LEVEL OF TIME-SPACE ORIENTATION AND RANGE OF PERIPHERAL VISION OF 12–13-YEAR-OLD GIRLS SELECTED FOR THE LOWER SILESIAN REGIONAL VOLLEYBALL TEAM

Damian **PAWLIK** ABEF, Andrzej **ROKITA** ABE, Marcin **ŚCIŚLAK** CFG, Sara **WAWRZYNIAK** BCD

University School of Physical Education in Wrocław

Keywords:

- Motor abilities,
- coordination,
- visual perception,
- volleyball.

Abstract:

Introduction: Time-space orientation is a bodily characteristic, which, depending on the level, can significantly affect players' technical preparation and suitability for playing. Volleyball is characterised by significant dynamics requiring the player to have a high level of peripheral vision (peripheral perception of movement), deep vision (evaluation of distance), and speed and accuracy of perception of moving objects (teammates, opponents, balls). The aim of the study was to determine the level and the differences in the levels of time-space orientation and the range of peripheral vision in 12–13-year-old players selected for the Lower Silesian Regional Volleyball Team after a 12-day camp, as well to define the relationship between peripheral vision and the level of time-space orientation.

Materials and Methods: The study included 12 players (12–13 years old) appointed to the Lower Silesian Regional Volleyball Team. A modified 'Reactive Shuttle Drill' test was employed to assess the level of time-space orientation. The player's range of vision was diagnosed using the Peripheral Perception (PP) test, a part of the Vienna Test System. The study was conducted before and after the sports camp.

Results: The level of time-space orientation did not reveal statistically significant differences. The average range of vision of players before the camp was 169.94˚, which increased by 3.87˚ after the camp, totalling 173.81˚. Spearman's rank correlation was calculated to discover the relation between the levels of time-space orientation and range of vision before and after the sports camp. No significant correlations between diagnosed variables were observed in the 12–13-year-old players of the Lower Silesian Regional Volleyball Team.

INTRODUCTION

Volleyball is significantly different from other team sports, not only due to its strength-speed nature, but mostly because of the time needed to master the motoric techniques. In this discipline, these are critical elements for competitive playing. The difficulty in performing various actions related to hitting the ball lies in the complex, whole-body movements during the short period of contact with the ball, so as to be compliant with the rules of the game. Time-space orientation is listed as a characteristic of the body that has an impact on players' technical preparation and suitability for playing [1,2]. It allows players to specify the position of their entire body or any of its parts with respect to different reference points that occur during competitive playing [3,4]. The player, using visual and sensory stimuli, is able to

recognise
a given space and objects located in it, i.e. the net, ball, and court [5]. A human being is able, at the level of the hippocampus, to create and modify recorded images, while the time component allows for the precise execution of motor actions relative to a moving object [5,6,7,8]. The higher the level of time-space orientation, the greater the precision a player should be able to demonstrate in actions such as receiving a serve, attacking an approaching ball and setting a ball in a particular place while maintaining appropriate pace.

Team sports are characterised by considerable dynamism, rapid changes occurring in the action and surprising situations that require players to have high perception skills. Football, volleyball, basketball and handball are sports where perception is a fundamental issue in this particular area regarding human movements. Therefore, excellent peripheral vision (peripheral perception of movement), a high level of so-called deep vision (evaluation of distances), and speed and accuracy of the perception of moving objects (teammates, opponents, balls) are of paramount importance for a player [9].

The eyes are one of the most important sensory organs related to the level of sports skills. Despite such an important role, this is rarely taken into account by coaches and players when designing training programmes [10], which is probably due to insufficient research or a lack of time regarding its inclusion in training programmes [11].

Researchers have shown that players experienced in team sports are better than novices when using visual signals that occur and, subsequently, are better at decision making [12,13].

The results of a study conducted on youth soccer players and those that did not practise this sport showed that the level of peripheral vision in all groups demonstrated a regular increase. Studies also indicated the existence of a relationship between a player's visual perception ability and their efficacy in the game [9].

