Spatial Orientation and Attention at 12 Years Old Artistic Gymnasts and Handball Players

Alexandra Predoiu, Gheorghe Dinuță, Ana-Maria Gavojdea

Abstract
The aim of our research consists of investigating the spatial orientation and concentration of attention (expressed through attention efficiency coefficient) at female non-athletes, artistic gymnasts and handball players. To solve the research matters we used the Spatial Orientation test (component of the computerized platform of psychological evaluation Cognitrom Assessment System, developed by Cognitrom) and Attention Concentration and Mobility CMA test (within PSISELTEVA tests, elaborated by RQ Plus). The application of the Mann-Whitney test, revealed statistically significant differences, regarding spatial orientation between the handball players and the female non-athletes and also, concerning attention efficiency coefficient between the artistic gymnasts and non-athletes.

Keywords: spatial orientation; attention concentration; artistic gymnastics; handball; non-athletes.

1. INTRODUCTION
A great part of our regular behavior is oriented by the mental representations of the static, dynamic and relational characteristics of the objects that suround us in the environment (Logie & Denis, 1991). According to McGee (1979) the spatial aptitude represents the ability to mentally manipulate, rotate, twist, fold or invert the presented visual stimuli. McGee identified five components of the spatial ability (Lieu & Sorby, 2009): spatial perception (the ability to identify horizontal and vertical directions), spatial visualization (the ability of depicting situations when the components are moving compared to each other), mental rotations (rotation of three dimensional solids mentally), spatial relations (the ability of recognizing the relations between the parts of a unit), spatial orientation (the ability of a person to mentally establish his or her location and orientation within a given environment). Other studies regarding the spatial ability mention that it can be divided in three major components: spatial orientation, spatial visualization and spatial relations (Kozhevnikov & Hegarty, 2001). Spatial orientation represents the ability to anticipate and to imagine a fixed array after a change in perspective. The other two components, spatial visualization and spatial relations, involve the ability to mentally rotate and manipulate spatial forms from a fixed perspective. In addition, the spatial orientation, being an ability to imagine the appearance of objects from different perspectives of the observer (Hegarty & Waller, 2004) implies the localization of the objects regarding the axes of the observer’s body (front/back, left/right and up/down). Although, specialized literature, consistently notes the gender differences concerning spatial abilities, the results of the studies regarding spatial orientation are mixed, varying from “marked differences” to “no-differences”. Researches, also show, that gender differences in spatial ability exist due to different strategies used to solve orientation tasks (varied experiences), the argument was that environmental influences play a primary role in the development of spatial ability (Coluccia & Louse, 2004). Studies regarding the spatial ability and age have found that age affects this ability (Mohler, 2008). Spatial ability improves with age in childhood years (Orde, 1996), but declines with age in adulthood (Pak, 2001). Cognitive sport psychology is concerned with the scientific study of how the mind works in athletic settings. Within this field, the term “attention” refers to one’s ability to focus on information coming either from external world or from internal sources, such as memory and imagination (Spieblberger, 2004). Attention is regarded as a passage way to other types of cognitive processing. Before language can be comprehended, visual-spatial relationships perceived, information remembered or problems solved, the stimuli must be attended to (Hersen & Turner, 2003). Specialized literature (Hsiigh, Huang, & Hung, 2003).
Recent research (Grigore, Mitrache, Predoiu & Păunescu, 2014) emphasized the fact that the student-athletes (all aged between 20 and 24, males and females) practicing individual sports (tennis, karate, gymnastics) register considerably higher performances when evaluating attention concentration and mobility under fast speed conditions, than the student-athletes practicing team sports (football, handball, basketball). Each sport has its own demands regarding the attentional focus or mobility and they also, vary in the length of time concentration needs to be maintained (some demand continuous concentration, while in others, it can be intermittent, with the need to refocus). The concentration of attention is considered to be a psychological skill that can be learned and developed through practice and dedication (Maynard & Crisfield, 2006).

2. ORGANIZATION OF THE RESEARCH

2.1. The purpose of the research

The aim of our research was to investigate the spatial orientation and concentration of attention (expressed through attention efficiency coefficient) at 12 years old female non-athletes, female artistic gymnasts and female handball players. As specialists of the sports domain (artistic gymnastics and handball) we were interested in finding the key factors, which influence the sports performance, at this specific age, in order to include them in our training strategy.

