

Original Article

Research on the brain asymmetry of qualified athletes using dance sport as an example

OLENA SPESYVYKH¹, GEORGII LOPATENKO², OLENA POLIANYCHKO³, ANASTASIA VOROBIOVA⁴, LESIA LYTVYNCHUK⁵, SVITLANA SALNYKOVA⁶

^{1,2,3} Borys Grinchenko Kyiv University, UKRAINE

⁴ National University of Ukraine on Physical Education and Sport, UKRAINE

⁵ National Academy of the State Border Guard Service of Ukraine named after Bogdan Khmelnytsky. UKRAINE

⁶ Vinnytsia Institute of Trade and Economics of KNUTE, UKRAINE

Published online: July 31, 2019

(Accepted for publication: June 25, 2019)

DOI:10.7752/jpes.2019.s4204

Abstract:

Aim: To determine the asymmetry coefficient of qualified dancers. *Materials:* The study involved 84 dancers of various qualifications of 18–35 years of age, who were divided into 2 groups for identifying individual features: 1) highly skilled – 44 athletes (6 – honoured masters of sports; 12 – masters of sports of international class; 26 – masters of sports of Ukraine); 2) athletes of first adult category – 40 athletes. Because the study was focused on dance couples, an equal number of men and women was represented in the sample. The study was conducted on the basis of the sport dance club "Supadance" at the National University of Ukraine on Physical Education and Sport (Kyiv, Ukraine). *Results:* A strong tendency towards right-hemispheric activity was revealed in both groups of dancers. The asymmetry coefficient of highly qualified athletes was significantly higher than that of the athletes of first adult category. *Conclusions:* The importance of a thorough assessment of the lateralization of brain function for the timely identification of sinistrality in sports and professional selection was confirmed. This is important because there are many left-handed leading athletes in different sports. Most of them are distinguished by a high level of creativity and abilities for original artistic work. The tendency towards right-hemispheric activity was determined. This criterion can be considered as one of the most significant components for the selection of children in dance sport. This tendency indicates the origins of special abilities.

Key words: type, dancers, dance sport, selection, highly skilled, right-hemispheric activity

Introduction

The principle of lateralization, proposed by A. Luria (1975), laid the foundation for the study of the asymmetry functioning of the hemispheres of the brain. The problem has been studied by scientists for many years, including researches in sport. Thus, experimental studies have been carried out on the manifestations of asymmetry in various sports (A. B. Kogan, A. B. Poroshenko, P. N. Ermakov, G. A. Kuraev, 1982); there are known data on the study of the asymmetry profile of athletes in various sports (E. M. Berdichevskaya, A. U. Gronskaia, Ya. E. Bugayets, Khachaturova I. E. 2011), the physiological and psychophysiological features of highly skilled athletes of a wide range of sports, and the characteristics of inter-hemispheric asymmetry of athletes (G. Korobeinikov, L. Korobeinikova, 2014; S. Wolf, E. Brölz, P. Keune, B. Wesa, M. Hautzinger, N. Birbaumer, et al., 2015; Polianychko O., Ljpatenko G., Biletska V., Yasko L., Spesyvykh O., Yeretyk A. (2018)).

As noted in previous researches, the lateralization of brain functions and the distribution of the brain functions between the hemispheres are important in athletes' training in dance sport. The tendency of beginning dancers to right-hemispheric activity predetermined the study of similar indicators of highly skilled athletes, who achieved significant results in elite sport (O. O. Spesyvykh, I. M. Soronovich, 2008).

The highest level of sport achievements become the property of talented athletes, as well as the whole nation. The effectiveness of competitive activity is closely related to the athlete's personal characteristics and depends largely on his individual psychological qualities (N. Vysochina, A. Vorobiova, 2017). The selection of talented athletes is reduced to finding the presence of physical and psychological, and also physiological qualities. The combination of such qualities contributes to the high results achievement. In this regard, the study of the lateralization of brain functions become one of the central problems in psychophysiology. It should be noted that the lateralization of brain functions is considered as a key factor in adapting to extreme loads in sport of higher achievements, as well as the ability to predict professional success basing on partial accounting for lateralization of sensory and motor preferences (A. Ulan, 2017). The importance of the further study of the individual characteristics of talented athletes is also due to the opinion of experts, who identified "ability and talent" as the most significant components of success in dance sport.

