Mazmanian[1ABCD], Lesia Korobeynikova[1ABCD], Władysław Jagiełło[2ACDE]

[1] National University of Physical Culture and Sport of Ukraine, Kyiv, Ukraine
[2] Jędrzej Śniadecki Academy of Physical Education and Sport in Gdansk, Poland

Source of support: Departmental sources

Received: 6 June 2010; **Accepted:** 7 July 2010; **Published online:** 27 July 2010

Abstract

Background and Study Aim: Examine the effects of different level combination of motivation to achieve success and motivation to avoid failure on psychophysiological states in elite judokas.

Material/Methods: Neuropsychological evaluation methods as simple (SRT) and choice reaction-time (CRT) tests, heart rate variability (HRV) measurements, psychological questionnaires. To explore obtained data methods of statistical analysis were used.

Results: Obtained data show that different combinations of levels of motivation to achieve success and motivation to avoid failure provoke different psychophysiological states. Conducted experiment revealed that combination of high levels of both motivation to achieve success and motivation to avoid failure provides better psychophysiological state in elite judokas compared to other groups with different combinations of motivational variables. It was shown that motivation to avoid failures had been formed as a personality formation, which compensates excessive tension, caused by high level of motivation to achieve and regulates the psychophysiological state. This phenomenon can be viewed as an effect of training in judokas.

Conclusions: Consideration of motivation as a complex multilevel functional system with integrated affective and cognitive processes allows considering this psychic process to regulate activity of a person in actual situation. Obtained data show that different combinations of levels of motivation to achieve success and motivation to avoid failure provoke different psychophysiological states. Conducted experiment revealed that combination of high levels of both motivation to achieve and motivation to avoid provides the high level of the psychophysiological state in elite judokas (psychophysiological state which maintains high level of efficient activity during trainings and competitions). The process of forming of the psychophysiological states in subjects is characterized by the cognitive-regulatory functional system.

Key words: choice reaction-time • simple reaction-time • motor reaction time • motivation to achieve • motivation to avoid failures

Author's address: Georgiy Korobeynikov, National University of Physical Culture and Sport of Ukraine,, Fizkulture St., 1, 03680 Kyiv, Ukraine, e-mail: george651@mail.ru

Background

Sport as a specific type of human activity combines different aspects of life and that is why should be viewed in spiritual and corporal unity. Its primary purpose is human perfection through harmonization of physical, aesthetical and moral development.

Sport is one of lies in the greatest motivation that allows athlete to yield to the long-term daily physical and psychological loading and to win. Due to this fact sport became the remarkable natural laboratory of human possibilities. The sports motivation basis constitutes comparison of own results with achievements of others, realization of own capabilities and self-affirmation as well as

Choice reaction-time – the latency of complexity reaction-time, the choice among differ figures (square, circle, triangle).

Simple reaction-time – the latency of simple reaction on any figures.

Motor reaction time – reaction of neuro-muscular system as part of choice reaction-time.

Motivation to achieve – motivation to achieve of successful on competition.

Motivation to avoid failures – motivation to avoid failures on competition.

cognition of the world [1]. Motivation in sport implies the presence of factors and processes which stimulate athlete to the action or inactivity in different situations. The key role of motivation lies in realization of abilities the «guided training» and forming athletes' behaviour by means of structural components of motivation [2]. The block of motivation executes such functions in the structure of sport activity [3]. It triggers the mechanism of activity and maintains its level during training and competitions. Also it regulates managing and application of various facilities of activity to achieve desirable results.

Human activities including sports are determined by different levels of regulation and complex mechanisms of psychophysiological functions organization. Various psychic phenomena can be characterized by their specific influence on inner processes. Such specificity can be represented by the changes of psychophysiological states. Intimate connection between psychic and physiological factors [4] forms a psychophysiological state of a person. Each psychic phenomenon appears to be related to physiological structures – it can influence physiological processes or be conditioned by them. According to our previous works [5], the structure of combats includes following components of the psychophysiological states: regulatory, cognitive and psychic.

