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Interhemispheric Asymmetries and Individual Features of Regulatory Functions in Sport Psychology

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Abstract

In the chapter, the ontogenetic and psychophysiological features of the functions of volitional (arbitrary) regulation of behavior and its connections with the individual features of interhemispheric asymmetries are considered. Methodologically, the study of the peculiarities of human regulatory processes was based on the concept of partial domination of A.R. Luria and on the principles of neuropsychology of individual differences developed by Prof. E.D. Chomskoy and Prof. V.A. Moskvina who implemented the application of this approach in relation to sports activities. In this topic, over the past 5 years, we have conducted several separate studies of male subjects (mainly related to sports) of different age groups—adolescents, young men, and adult men (from 13 to 35 years old); the total sample size in general was more than 400 people. Methods aimed at identifying features of interhemispheric asymmetries (features of partial domination by A.R. Luria), psychophysiological and psychodiagnostic methods aimed at diagnosing individual characteristics (first of all, volitional qualities), and characteristics of arbitrary regulation, such as the R. Kettella test and others, were used. The research results revealed a predominant connection of regulatory processes with the structures of the left frontal lobe (in men) and the strengthening of this connection (increase in its significance) as the brain structures mature and mature.

Keywords: sports psychology, psychophysiology, brain, individual characteristics, functional asymmetries, young athletes, sports of the highest achievements, will, arbitrary regulation of behavior

1. Introduction

Will in psychology, as an independent mental phenomenon, is considered along with the mind and emotions. The problem of individual characteristics of volitional regulation is of great importance in psychology; it is also important in sports psychology in the selection and training of highly qualified athletes and has long been the focus of attention of sports psychologists [1–4].

However, it should be recognized that the problem of volitional regulation of human behavior still does not have an unambiguous interpretation both in general psychology in general and in sports psychology in particular.

In Russian psychology (in the Soviet period of development), the line of studying the volitional efforts of a person was successfully presented. Its representatives viewed effort as a central and specific sign of will. These studies began such scientists as A.F. Lazursky, M. Ya. Basov, further continued V.N. Myasishchev, V.S. Merlin in Russian psychology 50–80s of the twentieth century. It was also developed in the psychology of sports—A.C. Puni [5], P.A. Rudik [6], etc. trait of will. Despite the importance of these studies for their time, however, they can be considered obsolete due to the emergence of new areas of knowledge, such as neuropsychology [7, 8], as well as the neuropsychology of individual differences [9, 10]. Further studies have shown the possibility and prospects of applying this approach to the problem of arbitrary regulation in sports and sports psychology [3, 11–14]. This review presents the views of the leading representatives of Russian sports psychology on the problem of the will and new work in the field of differential sports psychophysiology regarding the possibility of studying the problem of volitional regulation of athletes taking into account the individual characteristics of hemispheric asymmetry [11].

2. Sport psychology about the problem of voluntary regulation

2.1 Avksentiy Caesarevich Pugni, Doctor of Psychology, Professor, representative of the Leningrad School of Sport Psychology (1898–1985)

A. Ts. Pugni singled out three components in the volitional act: cognitive (finding the right solution, self-assessment of the results of volitional actions); emotional (self-motivated, gain); and performing (physical regulation through conscious coercion) [5]. In the concept of Puni, the will is defined as “the active side of the mind and moral senses, allowing a person to control himself, especially in the conditions of overcoming obstacles of various degrees of difficulty.” According to A. Puni, obstacles are a necessary condition for the actualization and development of the will. They arise as a result of the discrepancy between the capabilities of a person (his ideas, thoughts, feelings, and actions) objective conditions and characteristics of activity and are divided into external and internal. External obstacles were understood to mean any objective conditions and peculiarities of the external environment and activities that become an obstacle in achieving the goal, in solving particular problems; under internal obstacles—objective changes occurring under the influence of external conditions of human life and human activity and the state of the internal environment of his body, which serve as an obstacle to the achievement of goals. According to A. Puni, understanding of internal obstacles only as purely mental phenomena (adverse emotional and conflict mental states) is not always justified, since mental phenomena—secondary, derivatives, subjective side of objective changes, and the states of the internal environment of the body. External and internal obstacles interact, manifested in the difficulties of varying degrees [5].

2.2 Petr Antonovich Rudik, Doctor of Psychology, Professor, representative of the Moscow School of Sports Psychology, one of the initiators of the development of the psychology of sports in Russia (1893–1983)

He founded and headed the department of psychology at the GTSOLIFK (today the Russian State University of Physical Education, Sport, Youth, and Tourism),

under his leadership, research was carried out in four main areas [6]. The first group includes studies of the characteristic features of various psychological processes, as essential components of physical exercises. The second includes experimental studies of some sensory processes and motor reactions in their relation to physical exercise. The third includes psychological studies on the problem of training exercise and sports training. And, the fourth includes research on the problem of education of the volitional qualities of the individual during exercise and sports.

