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THE MOVEMENTS COORDINATION OF THE PRESCHOOLERS

(Preliminary communication)

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Abstract

The goal of this work was to research the coordination of the movements of the preschoolers and to determine eventual differences in relation to the gender. 120 examinees were engaged in this research and they were divided into two characteristic sub samples – according to the criteria of gender: sub sample of 60 boys and sub sample of 60 girls. The coordination of the movements of the preschoolers was evaluated by four motor tests. In the processing of the data achieved by the empirical research apart from numerical and percentage frequency on scale data the multivariate analysis of variance (Manova) and discriminative analysis were also used. From univariant procedures the Roy's test, Pearson's coefficient of contingency (χ) and coefficient of multiple corelation (R) were applied. The multivariate analysis of variance and the discriminative analysis indicate that between the boys and the girls in relation to the four variables for the evaluation of motor abilities there is a statistically significant difference. On the basis of the value of the Roy's test it can be stated that there is statistically significant difference between boys and girls for the variable throwing and catching of a tennis ball and for the variable bouncing of the ball against the floor and it is in favor of the boys.

Keywords*: motor tests, motor abilities, multivariate analysis of variance, discriminative analysis, Roy's test, Pearson's coefficient of contingency, coefficient of multiple corelation*

INTRODUCTION

The results of contemporary research indicate three clearly defined dimensions of coordination subspace, which were identified as: the factor of motor educability, the factor of motor intelligence and the factor of muscle coordination. Regular exercising of preschoolers in kindergartens contributes to the development of motor abilities. All children have a need for movement and most activities in preschools should be realized in correlation with physical education (Peeva & Nedkova (Пеева & Недкова), 2013). The significance of movement is closely connected with the body, mental, social and psychological development.

Coordination can be seen as an ability of fast, economic and multi purposeful solving of complex motor tasks, i.e. fast adaptation of movement to changes of outer conditions (Kukolj, 2006).

The basis of each movement is coordination. Coordination is very complex and multistructural qualitative motor ability. It is under the influence of mechanism for the regulation of movement, i.e. to its subordinated mechanism for the structuring of the movement. It carries everything in itself or almost all characteristics of all motor space (Idrizovic (Idrizović), 2011). Coordination is the ability of managing the movements of the whole body or parts of the loco motor complex (Bompa, 2006). It represents a very complex motor dimension, which can be also defined as motor intelligence. The structure of coordination was the topic of many studies studies (Hosek (Hošek), 1981; Drabik (Drabik), 1996; Metikos, Milanovic, Prot, Jukic, Markovic, (Metikoš, Milanović, Prot, Jukić, Marković), 2003; Neljak &Visković (Neljak & Višković), 2004) on the basis of which the following coordination components were determined: rhythmicality, balance, reaction ability, ability of kinesthetic differentiation, orientation in space, movement adequacy and synchronization of movements in time.

One of the many definitions of the coordination indicates that it is the question of "the ability for performing complex motor tasks harmonized in the time and space" (Djurkovic (Đurković), 1995). The goal is achieved more easily, more precisely and more directly when there is a higher quality of coordination. The movements are more economical, more flexible, and the consumption of energy is minimal. The importance of coordination is bigger, as far as the motor task is more complex. In this way we can differ four phases from the beginning of the exercising of a certain motor task up to the perfect coordination: the phase of mental exercise; the phase of irradiation; the phase of convergence and the phase of stabilization of the coordination (the phase of built dynamic – motor stereotype). The notions that are connected with coordination are the following ones: dexterity, agility and precision. The exercises that can help us in the process of the coordination development are: elementary (manipulative) exercises – crawling,

climbing, and going through, catching and throwing in different ways, elementary and sport games with a ball, racket games – table tennis (Ivanova (Иванова), 2016; Gateva (Гатева), 2013; Gikova & Tishinov (Гикова & Тишинов), 2014), and similar, gymnastics exercises on the floor or elastic table, dancing exercises – rhythmic exercises, children's folklore dancing and special activities – swimming, skating, rollerblading, bicycle riding etc. Sturza Milic (Sturza Milić), 2014).

