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MOTOR AND COGNITIVE FUNCTIONING OF STUDENTS OF FACULTY OF PHYSICAL EDUCATION

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Abstract. *The purpose of this research was to determine significant indicators of cognitive functioning, as a component in motor functioning, especially in sport and during studying at the faculties of physical education. The sample of 21 motor and 3 tests for evaluation of functioning of the perceptive, parallel and serial processors were analysed on the sample of 217 male students of The Faculty of Physical Education in Novi Sad. The results of the factor analysis, direct oblimin transformation, showed that there are four latent motor dimensions: coordination in rhythm, balance, flexibility and strength and power (general strength), which had motor factor in their intercorrelation one general. The results of regression of each motor dimension pointed to significant relations between parallel processor and coordination in rhythm, and general strength. The general motor factor is determined with 9.4% of cognitive functioning, especially of parallel and serial processors.*

Key words: *motor abilities, cognitive abilities, factor analysis, regression analysis.*

1. PROBLEM

At the realization of the most motor tests the subjects deal with corresponding motor tasks applying unfamiliarized, unpractised, and consequently unautomatic movement. In order to achieve it, they have to use voluntary movement. As we know, that has to be realized by complex mechanism in the central nervous system.

The brain has organized itself to deal with different types of functions. The left hemisphere is the analytic centre where information is processed sequentially, serially, and where the mathematical and language centres are located. The right hemisphere is where higher integration occurs in the form of spatial functions, parallel processing of

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information, and imagery. In sport, the left hemisphere is used to learn new skills, correct flows in technique, and to develop strategy when competing and that is why it is named "analyser". The right hemisphere controls the way an athlete integrates individual components of a skill into a complex whole and it is named "integrator". When athletes are in flow, their hemispheres know their roles and control of performance switches smoothly between the two as the situation demands. The analyser helps to correct errors and develop strategy and the integrator executes those well-learned skills automatically, and sometimes in new and creative ways.

The realization of motor tasks occurs in very similar way and starts in the same central analytic centre (thinking, deciding, planing) like at the realization of cognitive tasks. That similarity has been pointed at by a number of authors, and the most persistent were those who undertook the theory of "integrated development" (Cowell, Ismail and Gruber). Ismail and Gruber (1965) found that the highest relationship between cognitive and motor abilities were in the domain of coordination and balance, and the lowest in the domain of strength, speed and power.

The population of the students of physical education is similar to the population of athletes, but the students have to be familiar with much more sport activities than the athletes in one specific sport. The problem of this research was to found which components of cognitive functioning (according to Das, Kirby and Jarman, 1975; Wolf, Momirović and Džamonja, 1992; - perceptive, serial and parallel processors) have significant impact to the motor components of motor test performance, as well as to the general motor behaviour (ability, dimension).

2. Methods

2.1 The subjects sample

The subjects were 217 students of Faculty of Physical Education in Novi Sad, 19-22 years old, positively selected on the basis of motor and also on the basis of cognitive functioning, as well on the basis of biological, health and conative characterics.

2.2 Sample of motor and cognitive tests

The sample of motor tests consisted of the tests to estimate the following motor abilities:

Balance 1) One Foot Cross Balance-Eyes Open (B1POO), 2) One Foot Lengthwise Balance-Eyes Open (B1UZO), 3) One Foot Lengthwise-Eyes Closed (B1UZZ);

Explosive power: 4) Medicine Ball Put - Laying on Back (EBACM), 5) Standing Broad Jump (ESKOD), 6) 20m Dash (ESPR2);

Flexibility: 7) Leg Sideward - Side Stride Laying (GODBO), 8) Bend - Sitting Straddle (GPRAZ), 9) Back Stretch (GPREK);

Coordination of whole body: 10) Agility on the Floor (KOKTL), 11) Figure-8 Duck (KOSMI), 12) Crawling Through and Jumping Over Boxes (KPRPR);

Coordination in rhythm: 13) Legs and Arms Tapping (RBUBN), 14) Tapping on Horizontal Plates (RUDHO), 15) Tapping on plates in three planes (RUPL3);

Strength: 16) Horizontal Hold on Back (SHOIZ), 17) Hold in Dip Support (SIZSK), 18) Pull-ups (SZGIB);

Frequency of movement: 19) Two Foot Tapping (TNOGZ), 20) One Foot Tapping (TTAPN), 21) Plate Tapping (TTAPR.).

The sample of cognitive tests had three tests (Wolf, Momirović and Džamonja, 1992) with intention to estimate the efficiency of:

Perceptive processor - GIT-1 (test for matching the pictures);
Serial processor - GAL-4 (test of synonyms and antonyms);
Parallel processor - GS-1 (test of spatialization).

2.3 Statistical methods

The real motor dimensios were obtained using factor analysis with direct oblimin rotation of principal components and scree-test criteria for a number of significant dimensions. Every motor dimension was the criterion variable in regression analysis with the same system of predictive cognitive variables. The same procedure was applied to get the general motor dimension and relationship with the cognitive variables. These procedures were used to obtain the information of motor and cognitive functioning.

3. RESULTS

The results of factor analysis showed that there were four significant factors, which explained only 44% of total variance of the motor variables sample. The main results of the factor anaysis are presented in Table 1 (the pattern matrix of factors) and in Table 2 (the factor correlation matrix). These factors are interpreted as: 1) coordination in rhythm, 2) balance, 3) flexibility and 4) strength and power (general strength).