Talent is a high level of abilities (firstly, special) extremely significant for particular kind of activity

(including sports) as prerequisites for success, which are located in the innate structural and functional features of the brain (M. C. Corballis, M. J. Morgan, 1978). Modern ideas about the functional asymmetry of right-left hemispheric relations as common abilities for artistic activity are gaining in importance (N.V. Rozhdestvenskaya, 1983). V.V. Ivanov (1985) also points out (on the basis of the physiological foundations of the creative process) that the nonverbal right hemisphere normally is associated with creativity. M. Corballis (2014) make accent on the importance of the right hemisphere for creativity and intuition. Studies of A. Galaburda indicate that anatomical asymmetries may help explain the range of human talents (A. Galaburda, M. LeMay, T. Kemper, N. Geschwind., 1978). The level of children's mastery in dancesport was studied by a group of scientists of Lviv State University of Physical Culture (T. Osadtsiv, V. Sosina, F. Muzyka, B. Vynogrsdskiy, 2015). In general, we agree that taking into account knowledge about the inter-hemispheric connection of the brain will allow scientifically substantiate adequate pedagogical influences on the athlete's motor and mental sphere in the process of training, and will also improve principles of professional and sports selection. Thus, the study of asymmetry coefficient of qualified athletes will allow to discover its importance for further research and improve the system of professional selection in dancesport.

Hypothesis. For qualified ballroom-dancers, the activity of the right hemisphere is significant, and the asymmetry coefficient could be one of the determining factors for the selection of talented athletes.

The purpose of the research is to study an asymmetry coefficient of qualified dancers.

Material and methods.

The participants. The study involved 84 dancers aged 18–35 years, which were divided into two groups: 1) highly skilled – 44 athletes (6 – honored masters of sports; 12 – masters of sports of international class; 26 – masters of sports of Ukraine); 2) athletes of first adult category – 40 athletes. Since the study concerned dance couples, an equal number of men and women were represented in the sample.

Procedure (research organization). The study was conducted in Kyiv (Ukraine) on the basis of the sport dance club "Supadance" of the National University of Ukraine on Physical Education and Sport.

The lateralization of brain functions of ballroom-dancers was studied using the method of determining the asymmetry coefficient (Methodical developments for special psychiatric physiology of higher nervous activity, 1994). In this method, the level of functional asymmetry of the brain is expressed quantitatively in the form of the asymmetry coefficient (AC, %) based on the analysis of simple behavioral patterns.

The method of personality diagnosis using psychogeometric test by S. Dellinger is a projective method of studying personal qualities, which was used as an auxiliary to the main ones. The proposed test allowed to determine the orientation of the personality, to give a detailed description of personal qualities and characteristics of human behavior in typical situations. The accuracy of the predictive value of the test is 85% (D. Ya. Raygorod (2001)).

Statistical analysis. Using Student's t-test, the indicators of an asymmetry coefficient and right-hemispheric activity were compared. The significance of differences between the samples was determined on significance level $p < 0.05$. According to the obtained research data, the statistical indicators of the sample were determined: arithmetic mean – \bar{x} ; standard deviation – S. The data were processed using Excel 2010 spreadsheets (Microsoft, USA) and Statistica 6.0 (StatSoft, USA).

The results of the study.

Previous studies of asymmetry coefficient of dancers showed significant prevalence of the right hemispheric activity by young dancers, compared with their peers who do not engage in dancesport (Spesyvykh O. O., Soronovich IM., 2008). The data of E.V. Eismont (studies was established on 12-15 years old children, not practicing dancesport) confirmed the left hemispheric dominance, which is increasing with age (E.V. Eismont, N.V. Lutsyuk, T. A. Aliyev, 2012).