METHODS

The sample of examinees

In this research 120 preschoolers took part. They were divided into two sub samples: 60 boys average age of 6 (± 6 months), with the average height 119,83cm and average body weight 22,7kg and 60 girls average age 6 years (± 6 months), with average height 118,3cm and average weight 21,9kg. All preschoolers were healthy on the day of testing and they possessed written consent from their parents and the preschool principal.

The sample of variables

For the evaluation of the preschoolers' coordination of the movement the following tests were applied: *foot tapping synchronized on the same side* – (TN), *throwing and catching of a tennis ball with both hands* – (BIHTL), *bouncing of the ball against the floor with both hands alternately* – (OLOP), *and spot jumping synchronized on the same side* – (SUM).

The testing procedure

The foot tapping synchronized on the same side – (TN) – the examinee is sitting at the table so that he or she with one index finger touches the table, while the index finger on the other hand is raised a little from the surface of the table the foot on the same side as the raised index finger is also raised, while the other one (on the other side) is on the floor. (At the same time right hand and right foot are raised, i.e. left hand and left foot). On the mark the index finger tapping and the foot tapping is performed alternately so that the index finger and the foot at the same side are always raised or put down. The movements must be done in continuity, without longer breaks. The number of successfully performed tapping is written down. Maximally ten. Zero points – no tapping at all, 1 point – one successfully performed tapping, 2 points – two to four successfully performed tapping, 3 points – 5-9 successfully performed tapping and 4 points – 10 correctly performed tapping.

Throwing and catching of a tennis ball with both hands – (BIHTL), the examinee holds the tennis ball with both stretched arms (in front of him or her). He/she drops the ball from his/her hands and catches it again after one bounce from the floor. Evaluation: zero points – zero catching, 1 point – 1 catch, 2 points – 2 catches, 3 points – 3 catches, 4 points – 4 catches, and 5 points – 5 catches.

Bouncing the ball against the floor with both hands – (OLOP), the examinee hold the tennis ball in dominant arm stretched in front of him/her. He/she drops the ball from his/her hand and starts bouncing against the floor firstly with non dominant hand so that every next bouncing is done by the other arm alternately. The examinee can move if he/she needs it. Evaluation, zero bounces – zero points, 1 bounce – 1 point, 2 bounces – 2 points, 3 bounces – 3 points, 4 to 5 bounces – 4 points, 6 to 7 bounces – 5 points, 8 to 9 bounces – 6 points and 10 bounces – 7 points.

Spot jumping synchronized on the same side – (SUM), the examinee steps out with one foot and hand on the same side is stretched out forward. The hand on the other side in relation to the stepped out foot is stretched backwards. On the mark for the beginning of the task the examinee does spot jumping and he/she changes the position of arms and legs in the air – so that the other arm and leg are in relation to the starting position forward. The jumps must be performed without bigger breaks in continuity. The second try is done only if the examinee does not succeed to perform five correct tries during the first performance. The number of correctly done jumps is noted down, maximally five, zero points – no successfully performed jumps, 1 point – 1 successfully performed jump, 2 points – 2 to 4 successfully done jumps and 3 points – 5 successfully performed jumps. The jumps are not correctly performed in continuity, if the leg and the arm on the same side do not move simultaneously or if the examinee makes one more step.

Each of the researched variables has more modalities, so that foot tapping has five modalities, throwing and catching of a tennis ball has seven modalities, bouncing of the ball against the floor has six modalities and spot jumping has three modalities.

The research was done in the first term of 2015/2016 school year. After the consent of the preschool principal and the children's parents, by the choice of motor tests the coordination of preschoolers' movements was evaluated. The tests were performed in the premises of preschool during regular directed motor activities. The evaluations were done by the physical education teachers with the experience from the previous research, so that one test for all preschoolers was done by the same measurer.