P.A. Rudik considered will as the ability of a person to act in the direction of a goal, while overcoming external obstacles. In the minds of most people, the word “will” appears as a synonym for volitional regulation, that is, a person’s ability to overcome difficulties that arise. About the will of man can be judged by how he is able to cope with difficulties. According to P. Rudik, will is the ability of a person to act to achieve a consciously set goal, while overcoming internal obstacles. Thus, the will is synonymous with volitional regulation, whose function is to overcome difficulties and obstacles [6].

Under the leadership of P.A. Rudik staff of the department of psychology, a number of scientific works on the problems of volitional regulation in physical education and sport were carried out. P.A. Rudik noted that studies of the problem of volitional training of athletes, conducted at the Department of Psychology, cover the following range of issues: (1) the psychological structure of voluntary actions; (2) the characteristic of volitional qualities of a person and the conditions of their formation; and (3) analysis of the process of education volitional qualities of an athlete.

In connection with these works in the 70s. the XX century Russian scientists have come to understand the fact that volitional training is part of psychological preparation, considered as a holistic reaction and as an integral part of the training process, does not cover the whole variety of mental functions. The incompleteness of this reaction in its scope, its attribution of teachers to the training process, the awareness of the need to take into account the various components of the psyche led to the separation of psychological preparation as a special education in the framework of training, and not the training process. It is within the framework of the preparation of the qualities required by an athlete that he can get his certainty; therefore, independence, acting as a training process, aimed at the formation of certain qualities, functions, and processes. Psychological training is carried out only by “improving” skills aimed at ensuring a certain state of fitness (or fitness). Training is always connected with the upbringing and development of moral and volitional qualities necessary for an athlete—willpower, will to victory, achievement of a goal, composure, perseverance, firmness in dealing with difficulties, decisiveness, courage, self-confidence, ability to manifest willpower, aimed at overcoming obstacles, discipline, etc. These volitional qualities are formed in the process of training, not as some abstract abilities but as related to the specific conditions of sports activity [6].

At present, due to the growth of professionalization of top-level sports and the revival of mass and youth sports, the study of the psychological basis for the development of strong-willed activity in sports, the basics of the process of strong-willed training of athletes in various sports taking into account their individuality and sports specialization research challenge.

The neuropsychological approach turned out to be more promising in this regard [7, 8], including taking into account the individual features of interhemispheric asymmetry [2].

2.3 Aleksandr Romanovich Luria, Doctor of Psychology, Professor, academician, one of the founders of the Faculty of Psychology and the Department of Neuro- and Pathopsychology of Moscow State University, as well as such areas as neuropsychology and cultural-historical psychology, a world-famous scientist (1902–1977)

His concept [7, 8] on partial domination of brain areas suggests that the basics of individual differences in healthy people are related to the variability of combinations of partial domination of sensory and motor signs (which determines their different contributions to the processes of realization of higher mental functions). To study the features of the functional asymmetries of man, AR methods are now widely used. Luria aimed at assessing “partial left-handedness” (or partial dominance of certain areas of the brain), as well as samples from other authors (for example, the modified Annette questionnaire) included in the “Map of lateral signs” [2]. The partial dominance of certain areas of the brain enhances the corresponding functions (including in the sphere of motor activity), which is also directly related to the problem of motor endowments in sports [2]. N. Sakano paid special attention to the sample of A.R. Luria “cross hands,” which reflects the contralateral domination of the frontal brain [9]. And the frontal lobes are included in the third block of the brain, which is responsible for the functions of control, planning, and regulation of behavior [8].

Taking into account the features of functional asymmetries of the brain in sports activities is important in terms of identifying giftedness in certain spheres of the psyche (for example, in the motor sphere), which is associated with partial dominance of the frontal (motor) brain regions, especially its left frontal lobe. High-class athletes are educated at the level of limiting physical and mental stresses, which determines the deepening of the physiological mechanisms for improving the functional reserves of the human body in the process of adaptation to increasing loads and requires mandatory consideration of the individual characteristics of the athlete (including lateral ones) [2, 3].

The training of young athletes, taking into account their individual lateral profiles, is one of the central tasks of applying knowledge of neuropsychopedagogics in sports [12]. Psychophysiological diagnostics of individual features (including motor ones) can be used to test and identify gifted children and adolescents in certain sports.

