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DIFFERENCES IN PERIPHERAL VISION BETWEEN CONTEMPORARY DANCERS, FOLK DANCERS AND NON-DANCERS

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Abstract

Introduction. In stage performances, dancing requires synchronous connections, choosing paths in space, forming, balancing shapes, adjusting tempo and energy, as well as partnering. Therefore, in addition to proprioceptive abilities and central vision, peripheral vision is used to a large extent. Will the role of peripheral vision be relevant in selected dance styles and techniques? The aim of this study was to compare peripheral perception between contemporary dancers, folk dancers and non-dancers. **Material and Methods.** The study included 126 individuals. This group consisted of 48 contemporary dancers, 19 folk dancers and 58 non-dancers (the control group – students who did sports other than dance). The Vienna Test System was used to assess peripheral perception. Statistical analysis of the results was performed using a one-way analysis of variance (ANOVA). **Results.** Interpretation and analysis of the test results indicate that the dancers' visual range is relatively large, averaging 175.3° for contemporary dancers and 175.58° for folk dancers. As for the control group, the visual range was 172.64°. In the case of peripheral vision, statistically significant differences were noted between the control group and the contemporary dance group ($p < 0.01$) as well as between the control group and the folk dance group ($p < 0.05$). **Conclusions.** Contemporary and folk dancers did not show variation in peripheral vision. However, differences occurred between dancers and non-dancers. It was noted that the studied groups of contemporary and folk dancers had a better range of visual functions related to the peripheral visual field than the control group.

Key words: peripheral vision, contemporary dancers, folk dancers, Vienna Test System, peripheral perception

Introduction

Visual perception represents approx. 80-90% of the information one receives from the environment [1, 2]. The visual system directs the body to respond and provides relevant information about where and when to perform a task. If the visual system does not receive messages accurately or quickly enough, performance can be negatively affected. Peripheral vision plays an important role in the functioning and gathering of information [3]. It applies to many activities performed every day, such as walking, overcoming obstacles and driving. The use of central or peripheral vision depends on the situation and trade-offs, as well as experience, age, emotional state, the importance of the task at hand and knowledge of the environment [4].

A complex and extremely important issue is the use of central and peripheral perception in demanding conditions: time and space. An example of this is physical activity, which involves using central vision (focusing the eyes on one place) and peripheral vision (observing other objects and the surrounding space). In sports and physical activity, this skill becomes particularly important in processing information. It is crucial in making accurate decisions under time pressure. Thus, peripheral vision is necessary for gathering information from different sources. It deals with complex aspects of perception and provides many cues.

Enhancing peripheral vision skills and increasing the importance of visual training and its further use can significantly improve sports performance. Based on their observations, Kha-

nal et al. [5] recommends that visual skills training be incorporated into the routine training of athletes at all levels.

In the literature, we can find examples of peripheral perception studies concerning various sports, e.g. handball [6, 7] volleyball [8], soccer [9] or basketball [10]. Peripheral perception has also been studied in football referees [11] or basketball experts [12]. The ability to see and perceive peripherally plays an important role in sports such as field hockey, tennis, badminton or martial arts [13, 14].

Each sport has different visual needs and requirements distributed in spatiotemporal relationships. In selected forms of activity, key objects must be recognised quickly and accurately to ensure optimal performance. This aspect also applies to space and the variables that appear in it.

Will the role of peripheral vision be relevant in selected dance styles and techniques?

In many situations, dancing requires determining the position of our body and its parts in space. Partnering, complex choreographic structures, duets, or ensemble dancing in synchronous combinations and constructions require movement agility on stage.

Sight is a fast and reliable sensory input. However, dancers do not rely solely on vision [15]. In their case, proprioceptive abilities constitute an important element [16]. In dynamic stability conditions, dancers rely on other peripheral proprioceptive receptors more than on vision compared to untrained individuals [17]. However, in situations where postural stability is challenged, peripheral and focal vision appears to benefit various aspects of it [15, 18].