Studies on peripheral perception in team games were carried out both in Poland [9,14,15], and around the world [13,16,17,18,19,20,21,22].

STUDY AIM

The aim of this study was to determine the level and differences in the levels of time-space orientation and range of peripheral vision in 12–13-year-old players selected for the Lower Silesian Regional Volleyball Team after a 12-day camp. We also aimed to define the relationship between peripheral vision and the level of time-space orientation.

Research questions:

1. What is the level of time-space orientation of 12–13-year-old players selected for the Lower Silesian Regional Volleyball Team?
2. Did the level of girls' time-space orientation change after the 12-day volleyball camp?
3. What is the range of peripheral vision of 12–13-year-old players selected for the Lower Silesian Regional Volleyball Team?
4. Did girls' scope of peripheral vision change after the 12-day volleyball camp?
5. Is there a relationship between the level of time-space orientation and the range of peripheral vision of 12–13-year-old players selected for the Lower Silesian Regional Volleyball Team?

MATERIALS AND METHODS

Twelve girls attending volleyball classes, aged 12–13 years (6th grade of primary school) took part in the assessment. The examined respondents were the best players from nine sports clubs that were selected for the Lower Silesian Regional Team of Juniors (born in 2001). The evaluation was carried out one day before the Regional Team's sports camp and one day after the 12-day volleyball camp. A deliberate selection method was used due to the quality of the research material. In order to collect data, a method of observations was used, using a direct measurement technique.

To measure the level of time-space orientation, the girls were required to wear sports clothes and shoes suitable for playing volleyball. Before performing the tests, girls took part in a 15-minute dynamic volleyball warm-up [23], ending with dynamic accelerations in order to prepare the body for maximum effort and sudden changes of direction. The warm-up did not include static stretching, which could adversely affect the result.

A modified "Reactive Shuttle Drill" test developed by Fusion Sports (Fusion Sports, Coopers Plains, QLD, Australia) was applied to assess the level of time-space orientation. This equipment is part of the facilities of the certified Ball Games Research Laboratory of the Team Sports Department at the University of Physical Education in Wroclaw, which has been certified with the Quality Management System (PN-EN ISO 9001: 2009). The modified test had a form similar to the "Run for a ball" [24], and "Run towards numbered cones" (beh k očíslovaným metam) tests [25].

The examined player had to cover a distance from the contact mat to a gate randomly picked by the system five times [26,27].

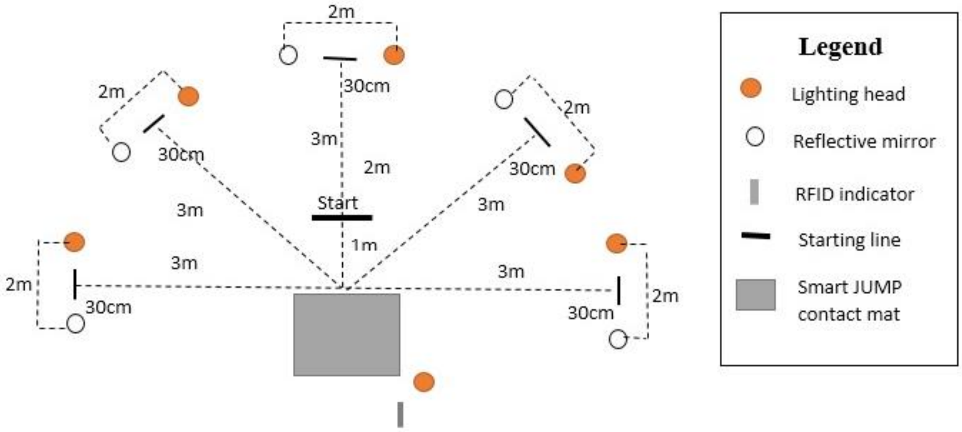

Fig. 1. A run towards five gates.