Every state represents a certain need in its relevant form – motivation. Mobilizing force together with guiding motivational variables which reflect the subjects' emotional prediction of possible results [6,7] both constitute a neurodynamic structure of motivation. Concerning the probability of success, Atkinson and Feather [7], say, "The person more motivated to achieve should prefer a moderate risk. His level of aspiration will fall at the point where his positive motivation is strongest, at the point where the odds seem to be 50–50" (p. 18). A person with a fear of failure does not want to take any risk, but when forced will choose either a task so easy it can not be failed, or a task so difficult it can not be expected to be accomplished.

This enables us to represent motivation as a source of certain influences on the athletes' behavioural reactions.

Obviously there are different forms motivation can take [8]. Motivational variables viewed here include the need for achievement and the fear of failure. That is a predominant force that directs our behaviour toward positive and negative outcomes. These motives are considered as working together to regulate achievement behaviour and they are treated as predictors for performance outcomes.

The need for achievement was conceptualized as an enduring characteristic of personality, a striving for success in any situation in which performance can be evaluated according to some standard of excellence. As pointed out by Atkinson [7] achievement motivation is a combination of motivational strength and situational variables. Achievement goals can affect the way a person performs a task and represent a desire to show competence.

Achievement motivation is the term that has been most frequently used to describe personal striving of individuals to attain goals within their social environment. As a psychological concept, it has wide implications for the behaviour of the individual [9]. Existing classical achievement motivation theorists claimed that activities are emphasized and oriented toward attaining success or avoiding failure. Motivational researchers share the view that achievement behaviour is an interaction between situational variables and the individual subject's motivation to achieve. Achievement motivation theorists focus their research attention on behaviours involving competence. Individuals aspire to attain competence or may strive to avoid incompetence, based on the earlier approach-avoidance research and theories.

In this study we tried to explore existing gaps concerning various combinations of opposing motivational variables to achieve and to avoid so called motivational conflict. A motivational conflict is determined as a psychic tension which arises up under the action of the opposite directed motivational variables.

Understanding of motivational conflict was formed in psychology within the framework of theory of the field. According to this theory various objects, that surrounds us possess certain valence – force which "attracts" a person. Accepting that different motivational variables do not exclude one another it was hypothesized that subjects showing combination of both high levels of motivation to achieve and to avoid should experience motivational conflict, which in its turn should provoke the state of psychophysiological tension. And it was further hypothesized that favourable psychophysiological state would be associated with lower level of motivation to avoid and higher level of motivation to achieve.

It is possible to consider motivation as a specific excitation of physiological structures, which has regulative influence on human activity. Motivation sets conditions for the psychophysiological states of person, and can be mediated through these states. So we can assume that motivation variables to achieve and to avoid are the psychophysiological components of purposeful activity [4,10]. Concepts explored in this paper concerned the identification of motivation types and their relation with psychophysiological states in qualified judokas. Here we tried to figure out how these different

types of motivation interact to describe psychophysiological state.

Our proposed study will examine the effects of different level combination of motivation to achieve success and motivation to avoid failure on psychophysiological states in elite athletes.

Material and Methods

Twenty seven healthy qualified athletes (19 male and 8 female), members of national judo team of Ukraine, participated in this study after giving their informed consent. Their mean age was 22.7±2.6 (SD) years. Each subject was tested individually. Each subject completed all test blocks in one day.

According to obtained results none of 27 participants in this study showed low level of motivation to achieve, while more than a half (67%) from the general group of subjects expressed high level of such motivational variable forms. For motivation to avoid failures in the general group the following distribution was obtained: high, medium and low level of motivation to avoid was expressed by 9 athletes per level (33%).

Researches were conducted as a part of a stage control on the base of the State Scientific Research Institute of Physical Culture and Sport (Kyiv) and directly during training camps.

Questionnaires by T. Elers have been used to study motivation [11]. This block consisted of 2 sub-tests of motivation to achieve and to avoid, containing 41 and 30 units respectively. Each test belongs to the monoscale methods. An overall level of expressed motivation to achieve and motivation to avoid has been calculated by the sum of points. Obtained levels of expression can be divided as from 1 to 10 points – low level; from 11 to 16 points – middle level; from 17 to 20 points – moderately high level, over 21 points – extremely high level. In the first sub-test subjects were asked to answer 41 "yes or no" questions. In the second sub-test subjects had to choose one of the three given adjectives that described their person the most propriety way.

