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One Legged Transitional Unbalance Stances in Hand-Eye Coordination Test

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Abstract

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In the field of physical activity a significant importance is held by hand-eye coordination, which is a major factor for improving dexterity. The improvement of dexterity is closely linked to the ability to maintain good hand-eye coordination in situations of fast transitional stances of partial unbalance. This paper implements a research protocol to identify the degree with which balance affects hand-eye coordination. In this study 185 students between 19 and 21 years old from the Faculty of Physical Education and Sport from Cluj-Napoca were used for the tests. The subjects were chosen from all of the three specializations during the handball module. The subjects were asked to take a general hand-eye coordination test that measured the number of successful mouse clicks in 30 on randomly appearing dots. The balance level was established using a force platform that recorded the changes of ground forces during a one-legged stance. The actual test to determine the influence of balance was recorded during the coordination test. The subjects were asked to perform the coordination test while trying to maintain the one-legged stance. The designed protocol ensured a satisfying visualization of the hand-eye coordination test results in the context of a smaller balance area. Furthermore, the statistical analysis of the data offered a special view of the case study with regards to the three specializations the Faculty to which the students are enrolled.

Keywords: Coordination; hand-eye; balance; students; test.

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1. Introduction

The behaviour of human gaze has been studied in various activities dynamic natural, including driving (Land, 1992; Land & Lee, 1994; Land, Horwood, 1995), music and reading (Goolsby, 1994; Kinsler, 1995; Land & Furneaux, 1997), typing (Inhoff, 1992), walking (Patla & Vicker, 1997), throw in basketball (Vickers, 1992), golf (Vickers, 1996) and cricket (Land & McLeod, 2000).

Although the use of gaze in these activities is a very specific, a common finding is that the brain uses gaze fixed to obtain spatial information for the controlling manipulators, an important issue is whether there are critical milestones that gaze is attracted and how these landmarks own acts.

Interact with many moving objects every day, when viewing a moving target subjects against a stationary target they follow almost automatically with eye movements (Lisberger, Morris & Tychsen, 1987). However, when subjects reach a target stationary, it was reported that gaze is anchored on the target (Neggers & Bekkering, 2001) and under certain conditions, it is anticipated movement of your hand to hit the target (Johansson & Westling, 2001).

The balance which is defined as the ability to maintain the centre of gravity within the support base with a minimum balance (Winter, 1995; Horak, 1987) control postural static is the ability to maintain a stable base of support with minimal movement while postural control dynamic is the ability to maintain a stable position during movement or restore postural following a disturbed (Horak, 1987; Winter, Patla & Frank, 1990).

1.1 Problem description

An example of basic stability testing may be a lunge that require muscles of the trunk to control backbone, pelvis and hips, while they raise the weight of the trunk. An example more challenging test of basic stability would be lifting weights, in which core muscles strong are used for proper alignment of the spine, while rising a progressively heavier weight. Another example is to maintain spine and torso in a time of stable alignment, sitting or standing on an unstable surface, such as a gym ball (Behm, 2010).

In order to ensure specific test requirements of most sports, it can use a system that allows monitoring of basic parameters during biomechanical circular rotation of the trunk (Zemková et. al., 2015).

The balance was measured through a computerized system, which consisted of a triangular plate with the force of 5 sensors at each corner. Force plate was connected to a PC and a software for analyzing (Good Balance TM Metitur Ltd, Finland) was installed to get synchronized with the force. Based on signals from each corner of the plate, the system looked at average speed of movements based on COP both ML and AP. These values are indicated in mm/s motherboard force was tested and calibrated automatically each time the computer program. This model of force plates has been tested for their validity and reliability to measure balance. (Era et. al., 2006; Bauer et. al., 2008; Hansson & Beckman, 2015).

In (Baghbaninaghadehi, 2013) the author tried to determine the effect of fatigue on the performance of static equilibrium has been used Paired T-test. The independent variable was the time (pre and post) and the dependent variable was the performance of static equilibrium, which was derived from the

FOBT test. The effectiveness of fatigue Protocol was determined by analysis of the EPR values with one way ANOVA repeated measurement.

In a test of forming the balance of six weeks, three times a week, followed balance using subjects UNIPEDE test (test of stability in one leg), and the limits of bipedal stability test ((maze test Anterior (AP) and medial displacement (ML) and center-speed pressure) measurements were recorded on a force platform Pasco, immediately after the brace, tape or after the first training session after six weeks. Differences in measurements of balance were compared between ankle stability conditions and time periods using two-way ANOVA ($\rho = 0.05$). The groups showed an improvement in speed CoP, reflecting a more stable center of mass. CoP increased speed brace group, which was significantly higher ($\rho = 0.006$) than the group band to six weeks (Fisher-Edwards et. al., 2015).

In (Land Mennie & Rusted, 1999) the authors found four functions of coordination hand eye loads Handling locating objects, directing hand or an object in hand to touch another object, guiding contact between two objects approach each another, and checking status variables related to pregnancy.

