

**RELATIONSHIP BETWEEN MOTOR ABILITIES AND SCHOOL
READINESS IN PRESCHOOL CHILDREN**

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Abstract

On the sample of 660 preschool-children (333 boys and 327 girls) at joining the first class, the battery of 16 motor tests was applied to analyze the relations between motor abilities and school readiness of children. By means of statistical program for the canonical correlation analysis in Mahalanobis space, the analyses were done separately for boys and girls.

Obtained relation showed that at boys, as well at girls, general motor ability is in positive correlation with general school readiness. Due to statistical significance and positive correlation between the set of motor variables and the set of school readiness variables, it must be pointed to extreme importance of motor exercising in preschool age.

Keywords: preschool children / motor abilities / school readiness.

INTRODUCTION

Development of children is the result of a complex interaction between hereditary, growth, maturation, environmental domains and has a biological and behavioral context. Biological development involves the differentiation of cells, that enables them to perform specialized functions or to refine functions that already exist. Behavioral development relates to the evolution of intellectual, psychological, and sociological attributes. Motor development of children could be defined in terms of progressive changes in motor performance, resulting from growth, maturation, and biological and behavioral development. It is known that mental, social, educational, and emotional maturity are positively related, and personality traits are related to academic and physical achievement (Ismail, & Gruber, 1971; Eunicke-Morell, 1989; Vernon, & Mori, 1992; Etnier et al., 1997; Dolenec, 2001; Dolenec et al., 2002; Pistotnik et al., 2002; Dolenec et al., 2004). The performance of a preschool child is associated with certain factors closely related to the total motor, emotional, social, and intellectual development (organismic age theory by Olson, according to Ismail, & Gruber, 1971).

The associations of motor and cognitive abilities for both boys and girls are positive and significant (Planinšec, 2002). On both sexes, the motor dimensions with the strongest associations with the cognitive abilities are those of coordination and speed of movement. Despite some differences between boys and girls, they still have a lot in common since the most important latent motor dimensions prevailing in the connection between motor and cognitive dimensions are similar. Cognitive abilities are responsible for the processes of foresight, planning, decision making, as well as comparison and processing of information with the use of long-term memory in solving problem situations. Motor tests of coordination also represent problem situations that need to be solved efficiently (Dolenec, 2001).

A paper-and-pencil tests assess neuromuscular development, fine motor skills, hand-eye coordination, and attention span. Owing to this, children write their names, copy geometric figures, write numbers, complete a drawing, recognize shapes, and discriminate among prepositions.

Some researches showed that longer attending nursery school (kindergarten) had significantly better impact on the results in school readiness tests of pre-school children at the enrolment in elementary school (Sabo, 2004). The same conclusion applies to motor abilities, especially in the domain of coordination, flexibility and balance (Sabo, 2003).

The aim of this paper is to analyze and determine relation between motor abilities and school readiness in preschool children, after their leaving kindergartens.

METHOD

Participants

The sample of subjects was drawn from the population of children in the city of Novi Sad (Vojvodina, Serbia & Montenegro) at joining the first class. This research was performed on the sample of 660 preschool children (333 boys and 327 girls), with average age of 6,5. All children attended kindergarten at least one year.

Instruments

The battery of 16 motor tests used in this research was selected on the basis of experiences with adults, and some of the tests were modified for small children (Bala, 1999a, 1999b, 2002). The tests estimate (for adults) the effectiveness of the following functional mechanisms: movement structuring, tonus and synergetic regulation, regulation of excitation intensity and regulation of excitation duration (Gredelj, Metikoš, Hošek, & Momirović, 1975; Kurelić et al, 1975). Motor abilities of preschool children were estimated by these motor test battery:

- **functional coordination:** 1) coordination by baton (CCOORB), 2) obstacle course backwards (COBSTA), 3) slalom (running) with 3 medicine balls (CSLA3M), 4) 15-m dash (DASH15);
- **frequency of simple movements:** 5) arm plate tapping (SARTAP), 6) foot tapping (SFOOTT);
- **flexibility:** 7) forward bend and touch on a bench (FFOBEN), 8) straddle split (FSTRASP);
- **balance:** 9) standing on two legs on a narrow balance beam, across, eyes open (BAC2LE), 10) standing on one leg on a narrow balance beam, along, eyes open (BAL1LE);
- **power (explosive strength):** 11) standing broad jump (EJUMP), 12) hand grip (EHANGR);
- **muscular endurance (isometric strength):** 13) bent-arm hang (IMHANG), 14) holding legs on a vaulting box (IMHOLE);
- **muscular endurance (isotonic strength):** 15) leg-lifting, lying on the back (ITLELI) and 16) sit-ups (ITSITU).

School-readiness of preschool children was evaluated by means of POŠ test battery (Toličić, 1986), which consist of four subtests:

- **understanding messages, demands, orders, as well as identification and understanding sentences, words and syntax:** 1) speech comprehension (SPEECH);
- **ability to conclude and use experience:** 2) reasoning (REASON);
- **fine hand coordination, as well as ability to copy different figures as a whole and their parts:** 3) grapho-motor ability (GRAPFO);
- **perceptiveness:** 4) understanding the amounts (AMOUNT).