Neurodynamic component was tested with a computer-based method "Diagnost-1" [12] and included visual-motor reaction time tests, which assessed an individual response time to presentation of visual targets on a computer screen. After practice, subjects were given simple- (SRT) and choice reaction-time (CRT) tests of 30 trials each. The subjects responded with the dominant hand to target stimuli. Visual stimuli have been presented on a computer 19-inch display with a 1024×768 resolution at a refresh rate of 100 Hz positioned in front of the subject. For registering subject responses double-handed handlebars connected to the computer running the experiment through the LPT port have been used.

For SRT test subjects were asked to press the button as quick as possible on each appearing stimulus (square, circle, triangle) using his/her preferred hand. Time of fixation per each displayed stimulus is 700 ms. Amount of stimuli was 30.

The CRT test included positive signals (square or circle) and negative (triangle) stimuli applied in random order. Time of stimulus fixation for the CRT constituted 900 ms per displayed unit. The subjects were instructed to press and then to release, as quickly as possible, the button on the right handlebar in response to the square, the button the left handlebar in response to the circle and do not react to the negative stimuli.

The following parameters for SRT and CRT tests were automatically registered: mean response latency (ms); CV – variation coefficient of SRT or CRT (%); means of errors; MRT – means of motor reaction time (ms); IPT – mean information processing time – as results of brain information processing (ms).

Heart rate variability (HRV) provides non-invasive data about the autonomic regulation of heart rate in real-life conditions. HRV, reflecting cardiovascular control exerted by both parasympathetic and sympathetic nervous system, has been used to evaluate modifications of autonomic functions due to acute exercise or training [13].

All data acquisitions were performed in the morning. The subjects were given enough time to relax before the test. HRV profile of athlete was characterized, with statistical and frequency analysis, during supine rest and 90° upright posture for 5 min cardio intervals ECG (RR) were recorded and analyzed before completing the rest experimental tasks. No instruction was given regarding respiration.

An ECG signal was recorded with computer-based method "Cardio+"© (Metekol, Nizhin, Ukraine) by a bipolar electrode pair placed at right and left wrists and ankles. RR – intervals were instantaneously determined by software (Cardio+ v.1.0.45.0, Nizhin, Ukraine) and were simultaneously transformed into heart period time series on-line.

To asses regulatory component we used following indices: RR – mean of RR intervals ECG (s); SDNN – standard deviation of RR – intervals ECG (s); CVRR – variation coefficient of RR-intervals (%), LF – low frequency

of HRV (ms^2); HF – higher frequency of HRV (ms^2); LF/HF – power ratio HRV (ms^2); SI – stress index (secret unit) [14].

$$SI = \frac{AMo}{2Mo \cdot \Delta RR}$$

Mo – mode of RR-intervals ECG (ms);
AMo – amplitude of the mode of RR-intervals ECG (ms);
ΔRR – mean of variation of RR-intervals ECG (ms).

All the RR-intervals were edited by visual inspection to exclude all the undesirable beats.

We carried out further analysis in sub-groups of participants with the different combinations of motivational variables levels using the Wilcoxon signed-rank test.

After studying motivational questionnaires, three groups were formed 9 subjects in each:

1. Subjects with the combination of both extreme high levels of motivation to achieve and to avoid;
2. Subjects with combination of both medium levels of motivation to achieve and to avoid (with insignificant predominance of motivation to avoid failures);
3. Subjects with low level of motivation to avoid overwhelmed by extreme high level of motivation to achieve.

Because of marked parameters in the distribution of some variables, descriptive statistics are given as median (lower quartile, upper quartile). Normality of data distribution was assessed by the Shapiro-Wilk test. Paired comparisons between groups were performed by the Wilcoxon signed-rank test. The strength of linear association between pairs of variables was assessed by the Pearson coefficient of correlation. Statistical significance was assumed for $p<0.05$.