The range of the field of vision was assessed by means of the Peripheral Perception test (PP) from the Vienna Test System (Schuhfried, Austria). The assessment of the range of vision was held in a separate room where adequate conditions for the test were provided (the space was at room temperature, and the room was lit so as to prevent reflections from hindering the vision of the monitor and illuminated signs (Fig. 2).

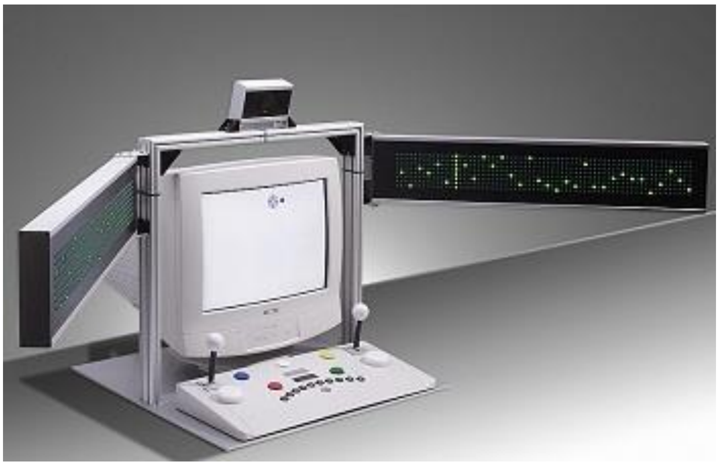

Fig. 2. The station for measuring peripheral perception.

The examined person sat on a chair with adjustable height at a distance of 40–60 cm from the monitor. The distance of the subject from the monitor was controlled by a sensor placed above the monitor. There was a control panel on the table in front of the monitor. The subject had a pedal under their foot that was used to assess the response to a light stimulus in the peripheral field of vision.

The study consisted of two tasks performed simultaneously: one involved maintaining the point-finder on a red ball moving horizontally in order to keep the viewing concentration on a centrally viewed object. The second task was to capture a vertical line of moving signs on visual sensors on the right and left sides of the monitor. After noticing a relevant sign (vertical line), the subject was to respond by pressing a foot pedal once. The proper test was preceded by a mandatory three-stage tutorial, which introduced the person to the isolated tasks, and guided them to the actual test. After completing the three instructional stages, information about starting the proper test appeared. The person being examined, by pressing the foot pedal, started the five-minute proper test involving the same tasks as in step 3 of the instructions (tracking the ball on a monitor screen and responding to vertical illuminated signs). After the test, the examined person was informed of the results. The results were automatically recorded in the Vienna Test System report.

The statistical analysis was calculated using statistical package Statistica 10.0, where basic calculations (the arithmetic mean, standard deviation, and Student's t-test to verify a relationship between visual fields before and after the camp and to define the level of time-space orientation before and after the camp) were performed. Further, Spearman's rank correlation was used to discover the relationship between the level of time-space orientation and the range of vision. The statistical significance was set at $p < 0.05$.

RESULTS

The statistical analysis included a comparison of the results of the level of time-space orientation and the range of peripheral vision in 12–13-year-old players on the Lower Silesian Regional Volleyball Team after the volleyball camp.

When comparing the level of time-space orientation, athletes achieved better results in the first test (17.12 seconds) than after the volleyball camp (17.65 seconds). However, the differences in girls' results were not statistically significant ($p = 0.14$) (Fig. 3, Tab. 1).

The range of peripheral vision of volleyball players before the camp was 169.94˚. After the camp, the range increased by 3.87˚, but the score difference was not statistically significant ($p = 0.09$) (Fig. 4, Tab. 1).