Visual accessibility contributes to greater postural stability [19], and the current view of dancers' proprioceptive abilities is not without controversy. Jola et al. [20] suggest that this advantage may be limited to movements in a single joint or to the best-trained positions, and it is not transferred to other positions. However, as research indicates [15, 20], dancers are able to match the position of one hand to the opposite hand better than non-dancers under various conditions. The authors conclude that dancers have a more coherent representation of the body. In their opinion, proprioception has a greater influence on the perceived location than in the case of non-dancers [20].

In stage performances, dancing requires synchronous connections, choosing paths in space, forming, balancing shapes, adjusting tempo and energy, as well as partnering. Therefore, in addition to proprioceptive abilities and central vision, peripheral vision is used to a large extent.

Material and Methods

The study included 126 individuals. This group consisted of 48 contemporary dancers from the Kiejstut and Grazyna Bacewicz Academy of Music, 19 dancers from the Folk Song and Dance Ensemble of the University of Warsaw 'Warszawianka' and 58 non-dancers (the control group). The control group ($n = 58$) included students from Józef Piłsudski University of Physical Education in Warsaw (Faculty of Physical Education and Health in Biała Podlaska) who did sports other than dance. The mean age in the groups of contemporary dancers, folk dancers and non-dancers was 22.76 ± 4.45 , 24.35 ± 4.17 , and 22.7 ± 0.97 , respectively. The study protocol was approved by the Ethics Committee of Józef Piłsudski University of Physical Education in Warsaw, and all procedures followed the ethical standards of the Declaration of Helsinki.

The Vienna Test System was used to assess peripheral perception. For the peripheral perception (PP) test, a device was used with 2 LED matrices (8 lines and 64 columns on each side), and an ultrasonic sensor to measure the distance and position of the participant's head (Fig. 1).

The PP test consists of two tasks that are performed simultaneously, i.e. a peripheral perception task, and a central tracking task that helps to focus on the centre of the visual field. The peripheral perception task involves secondary observation of flashing vertical lines that appear randomly in the peripheral visual field. The task involves recognising the lines and responding by pressing the pedal with the foot. The 80 required stimuli are generated (40 on the right and 40 on the left of the central visual field). Two parameters play a major role in this case: reaction time and margin of error. The results of both tracking and peripheral perception tasks are included in the evaluation. The coefficient of internal consistency (Cronbach's Alpha) is $r = .97$ for the angle of vision (right/left side) and $r = .96$ for tracking deviation (CTS Catalogue 2006). The Vienna Test System is a tool using foveal additive tasks with the best passive control to assess peripheral vision in sports activities [21, 22].

In the present study, variables such as visual field, visual angle (left/right), tracking deviation, the number of correct responses (left/right side), incorrect reactions, omitted responses, and response time median (left/right side) stimuli were recorded.

Statistical analysis

For the purpose of the study, the arithmetic mean, median, and standard deviation (SD) were determined. Statistical analysis of the results was performed using a one-way analysis of variance (ANOVA), while the equality of variance was verified

using Bartlett's test. If ANOVA revealed significant effects, the post hoc tests, including Bonferroni correction, were performed. Statistical significance was set at $p < 0.05$. The calculations were made using the R software [23] and rstatix [24].

Results

Total visual field is the resultant of the visual fields of the right and left eye. Interpretation and analysis of the test results indicate that the dancers' visual range is relatively large, averaging 175.3° for contemporary dancers and 175.58° for folk dancers. The values of the visual angle in the left eyes of contemporary dancers (87.38°) and folk dancers (88.15°) are similar to the values obtained for the right eyes (87.92° and 87.39° , respectively). As for the control group, the visual range was 172.64° , while the values of the visual angle came to 86.17° for the left eyes and 86.46° for the right eyes (Tab. 1.).

The number of correct responses to stimuli appearing on the left and right in the peripheral vision was similar. During the PP test, the number of omitted responses was the highest in the control group (4.29 ± 3.64). The average value of this parameter was 3.35 ± 2.98 in the group of contemporary dancers and 3.42 ± 3.79 in the group of folk dancers.