Human regulatory processes [8] to a greater extent associated with the third block of the brain, which includes the frontal divisions. Modern research confirms the existing opinion about the presence of asymmetry of brain blocks of Luria (including the third block). Today, it is established that regulatory aspects (at least in men) are mainly provided by the structures of the frontal regions of the left hemisphere. These provisions are confirmed by the data of psychodiagnostic studies of persons with different lateral features and the fact that the dominance of the left frontal lobe (in males) is associated with higher rates of formation of goal-forming functions [2]. Sample A.R. Luria is sometimes referred to as “Napoleon’s test” by experts. It is interesting to note that Napoleon himself (who is considered to be left-handed) had, nevertheless, the right indicator of the “cross-hand” test, which, according to our data, implies a higher level of organizational and prognostic abilities and capabilities [2].

Today, at the Department of Psychology of the Russian State University of Physical Education, Sport, Youth, and Tourism, continuing the traditions of P.A. Rudik, further studies of volitional (regulatory processes) in athletes from the standpoint of the neuropsychology of individual differences [10] and modern sports psychophysiology [11–14] are being conducted.

New data were obtained that indicate the presence of individual features of communication and communication; a higher level of communicative abilities of athletes is mainly associated with left hemisphere dominance [14].

3. Research of human regulatory processes in sports

3.1 Individual features of the propensity to risk and impulsivity

Individual features of the propensity to risk and impulsivity were revealed by the example of students of a sports university [15] with different signs of dominance of the regulatory block of the brain according to A.R. Luria.

The experiment was attended by 80 students of the second year of a sports university at the age of 17–18 years old, of which 44 boys and 36 girls. The study of the individual psychological characteristics of the subjects was carried out using the following tests: questionnaire A.G. Shmelev (aimed at assessing risk appetite) and the questionnaire V.A. Losenkov, aimed at assessing impulsiveness. When analyzing the results of psychodiagnostic testing, the sample of students ($n = 80$) was divided into two subgroups with different indicators of the “cross of hands” sample—right ($n = 33$) and left ($n = 47$).

Analysis of the data showed that higher values of “impulsivity” were noted in the subgroup of subjects with left indicators compared with the right ones (49.38 and 46.97 points, respectively, $p < 0.05$) in the questionnaire of V. Losenkov.

The cognitive styles of “reflexivity-impulsiveness” were distinguished by J. Kagan in the study of intellectual activity, when, in the face of uncertainty, a decision had to be made and the right choice was needed from a number of alternatives. Impulsive people want to achieve quick success, which is why they tend to quickly respond to a problem situation. However, the hypotheses are put forward and accepted by them without careful thought; therefore, they are often incorrect. For reflexive people, on the contrary, slow response in such a situation is typical; the decision is made on the basis of carefully weighing all the pros and cons. Impulsive worse than reflexive, coping with tasks to solve problems, where no alternative answers are indicated. Reflexive are more independent than impulsive. They have a higher attention span. Impulsive have less self-control, low concentration of attention, but more volume. By willingness to take risks, one can understand the potential of the subject, manifested in the desire to act in situations of uncertainty, and it is successfully realized when it is possible to reduce this uncertainty through cognitive and personal efforts. Under impulsivity refers to actions and decisions taken on the first impulse, without first analyzing the situation (such decisions can also be called emotional). If we consider such personal property as a propensity to risk, then it can also be understood as a person's desire to choose situations of risk, danger, and uncertainty and to receive new and stronger impressions from it (associated with adrenaline rush). There is an analysis of the correlation between the concepts of “rationality” and “impulsivity.” The trend of high rationality and low impulsivity, and vice versa, was revealed by prof. T. Kornilova both on the student sample and on the sample of teachers [15].

Many sports are associated with constant risk appetite. If we consider this concept more broadly, then it may reflect a common attitude to act in relation to various uncertain, risky situations. The readiness to resolve problem situations in the first place speaks of personal and social maturity.

3.1.1 Conclusion

According to the test data, it was found out that the right indicator in the “crosshair” sample correlates with lower “impulsivity” indicators for students

at a sports university. This suggests the presence of individual differences in the features of the regulatory functions and indicators of impulsivity associated with inter-hemispheric asymmetries of a person. The results obtained can be used in the preparation of athletes, taking into account their individual characteristics.

3.2 Studies of the individual characteristics of control over the action associated with functional asymmetries

The features of control over the action [16] were studied on the example of students of a sports university (boys and girls 16–17 years old, $n = 78$) with different signs of asymmetry of the regulatory block of the brain according to A.R. Luria. For the diagnosis of volitional regulation, the “Kul’s control scale” was used [17], which identified individual characteristics of control over the action, due to the asymmetries of the brain. The data obtained allow to conclude that lower emotional excitability, self-confidence (up to self-confidence), suppression of negative emotions, including the desire to avoid, move away, get out of situations that are extremely unpleasant and incompatible with human attitudes, to a greater extent associated with left hemispheric activation (right indicator of the sample “cross of hands”).