Statistical analyses were performed with STATISTICA 6.0 software (StatSoft Inc., USA).

Results

A cross-correlation analysis was used to explore associations between studied parameters of psychological, neurodynamic and regulatory indexes.

Motivation to avoid failures was revealed to be negatively associated with SRT and CRT (r=–0.55 and –0.45 respectively; $p<0.05$) and with the amount of errors in a choice reaction-time test (r=–0.51; $p<0.05$);

Also interconnection between motivation to avoid failure with indexes that characterize tension of the systems of heart rate regulation – RR and CVRR in upright position (r=0.43 and 0.59 respectively; $p<0.05$) has been shown. A negative association was obtained between motivation to avoid failure and SI in upright posture. Findings specify that high index of motivation to avoid failure meets better parameters of heart rate regulation together with speed and quality characteristics of information processing.

Data analysis revealed significantly lower indexes of latent periods of simple (SRT) and CRT in the first group of athletes comparing to the second and third groups, indicating the best possibilities of visual motor functions for athletes with combination of high levels of both motivational variables. Also first group shows significantly (Table 1) lower errors levels compared to groups

Table 1. Neurodynamic indexes in groups of athletes with different levels of motivation, median (lower quartile, upper quartile).

Indexes	Group 1	Group 2	Group 3
SRT latency [ms]	**239.4** 230.34; 255.29	**270.37*** 260.86; 280.8	**276.86*** 252.96; 280.3
MRT of SRT[ms]	**118.17** 105.9; 173.3	**115.37** 99.96; 143.42	**121.56** 114.3; 141.56
CRT latency [ms]	**405.8** 404.09; 421.29	**429.02*** 395.08; 436.66	**463.59*** 435.57; 485.99
CV [%]	**17.85** 15.2; 19.12	**17.52** 14.36; 21.47	**19.45** 16.96; 22.25
Errors	**0** 0; 1	**1*** 0; 2	**2*** 1; 3
MRT of CRT[ms]	**144.56** 120.61; 178.7	**131.23** 114.55; 140.05	**137.36** 130.11; 140.68
IPT [ms]	**180.03** 148.21; 196.87	**159.8** 124.35; 232.43	**189.91** 156.73; 197.66

* $p<0.05$, values are median (lower quartile, upper quartile).

Table 2. Parameters of the heart rate regulation in groups with the different levels of motivation (supine posture), median (lower quartile, upper quartile).

Indexes	Group 1	Group 2	Group 3
Mean RR [s]	**1.05** 0.95; 1.1	**0.95*** 0.8; 1	**0.95*** 0.8; 0.95
SDNN [s]	**0.052** 0.04; 0.07	**0.048** 0.039; 0.062	**0.049** 0.029; 0.067
CV RR [%]	**4.66** 4.39; 6.19	**5.93** 4.4; 6.39	**4.97** 4.02; 5.22
SI [secret unit]	**64.71** 38.25; 123.63	**71.74** 48.13; 109.32	**93.82** 50.32; 193.42
LF/HF ratio [ms^2]	**1.21** 0.26; 1.9	**0.63** 0.51; 1.33	**1.19** 0.4; 2.03

* p<0.05, values are median (lower quartile, upper quartile).

Table 3. Parameters of the heart rate regulation in groups with the different levels of motivation (upright posture), median (lower quartile, upper quartile).

Indexes	Group 1	Group 2	Group 3
Mean RR [s]	**0.75** 0.7; 0.85	**0.70** 0.65; 0.7	**0.65** 0.6; 0.7
SDNN [s]	**0.069** 0.05; 0.07	**0.054** 0.037; 0.07	**0.052** 0.043; 0.073
CV RR [%]	**8.82** 7.11; 13.12	**7.47** 5.49; 11.04	**6.3*** 4.24; 7.59
SI [secret unit]	**61.88** 56.93; 95.87	**109.33** 76.76; 182.89	**164.57*** 97.49; 256.71
LF/HF ratio [ms^2]	**5.05** 4.79; 5.56	**4.06** 3.6; 4.7	**5.26** 3.58; 5.81

* p<0.05, values are median (lower quartile, upper quartile).