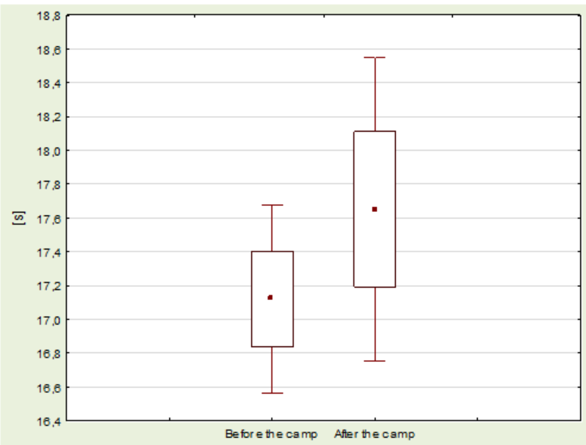

Figure 3. The results of the level of time-space orientation of 12-13-year-old Lower Silesian Regional Volleyball Team players

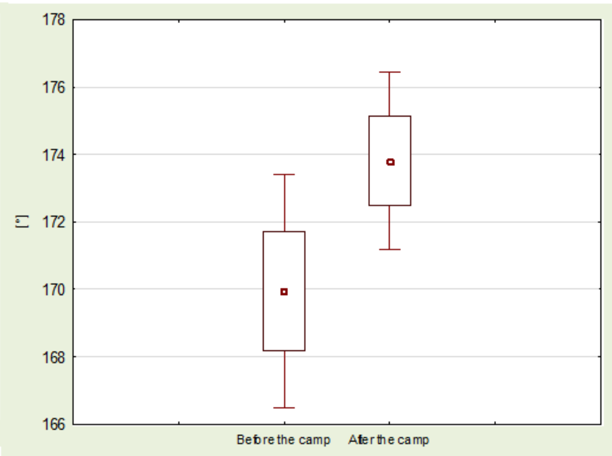

Figure 4. The results of the peripheral vision range of 12–13- year-old Lower Silesian Regional Volleyball Team players

Comparing the results of peripheral vision range for the right and left eyes, after the completion of the volleyball camp, vision ranges increased in both cases. The range of peripheral vision for the right eye increased by 2.07˚, and by 1.8˚ for the left eye. Differences in results were not statistically significant (Figs. 5 and 6, Tab. 1).

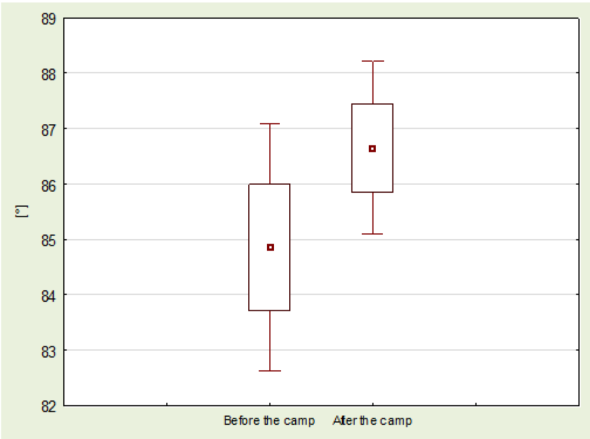

Figure 5. The results of the viewing angle for the right eye in 12–13-year old players on the Lower Silesian Regional Volleyball Team.

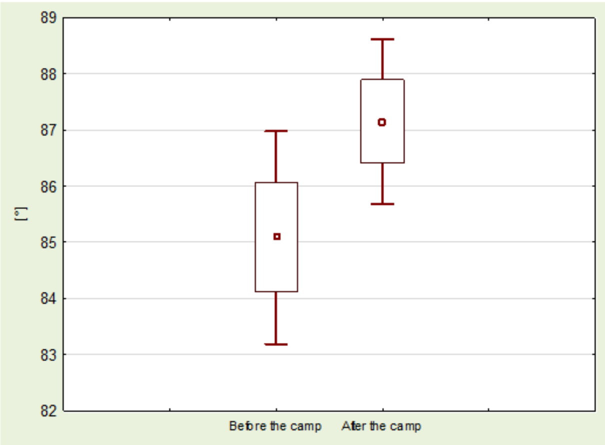

Figure 6. The results of the viewing angle for the left eye in 12–13-year-old players on the Lower Silesian Regional Volleyball Team.

