

## FUNCTIONAL ASYMMETRY OF CEREBRAL HEMISPHERES IN SPORTS GAMES: HANDBALL AND VOLLEYBALL

Dragoş Ioan Tohănean<sup>A,B,D,E,F,G</sup> Ioan Turcu<sup>A,B,C,D,E</sup>

*Faculty of Physical Education and Mountain Sports, Transilvania University from  
Brasov*

### Keywords:

- Functional asymmetry,
- Cerebral hemisphere,
- Profile,
- Handball,
- Volleyball.

### Abstract:

This study is a research approach comparative and ascertaining aimed at identifying the level of functional asymmetry of cerebral hemispheres for 60 senior female sports. 30 of them practice handball, 30 volleyball. A set of specific tests has been applied to determine the hemispheric level. Different hemispherical profiles were identified for research athletes, each with specific values and meanings. Of all athletes, about 75% was highlighted a dominant left cerebral hemisphere, aspect that has some meaning for the teams they are part of, a particular way to think and feel what influences the relevant training methodology and other factors that determine the approach of the sports competition.

The overall conclusion is that finding the level of cerebral asymmetry reveals valuable information about athletes, data that can make a major contribution in optimizing the way of sports training.

## INTRODUCTION

Knowing the synergistic mode and the specialized functioning of the cerebral hemispheres are a particularly relevant step for a correct prediction of the particular operational mode of the individual. The anticipation of human behavior becomes very important and necessary, especially when it is desired to achieve some outstanding performance in a field of activity, where the stake, the costs, the effort and the desire for success do not allow the existence of parameters that cannot be control.

The terms functional *asymmetry* and *hemisphericity* result from the evolution of the understanding of cerebral hemisphere contribution to mental functions, respectively of indicating the specific functional character of the two cerebral structures: right and left [Botez 1996, Herrmann 1996]. The dominant hemisphere concept emerged as a result of a discovery of a disturbance of the function of language, a matter determined by the existence of a lesion within the left hemisphere. More recently, American psycho-physiologists are convinced that the functional asymmetry of the two brain structures is pronounced, has a specialization character: the left assuring verbal symbolism and the right spatial perception.

In an effort to summarize, we highlight the general features of the two hemispheres [Roco 2004, Petre 2009]:

- *The left hemisphere* mainly refers to language, linguistic and writing aspects, computation, analysis and abstraction, the method of doing methodically. The specific feature is the rational

approach. Everything works on the cause-effect principle. Preserves and stores the experiences of the physical world. Evaluates quality, judges, measures, drives knowledge based on arguments. Performs operations, comparisons, and rationalizes. People with left hemispherical dominance prefer to make plans, organize themselves in a certain way, control, act analytically, practically, they can be rigid and reductionist.

- *The right hemisphere* is the component of thinking without language, knowing the tones, sounds, colors. She is leading the overall picture, overall. Works based on images, mental representations, preserves lived or imagined experiences, manages artistic, spirit-oriented senses. It makes the synthesis of ideas; imagination and intuition are its dominant aspects. Assess things according to context, feelings, the approach may seem disorderly, has a leap forward, the way it works by association of ideas. It favors dreams, spontaneity and romance.

For Ned Hermann and his team, this horizontal approach (left hemisphere / right hemisphere) seemed unsatisfactory, superficial, for which reason he developed a compliments model called *The Whole Brain Model* [Herrmann 1996, Roco 2004]. The proposed variant was formed by combining the works and experiments of Paul MacLean (the three-dimensional brain model: reptilian, limbic, neocortex) with those whose promoters were Roger Sperry, Joseph Bogen, Michael Gazzaniga (two-half brain separation).

This model is organized horizontally and vertically, being metaphorically structured in four dimensions or specializations.

A. *Upper left*. When this sector is activated the person concerned appreciate things and ideas thoroughly on the component parts. She prefers a mathematical way of working out technical and scientific concepts, operating with logical, algorithmic reasoning, a detailed and accurate contemplation of all the facts (with all their faces) when it comes to making decisions.