The results are consistent with data from a study conducted by Y. Kul together with S.A. Shapkin and A.N. Gusev [17], who revealed left-hemispheric dominance of practically all components of self-regulation in the action-oriented subjects. When an unpleasant event occurs in the action-oriented subjects, the control system quickly identifies the unpleasant event, determines the degree of influence on the system (compared to other events), and alerts the mechanisms of the left hemisphere associated with the processes of preparation and control of motor programs. The authors believe that action-oriented subjects already at the early stages of processing stress information overcome the negative impact while maintaining a complex of relationships within the action control system (selective attention, emotional preferences, targeted representations, etc.).

The data obtained can be useful in the preparation of highly qualified athletes, (taking into account the individual characteristics of arbitrary regulation and control over the action in sports psychology).

3.3 Research of communication of volitional qualities and stability of motivation for playing football

Studied communication qualities and sustainability motivation to play football on the example of the 21st athlete-football (boys 15–16 years, $n = 21$). For the diagnosis was applied, the method “Color test” Luscher M., “Diagnostics of the motivational structure of personality” of Milman V., “Assessment of the relationship to the coach, the partners” of Marishchuk V.L. et al., “Analysis of the level of development of volitional qualities” of Puni A. Identified individual peculiarities of communication motivation to play football with the level of development volitional qualities of young footballers.

3.3.1 Conclusion

1. In football players aged 15–16 years old, the sustainability of sports motivation is promoted by:
 - a. Pervasiveness and perseverance developed above the average, characterizing the stability of a motive as a motivational attitude and situationally

manifesting stability of a motive, respectively, as well as endurance and self-control;

- b. Attitude to the coach (except for the athletes of the group who are experiencing negativism, inadequate reactions, and resentment toward the coach);
- c. The tendency toward frustration stability, predisposing to action in case of failures;
- d. Willingness of the group for creative work (the motive of creative activity is the highest indicator of the motivational profile of a group of football players in general).

2. Reduce the sustainability of sports motivation:

- a. Unproductive compensatory activity, tension, and frustration due to losing at competitions are compensated for by experiencing a negative attitude toward life and the demand to fulfill one's requests, otherwise the relationship is interrupted (except for the second subgroup);
- b. The predominance of terminal motivation over procedural, including poorly developed motives of public utility;
- c. Emotional passivity and multidirectionality within the emotional sphere (which is typical for young people), including associated with identified contradictions in motivational tendencies [striving for a high level of livelihoods with unwillingness to take active steps in the workplace (learning) activities].

The results can be used in the preparation of athletes, taking into account their individual characteristics and the level of development of volitional qualities of young football players [18].

3.4 Sports managers' goal-setting and psychological timing abilities

3.4.1 Background

Sport management may be described as the theory and practice of efficient corporate control in the sports sector, with the individual psychological qualities of a manager being crucial for the process success [19]. These qualities may include the following: time perception, timed prospects, goal-setting, field-dependence/independence, anticipation, etc. [2], and each of these qualities may be analyzed versus the individual interhemispheric asymmetries [2, 5, 6, 11].

3.4.2 Objective of the study

Objective of the study was to identify and rate the time perception variations in sport managers in the context of their individual functional asymmetries.

3.4.3 Methods and structure of the study

Subject to the study was a sample of right-handed highly educated mid-level sport managers aged 25–35 years ($n = 30$). The individual interhemispheric asymmetries were tested based on the Luria's Arms Folding Test [5], the test data being indicative of a domination of the relevant counter-lateral frontal

lobe [2, 7]. Based on the Arms Folding Test Rates (AFTR), the sample was split up into the following two groups: Right AFTR Group and Left AFTR Group of 15 people each.

The time perception characteristics of the subjects were tested using the Time Semantic Differential Test (E.I. Golovakha and A.A. Kronik) [20] that implies the time perception process as the structure including the following three constituents: time continuity/discretion, time intensity, and the emotional attitude to a time range [20]. The study data were statistically processed using STADIA software.

3.4.4 Study results and discussion

The test data generated by the Temporal Semantics Differentiation Test showed notable differences only on the Time Intensity scale, with the Right and Left AFTR Groups rated by 19.4 points and 14.5 points on average, respectively ($p < 0.001$).

It should be noted that the time perception and timed prospects are known to be closely correlated with the goal-setting ability. As provided by A.N. Leontiev, a goal plays a system-forming role when an activity is designed, as follows: “Goal-setting process provides a key impetus for one or another subject activity”; with the goal-setting (goal-constructing) notion being defined as the “subjective identification of the goal that means the nearest target outcome for the subject activity that drives it forward” [19]. Such notion as anticipation (meaning the ability to foresee/predict a sequence of events) also plays an important role in the time perception, with the anticipation development level being generally considered indicative of the manager’s mental qualities on the whole.