In the case of peripheral vision, statistically significant differences were noted between the control group and the contemporary dance group ($p < 0.01$) as well as between the control group and the folk dance group ($p < 0.05$). However, no differences were found between the contemporary dance group and the folk dance group. The correlations were observed for the left eye's visual angle at $p < 0.01$ between the control group and the folk dance group, and at $p < 0.05$ between the control group and the contemporary dance group. The angle of vision of the right eye indicated differences (at $p < 0.05$) between the control group and the contemporary dance group only. The remaining variables showed no statistically significant differences (Fig.1-II).

The calculated value of the left eye's visual angle – p-value (0.09236), was found to be lower than the accepted level of statistical significance $p < 0.05$, while the p-value of the number of incorrect reactions (0.0001379) was found to be lower than the level of $p < 0.001$. It clearly indicates that the dispersion of the data (variances) in the analysed samples (measurements) of the three groups is significantly different. The other tested values (field of vision, right side visual angle, the number of correct reactions right/left, etc.) did not point to statistically significant differences.

Discussion

There is a scarcity of data on the issue of peripheral perception in sports (in dance in particular). The correct perception of a larger number of different details affects the quality and facilitates the prediction of actions, and thus the decision-making process is faster and more effective.

Choreographers typically use both symmetry and asymmetry as parts from which they create movement sequences. In this regard, variety is often found in arrangements and dance formations. However, there are examples that support symmetrical solutions. In terms of dance design and teaching movement structure, the strength of symmetry and the ideals it supports may be based partly on the long history of the ballet form and related ballroom dances, which, like country or folk, are largely symmetrical [25, 26]. In their research on peripheral perception in other sports, Polishchuk and Mosakowska [14] showed the phenomenon of crossed laterality, which clearly occurred

Table 1. Mean values of the indices obtained in the peripheral perception (PP) test conducted on contemporary dancers, folk dancers and non-dancers

groups	A - control			B - contemporary			C - tradinional			p
	x	± SD	Me	x	± SD	Me	x	± SD	Me	
Age	22.7	0.97	-	22.76	4.45	-	24.35	4.17	-	-
Visual field	172.64	4.47	172.9	175.3	4.25	174.2	175.58	3.56	175.2	AB** AC**
Vision angle - left eye	86.17	2.56	86.2	87.38	2.59	87.6	88.15	1.66	88.1	AB** AC**
Vision angle - right eye	86.46	3.20	86.5	87.92	2.44	88.3	87.39	2.43	87.2	AB*
Omitted responses	4.29	3.64	4.0	3.35	2.98	3.0	3.42	3.79	2.0	-
Tracking deviation	11.20	1.67	11.1	11.04	1.30	10.8	10.63	1.1	10.5	-
The number of correct responses - left side s.	16.47	2.58	17.0	16.76	2.43	17.0	17.58	1.95	18.0	-
The number of correct responses - right side s.	16.72	2.53	17.0	17.0	1.93	17.0	16.74	2.51	17.0	-
The number of incorrect reactions	1.55	1.70	1.0	2.33	2.64	1.0	1.16	1.21	1.0	-
Response time median - left side stimuli [s]	0.60	0.08	0.59	0.59	0.08	0.58	0.60	0.06	0.59	-
Response time median - right side stimuli [s]	0.59	0.08	0.59	0.60	0.07	0.60	0.60	0.08	0.58	-
Response time median right/left side stimuli [s]	0.59	0.08	0.59	0.59	0.07	0.59	0.59	0.06	0.59	-