B. *Lower left*. Activating this dial highlights the fact that the individual has the ability to self-control his emotions. This fact actually comes as a consequence of a series of actions and habits: to plan, organize, order, classify, so that everything is safe, clear and orderly. The person is very attentive to the details, she is the adept of a planned life quite strictly, with respect certain rules and principles. These issues give him efficiency in the actions he takes. Has solidity on all levels, may have difficulty when faced with situations that require rapid adaptation to atypical, unexpected events.

C. *Lower right*. The activation of this specialization implies a sociable person who feels good in the groups, eager to communicate verbally but also nonverbal, empathetic, very well understanding the affective states of those around. She has no emotions when he has to talk about his feelings, has many passions, and is animated by ideals and values.

D. *Upper right*. This activation makes the person concerned think globally, is not concerned with details and rules, notices the whole, has many ideas, associates the various events and events, finding new solutions, being prone to artistic activities. To solve problem-type situations, imagination and intuition are used.

The ways of identifying hemisphericity are [Herrmann 1996, Roco 2004]:

- a. *Classic surgery* - applicable only in extreme cases, when the person concerned has suffered brain injury and requires such an intervention, a situation in which the individual is in the position to use only certain cortical areas in a hemisphere;
- b. *Electroencephalogram* - the method by which the electrical activity of hemispheres is measured;
- c. *Electrooculogram* - which measures the electrical activity of the eyes in the course of some activities;
- d. *Questionnaires and tests* - developed by correlating the answers to some questions with the level of activation of cerebral hemispheres highlighted by electroencephalogram.

In the specialized literature there are various studies that refer to the way the functional asymmetry of cerebral hemispheres manifests in motion activities:

Boulinguez, Ferrois and Graumer [2003] pointed out that although it is not possible to clearly identify how the hemispheres interact when processing spatial-temporal information; however, it was known that the response time was shorter for the left hand than for the right hand and shorter response times for left-handed hemifil than for right hemifiers for both hands. Thus, it is concluded that there is likely to be a right hemisphere specialization for the perception of the trajectory, and that this hemispheric asymmetry is independent of skill.

Mikheev et al [2002] conducted a study that had as subjects judo practitioners. They decoded differences in hemispheric specialization by analyzing hand and foot movements, postural preferences, and field and visual dictation tests. The results revealed that athletes prefer to perform various left hand movements although they are right-handed, verbal listening tasks and lateral visual field have noted a more pronounced activation of the right hemisphere. The overall conclusion was that long-term training in judo performance causes changes in preferences lateralization due to neuroplasticity, and the right hemisphere system is more involved in what it represents action routines.

Neurophysiological correlations determined by physical exercise on academic results were studied by Schneider and his collaborators [2009]. It was monitored electrocortical activity of 10-11 year old students after moderate exercise on bicycle (15 minutes). After this type of effort, an increase of alpha waves in precuneus was observed (a circumvolution on the medial side of the cerebral parietal lobe located between the two hemispheres. Note added by authors of this article) and also a decrease in beta waves in the left-hand temporal areas. It has been concluded that the stresses of cognitive concentration are particularly hardened by induced neuroplasticity of physical exercise in regions of linguistic processing.

## **MATERIAL AND METHODS**

This research approach is an ascertaining and comparatively study by which we wanted to identify the level of functional asymmetry of the cerebral hemispheres for 2 groups of athletesfemale seniors: 30 who practice handball and 30 who practice volleyball.To highlight this, we used a specific psychological test battery and included the following instruments:

1. *The Action Preference Questionnaire* integrates 72 items grouped into 4 sections A; B; C; D; each of them having 18 items corresponding to the four brain sectors: The response variants enclose on a continuum between 1 and 5, where 1 represents a very low agreement for the item's statement and 5 total agreements. Intermediate variants 2, 3, 4 reveal different agreed values. This instrument provides information on the existing ratio on the Rationality-Emotionability-Left-to-Operate-Right Operation mode.

2. *Test of determining the functional level of the cerebral hemispheres* contains 50 items grouped to the odd current numbers refers only to the left hemisphere, and those from the numbers appear to the right hemisphere. The response options are on the range 1-5, where 1 signifies disagreement or very low agreement, and 5 total agreements for item

3. *Personal hemispheric preference test (Richi Linksman)*; This instrument contains 36 items, each of which has 3 alternative a, b or ab responses. The statements of type a indicate hemispheric left dominance and hemispherical "b" right. The two grouped responses reveal mixed preference.