The above findings were supported by the relevant intellectual test data including the Raven’s Progressive Matrices (RPM, a nonverbal group test) and Cattell’s Questionnaire data. The test results may be explained by the higher level dynamic characteristics of the thinking process in the male subjects tested with the Right AFTR by the Hands Crossing Test [2]. We believe that the finding gives us reasons to state that the male subjects tested with the Right AFTR by the Arms Folding Test are more rational, self-reliant, and independent, plus more stable in the behavioral models they opt for. The individuals tested with the Left AFTR by the Arms Folding Test showed lower rates on a few test scales, the rates being indicative of the higher emotionality, egocentrism, field-dependence, sensitivity to stresses, and lower stability of the chosen behavioral models. The study data and analyses also showed their higher developmental rates in verbal intelligence, emotional stability, domination, self-control, field-independence, anticipation ability, overall internality, and self-management ability (including the goal-setting ability).

Our study findings may be interpreted as indicative of the sport managers with dominating left frontal lobe being more inclined to perceive and rate time in a more intense manner and, hence, expected to show higher self-management, self-control, and anticipation rates, i.e., the qualities of high professional value for a sport manager.

3.4.5 Conclusion

The study data may be applied for the differentiation diagnostics in the human resource screening/selection process for the sport management positions and for the vocational orientation purposes.

3.5 Study of individual peculiarities of regulation in young sportsmen of different ages

One of our last studies concerned the study of the individual characteristics of arbitrary regulation on the example of students of a sports university, taking into account the signs of functional asymmetries. Individual differences were studied in young athletes with regard to partial asymmetries according to A.R. Luria. To identify the individual psychological characteristics, a study was conducted with the help of R. Cattell's personal questionnaire (HSPQ); 45 teenagers 14–16 years old engaged in wrestling participated in the experiment. Of these, 25 subjects were with right-hand indicators of the “crossing hands” test according to A.R. Luria, which reflects the dominance of the left frontal divisions and 20 adolescents were with the left indicators of this test. The technique was also carried out on 110 students of 1–4 courses of a sports university at the age of 18–25 years (young men) also with different signs of asymmetry. It was revealed that the partial dominance of the left frontal lobe (both in adolescents and young men) is associated with higher indices of individual characteristics associated with volitional regulation.

3.5.1 Methods of research

The experiment was conducted in the form of group testing of two samples of subjects. To identify the individual psychological characteristics, a study was conducted using the personal questionnaire R. Cattell (adolescent version—HSPQ) in which 45 adolescents 14–16 years old engaged in wrestling participated. Of these, 25 subjects were with right-hand indicators of the “crossing hands” test according to A.R. Luria [7], which reflects the dominance of the left frontal regions (related to the arbitrary regulation of behavior) and 20 adolescents were with the left indicators of this sample. The study was conducted on the basis of the sports school of the Department of Physical Culture and Sports of Moscow [21].

A similar study was also conducted on 110 students of 1–4 courses of a sports university at the age of 18–25 years. For the study, the personal questionnaire was used by R. Cattell (Form A) and the indicators of the “cross-hand” test according to A.R. Luria. Thus, the total volume of the samples studied was 155 subjects. Statistical data processing was performed using the U-Wilcoxon-Mann-Whitney test.

3.5.2 The results of the study of teenage athletes

Comparison of the averaged data of the personal questionnaire R. Cattell (adolescent version—HSPQ) showed the following. According to factor E (“subordination—dominance”), higher values were noted in the group of adolescents with the right indicator of the “crossing of arms” sample—6.8 stan, in the group with the left indicator—5.2 ($p < 0.05$), which indicates about greater activity and leadership qualities of the subjects with the right indicators. The values for factor Q2 (“degree of group dependence”) are higher in the group with the right symptom—6.6 stan, in the group with the left—4.3 ($p < 0.03$). The values for factor Q3 (“degree of self-control”) are higher in the group with the right symptom—6.2 stan, in the group with the left—4.4 ($p < 0.03$).

3.5.3 The results of the study of students of sports universities

On the factors of the questionnaire R. Cattell (form A) were obtained the following results. According to the factor F (“expressiveness-restraint”), higher values

were noted in the group of persons with the right indicator of the “crossing of arms” sample—5.5 stan, in the group with left—4.7 stan ($p < 0.03$), which indicates about greater activity, liveliness, and flexibility of behavior of subjects with the right indicator of the sample “cross arms”. The values for the N factor (“naivety—insight”) were lower in the group of people with right-hand indicators of the “crossing hands” test—5.1 stan, while in the group with left ones they were higher—5.9 stan ($p < 0.03$).

3.5.4 Discussion

In general, according to the results of the study, subjects with left hemispheric dominance reveal higher data on the R. Kettell method scales, which are associated with activity and self-organization, which in general may indicate a greater severity of indices of arbitrary regulation in this group of individuals.