*** - $p < 0.001$, ** - $p < 0.01$, * - $p < .05$.

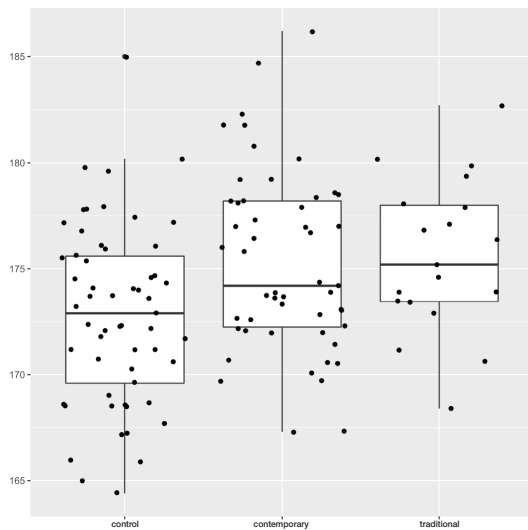


Figure 1. Vision field

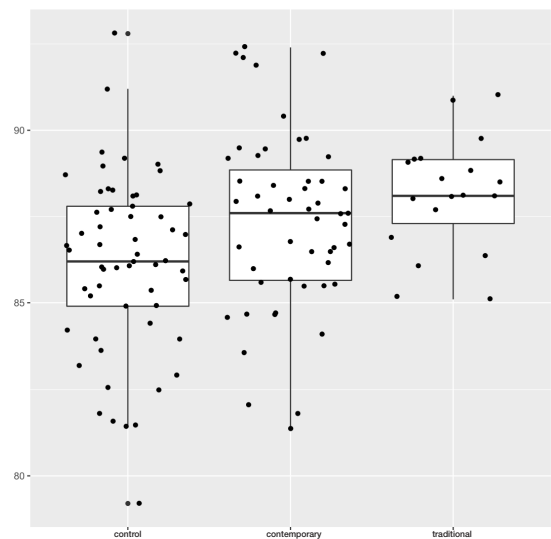


Figure 2. Vision angle - left eye

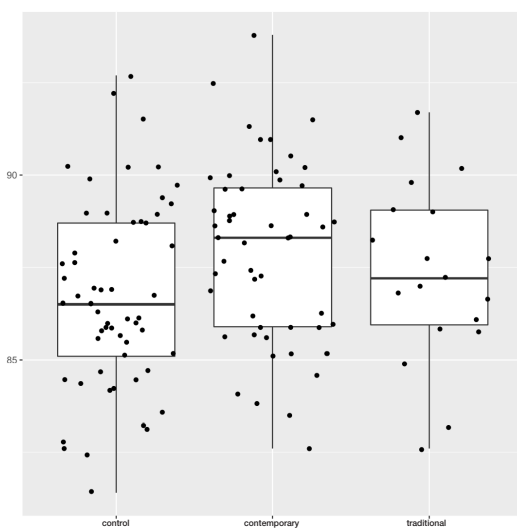


Figure 3. Vision angle - right eye

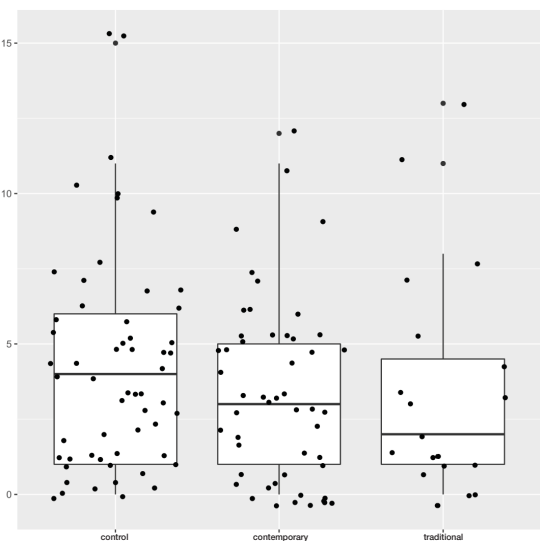


Figure 4. Omitted responses

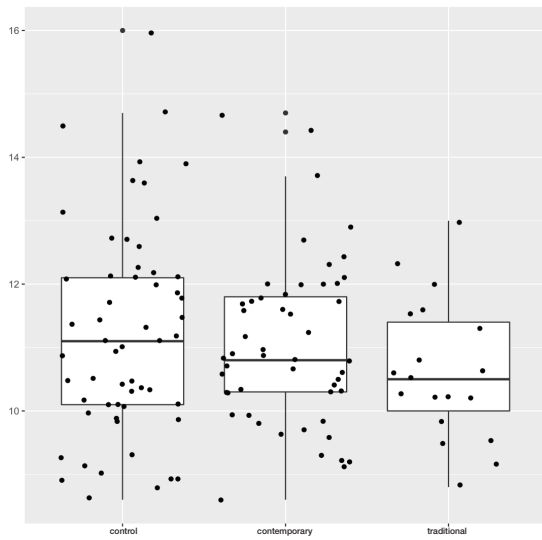


Figure 5. Tracking deviation

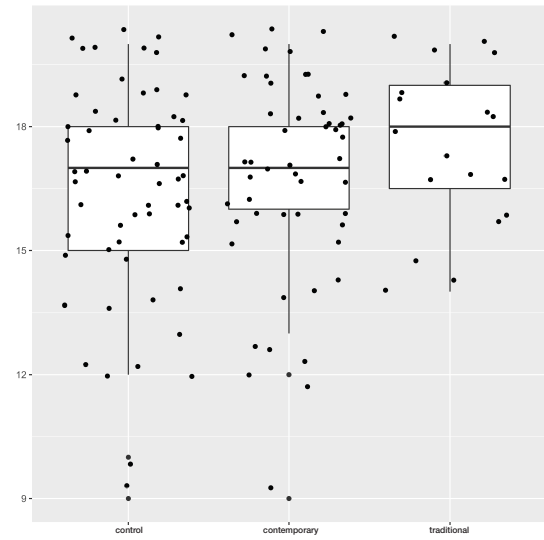


Figure 6. The number of correct responses - left side stimuli

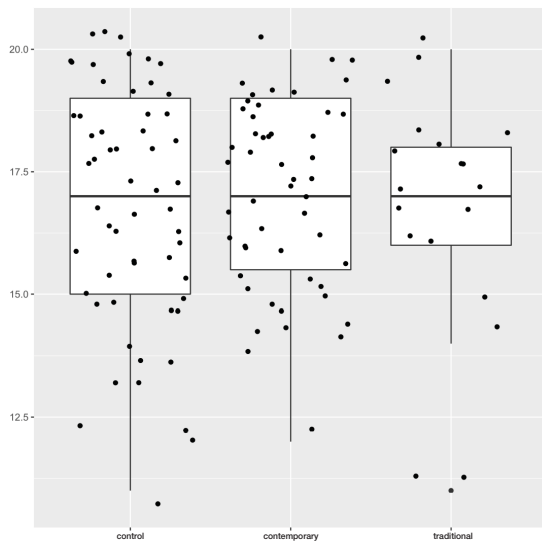


Figure 7. The number of correct responses - right side stimuli

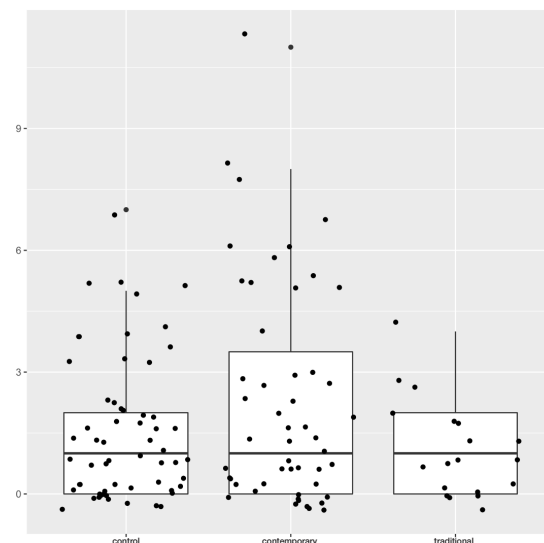


Figure 8. The number of incorrect reactions