In the processing of the data acquired by the empirical research apart from numerical and percentage frequency on scalar data multivariate analysis of variance (Manova) and discriminative analysis were also applied. From univaraint procedures the Roy's test, the Pearson's coefficient of contingency (χ) and the coefficient of multiple corellation (R) were also applioed.

RESULTS AND DISCUSSION

For the variable foot tapping for boys and girls the most present is the first modality, which 19 boys achieved and it represents 31`.7% and 18 girls, which represents 30.0%. It means that none of the foot tapping

Table 1. Numerical (n) and percentage (%) representation of the modality foot tapping (TN) in relation to boys and girls

Gender	TN-1		TN-2		TN-3		TN-4		TN-5	
	n	%	n	%	n	%	n	%	n	%
Boys	19.	31.7	17.	28.3	7.	11.7	12.	20.0	5.	8.3
Girls	18.	30.0	16.	26.7	11.	18.3	9.	15.0	6.	10.0

Table 2. Numerical (n) and percentage (%) representation of the modality throwing and catching of a tennis ball (BIHT) in relation to boys and girls

Gender	BIHTL-1		BIHTL-2		BIHTL-3		BIHTL-4		BIHTL-5	
	n	%	n	%	n	%	n	%	n	%
Boys	12.	20.0	13.	21.7	14.	23.3	17.	28.3*	4.	6.7
Girls	13.	21.7	17.	28.3	15.	25.0	7.	11.7	8.	13.3

Table 3. Numerical (n) and percentage (%) presence of the modality bouncing of the ball against the floor (OLOP) in relation to boys and girls

Gender	OLOP-1		OLOP-2		OLOP-3		OLOP-4		OLOP-5		OLOP-6		OLOP-7	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Boys	1	1.7	8	13.3	12.	20.0	12.	20.0	14.	23.3	11.	18.3	2	3.3
Girls	0	0.	8	13.3	13.	21.7	12.	20.0	15.	25.0	5.	8.3	7	11.7*

Table 4. Numerical (n) and percentage (%) presence of the modality spot jumping (SUM) in relation to boys and girls

Gender	SUM-1		SUM-2		SUM-3	
	n	%	n	%	n	%
Boys	8.	13.3	23.	38.3	29.	48.3
Girls	9.	15.0	24.	40.0	27.	45.0

Table 5. The significance of difference of boys and girls in relation to the state of motor ability

Analysis	n	F	p
Manova	4	2.778	.030
Diskriminative	4	2.754	.031

Table 6. The significance of differences between boys and girls in relation to certain variables for the evaluation of motor ability

Variables	χ	R	F	p	Kd
TN	.110	.111	1.410	.238	.011
BIHTL	.220	.226	6.114	.015	.032
OLOP	.220	.226	6.108	.015	.029
SUM	.036	.036	.144	.705	.001

Legend: χ - Pearson's coefficient of contingency, R – the coefficient of multiple correlation,
F – the value of the Roy's test, p – the level of statistical significance and Kd – the discriminatory coefficient

Table 7. The characteristics of subsamples in relation to the researched variables

Variables	Boys	Gyrls	dpr%
Throwing and catching of a tennis ball (BIHTL)	BIHTL-4*	-	43.84
Bouncing of the ball against the floor (OLOP)	-	OLOP-7*	39.73
Foot tapping (TN)	-	-	15.07
Spot jumping (SUM)	-	-	1.37

was not realized. A very small percentage of boys, only 8.3% and girls 10.0% have the modality five, which indicates that they completely realized the task and did ten foot tapping.

For the variable throwing and catching of tennis ball (BIHT) for boys the most present is the fourth modality, which was achieved by seventeen boys which represents 28.3% (four catching). For girls the most present is the second modality (two catches) which was achieved by 17 girls and that represents 28.3%. On the fifth place for boys by the representation is the modality five (five catches) which was achieved by only four boys, which represents 6.7%. For girls on the fifth place by the representation is modality four (four catches) which was achieved by seven girls, which represents 11,7%.