2.2. Participants

A number of 38 participants, having the age of 12 years old, participated in the study. They were divided in three groups, as it follows: a group of 11 female athletes practicing artistic gymnastics, a group of 12 female handball players (both groups of athletes having a competitive experience comprised between 3 and 4 years) and a group of 15 female participants who do not conduct systematic physical activities.

2.3. Methods

In order to conduct the research matters, we used: observation, conversation, test – Spatial Orientation test (component of the computerized platform Cognitrom Assessment System, developed by Cognitrom), Attention Concentration and Mobility CMA test (within PSISELTEVA tests, elaborated by RQ Plus), statistical processing methods - SPSS and data interpreting. We mention that the tests were applied collaborating with the specialists from the Psychopedagogy Laboratory within the National University of Physical Education and Sports, Bucharest.

2.4. Description and development

Spatial Orientation test measures a person’s capacity to analyze a field of stimuli from a given perspective and to provide information about that field, starting from a new required perspective. The subject’s task is to analyze, from a fixed point, a surface with many objects on it and then to choose, among many alternatives, two that are identical with the initial perspective. In order to facilitate the spatial orientation direction, the variants of response contain a circle (through which the investigated person analyzes the surface), an “X” and an arrow (to delimit the perspective direction and sense of analysis). The two correct variants of response present the surface in the target-image seen from different positions. The test is administered within a 5 minute time limit. A high score indicates that the person has a very good spatial orientation, manages to analyze the spatial relations that exist among different elements of a field, to construct an appropriate mental picture of it and then to recognize the respective space from another perspective. CMA test is conceived under the shape of a dynamic model made of task-sequences with progressive degrees of difficulty. The task consists of giving pre-established answers in time-required conditions. Image content – four squares (one set in the centre, three below on the horizontal) inside of which 2, 3, 4 or 5 triangles are placed, depending on the difficulty. Through a rotating movement, at pre-established lapses of time the triangles inside the squares change their position; when the rotating movement stops it means there is a signal-stimulus. The task of the subject is to give an answer each time the triangles inside the model-square stop moving by choosing the square which has an identical content from the three squares situated on the horizontal (below the model-square). The answering device consists of a lever with three buttons.
2.5. Results of the Spatial Orientation and CMA tests

Among the coefficients provided by the battery soft, we shall present the following parameters:
CMA test: the attention efficiency coefficient (correctly issued answers);
Spatial Orientation test: the number of correct answers issued at the test.

3. RESULTS

Preliminary data analysis (box-plot charts) has emphasized that in the case of the results obtained at Spatial Orientation and CMA tests, there were no extreme values, per each group of subjects. Through the Kruskal-Wallis H test (Labăr, 2008) it was verified if there are statistically significant differences among the three groups of participants, in terms of results obtained for the spatial orientation and concentration of attention tests. Table 1 shows the value of the Kruskal-Wallis H (Chi-Square) test, the freedom degrees (df) and the threshold of statistical significance (Sig.).

Table 1. Results for group “artistic gymnasts” vs. group “handball players” and group “non-athletes” – Test Statistics\(^a, b\)

<table>
<thead>
<tr>
<th>Spatial orientation</th>
<th>Attention efficiency coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>5.928</td>
</tr>
<tr>
<td>df</td>
<td>2</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.032</td>
</tr>
<tr>
<td>df</td>
<td>2</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.014</td>
</tr>
</tbody>
</table>

\(^a\) Kruskal Wallis Test; \(^b\) Grouping Variable: participants

Whereas \(H (3) = 8.543\), respectively \(H (3) = 5.928\) and \(p = 0.014\), respectively \(p = 0.032\), it is found that there are significant differences among the groups, according to the results obtained by the participants for the attention efficiency coefficient and spatial orientation. To compare by pairs the results obtained by the tested groups of participants, we used the Mann-Whitney (U) test, for two independent samples and we adjusted the threshold of statistical significance - Bonferroni method, according to the number of comparisons (three in our case), in such manner that \(p = 0.05/3 = 0.017\) (table 2). We will present the results for the significant comparisons.