Table 1. Variables assessed before and after volleyball camp.

Variables	$\bar{X}$	SD	Difference	SD Differ.	t	df	p
Time-space orientation before the camp	17.12 [s]	0.98					
Time- space orientation after the camp	17.65 [s]	1.59	-0.53	1.17	-1.57	11	0.14
Field of vision before the camp	169.94 [˚]	6.12					
Field of vision after the camp	173.81[˚]	4.63	-3.87	7.34	-1.83	11	0.09
Viewing angle of right eye before the camp	85.08 [˚]	3.36					
Viewing angle of right eye after the camp	87.15 [˚]	2.58	-2.07	4.52	-1.58	11	0.14
Viewing angle of left eye before the camp	84.85 [˚]	3.94					
Viewing angle of left eye after the camp	86.65 [˚]	2.77	-1.80	3.67	-1.70	11	0.12

The level of statistical significance is at $p < 0.05$.

Table 2. Spearman's rank correlation for the examined variables.

Variables	**TSO1**	**TSO2**	**VAL1**	**VAR1**	**FV1**	**VAL2**	**VAR2**	**FV2**
TSO1	1.00	0.68*	-0.28	-0.30	-0.34	0.14	0.08	0.13
TSO2	0.68*	1.00	-0.47	-0.59*	-0.63*	0.04	-0.06	-0.01
VAL1	-0.28	-0.47	1.00	0.04	0.86*	0.44	-0.07	0.22
VAR1	-0.30	-0.59*	0.40	1.00	0.81*	-0.03	-0.15	-0.10
FV1	-0.34	-0.63*	0.86*	0.81*	1.00	0.27	-0.13	0.09
VAL2	0.14	0.04	0.44	-0.03	0.27	1.00	0.50	0.88*
VAR2	0.08	-0.06	-0.07	-0.14	-0.13	0.50	1.00	0.86*
FV2	0.13	-0.01	0.22	-0.10	0.09	0.88*	0.86*	1.00

TSO – time-space orientation, VAL – vision angle of left eye, VAR – vision angle of right eye, FV – field of vision, 1 – test before the camp, 2 – test after the camp, * statistical significance at $p < 0.05$

Spearman's rank correlation was calculated while searching for the examined relationships between variables. There was no significant correlation between the level of time-space orientation and peripheral vision range of 12–13-year-old players on the Lower Silesian Regional Volleyball Team (Tab. 2).

DISCUSSION

The aim of the study was to determine the difference in the level of time-space orientation and the range of peripheral perception in players of the Lower Silesian Regional Volleyball Team before and after a 12-day sports camp.

The results showed that girls training in volleyball achieved worse results in the level of time-space orientation after the volleyball camp; however, an increase in the range of peripheral vision was observed. In both cases, the differences in results were not statistically significant ($p < 0.05$).

A comparison of other authors' time-space orientation results involved a review of literature specifically looking at "Run towards balls" test results [24] this being the basis for performing the test described in this article.

Volleyball players taking part in a modified "Run towards gates" test achieved results of 17.12 seconds before the camp and 17.65 seconds after the camp. The range of scores proposed by Raczek et al. [24] for girls of the same age performing the "Run towards gates" test is between 7.8 seconds (very good result) and 10.8 seconds (mediocre result). Such a scale of score results in the "Run towards numbered cones" (Beh k očíslovaným metam) test is confirmed by Belej and Jünger [25]. The authors examined girls aged between 10 and 14 years. 10-year-old girls achieved a mean score of 11 seconds in the first test and 10.83 seconds in the second test, whereas 14-year-old girls scored, respectively, 10.09 and 9.85 seconds.