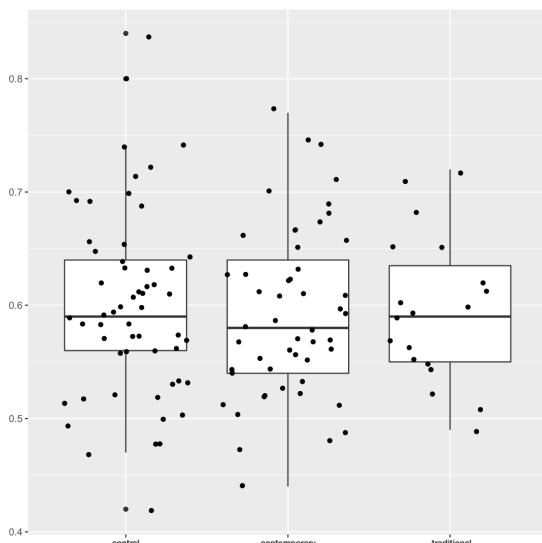


Figure 9. Response time median - left side stimuli [s]

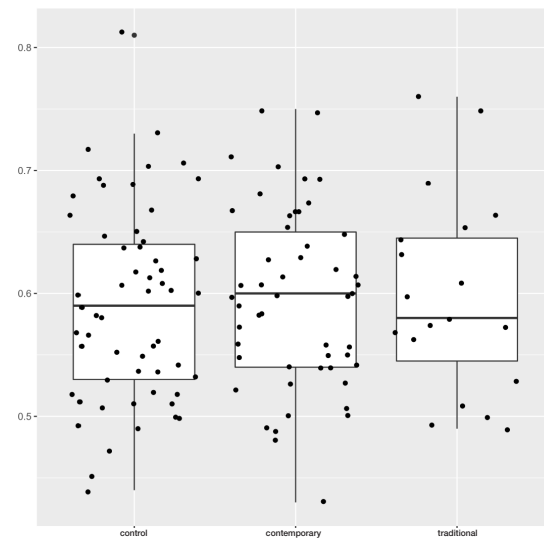


Figure 10. Response time median - right side stimuli [s]

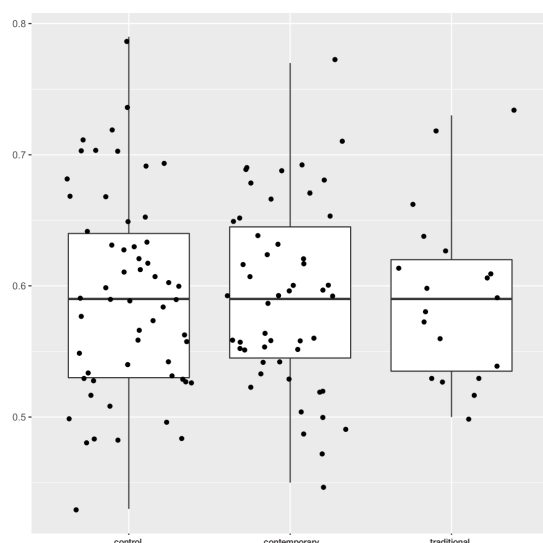


Figure II. Response time median right/left side stimuli [s]

in badminton players under study. In their case, the visual angle between the right eye and the left eye showed a significant difference in favour of the left eye. The dominance of the right upper limb was accompanied by a greater visual angle in the left eye. Despite the dominance of the left eye, shorter reaction time and greater accuracy of decision-making were observed in the exposure to right-side stimuli.

In the current study, the differences noted between dancers and non-dancers in the visual angle of the right eye may stem from the very structure of the contemporary dance and its training. The subject of symmetry or asymmetry in dance is not precise although some forms show a clear preference for one or the other. The goal of a ballet, folk or ballroom dancer may be to eliminate the body's natural asymmetry, while an improviser or performer in a dance theatre company uses new possibilities that small or pronounced asymmetries bring to the performance creation process [25]. However, the above observations call for further investigations with regard to the nature of dance techniques and styles.