The activity of the right hemisphere of dancers (children and adults) is decreasing with age slightly and there is a tendency to some increasing of the left hemisphere activity. This is due to:

- volitional regulation in sport activity, which activates the functions of the left (speech) hemisphere. V. Moscvin notes that the volitional regulation of teenage athletes (14–16 years old) is associated with a predominance of the left hemisphere (V. Moscvin, N. Moscvina, 2016);
- the formation of controlled movements through the regulatory function of the language (O. Shynkaruk, A. Ulan, 2016). The formation of voluntary consciously controlled movements, which have primary importance in sports activities, is closely connected with clarifying the role of word (M. C. Corballis, 2014).

In dancesport, the formation of conscious movements is particularly significant, and subsequently the degree of conscious control of them becomes no less important. This is determined by the competition rules, according to which judges evaluate the controllability of movements and the ability of partners to maintain a balance. The level of right hemispheric activity in the groups of athletes of the first adult category and highly skilled dancers was determined by summing up the indicators of the low level of asymmetry, ambidexterity and sinistrality. Table 1 shows the average values of an asymmetry coefficient of dancers of various qualifications.

Table 1

The ratio of the asymmetry coefficient of dancers of various qualifications (n = 84)

The level of asymmetry	value level, score			
	I group (n = 44)		II group (n = 40)	
	\bar{x}	S	\bar{x}	S
High and very high	84,6	4,6	84,6	5,3
Above the average	59,4	5,3	62,4	4,6
Average	46,1	3,9	46,7	3,8
Below the average	32,9	2,8	32,7	2,1
Low	23,1*	1,3	15,4	1,4
Ambidextria	7,7*	0,6	4,2	0,5
Left-handedness (sinistrality)	-14,1*	1,3	-7,7	0,9

Notes: I group – highly skilled athletes, II group – athletes of first adult category;
* – statistically significant difference between athletes of I and II groups ($p < 0.05$)

The table 1 data indicates that the level of asymmetry from high to below the average for the dancers of the two groups have approximately equal values. Significant differences were recorded in terms of low level of asymmetry, ambidexterity, and sinistrality.

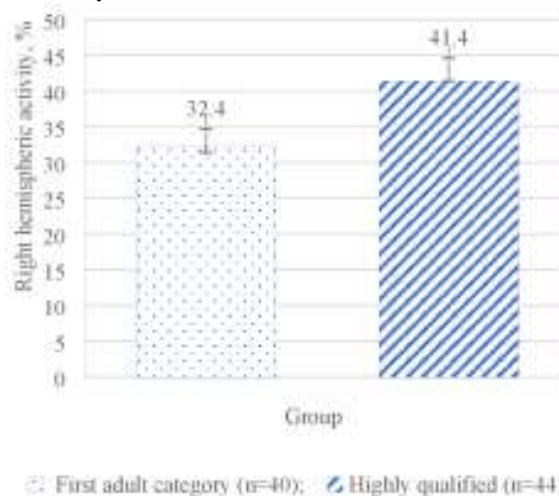


Fig. 1. Values of the indicator of right hemispheric activity among dancers of various qualifications (n = 84); $p < 0.05$

Figure 1 illustrates the average values of an asymmetry coefficient of the dancers. The study revealed a strong tendency in both groups of athletes towards right hemispheric activity. In athletes of the first adult category, the average value of AC is 32.4 (2.3%), which corresponds to the indicator “below average”. Highly qualified athletes have higher AC with an average value of 41.4 (3.2% – the level of “average”). These differences between the two groups of dancers are statistically significant ($p < 0.05$).

To ensure a comprehensive approach to the diagnostics of functional asymmetry, we used the psychogeometric test by S. Delinger. The doctrine of psychological types by C. Jung and theoretical ideas about the functional asymmetry of the cerebral hemispheres are the theoretical background for psychogeometry (S. Dellinger, 1989). A person behaves in accordance with the manifestations of his personality, depending on age or situation, without losing the dominant form. The stability of the dominant form is determined by the natural prerequisites, the educational system and life circumstances. The comparison of the person in this test with a geometric figure gives an idea of the dominant features of his character (A. Alekseev, L. Gromova, 1991). The study of athletes-dancers of various qualifications using the projective psychogeometric test allowed us to establish their dominant types (Table 2).