Table 2. Results for group “handball players” vs. group “non-athletes” - Test Statistics\(^b\)

<table>
<thead>
<tr>
<th>Attention efficiency</th>
<th>Spatial orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mann-Whitney U</td>
<td>66.000</td>
</tr>
<tr>
<td>Z</td>
<td>-1.210</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.226</td>
</tr>
<tr>
<td>Exact Sig. [2*(1-tailed Sig.)]</td>
<td>.256(^a)</td>
</tr>
</tbody>
</table>

\(^a\) Not corrected for ties; \(^b\) Grouping Variable: participants

The Mann-Whitney test value, in the case of the comparison between the handball players group and non-athletes group, for the spatial orientation, is 36.500. The table critical value for 0.05 alpha level and \(N = 12\) (for the handball players group), respectively \(N = 15\) (non-athletes group) is 49. Whereas calculated \(U\) value is lower than the table critical value (36.500 < 45), and \(p = 0.007\), we may conclude that between the handball players (Median = 14.50) and the female non-athletes (Median = 11.00), there are statistically significant differences in terms of spatial orientation. The effect size is \(r = 0.50\), which shows us that the effect of group variable (handball players/ female non-athletes) on the results is strong, in terms of spatial orientation. In the case of the comparison between the handball players and the female non-athletes group no statistically significant differences were found, for the attention efficiency coefficient.

The Mann-Whitney test value, in the case of the comparison between the artistic gymnasts group and non-athletes group, for the attention efficiency coefficient, is 28.000. The table critical value for 0.05 alpha level and \(N = 11\) (for the artistic gymnasts group), respectively \(N = 15\) (non-athletes group) is 45. Whereas calculated \(U\) value is lower than the table critical value (28.000 < 45), and \(p = 0.004\), we may conclude that between the
artistic gymnasts (Median = 0.84) and the female non-athletes (Median = 0.76), there are statistically significant differences in terms of attention efficiency coefficient. The effect size is r = 0.56, which shows us that the effect of group variable (artistic gymnasts/ female non-athletes) on the results is strong, in terms of the attention efficiency coefficient. In the case of the comparison between the artistic gymnasts group and the female non-athletes group, no statistically significant differences were found, for spatial orientation.

4. CONCLUSIONS

Our study accentuates the statistically significant differences between the female athletes practicing artistic gymnastics, the handball players and the female participants who do not conduct systematic physical activities, regarding the spatial orientation and the concentration of attention (expressed through attention efficiency coefficient). Thus, our research emphasizes statistically significant differences between the handball players and the female non-athletes, in connection to the spatial orientation. For this dimension we didn’t found significant differences between the artistic gymnasts and the female non-athletes. This aspect can be explained by the fact that in handball, the spatial memory is needed in order to understand the complex situations generated by the athletes own actions or by the opponents. Consequently, practicing handball, as a complementary sport, may have a positive influence on the improvement of the spatial skills of the female artistic gymnasts. Also, in the case of the non-athletes, the handball game, practiced as a physical systematic activity, can be an effective way of developing the spatial orientation. The study results, also show, that there are significant differences between artistic gymnasts and female non-athletes, regarding the attention efficiency coefficient. In the case of the handball players this finding does not apply. This aspect can be related with the fact that, in artistic gymnastics the athletes perform antigravitational movements on different apparatus (for example: uneven bars, horizontal bar, vault), the risk of injury being high. At the same time, the phenomenon of social loafing may manifest in handball, while in artistic gymnastics, being an individual sport, the effort to achieve the goal (which involves intense focusing of psychic energy) “falls” only on one’s shoulder. Therefore, in order to enhance the attentional skills such as concentration, for the handball players, the specialists may include in their training strategy, the practice of artistic gymnastics, as a complementary sport and also, exercises used on daily basis, by the artistic gymnasts. In addition, for the non-athletes, the practice of artistic gymnastics can represent a successful activity, for the development of the attention concentration. Our research has been limited by the psycho-physical state of the participants during testing (fatigue, affective-motivational factors) which may cause fluctuations of the motor answers. The sample of athletes, can be appreciated as another limitation, considering that the situation could be different if the sample would be constituted, only of male athletes. The specialists of the field can benefit from the data provided by the research results, in order to scientifically conduct the sports training and design programs, for the investigated dimensions (spatial orientation and concentration of attention) associated with sports performance. The Spatial Orientation and CMA tests may offer important data, regarding the spatial and respectively, attentional skills, which may become objective points in specific training or in the case of practicing systematic physical activities.

5. ACKNOWLEDGEMENTS

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6. REFERENCES


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