The obtained data correlate well with the results of previously conducted psychodiagnostic studies. According to the data of the conducted experiments, it can be stated that as they mature (as they move from adolescent to older age groups), there is an increase in the indices of volitional qualities of the personality (in the method of M. Chumakov) and the indicators of the sustainability of the choice of color incentives. This is especially clearly manifested in the “left hemisphere” subjects (i.e., with the right-hand indicators of the “crossing hands” test) [2].

3.5.5 Conclusion

The obtained data can be successfully used in solving differential diagnostic problems in sports psychology, including the diagnosis of individual features of the regulatory functions of athletes.

The results show the presence of asymmetry of the third (regulatory) block of the brain according to A.R. Luria. This position is also confirmed by the data of psychodiagnostic studies of adolescents and young men with different lateral features [13, 21] and previously established data that the partial dominance of the left frontal lobe (often in males) is associated with higher rates of goal formation and volitional regulation. Our pilotage studies conducted earlier show that these indicators are less specific (more “blurred”) for girls and women, i.e., they are not always confirmed by statistical processing. The results can be used practically to diagnose the individual characteristics of arbitrary regulation in sports psychology when training highly qualified athletes and to predict human behavior in extreme sports [2, 3].

3.6 Study of voluntary regulation and motivation achievement of success in young figures

Motivation to play sports is associated with many mental qualities, including their volitional characteristics [22]. Earlier, we noted that, according to psychodiagnostic studies, males with left hemispheric domination can identify higher levels of voluntary regulation, organization, risk appetite, focus on success, and higher levels of anticipation (or anticipation of future events) [2]. In sports psychology, such quality as the ability to anticipate and predict the development of future events is considered an important personal characteristic. Taking into account all the above, we conducted a study to identify the links of regulatory functions with the motivation to achieve success and other personal characteristics among teenagers-skaters (singles).

3.6.1 Research methods

The method of diagnostics of signs of partial domination according to A.R. Luria [7] was used (as a method of psychophysiological and neuropsychological diagnosis of the individual characteristics of human inter-hemispheric asymmetry). When implementing the method of psychological testing, we used the test of T. Ehlers (for studying the features of success motivation), the adolescent version of the test by G. Eysenck and the adolescent version of the R. Cattell method (HSPQ—for the study of the individual psychological characteristics of figure skaters). Statistical data processing was performed using the U-Wilcoxon-Mann-Whitney test.

3.6.2 The subjects

The study involved lone skaters aged 13–14 years (adolescent boys, $n = 45$). The subjects were divided into two subgroups: the first included subjects with a left hand cross-over indicator ($n = 23$), which reflects the partial dominance of the right frontal lobe related to the regulative block of the brain according to A. Luria. The second group consisted of subjects with a right-hand indicator of the “crossing of arms” sample according to A.R. Luria, which reflects the partial dominance of the left frontal lobe ($n = 22$). All subjects had approximately the same age and social status. The study was performed on the basis of schools of figure skating in the city of Vienna (Austria) [22].

3.6.3 The hypothesis of the study

Adolescent boys of 13–14 years old with right-hand indicators of the “cross-hand” test (which reflects the partial dominance of the left frontal lobe of the regulatory block of the brain) may show a higher level of motivation for success compared with adolescents with left-hand indicators of this test.

3.6.4 Purpose of the study

To study the features of the motivation to achieve success with single skaters (adolescent boys aged 13–14 years), taking into account individual psychological characteristics and profiles of functional asymmetries.

3.6.5 Results and discussion

3.6.5.1 Test T. Ehlers

In the aggregate of the characteristics of an effective sports activity, an important factor is the motivation to succeed. A real athlete with a high level of motivation is always at the center of any sports situation, and effective activity in any field implies a high degree of motivation.

The study of patterns and characteristics of the motivational sphere makes it possible to predict the behavior of an individual in a given situation. Therefore, the motivational sphere is one of the most important components of personality; it becomes the main object of study for psychological science in general and in the study of behavioral psychology in sports in particular.

According to T. Ehlers, the motivation to achieve success may manifest itself as follows: a person with a higher motivation to success prefers a medium or low level of risk, and he avoids a high level of risk. With strong motivation, the expectation of success is usually higher than with weak motivation; in their activities, people with strong motivation put more effort and energy to succeed, they show a desire for success.

On the scales of the T. Elers questionnaire, the following statistically significant differences were obtained (in terms of averages). In the course of the study, differences were found in the degree of manifestation of the level of motivation for achieving success in the “right hemisphere” ($n = 23$) and “left hemispheric” ($n = 22$) subjects, who were 15.2 points and 18.6 points, respectively, the differences are significant ($p < 0.05$). Thus, the indicators of motivation of the first group correspond to the average level of motivation to achieve success (for the “right-hemisphere,” $n = 23$) and a higher level of motivation for achieving success for the second group of figure skaters (for the “left-hemisphere,” $n = 22$).