Such variance of results recorded by us and other authors may be due to variations in the ways the test was performed. On one hand, stopping in front of the ball and touching it, on the other hand, running a distance of 3 m to the gate line and crossing it. Another reason for different results may be due to inaccurate time measurements taken during the test (switching the timer on too early, switching it off too early). The Smart Speed System records results electronically to the nearest 0.001 seconds without interference from the examining person. The task of the person carrying out the "Run towards balls" test is to raise cards with numbers or coloured cards to inform the person being examined in which direction they should run. A modified version of the Reactive Shuttle Drill test completely eliminates the examining person from interfering in the test results. An electronic system randomly selects heads that are supposed to light up, and it activates the lightning signal after stepping onto the mat. Due to the similar design, yet a different manner of performing the tasks, the results of the "Run towards balls" and "Run towards numbered cones" (Beh k očíslovaným metam) tests should not be compared with the Reactive Shuttle Drill test.

Two publications can be found in the literature where the level of time-space orientation was evaluated by a modified version of the Reactive Shuttle Drill test. Pawlik et al. [26] evaluated the level of time-space orientation in children aged 9–10 years with and without specific learning disabilities

In girls developing normally, the average score was 23.32 seconds, while, in girls with specific learning disabilities, the score was 24.23 seconds. The test time in this study was similar, but the results should not be compared because of the different ages of subjects and the different layout of gates in relation to the reaction mat [26].

Rokita et al. [27] examined girls aged 14–16 years who practised fencing and achieved a mean score of 19.41 seconds. A better result obtained by volleyball players, both before (17.12 seconds) and after the camp (17.65 seconds) is the effect of shortening the distance between the reaction mat and the gate from 4.5 m to 3 m. Changes were made so that the distance between the base (contact mat) and the gate was the same as in the "Run towards numbered cones" (Beh k očíslovaným metam) [25] and "Run towards balls" tests [24]. Considering the above tests, the form of the starting point of the test also changed. Volleyball players began to run from the middle of the semicircle so that each time they stepped onto the mat and ran towards the gate, were the same in both the first and each subsequent attempt.

As we cannot compare our results with those of other authors, this limits our study to the comparison of the results within the study group before and after the volleyball training camp. A slight decrease in the mean level of capacity of the time-space orientation could be the cause of fatigue of the body, both in terms of energy and the nervous system.

However, the range of peripheral vision using the Vienna Test System (tests of PP) was examined by other researchers as well [28,29,30,31,32].

Zwierko [28] compared the field of vision of handball players and non-training individuals. The mean field of vision in these groups amounted to 170.95˚, and the differences between the groups were not statistically significant. Zwierko et al. [29] examined the range of peripheral vision in handball players aged 21 years (± 3.09), where the vision range was 167.46 (± 12.83). Polishchuk and Polishchuk [30] evaluated the range of peripheral vision of basketball players, which was 169.1˚. In 2009, Polishchuk and Polishchuk [30], made a similar analysis of badminton players, whose range of vision was 172.9˚. Furthermore, Vila-Maldonado et al. [32] studied 17-year-old female volleyball players, whose range of vision was 167.2˚, while in non-training individuals it was 168.5˚.

A comparison of our results to the results of the above-mentioned authors showed that the widest field of vision was observed in volleyball players who had completed a 12-day regional team camp (173.81˚).

Our study examined one of the highest ranges of peripheral vision, amounting to 183.53˚, compared to the results of other authors [28,30,31,32]. The results may be due to the selection of research participants. The volleyball players included in our study were elite players that successfully passed the selection process held throughout the Lower Silesia, while studies of other authors were based on club athletes.