For the variable bouncing of the ball against the floor (OLOP) for boys and girls the most present modality is the fifth modality, which was achieved by fourteen boys which represent 23.3% and fifteen girls which represents 25.0%. It means that boys and girls achieved six to seven successful tries of the bouncing. On the last place for boys and girls is the modality one (one bounce), where we can see that there is a boy who succeeded in bouncing the ball only once.

For the variable spot jumping (SUM) modality three is on the first place (5 jumps) by its presence for boys with 48.3% and for girls with 45.0%. On the second place is the modality two (2-4jumps), which was achieved by 23 boys which represents 38.3% and 24 girls which represents 40.0% On the third place is the modality one (4-5 jumps). Modality one is present at eight boys which represents 13.3% and nine girls which represents 15.0%.

On the basis of the value of the Table 5. it can be stated that there is statistically significant difference between boys and girls in relation to four variables for the evaluation of motor abilities. The level of statistical significance is p=0.030.

The discriminative analysis indicates that the level of statistical significance is p=.031, for four researched variables, according to the evaluation of motor ability. It means that there is statistically significant difference and clearly defined border between boys and girls in relation to the evaluation of motor ability.

The values indicate that between boys and girls there is statistically significant difference for the variable throwing and catching of a tennis ball with the level of statistical significance of p=.015 and for the variable bouncing of the ball against the floor with the level of statistical significance p=.015. Statistically significant differences are in favor of the boys. Statistically significant difference between the boys and the girls was not stated for the variables foot tapping (p=.238 and spot jumping with the level of statistical significance p=.705.

The discriminative coefficients indicate that the biggest contribution of this between boys and girls in relation to the researched variables is for throwing and catching of a tennis ball with the value .029.

The fact that p=.031, discriminative analysis, which means that there is clearly defined border between boys and girls, i.e. it is possible to determine characteristics of each subsample in relation to the researched variables. On the basis of the values in the Table 7. we can determine the properties of each subsample. The subsample of boys is mostly defined by the variable throwing and catching of a tennis ball, since the contribution to the characteristics is 43.84%. The subsample of the girls is mostly defined by the variable bouncing the ball against the floor and the contribution to the characteristics is 39.73%.

CONCLUSION

The analysis of the coordination of the movements of preschoolers was done on the sample of four variables. Each of the researched variables has more modalities, so that foot tapping has five modalities, throwing and catching of a tennis ball has seven modalities, bouncing the ball against the floor has six modalities and spot jumping has three modalities. Multivariate analysis of variance and discriminative analysis indicate that between the boys and girls in relation to four researched variables of coordination there is a statistically significant difference and clearly defined border. The Roy's test indicates that between boys and girls there is statistically significant difference for the variable throwing and catching of a tennis ball with the level of statistical significance p=.015 and for the variable bouncing of the ball against the floor with the level of statistical significance p=.015. Statistically significant difference between boys and girls was not stated for the variables foot tapping (p=.238) and spot jumping with the level of statistical significance p=.705. The discriminative coefficients show that the biggest contribution between boys and girls in relation to the researched variables, i.e. that the biggest difference is for throwing and catching of a tennis ball with the value of .029.

Bala and Jaksic (Bala i Jakšić) (2009) point out that the boys by the credit of richer motor life achieved by

chasing for ball, climbing trees and running, and stronger wish for victory and stronger motive for achievement in these ages, achieve better results in the tests of strength, coordination and speed of running in relation to girls. Girls have different interests, they have a bit "more peaceful" life considering the games, and achieve better results in subtle, precise movements(Dimitrova (Димитрова), 2015; Spasovska (Спасовска), 2011). Contemporary research and the results direct towards obligatory more organized and expert work in preschools with the aim of promoting correct motor development of preschoolers (Ilieva (Илиева), 2015; Marković (Марковић), 2016.

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