Table 1. Pattern matrix of motor dimensions

VARIABLE	COORDINATION	BALANCE	FLEXIBILITY	STRENGTH-POWER
1. B1POO	−.09	.71	−.09	−.05
2. B1UZO	.03	.62	.02	−.01
3. B1UZZ	.07	.43	−.03	.12
4. EBACM	.03	.20	−.09	.11
5. ESKOD	.16	.19	−.04	.57
6. ESPR2	−.11	−.05	.01	−.61
7. GODBO	.14	−.02	.68	−.26
8. GPRAZ	−.21	−.03	.82	.16
9. GPREK	.11	−.22	.81	.14
10. KOKTL	−.42	−.19	−.18	−.13
11. KOSMI	−.30	−.35	−.20	−.03
12. KPRPR	−.16	−.34	−.39	.00
13. RBUBN	.35	−.36	.01	.47
14. RUDHO	.82	−.08	−.13	.04
15. RUPL3	.72	−.03	−.14	.14
16. SHOIZ	−.17	−.07	−.00	.57
17. SIZSK	−.09	.38	.24	.49
18. SZGIB	.03	.29	.22	.56
19. TNOGZ	.64	−.05	.15	−.12
20. TTAPN	.33	.28	.16	−.07
21. TTAPR	.55	.14	.08	−.07

Significant positive correlations were found between all motor dimensions, except between flexibility and strength and power. This interrelation indicated to the general motor dimension, which was obtained using the same factor analysis upon the primary factor correlation matrix. The general motor dimension was determined by the primary motor abilities in successive order as follow: coordination in rhythm, balance, flexibility and general strength (table 3). The results showed that so–called mechanism of central regulation of movement (coordination in rhythm, balance and flexibility) was predominated upon the mechanism of energetic regulation (strength and power).

Table 2. Factor correlation matrix

FACTOR	COOR	BALA	FLEX
COORDINATION			
BALANCE	.20		
FLEXIBILITY	.24	.15	
STRENGTH–POWER	.18	.18	.06

Table 3. Structure matrix of general motor dimension

FACTOR	GENERAL MOTOR
COORDINATION	.70
BALANCE	.63
FLEXIBILITY	.58
STRENGTH–POWER	.53
Cum Pct	37.8

Regression of every motor dimension showed that there was significant influence of cognitive functioning on coordination in rhythm and to general strength (Table 4). Those findings were a little strange, as we know that the highest influence in normal youth population is on coordination and balance and no significant influence on strength and power. This was a good reason to investigate general motor dimension of student, because they have to have it well–developed. The results of regression of general motor dimension (Table 5) showed statistically significant influence of cognitive functioning on that dimension. Even the tenth of total variance (multiple R=.31) of motor functioning could be explained by cognitive functioning. According to these results, the most important influence on motor functioning is by parallel and then by serial processing, but not by perceptive processor. That probably happened because of high roles of coordination and balance in the structure of general motor dimensions. In that way the results of this research, which couldn't be explicitly found at the regression analyses of separated motor dimensions, support the results obtained by Ismail and Gruber (1965).

Table 4. Regression of motor dimensions

	COORDINATION		BALANCE		FLEXIBILITY		STRENGTH–POWER	
PROCESSOR	Beta	q	Beta	q	Beta	q	Beta	q
AL–4 (SERIAL)	.07	.28	.14	.05	.11	.13	.01	.85
IT–1(PERCEP)	–.04	.51	–.12	.09	.05	.45	–.07	.30
S–1 (PARALL)	.32	.00	.05	.46	.02	.73	.20	.00
MULTIPLE R	.34		.17		.15		.20	
Q	.00		.09		.19		.04	

Table 5. Regression of general motor dimension

COGNITIVE PROCESSOR	Beta	q
AL–4 (SERIAL)	.14	.04
IT–1 (PERCEP)	–.08	.27
S–1 (PARALL)	.25	.00
MULTIPLE R	.31	
Q	.00	

Such results could be explained by positive selection of subjects, their sport activities and experiences in the sports whith higher demand for the role of parallel processor and by other factors. At the same time, perceptive processor has to be well–developed at all students, because of the way of selection to enrol in faculty of physical education, what means that they were homogenous, i.e. they didn't show high variability in that cognitive ability.

Because of significant impact which had the system of the variables for estimating the cognitive functioning (especially the parallel processor) on the general motor behaviour, it could be concluded that the central nervous system doesn't produce the impulses for specific and separate muscles which act in particular movements, but for the movement in the whole. In simple way that means that the central nervous system doesn't recognise the muscles but the movement. These findings support the results of previous researches and the experiences of many coaches.

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MOTORIČKO I KOGNITIVNO FUNKCIONISANJE STUDENATA FAKULTETA FIZIČKE KULTURE

Gustav Bala, Mirjana Franceško

Problem u ovom istraživanju bio je da se odrede značajni indikatori kognitivnog funkcionisanja, kao komponente motoričkog funkcionisanja, naročito u sportu i kod studenata fakulteta fizičke kulture. Uzorak od 21 motoričkog i 3 testa za procenu funkcionisanja perceptivnog, paralelnog i serijalnog procesora bio je analiziran na uzorku od 217 studenata

Fakulteta fizičke kulture u Novom Sadu. Rezultati faktorske analize, uz direktnu oblimin rotaciju, pokazali su postojanje četiri motoričke dimenzije: koordinacije u ritmu, ravnoteže, gipkosti i generalne snage, koje su u osnovi imale generalni motorički faktor. Rezultati regresione analize svake pojedine motoričke dimenzije ukazali su na značajne relacije između paralelnog procesora i koordinacije u ritmu i generalne snage. Generalni motorički faktor bio je definisan 9.4% kognitivnim funkcionisanjem, naročito paralelnim i serijalnim procesorima.