Table 2

Dominant personality types of dancers of various qualifications (n=84)

Type	Number of athletes. %	
	I group (n=44)	II group (n=40)
"Zigzag" (creativity, oeuvre)	45,8	46,7
"Triangle" (leadership, focus on winning)	20,8	26,7
"Circle" (satisfactory interpersonal relationships)	16,7	3,3
"Square" (diligence, industrious)	–	3,3
"Rectangle" (temporary transitional form of personality)	16,7	20

Notes: I group - highly qualified dancers, II group - dancers of first adult category

As can be seen from the table 2, the indicators of athletes of both groups have similar values – they are dominated by a creative, oeuvre type (“Zigzag”), as well as a type with focus on success (“Triangle”). Diligent, industrious type (“Square”) has insignificant performance among dancers of the first adult category and is absent among highly skilled ones. The most significant differences were of the type oriented towards satisfactory interpersonal relations (the “Circle”). Highly qualified dancers looking for harmonious interpersonal relationships in 5 times more than unqualified. This indicates the importance of this indicator to achieve success in sport activities.

In general, it should be noted that a comparative analysis of the right-hemispheric activity of the dancers according to two methods showed approximately similar results: the number of highly qualified athletes with right-hemispheric activity in the study of AC is 42.2%, and in the psychogeometric test (creative type Zigzag) - 45.8 %

Discussion.

Researchers are actively interested in the problem of inter-hemispheric asymmetry and its effect on sports activities. Studies by E.M. Berdichevskaya provide data on the variants of the asymmetry profile of athletes in various sports (E. M. Berdichevskaya, A. U. Gronskaya, Ya. E. Bugayets, I. E. Khachaturova, 2011). However, such data is absent for dancesport, since it is a relatively young kind of sport, the study of the problems of which has just begun. Taking into account the perspective of the study of interhemispheric asymmetry, we tried to study an asymmetry coefficient of dancers. Such studies will allow to actualize the problem of accounting the lateralization of brain functions in the training process in dancesport.

The psychophysiological base of abilities, the significance of psychophysiology and the whole complex of knowledge, without which it is impossible to develop creativity and special abilities at the modern level. However, the relevance of studies of special dance abilities, their inclinations, nature, structure, psychophysiological features relates to classical dance and adolescents professionally trained in choreography. This is a significant difference from the ballroom-dancers. Our research also focuses on the study of special dance abilities, but in relation to dancesport as a sport. Previous studies of asymmetry coefficient established the tendency of ballroom-dancers to right-hemispheric activity (O.O. Spesyvykh, I. M. Soronovich, 2008). However, the study was conducted on the material of children and adolescent groups and did not affect the problems of elite sports, where the highest results are achieved. For the first time, the study of the indicators of an asymmetry coefficient of qualified dancers had been carry out. It allowed to make a more complete picture of the values of asymmetry coefficient for athletes of different ages. The AC is significant among the dancers and reflected a strong tendency towards right hemispheric dominance, regardless of the age and qualifications of the athletes.

The need to account the lateralization of brain functions for elite athletes is noted by S. Wolf (2015), but studies have been conducted for tennis players and on the basis of electroencephalographic data. G. Korobeinikov, L. Korobeinikova (2014) investigated the features of the lateralization of brain functions and cognitive functions in elite athletes (age 18-25 years) of Greco-Roman wrestling. In contrast to our research, it has been proved that wrestlers with brain symmetry have more range opportunities in the manifestation of cognitive functions: operational thinking, perception and information processing in comparison with wrestlers with functional brain asymmetry (G. Korobeinikov, L. Korobeinikova, 2014). The established strong tendency for the right-hemispheric dominance of the ballroom-dancers allows to recommend including the test for asymmetry coefficient determining to the system of professional selection. Many researchers point to the need for the earliest possible diagnostic of special abilities of children [A. Galaburda, M. LeMay, T. Kemper, N. Geschwind, 1978; O. Shynkaruk, A. Ulan, 2016; A. Ulan, 2017]. In this regard, the diagnostic of right-hemispheric activity can provide substantial assistance in establishing a developed sensory system of talented children and in predicting their potential success. In general, the asymmetry coefficient does not determine the effectiveness of competitive activity, but indicates a general predisposition for practicing dancesport.

