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The influence of spatial perception on control and energetic parameters

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Abstract

The paper assesses the influence of spatial perception on the control and energetic parameters measured in three cases: while the participant visualizes his/her performance, blindfolded and while he/she performs standard tests for energetic and control parameters. The experimental system used to analyze the influence of spatial perception is based on the Kinect depth sensor and tailor made software which allows the initialization and the computation of kinematic parameters. The paper also discusses the results for the left upper limb, the right upper limb and for both limbs involved in vertical jumping, considered to be the standard test for assessing the energetic and control parameters.

Keywords: kinect sensors, vertical jump, control parameters, energetic parameters

1. Introduction

The term sports intelligence is an important factor in success or failure in sport (M. Niculescu, 2000).

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Considered to be a particular form of general intelligence, but different in substance, this concept occurs and grows in relation to the sport activity, proving the adjustment to the requirements of training, contributing to the changes occurring during different training stages (St. Tudos, G. Mitrache, 2006).

Sports intelligence can be defined as the availability and assimilation harmony of sports requirements, together with personal adaptation to them.

It is well known that motor intelligence completes psycho-motricity scheme, along with other components: coordinative abilities, ideo-motricity, body scheme, speed movements and praxis. This psycho-motor component has been defined as psycho-motor intelligence, special aptitude, cognitive organization, adaptability etc.

According to A. Gagea (1999), motric intelligence is expressed through some specific features as: motor memory, creativity, motor skills, and spatial-temporal sense.

The authors (E. Colibaba and I. Bota, 1998) argue that motric intelligence is a very important factor in athletes’ training program. It appears as an adjustment of already automated movements (P. Ichim, M. Ion-Ene, 2001), under constantly changing playing conditions, new movements and new technical execution styles etc.

Real needs of training stages and competitions require a mix of motric skills, which are analyzed using energetic and control parameters. The study aims at revealing the influence of spatial-temporal sense on some kinematic parameters of athletes while performing a vertical jump test under three conditions which will be described below.

2. Objectives and methods

The aim of this paper is to determine the influence of spatial perception on the control and energetic parameters (Bosco, C., Luhtanen, P., Komi, P.V., 1983). The experiment was conducted on a group of three athletes. The participants had to jump on both legs, on the right leg and the left leg, firstly being blindfolded, then while visualizing their performance on TV screen, and finally under normal conditions for vertical jump test.

The tests took place in the Biomechanics Lab. of “Dunarea de Jos” University and all the participants gave their consent to the testing protocol according to ethical principles.

All the participants performed three series of vertical jumps on a carpet, on both legs, on left leg and on right leg, under the conditions mentioned above.

The equipment used in the experiment consisted of the special carpet with pressure sensors used in MGM-15 test (ref.) shown in fig.1 and the kinect sensor (Ganea, D., Mereuta, C., Mereuta, E., 2013).

The results were collected and processed and they have proved to be relevant to the aim, meaning that they have revealed that the spatial-temporal sense has an important influence on the energetic and control parameters.

![Fig. 1. The MGM -15 equipment](image-url)
The energetic and control parameters reveal the mixture of two or three motric abilities, as a consequence of a mixed effort of the athlete such as aerobic – anaerobic, alactacid and lactacid present in some moments of the competition or during the training process (Viitasalo, J.T., Bosco, C., 1982).

The energetic parameters are shown in fig.2 and they emphasize the energetic resources of an athlete, providing information on the force-velocity ratio, on the velocity and on the force. These parameters are used as an instrument of training appraisal, meaning that it is possible to assess the unbalance between force and velocity during different training stages and to act accordingly (Mereuta, C., Mereuta, E., 2010, 2012, 2013). The energetic parameters are: the average unit power (AUP), the average flying height (AFH), and the repetition rate (RR).

The control parameters (fig.3) provide information on how an athlete is able to control its energetic resources and how he can control the finishing stages of an action (Mereuta, C., Mereuta, E., 2013, Mereuta E., Mereuta C., 2012). These are also important aspects, mainly for the trainer who can adjust his/her training program to each individual and who can assess realistically his/her performances and training levels. The control parameters are: the energetic variability coefficient (CVE) and the structural variability coefficient (CVS).

### 3. Results and discussions

The results provided by the experiment are shown in table 1, for one of the three athletes. The energetic parameters and the control parameters are provided by the MGM-15 platform for the three conditions to which the athletes were subjected.