3.6.5.2 Test Eysenck (adolescent version)

In the “right-hemisphere” skaters on the scale of “neuroticism-mental stability,” this figure was 17.2 points, which corresponds to an increased level of neuroticism and indicates their higher emotionality. In the “left hemispheric” group, this indicator was 9.5 points, which corresponds to the normative indicators ($p < 0.05$). Differences in other scales between groups in this method were not identified.

3.6.5.3 The teenage version of the test R. Cattell (HSPQ)

For HSPQ factors, data were obtained: the “left hemispheric” skaters (as opposed to the “right-hemispheric”) showed a higher level of emotional stability (factor C, 4.4 and 6.3 stan, respectively, $p < 0.05$); these adolescents are more self-sufficient and less dependent on the group (factor Q2, 4.5 and 7.6 stan, respectively, $p < 0.05$); they also show a higher level of self-control or volitional qualities (factor Q3, 5.3 and 7.2 stan, respectively, $p < 0.05$).

Thus, after analyzing the data obtained, the following conclusions can be made: the indicators of motivation of the “right-hemisphere” group correspond to the average level of motivation for achieving success and a higher level of motivation for achieving group success (“left-hemisphere” adolescents, $n = 22$). Psychodiagnostic indicators of “right-hemispheric” skaters ($n = 23$) show higher neuroticism indicators in Eysenck’s technique, which indicates their greater emotionality and lower level of neuropsychic stability, which indicates a lower resistance to stress. The “left hemisphere” skaters ($n = 22$) have a higher level of emotional stability (factor C in the HSPQ test); these adolescents are more self-sufficient and less dependent on the group (factor Q2); they also show a higher level of self-control (factor Q3 of the HSPQ test), which indicates a higher level of development of volitional regulation, in contrast to the “right-hemispheric” skaters (the identified differences are significant).

3.6.6 Conclusion

The indicators of the “right-hemispheric” and “left-hemispheric” teenage skaters have significant differences related to the individual characteristics of inter-hemispheric asymmetries. In adolescent athletes with dominance of the left hemisphere, links were found between hemispheric dominance and a tendency toward authoritarian behavior, the presence of a high level of motivation for success, a tendency to take risks and to rivalry, a higher level of organizational skills. In the activity of right-wing athletes, organizational skills are less pronounced, they are more focused on avoiding failures than on achieving success. It should also be noted that these features (the connection between a higher level of arbitrary regulation and the motivation to succeed)

are more clearly expressed in males; in women, these connections are not always so straightforward.

Thus, the hypothesis of the study that the motivational and volitional sphere of adolescent athletes is associated with the psycho-physiological features (individual hemispheric asymmetry) is fully confirmed; the goal of the study is achieved.

3.7 Regulatory functions and Internet dependence persons for student higher education

The problem of the regulation of the psyche is one of the main in modern psychology [2]. Deregulation is considered dependent forms of behavior (so-called addiction). Such manifestations as accentuation and psychopathization of a person in an unstable type are a pronounced manifestation of dependence and lack of independence. In clinical psychology, addictive behaviors are more studied on the example of chemical addicts (chronic alcoholism and drug addiction). Modern studies indicate a significant accumulation of signs of right-hemispheric partial domination of chemical addicts [2].

Recently, papers have emerged concerning the study of the characteristics of inter-hemispheric asymmetries in young Internet addicts. Analysis of behavioral reactions in groups of Internet addicts showed that dependent behavior is more typical of right hemisphere subjects and ambidexters. For groups with the right hemisphere specialization, the various parameters of addictive realization manifest themselves with a pronounced desire to violate the norms and social rules. Similar data were obtained in our study [2].

The literature data show that the features of functional asymmetries and the individual characteristics of psychological time in Internet addicts are still little studied. To study the individual characteristics of psychological time in this category of persons, we conducted a study with students of a sports university.

3.7.1 Hypothesis

A higher level of Internet addiction is associated with the predominance of right hemisphere dominance, which also affects the specifics of temporal perception.

3.7.2 The technique

To identify the possible connection of Internet addiction with the peculiarities of psychological time in a sample of young subjects (students of a sports university 18–17 years old, $n = 100$), the following psychodiagnostic methods were used:

1. Features of individual profiles of laterality, taking into account signs of partial dominance according to A.R. Luria (test “Map of lateral signs”) [2].
2. The severity of Internet addiction (Kulakov S. test, 2004).
3. Features of time perception using the Zimbardo test (taking into account the availability of data on the individual features of the perception of time with different variants of the dominance of the right or left hemispheres) [2].
4. Individually psychological features using the test R. Cattell (form A).

(Other psychodiagnostic methods were used; however, these results are not considered in this article.)