Referring to Kohmura and Yoshiki [33], who conducted a study on a group of baseball players, positive, significant changes in visual perception after applying a four-week visual training programme were observed. Therefore, introducing a set of exercises, with the aim of increasing the range and quality of visual perception of players seems to be important, and it was shown that it was possible to improve these qualities during the training process. The introduction of an appropriate set of exercises in the training process may have a positive influence not only on the development of the central and peripheral field of vision, but also on the quantity and quality of perception of the situation on the court.

SUMMARY AND CONCLUSIONS

1. The level of time-space orientation of volleyball players on the Lower Silesian Regional Volleyball Team amounted to 17.12 seconds.
2. The level of time-space orientation in girls after a 12-day volleyball camp slightly decreased by 0.53 seconds (17.65 seconds), but the differences were not statistically significant.
3. The range of peripheral vision in 12–13-year-old volleyball players on the Lower Silesian Regional Volleyball Team was 169.94˚.
4. The range of peripheral vision in players after a 12-day volleyball camp increased by 3.87˚ (173.81˚), but the differences were not statistically significant.

5. There was no correlation between the level of time-space orientation and the range of peripheral vision of 12–13-year-old volleyball players on the Lower Silesian Regional Volleyball Team.

Given the above, it appears that the most important aspect of the training process is to monitor its effects, not only before and after, but also a few weeks after the end of a sports camp. In addition, intensified volleyball training can help increase the range of vision of players; however, in order to achieve a permanent and significant result in that regard, sports camps must be followed by an appropriate set of exercises shaping the range and quality of perception, thus creating an opportunity to determine the long-term effects of these camps.

REFERENCES

1. Zwierko T. (2004) Ocena poziomu wybranych elementów sprawności psychomotorycznej u zawodniczek uprawiających piłkę siatkową. Zeszyty Naukowe Uniwersytetu Szczecińskiego. 404, 21, p. 119-128.
2. Klocek T., Żak S. (2001) Strukturalne i motoryczne determinanty skuteczności gry w piłce siatkowej kobiet. Antropomotoryka, 22, p. 65-80.
3. Hirtz P. (1985) *Koordinative fähigkeiten im schulsport, Berlin.*
4. Osiński W. (2003) Antropomotoryka, wyd. II rozszerzone. Wyd. AWF, Poznań.
5. Notarnicola A., Maccagnano G., Pesce V., Tafuri S., Novielli G., Moretti B. (2014) Visual- spatial capacity: gender and sport differences in young volleyball and tennis athletes and non-athletes. BMC Research Notes, 7:57. http://www.biomedcentral.com/1756-0500/7/57, Accessed 1.10.2014.
6. Burgess N., Maguire E.A., O'Keefe J. (2002) The Human Hippocampus and Spatial and Episodic Memory. Neuron, 35, p. 625-641.
7. O'Keffe J. (1975) Place units in the hippocampus of the freely moving rat. Experimental Neurology, 51, p. 78-109.
8. Rohenkohl G., Gould I.C., Pessoa J., Nobre A.C. (2014) Combining spatial and temporal expectations to improve visual perception. Journal of Vision, 14, (4):8, p.1-13.
9. Ciućmański B., Wątroba J. (2005) "Training of selected visual perception abilities and the efficiency of footballers (in Polish)", In: Żak S., Spieszny M., Klocek T. (eds.), *Team sports in physical education and sport* (in Polish), AWF Krakow, Studia i Monografie, 33, p. 298–303.
10. Wood J., Abernethy B. (1997) An assessment of the efficacy of sports vision training programs.
11. Coffey B., Reichow A. W. (1995) Visual performance enhancement in sports optometry. Sports vision. Oxford: Butterworth-Heinemann.
12. Abernethy, B. (1987) Selective attention in fast ball sports, II: Expert novice. Australian Journal of Science and Medicine in Sport, 19, 4, p. 7-16.
13. Williams M., Davids K., Burwitz L., Williams J. (1993) Cognitive knowledge and soccer performance. Perceptual and Motor Skills, 76, p. 579-593.
14. Mańkowska M., Poliszczuk I., Poliszczuk D., Johne M. (2015) Visual perception and its effect on reaction time and time-movement anticipation in elite female basketball players. Journal of Sport Tourism, 22, p. 3-8.
15. Młodkowski J. (2004) Antynomia centrum i peryferii w procesie widzenia. Acta Universitatis Lodziensis Folia Psychologica, 8 p. 135-146.
16. Curcio C.A., Sloan K.R., Kalina R.E., Hendrickson A.E. (1990) "Human photoreceptor topography", Journal of comparative neurology, 292, p. 497–523.
17. Williams A. M., Elliott D. (1999) Anxiety, expertise, and visual search strategy in karate. Journal of Sport & Exercise Psychology, 21, p. 362–375.