In different sports, the comparison of visual functions between athletes and untrained individuals is becoming quite an interesting issue. Peripheral perception in athletes and non-athletes constitutes a very complex problem. There are examples of sports in which these relationships are clearly noticeable. In the athlete population, superior performance was reported in selected visual skills of vergence facility, saccades, visual reaction time, peripheral awareness, and near point of convergence [27]. Williams and Thirer [28] revealed statistically significant differences with respect to central and peripheral visual fields between American football players, fencers, tennis players and non-athletes. However, at this stage of research it is difficult to determine whether wider peripheral vision was the result of training or the initial selection of athletes [6].

Interestingly, Vila-Maldonado et al. [8] revealed that experienced volleyball players made better decisions in match situations than their inexperienced peers; however, no differences were found in laboratory tests. In this case, there were no differences between players and inexperienced participants in such areas as prediction, peripheral perception and visual recognition speed tested in a non-sport-related laboratory situation.

There are also examples of studies in which visual functions related to peripheral vision did not differentiate athletes

from non-athletes. Compared to their untrained counterparts, handball players did not demonstrate higher levels of peripheral vision in terms of the visual field, width, and correctness of responses to visual stimuli. However, handball players had significantly shorter reaction times to stimuli appearing in the peripheral visual field compared to non-athletes [6].

When analysing peripheral visual field perceptions in the contemporary dance group ($175.3^\circ \pm 4.25$) and the folk dance group ($175.58^\circ \pm 3.65$), it is worth comparing the results with the findings of studies on other sports where the Vienna Test System was employed. For example, lower indicators of the visual field were recorded for basketball players ($174.61^\circ \pm 4.01$) [10], badminton players ($172.9^\circ \pm 4.45$) [14] as well as handball players - study I ($170.95^\circ \pm 9.15$) [6] and handball players - study II ($167.46^\circ \pm 12.83$) [7].

In the present study, dancers displayed the smallest differences in the angle of vision of the right and left eye, which in contemporary dance and folk dance groups did not exceed 1° . For female basketball players, it was approx. 2° , badminton players - 7° , and handball players - 10° and 9° [6, 7, 10, 14].

Similar to our study, the above-mentioned investigations [6, 7, 10, 14] did not reveal statistically significant differences in lateralization of reaction time to stimuli in the peripheral visual field.

Dancers did not exhibit the highest values of reaction time to stimuli in the peripheral visual field in these studies [6, 7, 10, 14]. The fastest reactions were obtained by handball players (left side: 0.55 ± 0.07 ; right side: 0.54 ± 0.05), handball players - study II (left: 0.51 ± 0.07 , right: 0.53 ± 0.05) followed by contemporary dancers (left: 0.59 ± 0.08 , right: 0.6 ± 0.07), folk dancers (left: 0.60 ± 0.06 , right: 0.60 ± 0.08) female basketball players (left: 0.63 ± 0.26 ; right: 0.59 ± 0.08) and badminton players (left: 0.66 ± 0.07 ; right: 0.66 ± 0.05).

Peripheral perception under training conditions and the correlation of these indicators with changes in lactic acid levels is yet another issue. Zwierko et al. [7] found no correlations between variables in this regard; however, other researchers show that aerobic capacity suppresses the increase in peripheral visual field reaction time during vigorous exercises.

The visual system is one of the most important sensory systems used during the performance of complex sports tasks. Despite playing such an important role, this function is rarely taken into account when designing a training programme by both coaches and athletes [29]. Numerous studies point to an urgent need to train perception, as it has a direct impact on performance [10].

Conclusion

Dancers from the studied contemporary and folk dance groups do not manifest differences in peripheral perception. Contemporary and folk dances, despite differences in the structure and nature of movement on stage as well as in compositional combinations and symmetry-asymmetry planes, did not show variation in this regard. However, differences occurred between dancers and non-dancers. It was noted that the studied groups of contemporary and folk dancers had a better range of visual functions related to the peripheral visual field than the control group.

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