This test battery was applied only once, after which the data obtained was collected, processed and interpreted.

**RESULTS**

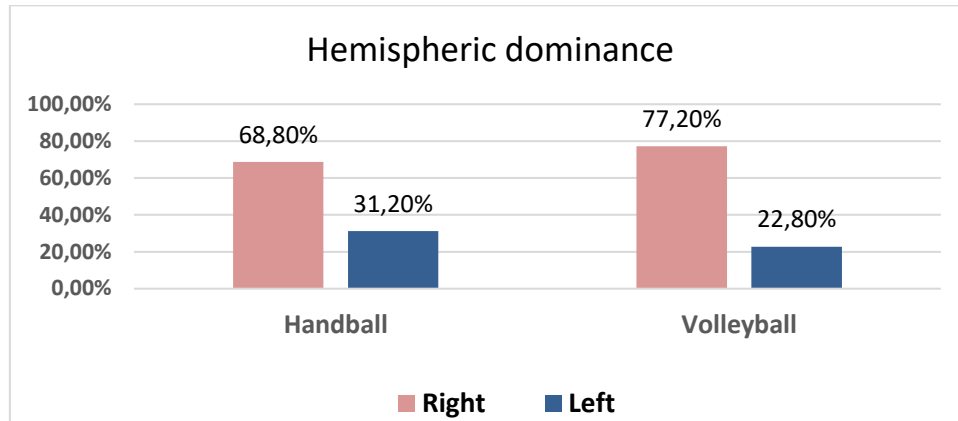


Fig.1 Percentage of hemispheric functional dominance for subjects investigated on the two categories of sports games: handball and volleyball

As can be seen from Figure 1, the percentage of left-most dominant players is higher than the right-handed percentage for both sports. By analyzing the groups of athletes comparatively, the percentage of left-handed volleyball players is higher than those who practice handball, the percentage difference in this direction being 8.40%.

The results were obtained following the psychological tests 2 and 3 of the above presentation.

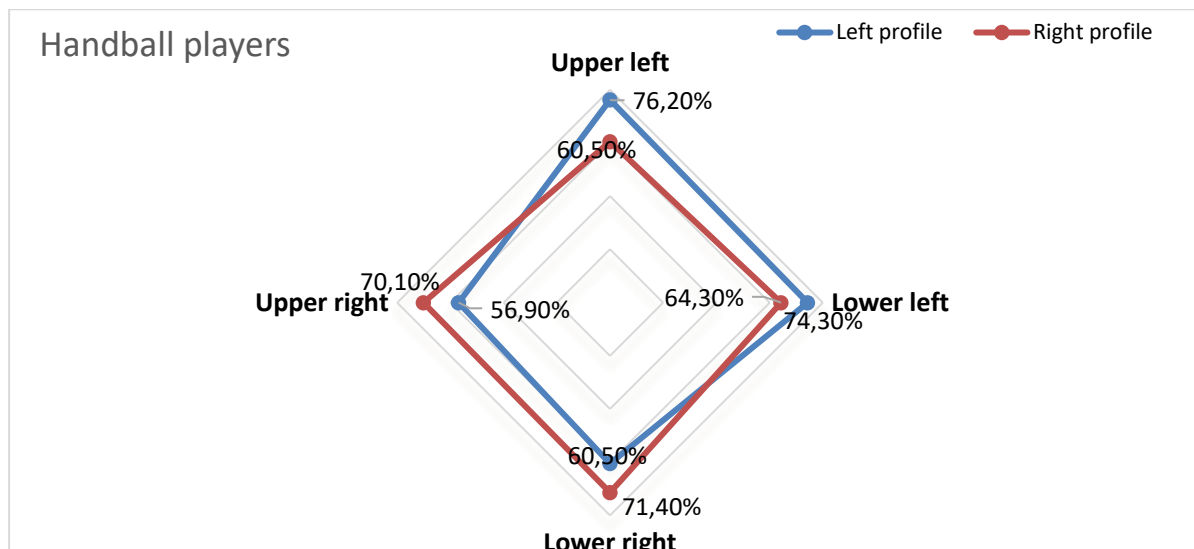


Fig. 2 Functional asymmetry profiles (left and right) for the athletes who practice the handball game

From the analysis of the data shown in Figure 2, it is observed that the highest weights of activation of some dials exceed 70%, reaching up to 76.2% for the Upper Left on the left dominant profile for handball players. The average of the lowest activators is about 60%. The differences between the two profiles (left and right) are not very large, just a few percent.