In our opinion, our study confirms the data of A. B. Kogan (1982), E. M. Berdichevskaya and A. S. Gronskaya (2011) about the importance of taking into account the asymmetry profile in the selection and training of athletes in various sports. But in dancesport as well as in all sports, a scientifically based system of professional selection is needed, which will identify the most perspective and talented athletes. Its development is just beginning. Our data, taking into account the number of samples, allows us to raise the question of the importance of this indicator and its inclusion as a significant component in the system of professional selection.

Our data also confirms researches in elite sport (E.M. Berdichevskaya, A. U. Gronskaya, Ya. E. Bugayets, I. E. Khachaturova, 2011; V. Moscvin, N. Moscvina, 2016) on the importance of thorough assessment of functional asymmetry for the timely identification of elements of “sinistrality” in sports and professional selection, since such athletes occupy leading positions in a number of sports and among elite athletes there are many left-handers, most of which are distinguished by a high level of creativity and strong abilities for original artistic creation. Thus, for the first time, the asymmetry coefficient was studied for dancers of different ages and qualifications. These studies significantly complemented the knowledge about factors that influence to the success of sportsmanship, confirmed the need to take into account lateralization of brain functions for the selection in dancesport. As well as studies have revealed prospects for the implementation of results in the

practice of sports and further study of psychophysical factors that contribute to improving the effectiveness of dancers' performances.

Findings.

1. The significance of inter-hemispheric asymmetry for sports activities noted by researchers has not been reflected yet in such kind of sport as dancesport and, moreover, for the sport of higher achievements.
2. Taken into account the importance of the psychophysiological component in the training process of athletes, for the first time the asymmetry coefficient of the ballroom-dancers was studied.
3. This study supplemented and completed the previous study of similar indicators for children. Thus, the most complete picture of the lateralization of brain functions has been established, depending on age and qualifications. A persistent tendency for the right-hemispheric activity of several groups of athletes of various age and qualifications (total 146 people: 84 adults and 62 children) has been registered.
4. The hemispheric dominance for comparison was also determined by the method of S. Delinger. Totally, the obtained results give reasons to consider as reasonable the accounting of data on right hemispheric activity in the formation of dance pairs.
5. Right-hemispheric activity presumably indicates the presence of special abilities. Based on this, the indicators of asymmetry coefficient may be significant for the process of selection of children for dancesport.
6. Dancesport, like another sport, requires the development of a system of professional selection. The presented research can contribute to this process, justifying the need to take into account the lateralization of brain functions in the selection of talented athletes and predict their success.

Conflict of interest. The authors note that there is no conflict of interest.

Reference:

- Alekseev A., Gromova L. (1991) Psychogeometry for managers. (in Russian), L. Knowledge; 163 p.
- Berdichevskaya EM, Gronskaya AU, Bugayets YaE, Khachaturova IE. (2011) Functional asymmetries in ensuring effective activity in sports. (in Russian). *Asymmetry*, 62-64.
- Ivanov VV. (1985) Unconscious, functional asymmetry, language and creativity (in Russian), *Unconscious*, 67-90.
- Kogan A. B, Poroshenko AB, Ermakov PN, Kuraev GA. (1982) On the significance of functional lateralization in the formation of complex motor acts in athletes; (in Russian), 989-993.
- Luria A.R. (1975). Evolutionary introduction to psychology (in Russian) MGU Publishing House; 73 p.
- Methodical developments for special psychiatric physiology of higher nervous activity, (1994) (in Ukrainian) All Ukrainian Exhibition Center "Kyiv University", 68 p.
- Raygorod D.Ya. (2001) Practical psychodiagnostics. Methods and tests (in Russian), Samara: Publishing house "Bakhrakh", 672 p.
- Rozhdestvenskaya N.V. (1983) Problems and searches in the study of artistic abilities, (in Russian) in the book. *Artistic creativity. Collection*, 412.
- Spesyvykh O.O, Soronovich IM. (2008) Investigation of the asymmetry coefficient in athletes-dancers (in Ukrainian), *Theory and Methods of Physical Education and Sports*, 65-68.
- Eismont EV, Lutsyuk NV, Aliyev TA. (2012) Features of hemispheric asymmetry in children 10-15 years old, (in Russian), *Psychophysiological and visceral functions in health and disease: mes. VI reports of the Intern. scientific Conf.* 235 p.
- Corballis MC. (2014) Left Brain, Right Brain: Facts and Fantasies. *PLoS Biol.*; 12(1): e1001767.
<https://doi.org/10.1371/journal.pbio.1001767>.
- Corballis MC, Morgan MJ. (1978) On the biological basis of human laterality: I. Evidence for a maturational left right gradient. *Behavioral and Brain Science*, 2: 261-336.
- Dellinger S. (1989) *Psycho-geometrics: How to Use Geometric Psychology to Influence People*. Prentice Hall, 204.
- Galaburda A, LeMay M, Kemper T, Geschwind N. (1978) Right-left asymmetries in the brain. *Science*, 852-856.
- Korobeynikov G, Korobeinikova L. (2014) [Functional brain asymmetry and cognitive functions in elite wrestlers](#). *International Journal of Wrestling Science*, 4 (1): 26-34.
- Moscvin V, Moscvina N. (2016) Asymmetry and individual characteristics of strong-willed regulation teenage athletes. [Austrian Journal of Humanities and Social Sciences](#), 5-6: 22-24.
- Osadtsiv T., Sosina V., Muzyka F., Vynogrsdskiy B. (2015) Evaluation system of technique level for children aged 7 - 9 (who are engaged in dancesport), *Journal of Physical Education and Sport ® (JPES)*, 15(1), Art 2, pp. 9 - 14, 2015 online ISSN: 2247 - 806X; p-ISSN: 2247 - 8051; ISSN - L = 2247 - 8051
- Polianycho O., Ljpatenko G., Biletska V., Yasko L., Spesyvykh O., Yeretyk A. (2018) The psychological influence of open and enclosed spaces on the regulation of motor activity *Journal of Physical Education and Sport ® (JPES)*, 18(2), Art 102, pp. 703 - 705, 2018 online ISSN: 2247 - 806X; p-ISSN: 2247 - 8051; ISSN - L = 2247 - 8051
- Shynkaruk O, Ulan A. (2016) Modern views of left-hander phenomenon manifestation in sport. *Fizvykhovannia*,

- sport i kulturazdorovia u suchasnomususpilstvi, 3: 117–124.
- Shynkaruk O, Ulan A. (2016) Sports selection and orientation of athletes' preparation with account for functional asymmetry: theoretical prerequisites. *Teoriya i metody fizykhovannia isportu*, 1: 15–18.
- Ulan A. (2017) Statistical analysis of the manifestation of manual asymmetry among the leading fencers of the world and Ukraine. *Teoriya i metody fizykhovannia isportu*, 4: 47–52.
- Vysochina N, Vorobiova A. (2017) The system of psychological correction of athlete's personality in Olympicsport. *Sporto mokslas*. 4(90):35–45. DOI: <http://dx.doi.org/10.15823/sm.2017.37>
- Wolf S, Brölz E, Keune PM, Wesa B, Hautzinger M, Birbaumer N, et al. (2015) Motor skill failure or flow-experience? Functional brain asymmetry and brain connectivity in elite and amateur table tennis players. *Biol. Psychol.*, 105: 95–105. doi: 10.1016/j.biopsycho.2015.01.007.