2 and 3. So we can conclude that first group subjects differ from others with greater information processing speed and accuracy.

It should be noted that statistical results showed no significant differences between the second and the third groups. But it is possible to mark lower mean central information processing time in the second group of athletes. We expected that subjects classified in the first group would have a different orthostatic response than those in the second and third group. In fact, the percentage of changes for CV and SI when subjects moved from the supine to the upright posture differed between these groups. This suggests that groups 2 and 3 have a greater decrease in global autonomic regulation of the heart during orthostatic stimulation than group of subjects with extremely high levels of both motivational variables.

Analysis of HRV data shows significantly greater tension of the vegetative regulation in a group with extremely high level of motivation to achieve and low level of motivation to avoid (group 3). It has been indicated by statistically higher stress index SI in athletes of third group (Tables 2 and 3). Growth of heart rate regulatory mechanisms tension in subjects of third and second group is accompanied by decline in nervous system functional state level, due to substantial activating of sympathetic and attenuation of vagal influence on the sinus node (see Table 3) during upright 90° test. This is specified by significantly higher indexes of mean RR in supine and CV of RR-intervals in upright posture (for the third group).

Discussion

As a change of heart rate variability reflects the dynamics of the emotional states of person [15,16], it is possible to imply that motivation to avoid failures is the regulator of functional systems tension of cognitive (neurodynamic indexes) and regulator (vegetative heart rate regulation indexes) processes.

Latent reaction time periods are related to functional brain systems activity [17]. By the error reactions it is possible to assess activity of the attention and short-term memory systems [18]. Non-significantly greater variation coefficient of CRT in the third group can

indicate instability of the system which provides this type of activity [18].

According to obtained results it is possible to assume that motivation to achieve success is responsible for activating of sympathetic, and motivation to avoid failures – parasympathetic nervous system (it can be explained by positive correlation of motivation to avoid and index of mean RR indicating the effect of vegetative influence on a sinus node).

Parasympathetic and sympathetic nervous system activity can be estimated by LF/HF ratio as an index of sympathovagal balance [13]. Our results show statistically non-significant diminishing of LF/HF ratio, in the second group with insignificant predominance of motivation to avoid failures and increase in the third group in which motivation to achieve prevails.

Success appears to have a price. Motivation to achieve causes tension and mobilization of energy resources of organism – thus excessive motivation can exhaust these resources. Thurstone [19] claimed that over motivation can worsen quality of achievement. Probably for every task there is an optimum strength quantity of motivation to maintain concrete task executing efficiency at maximal rate.

At first, growth of energy mobilization can appear such immense, that it will exceed a level, necessary for the performance of task: it is possible to try abundantly, that will result in violation of delicate co-ordination of efforts. Secondly, excessive tension can result in cognitive limitation: a person fully focuses attention on blocked ways to achieve the purpose or on an unattainable result so that does not see possibility of alternative ways or other suitable purpose. And at last growth of tension is often accompanied by emotional excitation, which obstructs the rational processes of reasoning and choice: a person worries, panics and ruins control of a situation. We can assume that there is a certain threshold of tension exceeding of which leads to qualitatively different influences on the behaviour.

Tension is necessary, as it leads to mobilization of forces and power resources of organism. Regarding this fact we can say that there is a certain optimum for the state of tension of the systems involved in vegetative regulation when maximal efficiency of activity is reached.

In this case motivation to avoid is a factor, which regulates the psychophysiological state of an athlete. In the presence of extremely high level of motivation to achieve high level of motivation to avoid secures the decrease of regulator systems tension and maintains high-rate psychomotor performance retaining purpose achievement setting. An aim as an expected and desirable result of activity needs permanent tension of strength. Person who aspires to achievements, experiences permanent desire and volitional tension which affects his psychophysiological state. It is possible to draw an inference that motivation to avoid failures was formed as psychic structure, which compensates excessive tension, caused by the excessive level of motivation to achieve and regulates the psychophysiological state. This phenomenon can be considered as a training effect in elite athlete.