1.2 Subjects

The target population of our study consisted of first year students from the Faculty of Physical Education and Sport, Babes-Bolyai University Cluj-Napoca. We've selected the first year students due to the fact that there were no major differences on a curriculum level between the three specializations that the students were enrolled in. Even though there might be some differences of physical development on an individual level, we only chosen the students that, during the experiment, only attended the faculty's curriculum. This fact ensured that no subject had extra hours to develop his or hers balance and hand-eye coordination.

A number of 185 students were included in this study with the ages between 19 and 21 years old. The students were both males and females from all of the three specialization from the Faculty of Physical Education and Sport. They were split according to their specialization into three groups: group EFS consisting of 72 subjects, group SPM consisting of 50 subjects and group Kineto consisting of 63 subjects.

All the subjects were briefed beforehand regarding what the experiment consisted of and what they were required to do. The subjects were assured that any personal information would not be made public and their personal data recorded will be analysed under the cover of anonymity. Moreover the subjects were instructed how to control social and routine aspects of their lives so that those variables would not interfere with the experiment's results. Also, after the briefing, the subjects were asked to confirm their understanding of what was required on a premade consent form. Even though there were some that refused, all of the 185 subjects selected in the experiment agreed and signed the form.

1.3 Methods and materials

Our study used the AMTI Netforce platform to record the data needed for the balance evaluation. This instrument is a force platform that records the variations in force projected by the subject on it during the test. We also used a software that complements the platform, BioAnalysis. This analysis software allows us to calculate different indexes that characterize the quantitative and qualitative aspects of balance. Due to the fact that we wanted to see what is the influence of one-legged stances on the hand-eye coordination, we used this duo to find out what is the value for the center of pressure's (COP) velocity. The velocity of COP is an indicator for the postural control during unstable balance stances. (Masani et. al., 2014; Riach & Starkes, 1994)

The protocol for our research was split into three different stages, one for each of the segments of our study:

- The initial hand-eye coordination test
- The initial balance test without the hand-eye test
- The final balance test with the hand-eye test

For the initial hand-eye test, the subject was asked to click randomly appearing black dots on a 20 by 20 grid. There was a time limit of 30 seconds in which the subject had to accumulate as many success clicks as possible. Due to the fact that a mouse and computer were used for this test we allowed each subject 5 tries, and we kept the best one of them.

For the initial balance test the subject was placed on the force platform exactly in the stance for the final measurement: on one leg with the clicking hand on the mouse support table. The leg used for the balance test was the opposite leg of the clicking hand; in this way we were able to allow each subject the best chance of a high control of posture. The subject was asked to maintain the stance for 30 seconds. If the measurement was flaud or an error appeared we allowed a 10 minute rest before another attempt was made.

For the final test both of the procedures were followed so that we could get the data we needed to identify the degree of influence of balance on the hand-eye coordination.

1.4 Results

The data collected during the tests was analysed using the SPSS v17. Two statistical calculations were conducted: paired sample t-test and bivariate correlation.

A paired-samples t-test was conducted to compare the value of the initial hand eye coordination test(HE_Test_Ini) and the value of the final test(HE_Test_End) for the students in the EFS group. There was a significant difference in the scores while in a stable stance ($M=32.7$, $SD=3.61$) and unstable stance ($M=31.6$, $SD=3.98$) conditions; $t(71)=3.86$, $p = 0.0002$. These results suggest that unstable stances really do affect hand-eye coordination. Specifically, our results suggest that hand-eye coordination lowers during unstable stances for this group.(Table 1 and 2)

A paired-samples t-test was conducted to compare the value of the initial COP's velocity(Velocity_Ini) and the value of the final COP's velocity(Velocity_Final) for the students in the EFS group. There was a significant difference in the scores without the hand-eye test ($M=1.7$, $SD=0.56$) and with the hand-eye test ($M=1.9$, $SD=0.49$) conditions; $t(71)=-3.00$, $p = 0.04$. These results suggest that hand-eye tasks really do affect the postural control due to the fact that the velocity of the COP is increasing. Specifically, our results suggest that hand-eye tasks lower the postural control during unstable stances for this group. (Table 1 and 2)

Table 1. Paired Samples Statistics for EFS group

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	HE_Test_Ini	32.7639	72	3.61722	.42629
	HE_Test_End	31.6667	72	3.98236	.46933
Pair 2	Velocity_Ini	1.7041	72	.56940	.06710
	Velocity_Final	1.9444	72	.49665	.05853

Table 2. Paired Samples Test for EFS group

		t	df	p
Pair 1	HE_Test_Ini - HE_Test_End	3.863	71	.000
Pair 2	Velocity_Ini - Velocity_Final	-3.002	71	.004