3.7.3 Sample

Students from the 1–2 courses of the Russian State University of Physical Culture, Sports, Youth, and Tourism of 17–18 years old acted as subjects; the sample size was 100 people.

3.7.4 The results of the study

Currently, the study is ongoing, the data obtained are preliminary. As a result of the use of factor analysis, nine factors were identified (factorization completeness was 90%).

The factor “Behavior normativity” suggests that students with a predominance of right laterality (left hemisphere) in the motor and analyzer fields tend to behave in accordance with generally accepted standards, are able to foresee the possible consequences of their actions, are motivated to achieve future goals, and are ready to sacrifice today’s pleasures for the sake of future success are more disciplined. High rates were noted on the “Normativity of Behavior” scale (factor G) of the R. Kettell test and on the “Future” scale in the F. Zimbardo’s “Time perspective” method.

On the contrary, subjects with a predominance of left laterality (right hemisphere) in the motor and analyzing spheres are subject to emotions, disagree with generally accepted moral norms and standards, ignore duties, can act antisocial, inconstant, changeable, careless, lazy, independent, subject to influence unprincipled, irresponsible, and unorganized. Indicators of time perception are more related to the orientation to the present and the past.

3.7.5 Discussion

The data obtained are generally consistent with the proposed hypothesis. Earlier in our works, manifestations of left hemispheric insufficiency in individuals with addictive behaviors have been identified, which explains the weakness of predictive and regulatory functions [2].

We found that patients with chronic alcoholism tend to rate time as more discrete, less stressful, and less pleasant (compared to healthy subjects). The temporal orientation of patients is characterized by a lesser connection with the present and a greater orientation toward the past. In patients with chronic alcoholism, an abnormal distribution of individual lateral profiles is also detected. The results of our study of drug addicts show that there are significant differences in the nature of temporal orientations between drug addicts and healthy subjects. Drug addicts are more centered on the past and the present; the future is less significant for them. At the same time, drug addicted individuals feel time as less stressful (stretched, slowly flowing, empty, and unorganized) and less emotionally pleasant compared to healthy subjects. Assessment of drug addiction time is less pleasant due to the greater connection of the right hemisphere with negative emotions. The predominance of right-hemispheric functions in drug addicts can be explained by experiencing time as less stressful, since the left hemisphere is associated with a higher level of activity, and the right hemisphere is associated with relaxation and relaxation. It has been established that left-hemispheric individuals are more inclined to underestimate and re-measure durations compared to right-hemispheric individuals who are more inclined to overestimate and under-measure time intervals [2].

S.L. Rubinstein wrote that one of the most important components of the structure of personality is its focus [23]. The amorphousness and vagueness of life goals and the absence of a specific orientation of the individual can be considered as the soil on which different states of dependence develop. It is noted that the lack of

volitional regulation and autonomy most often affects persons with an accentuation of the person of an unstable type who easily fall under someone else's negative influence, often drop out of school or work, alcoholize, or use drugs.

3.7.6 Conclusion

The research data testify to the weakness of regulatory processes in groups of Internet addicts and the accumulation of signs of right-brain partial domination in their sample. Thus, previously obtained data on the accumulation of signs of right-hemispheric domination in chemical addicts (in young people with manifestations of chronic alcoholism or drug addiction) [2, 24] can be extended to intensity addicts, which indicates the weakness of the functions of arbitrary regulation in them and says about the features of time perception in this sample. The stated results are preliminary (the main body of data is in the final stages of processing); however, they already indicate the presence of individual features of time perception in Internet addicts of a young age and can be used for differential diagnosis [25].

4. Conclusion

The obtained data allowed testing the methods of psychological and psychophysiological diagnosis of regulatory processes in sports. The research results confirm the prospects and productivity of the study of the problem of volitional regulation of athletes, taking into account the individual characteristics of interhemispheric asymmetry from the standpoint of differential sports psychophysiology [11].

The data show the presence of asymmetry of the third (regulatory) block of the brain according to A.R. Luria. This position is confirmed by the data of psychodiagnostic studies of adolescents and young men with different lateral features and coincides with previously established data that the partial dominance of the left frontal lobe (more often in males) is associated with higher rates of goal formation and volitional regulation. In general, the results of the research allowed to identify the preferential relationship of regulatory processes with the structures of the left frontal lobe (in men) and the strengthening of this connection (growth) as the brain structures mature and mature.

The presence of weakness in arbitrary functions of right-hemispheric Internet addicts also indirectly confirms the greater involvement of the left hemisphere in the arbitrary regulation of behavior (mainly in males).

The problem of individual features of voluntary regulation in female subjects remains unresolved, which may be associated with such a concept as "gestational dominant" (which provides the function of procreation), and which may have variable hemispheric localization. This requires further more in-depth research in this area.

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Conflict of interest

The authors have no conflicts of interest to disclose.

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