The individual's perception of probability to accomplish the task would cause a need to achieve and a fear of failure. Both are strong emotions that influence the individual's decision on whether or not to attempt the task [20]. If a task simultaneously arouses an individual's motivation to approach the task and motivation to avoid the task, then the sum of the two motivations will be the result. If the result is more positive to approach the task, then the individual will be motivated toward the task. If the result is more positive to avoid the task, then the individual will be motivated to avoid the task. The strength of motivation is also important. Different variables are taken into account for each task and often this is done subconsciously. These variables factor into how much the individual is motivated to approach or avoid the task [21]. In a person motivated to achieve, his behaviour is directed by a positive possibility. In a person motivated to avoid failure, behaviour is directed by an undesirable possibility. The same person may experience both motives at the same time depending on the situation. Which motive the person selects depends on the relative strength of the achievement motives, either to achieve success, or to avoid failure. An individual will find a task easy if he has a high probability of successfully completing the task. An individual will find a task hard if he has a low probability of successfully completing the task.

No matter how much enjoyment athletes receive from their work, people engaged in sport must perform tasks in the pain threats and competition framework. They most definitely face some anxiety and fear about not meeting their trainer standards and perform tasks based on avoidance motivation in order to prevent from losing. They may also aim to perform tasks better both for an ego-boost and for avoiding social incompetence.

It seems idealistic to have one's motivation completely based on receiving positive reinforcement and self-improvement in order to achieve personal success, perhaps it is not realistic. Motivation based on avoidance characteristics may be detrimental to one's self in excess, but it may be a necessary tool in some regards towards the development of long-term approach and mastery goals.

In contrast too much motivation through means of avoidance would completely "undermine intrinsic motivation".

With a deprivation of approach and mastery type goals an athlete may lack the inner-drive needed to succeed in sports. An individual chooses the easiest route and removes most or all task-related effort in order to avoid failure and low self-esteem.

A delicate balance of both approach and avoidance motivation may lead to a more well-rounded and successful individual.

Research conducted by Baturin [22], revealed that subjects directed on avoidance of failures possess higher frustration endurance. Particularly, due to this [23] considers relatively equal combination of motivations to achieve success and avoid failure to be optimal. Results of his works [24] show that overall effectiveness of individuals' activity depends on combination of motivational variables to achieve and to avoid under high level of activity regulation i.e. the psychophysiological states of subjects. Subjects experiencing medium level of motivation to avoid and reduced level of motivation to achieve attain the best results in executing test task at the initial decreased activity regulation level. Such combination of motivational variables results in weakening of subjective criterion strictness of success and allows person to regard unsuccessful results more easily.

As proposed by [23] in his works with sport game players demonstrates that motivation to achieve success and motivation to avoid failures can be compared to attacking and protective strategy. According to this information we can assume that judokas with combination of high levels of both motivational variables are more flexible due to using both strategies during a fight. It is consistent with our data that athletes of the first group perform high speed and quality of information processing comparatively with other groups. Obtained results indicate large possibilities for subjects with combination of high levels of both motivational variables to adequate assessment of situation and rapid decision-making without considerable tension of regulator systems, saving psychophysiological state which maintains high level of efficient activity during trainings and competitions.

To resume the results of our study we can conclude that efficiency of psychomotor performance and optimality of the psychophysiological state is determined not only by the high level of motivation to achieve or avoid failure, but by their combination.

Conclusions

Obtained data show that different combinations of levels of motivation to achieve success and motivation to avoid failure provoke different psychophysiological states. Conducted experiment revealed that combination of high levels of both motivation to achieve and motivation to avoid provides the high level of the psychophysiological state in elite judokas (psychophysiological state which maintains high level of efficient activity during trainings and competitions). The process of forming of the psychophysiological states in subjects is characterized by the cognitive-regulatory functional system.

The presence of activity regulating system tension is predetermined by the decline of level of the psychophysiological state and worsens psychomotor performance with the simultaneous increase of amount of errors during CRT test.

Lastly, research of individual characteristics of motivational sphere in elite judokas discovered that motivation to avoid failures composes a personality formation, which compensates excessive tension, caused by high level of motivation to achieve and thus regulating actual psychophysiological state. This might be considered as an effect of training in athletes.