A paired-samples t-test was conducted to compare the value of the initial hand eye coordination test(HE_Test_Ini) and the value of the final test(HE_Test_End) for the students in the SPM group. There was a significant difference in the scores while in a stable stance (M=31.5, SD=4.08) and unstable stance (M=33.1, SD=2.76) conditions; t(49)=-2.79, p = 0.007. These results suggest that unstable stances really do affect hand-eye coordination. Specifically, our results suggest that hand-eye coordination increases during unstable stances for this group. (Tabel 3 and 4)

A paired-samples t-test was conducted to compare the value of the initial COP's velocity (Velocity_Ini) and the value of the final COP's velocity (Velocity_Final) for the students in the SPM group. There was a significant difference in the scores without the hand-eye test (M=1.7, SD=0.35) and with the hand-eye test (M=2.01, SD=0.50) conditions; t(49)=-4.22, p = 0.000. These results suggest that hand-eye tasks really do affect the postural control due to the fac that the velocity of the COP is increasing. Specifically, our results suggest that hand-eye tasks lowers the postural control during unstable stances for this group. (Table 3 and 4)

Table 3. Paired Samples Statistics for SPM group

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	HE_Test_Ini	31.5200	50	4.08701	.57799
	HE_Test_End	33.1200	50	2.76007	.39033
Pair 2	Velocity_Ini	1.7013	50	.35643	.05041
	Velocity_Final	2.0098	50	.50459	.07136

Table 4. Paired Samples Test for SPM group

		t	df	Sig. (2-tailed)
Pair 1	HE_Test_Ini - HE_Test_End	-2.790	49	.007
Pair 2	Velocity_Ini - Velocity_Final	-4.225	49	.000

A paired-samples t-test was conducted to compare the value of the initial hand eye coordination test (HE_Test_Ini) and the value of the final test (HE_Test_End) for the students in the Kineto group. There was a significant difference in the scores while in a stable stance (M=31.7, SD=4.4) and unstable stance (M=29.9, SD=4.6) conditions; t(62)=6.2, p = 0.000. These results suggest that unstable stances really do affect hand-eye coordination. Specifically, our results suggest that hand-eye coordination lowers during unstable stances. (Table 5 and 6)

A paired-samples t-test was conducted to compare the value of the initial COP's velocity (Velocity_Ini) and the value of the final COP's velocity (Velocity_Final) for the students in the Kineto group. There was a significant difference in the scores without the hand-eye test (M=1.7, SD=0.42) and with the hand-eye test (M=2.12, SD=0.65) conditions; t(62)=-5.06, p = 0.000. These results suggest that hand-eye tasks really do affect the postural control due to the fact that the velocity of the COP is increasing. Specifically, our results suggest that hand-eye tasks lowers the postural control during unstable stances. (Table 5 and 6)

Table 5. Paired Samples Statistics for Kineto group

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	HE_Test_Ini	31.6984	63	4.41637	.55641
	HE_Test_End	29.9365	63	4.62069	.58215
Pair 2	Velocity_Ini	1.7727	63	.42224	.05320
	Velocity_Final	2.1201	63	.65569	.08261

Table 6. Paired Samples Test for Kineto group

		t	df	Sig. (2-tailed)
Pair 1	HE_Test_Ini - HE_Test_End	6.200	62	.000
Pair 2	Velocity_Ini - Velocity_Final	-5.065	62	.000

2. Discussion

Our study showed that there is a certain influence that one legged unbalance stances has over hand-eye coordination. The statistical data confirmed that there is a significant loss in postural control during hand-eye coordination tasks. The increase in COP's velocity is different between the three specializations, but nevertheless it does show a struggle to maintain the body in the required transitional stance. Moreover, there was a surprising result of the paired sample t test for the hand-eye coordination test regarding the SPM group compared to the other two.

The fact that the hand-eye coordination improved for the SPM group compared to the other two can be explained by the basic differences between the groups. The EFS group is the group from the physical education specialization that has an average number of physical classes during a week. The Kineto group is made up by the students from the kinesiology specialization that has the lowest number of physical classes during the week. The final group, SPM, is the group that contains most of the current or former athletes that follow the sports performance specialization. This branch of study has the highest amount of physical classes during the week. Considering all of these it's possible that with a lot of training for team sports, like handball, may increase the hand-eye coordination during unstable transitional stances.

Another aspect that we had to take into account is the fact that all of the subjects were tested during the handball module, which had an impact on the overall hand-eye coordination due to the specificity of learning the handball techniques.

The limitations of our experiment are related to the high number of subjects that took part in the study. The amount of variables that we had to take into account for each subject made it hard for us to make sure the tests were reliable. Day to day routine, sleep-wake rotation and resting variables were the hardest to control. Some easy to keep track of variables were eating, training and class attendance for each subject. Even though the subject's initial performance level is not a homogenous variable, the study took into consideration this aspect with the initial testing of all subjects. The initial test was able to set the overall performance level for each group of subjects. All things considered, the high number of variables is not a liability for our study due to the fact that the data recorded was sufficient enough to overcome the drawbacks of subjective variables that we couldn't control.

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