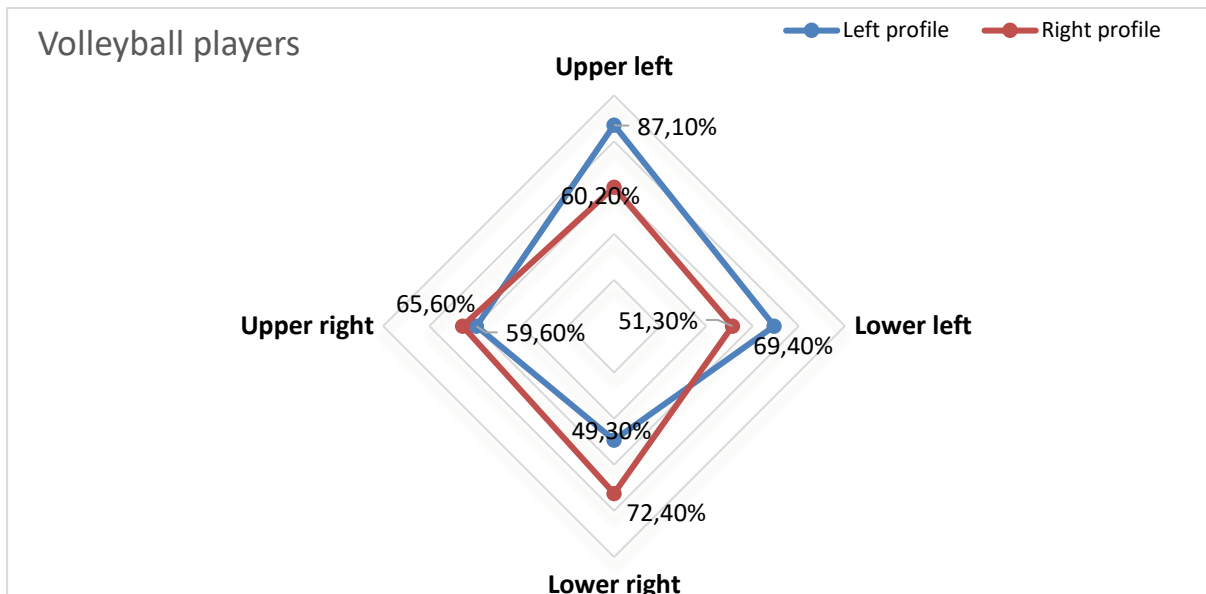


Fig. 3 Functional asymmetry profiles (left and right) for the athletes who practice the volleyball game

Figure 3 shows that between the two (left and right) profiles for volleyball players, the differences are higher, with the highest level of activation being recorded in the Upper left, being 87.10%. By comparison, the highest activation on the left profile is 65.60% at Upper right, so a difference of 21.5. The lowest value is found in Lower Right, being 49.3.

The results presented in Figures 2 and 3 were obtained by applying the Action Preference Questionnaire.

## CONCLUSIONS

From the horizontal analysis of the functional asymmetry of cerebral hemispheres in the subjects included in the study it is obvious that most of them are dominant left. Nearly 75% of the athletes of both groups functions according to the left hemisphere specific modalities. This means that the majority of them are generally analytical people, they are trained methodically, prefer a training approach and step-by-step competition, sequentially, they plan their activities thoroughly, are rational, they easily support the routine aspects. In sport these aspects reveal predictability, seriousness, methodical preparation, pragmatics, correct engagement in reality, observance of codes or principles within the team. We considered that the higher percentage for volleyball players is due also to the characteristics of the game itself, which generally takes place over the three-handed range, which does not allow you to develop more or at least not as much as in handball. This may be a limiting factor from this point of view.