**Table 1. Experimental results**

<table>
<thead>
<tr>
<th>Vertical jumping on both legs</th>
<th><strong>ENERGETIC PARAMETERS</strong></th>
<th><strong>CONTROL PARAMETERS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter</strong></td>
<td><strong>Blind folded</strong></td>
<td><strong>Visualizing the motion</strong></td>
</tr>
<tr>
<td>Average unit power</td>
<td>3.69</td>
<td>4.23</td>
</tr>
<tr>
<td>Average flying height</td>
<td>0.25</td>
<td>0.3</td>
</tr>
<tr>
<td>Repetition rate</td>
<td>0.23</td>
<td>0.22</td>
</tr>
<tr>
<td>Energetic variability coefficient</td>
<td>8.09</td>
<td>6.34</td>
</tr>
<tr>
<td>Structural variability coefficient</td>
<td>18.84</td>
<td>18.22</td>
</tr>
</tbody>
</table>
Enetic and control parameters for vertical jumping test on both legs

In addition, in fig. 4 the influence of spatial perception on the energetic parameters for vertical jumping test on both legs is revealed.

Thus, the average unit power increases (14%) when the athlete performs vertical jumps on both legs and visualizes his performance, comparative to the blindfolded situation. However, the proportion of the maximum power developed on vertical jumping on two legs, it is found that the best values are recorded for the standard test case (84.71%).

As far as that goes, the average flying height is found to be maximum with respect to maximum height, for the standard test (84.21%), but when the athlete visualizes his performance, the parameter is 20% higher than for the blindfolded case.

The repetition rate for all the cases proves that the athlete has poor velocity.

Regarding the control parameters, it is revealed that the best value for energetic variability coefficient is provided by the test conducted with visualization of motion (6.24) proving that in this case the athlete has a better control on its own energetic resources. As for the structural variability coefficient, it also registers the best values (18.22) in this test case. This is the parameter that describes the athlete’s control on completion stages of sport activities.

In fig. 5, the influence of spatial perception on the energetic parameters for vertical jumping test on right leg is revealed.

Thus, the average unit power considerably increases (85%) when the athlete performs vertical jumps and visualizes his/her performance, comparative to the blindfolded situation. However, concerning the proportion of the
maximum power developed on vertical jumping on right leg, it is found that the best values are recorded for the standard test case (72.2%).

As far as that goes, the average flying height is found to be maximum with respect to maximum height, for the standard test (75.1%), but when the athlete visualizes his/her performance, the parameter is 100% higher than for the blindfolded case.

The repetition rate for all the cases proves that the athlete has poor velocity, but better values are obtained while visualization the motion on TV screen.

Regarding the control parameters, it is revealed that the best value for energetic variability coefficient is provided by the blindfolded test (10.16) proving that in this case the athlete has a better control of his/her own energetic resources. As for the structural variability coefficient it also registers the best value (11.02) in this test case. This is the parameter that describes the athlete’s control on completion stages of sport activities.

In fig. 6, the influence of spatial perception on the energetic parameters for vertical jumping test on left leg is revealed.

Thus, the average unit power considerably decreases (64%) when the athlete performs vertical jumps and visualizes his/her performance, comparatively to the blindfolded situation. However, concerning the proportion of the maximum power developed on vertical jumping on left leg, it is found that the best values are recorded for the standard test case (77.45%).

As far as that goes, the average flying height is found to be maximum with respect to maximum height, for the standard test (76.19%), but when the athlete visualizes his/her performance, the parameter is 52% smaller than for the blindfolded case.

The repetition rate for all the cases proves that the athlete has poor velocity, but better values are obtained while blindfolded.

Regarding the control parameters, it is revealed that the best value for energetic variability coefficient is provided by standard test (7.18) proving that in this case the athlete has a better control of his/her own energetic resources. As for the structural variability coefficient it also registers the best value (10.09) in blindfolded test case. This is the parameter that describes the athlete’s control on completion stages of sport activities.
4. Conclusions

This experiment proves that there is an important influence of the spatial perception on the energetic and control parameters. Thus, it is proved that for all the participants in the test the energetic parameters are influenced by the spatial perception, proving that the athletes are aware of their performance and try to emphasize their best motric qualities, like velocity and force (Badiu, T., Ion-Ene, M., Robu, D., et. al. 2001). The force velocity ratio is better when the athlete visualizes his/her performance, compared to the blindfolded case (fig.7). As for unitary asymmetry it is proved that better results are obtained also in this testing case (fig.8).

The test was irrelevant for left foot jumps, maybe because that all the tested athletes are right-handed. Better results were observed while performing vertical jumps on the right leg.

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References