Further research needs to be conducted to examine the effects of different combinations of motivational variables upon athletes' performance e.g. competitive activity. Thus, illustrating that motivation has a significant effect on performance outcomes may increase attention and research examining some of the same issues sport psychology is focusing upon. This further research would clearly link laboratory experimental findings with settings and tasks relevant to the target population.

References:

1. Mcintosh P: Motivation of Olympic athletes. Olympic Review, 1982; 180: 165–76
2. Biddle S: Motivation and participation in exercise and sport. Sport Psychology: an integrated approach. Proceedings of 8th World Congress on Sport Psychology, Lisbon, 1993' 22–42
3. Dmitrienkova LP: Comparative description of achievement motives in the different kinds of sport. Psychological aspects of preparation of athletes. Smolensk: Znanie, 1980
4. Iljin EP: Motivation and motives. Sankt Petersburg, 2000
5. Korobeynikov GV, Konyaeva LD, Rossokha GV et al: Research of the psychophysiological states of qualified athletes. J Topical Problems of Physical Culture and Sports, 2005; 6–7: 71–74
6. Anokhin PK: Biology and neurophysiology of conditioned reflex. Moskva: Medicine, 1968
7. Atkinson JW: An Introduction to Motivation. N.Y.: Van Nostrand Reinhold, 1964
8. Halisch F, Kuhl J (eds.): Motivation, intention, and volition. Edn. Berlin; N.Y.: Springer Verlag, 1987
9. Cassidy T, Lynn R: A multifactorial approach to achievement motivation: the development of a comprehensive measure. Journal of Occupational Psychology, 1989; 301–12
10. Madsen KB: Modern Theories of Motivation. Copenhagen: Munksgaard, 1959
11. Raygorodskiy DY: Practical psychodiagnostics. Methods and tests. Samara: Bakhrakh, 1998
12. Makarenko NV: Method of conducting of experiment and estimation of individual neurodynamic properties of high nervous activity of a man. J Physiology, 1999; 45: 125–31

13. Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Heart rate variability. Standards of measurement, physiological interpretation, and clinical use. Eur Heart Journal, 1996; 17(3): 354–81
14. Baevskiy RM, Ivanov GG: Heart rate variability: theoretical aspects and possibilities of clinical application. Ultrazvuk, funkcion, diagnjstic, 2000; 13: 108–27
15. Danilova NN: Heart rate and information loading. Vestnik Moskwa University, 1995; 14: 14–27
16. Nuissier F, Chapelot D, Vallet C, Pichon A: Relations between psychometric profiles and cardiovascular autonomic regulation in physical education students. Eur J Appl Physiol, 2007; 99: 615–22
17. Vladimirov AD, Timofeeva TV: Modal characteristics of lateral asymmetry (reaction time analysis). Neyropsikhologicheskiy analiz mejpolusharnoy asymmetrii mozga. Moskva: Nauka, 1986; 168–74
18. Kucenko TV, Filimonova NB: Functioning of information processing subsystems during realization of error reactions. Biology Sciences. Vistnyk Cherkasskogo universitetu. Cherkassy, 2007; 105: 55–61
19. Thurstone LL: Ability motivation, and speed. Psychometrika. New York: Springer, 1937; 2(4): 249–54
20. Bar-Tal D, Frieze I, Greenberg M: Attributional analysis of achievement motivation, some applications to education. Chicago, IL: American Educational Research Association Annual Meeting. ERIC Document Reproduction Service Number ED 087 976, 1974
21. Atkinson JW: Towards experimental analysis of human motivation in terms of motives, expectancies, and incentives. Motives in fantasy, action, and society. Princeton, NJ: Van Nostrand, 1958; 44: 630–43
22. Baturin NA: Influence of success and failure on the functional state of person. J. Voprosy psychologii, 1984; 5: 131–37
23. Stepanskiy VI: Influence of motivation of achievement of success and avoidance of failure on adjusting of activity. Questions of psychology, 1981; 6: 59–74
24. Shilenkov SN: Sociopsychological providing of sport games commands preparation to the competitions. PhD tesis, Sankt Petersburg, 1996