Percentage of right hemisphere players (about 15%) may represent that level (optimally maybe) that complements what we mentioned earlier. Right hemisphere players, even if they do not fully respect the coaches' instructions or may not reach all of their proposed goals in a sequential manner, have a great potential to improvise and surprise opponents with unexpected and impressive executions, can easily destabilize some systems defense, may motivate the team when appropriate. Not adhering to strict rules of play and training, they can often surprise you with something new and effective when you expect less.

Inside the general characteristics presented in the introductory part of this study, we can add some aspects whose significance prevails more on the specific behavior of the sport:

- Upper left - The athlete prefers to perform a preliminary analysis on all variables that would ensure sport success: rigorous training, opponent value, effort recovery, equipment, training / play conditions, etc. all these aspects done in a rational and thorough manner;
- Lower left - The performer feels the need to control very much the level of emotivity specific to the performance of the sports competition, which is done by calling upon the set of technical-tactical procedures that he / she can apply best, in fact to everything he / she knows to perform very well, aspect that gives them competitive stability.
- Lower right - The athlete resonates relatively easily either positively or negatively with teammates or opponents, referees, and the public. He has no difficulty in honestly and directly expressing his personal reflections on the quality of the game, arbitration, etc., assuming the consequences of these personal views.
- Upper right - The player acts very well especially in times of competition where there is greater ease in applying the tactical plan, adapts easily to new tasks and new situations, perceives very well the positioning of teammates, opponents in the game space, anticipates the easy future trajectories of the ball.

Analyzing the asymmetry profiles on the four dimensions (both left / right and handball / volleyball) we can conclude that there are real differences between the athletes of the two groups. If the left / right handball profiles show a higher degree of similarity, for volleyball the differences are obvious.

The most important aspect is that it is relevant for coaches to know their athletes better and thus to be able to restructure their way of communication, the level of exigency, the way of training (as far as possible) according to the individual particularities of the athletes. Knowing the level of hemispheric dominance and its significance provides additional relevant information about athletes in a relatively light and objective manner. We are convinced that things can be optimized taking into account these issues. It is inefficient, for example, to have a specific approach left hemisphere for dominant athletes and vice versa. Individualized training primarily allows for such an approach, which will have beneficial effects on the work of the coach, athletes' performances, reduction of stress specific to this field of activity for all involved.

## REFERENCE

1. Botez M.I. (1996), *Neuropsihologia clinic și neurologia comportamentală*, ediția a II-a. București: Medicală, pp. 273-287.
2. Boulinguez P., Ferrous M., Graumer G. (2003), *Hemispheric asymmetry for trajectory perception*. Cognitive Brain Research. Volume 16, Issue 2, pp. 219-225, doi.org/10.1016/S0926-6410(02)00276-8
3. Herrmann N. (1996), *The whole brain business book, Unlocking the power of whole brain thinking in organizations and individuals*. New York, San Francisco, Washington D.C., Auckland, Bogota, Caracs, Lisbon, London, Madrid, Mexico City, Milan, Montreal, New Delhi, San Juan, Singapore, Sydney, Tokyo, Toronto: McGraw-Hill, pp. 6-19; 58-72.
4. Mikheev M., Mohr C., Afanasiev S., Landis T., Thut G. (2002), *Motor control and cerebral hemispheric specialization in highly qualified judo wrestlers*. Neuropsychologia, Volume 40, Issue 8, pp. 1209-1219, doi.org/10.1016/S0028-3932(01)00227-5
5. Petre R.A. (2009), *Modelul unificator al psihicului uman, normal și paranormal*. Brașov: Spiritus, pp.33-44.
6. Roco M. (2004), *Creativitate și inteligență emoțională*. Iași: Polirom, pp. 52-97; 212-214.

7. Schneider S., Vogt T., Frysch J., Guardiera P., Strüder H. K. (2009). *School sport—A neurophysiological approach*. *Neuroscience Letters*, Volume 467, Issue 2, 25 December, pp. 131-134, doi.org/10.1016/j.neulet.2009.10.022