18. Williams A. M. (2000) Perceptual skill in soccer: Implications for talent identification and development. Journal of Sports Sciences, 18, p. 737-750.
19. Ludeke A., Ferreira J. T. (2003) The difference in visual skills between professional versus non-professional rugby players, The South African Optometrist, 4, p. 150-158.
20. Jafarzadehpur E, Yarigholi MR. (2004) Comparison of visual acuity in reduce lamination and facility of ocular accommodation in table tennis champions and non-players. Journal of Sport Science and Medicine, 3, p. 44-48.
21. Vaeyens R, Lenoir M, Williams AM, Phillippartes RM. (2007) The Effect of task constraints on visual search behavior and decision making in youth soccer players. Journal of Sport & Exercise Psychology, 29,2, p. 147-69.
22. Ghasemi A., Momeni M., Rezaee M., Gholami A. (2009) "The difference in visual skills between expert versus novice soccer referees", Journal of Human Kinetics, 22, p. 15–20.
23. Biernat R. (2010) Strategia zapobiegania urazom w siatkówce wyd. 1, Olsztyńska Szkoła Wyższa, Olsztyn.
24. Raczek J., Mynarski W., Ljach W. (2003) Kształtowanie i diagnozowanie koordynacyjnych zdolności motorycznych. Wyd. AWF, Katowice.
25. Belej M., Jünger J. (2006) Motorické testy koordinačných schopností, Prešovska univerzita
v Prešove, Fakulta športu, Prešov.
26. Pawlik D., Rokita A., Cichy I. (2013) Orientacja czasowo-przestrzenna uczniów ze specyficznymi trudnościami w uczeniu się. Rozprawy Naukowe, 43, p. 46-56.
27. Rokita A., Bronikowski M., Popowczyk M., Cichy I., Witkowski M. (2014) Precision and coordination parameters of Polish elite cadet fencers. Medicina Dello Sport, 67, 3, p. 369–381.
28. Zwierko T. (2007) Differences in Peripheral Perception between Athletes and Nonathletes. Journal of Human Kinetics, 19, p. 53-62.
29. Zwierko, Głowacki T., Osiński W. (2008) The effect of specific anaerobic exercises on peripheral perception in handball players. Kinesiologia Slovenicka, 14, 1, p. 68-76.
30. Polishchuk D., Polishchuk T. (2008) Identifying levels of peripheral vision abilities and complex reactions in basketball players, (in:) Book of Abstracts of 13th Annual Congress of the European College of Sport Science, 9-12 July; Estoril - Portugal, 459.
31. Poliszczuk T, Mosakowska M. (2009) Interactions of peripheral perception and ability of time-movement anticipation in high class competitive badminton players. Studies in Physical Culture and Tourism, 16, 3, p. 259-265.
32. Vila-Maldonado S., Sáez-Gallego N.M., Hernández J.A., Garcia-López L.M. (2014) Decision-making in volleyball block: Comparison between elite and amateur players. Revista de psicologia del deporte. 23, 2, p. 239-246.
33. Kohmura Y, Yoshigi H. (2004) Training effects of visual function on college baseball players. Hum Perform Measurement, 1, p. 15-23.