Procedures

Relations between motor abilities and school-readiness of children were computed by the means of the statistical program for the canonical correlation analysis in Mahalanobis space with additional identification structures and reliability estimates of factors significant at 0.05 under Bartlett significance tests CANSANBT (Momirović, 1999). The analyses were done separately for boys and girls.

RESULTS

On the basis of intercorrelations of motor and school readiness variables (table 1) it is not possible to notice certain tendency of relation neither in boys, nor in girls. This is really hard to do only with all analysed manifest variables when there are only a few which are statistically significant (which are highlighted). Table 1 is showed because it was the initial matrix for canonical correlation analysis (tables 2,3 and 4).

Table 1: Cross correlations of Mahalanobis motor and school readiness variables

<i>VARIABLE</i>	<i>SPEECH</i>		<i>REASON</i>		<i>GRAPFO</i>		<i>AMOUNT</i>	
	<i>Boys</i>	<i>Girls</i>	<i>Boys</i>	<i>Girls</i>	<i>Boys</i>	<i>Girls</i>	<i>Boys</i>	<i>Girls</i>
CCOORB	-.058	-.060	-.043	-.035	-.106	.002	.027	-.178
COBSTA	-.189	-.109	.022	-.116	-.092	-.071	-.153	-.089
CSLA3M	-.040	-.070	-.091	-.235	-.074	-.187	.031	.042
CDASH15	-.108	-.038	-.099	-.141	-.168	-.084	-.074	-.155
SARTAP	.062	.120	.113	-.017	.224	.117	.045	.096
SFOOTT	.114	.009	.033	.024	.113	.026	.021	-.020
FFOBEN	.063	-.011	-.031	-.031	.081	.153	.056	.137
FSTRASP	.084	.207	.040	.026	.056	.117	.057	.195
BAC2LE	-.052	-.067	.041	.019	.098	.030	.007	.053
BAL1LE	.116	-.065	.082	.011	.055	.047	-.010	-.124
EJUMP	.141	.061	.033	-.028	.048	.062	.034	.141
EHANGR	-.010	.078	.067	.061	.129	-.029	.025	-.001
IMHANG	.009	-.013	-.032	.107	.019	.084	-.016	-.062
IMHOLE	.060	-.002	.089	-.008	-.033	.068	.019	.000
ITLELI	.035	-.004	.154	.036	-.029	-.042	.066	.005
ITSITU	-.012	.061	-.067	-.024	-.002	.100	-.018	-.098

Bartlett significance tests for evaluation the canonical correlations of corresponding pairs of canonical factors shows that, in boys, only the first pair is statistical significant in explanation of the relation between the sets of analyzed variables ($\rho=.535$ in table 2). This relation accounts for 29% of common variances by these two sets of variables. In girls, first two pairs of canonical factors are statistically significant, the first pair explained about 30%, and second pair only about 13% of common variances of the corresponding canonical relations.

Table 2: Canonical correlations and Bartlett significance tests

	<i>B o y s</i>					<i>G i r l s</i>					
	<i>rho</i>	<i>lambda</i>	<i>hi2</i>	<i>df</i>	<i>p</i>	<i>rho</i>	<i>lambda</i>	<i>hi2</i>	<i>df</i>	<i>p</i>	
f1	.535	.625	151.125	64	.000	f1	.547	.553	186.430	64	.000
f2	.251	.875	42.757	45	.567	f2	.364	.788	74.762	45	.003
f3	.220	.934	21.830	28	.789	f3	.229	.909	30.010	28	.363
f4	.134	.982	5.859	13	.951	f4	.202	.959	13.126	13	.438

LEGEND:

f – pair of canonical factors

ρ – canonical correlation coefficient

hi^2 – hi square test

df – degree of freedom

p – significant level of ρ

Table 3 shows the structure of the first motor canonical factor of boys, as well as the structures of both factors of girls. Table 4 shows the structures of school readiness canonical factors of boys and girls.

Table 3: Structure of first canonical factors

<i>VARIJABLA</i>	<i>Boys</i>		<i>Girls</i>	
	f1	f1	f1	f2
CCOORB	-.211	-.278	.264	
COBSTA	-.379	-.336	-.114	
CSLA3M	-.185	-.329	-.692	
CDASH15	-.435	-.376	-.063	
SARTAP	.453	.315	-.071	
SFOOTT	.297	.023	.107	
FFOBEN	.176	.271	-.112	
FSTRASP	.219	.533	-.183	
BAC2LE	.103	.041	-.020	
BAL1LE	.246	-.149	.302	
EJUMP	.250	.257	-.232	
EHANGR	.215	.078	.062	
IMHANG	.001	.060	.396	
IMHOLE	.096	.056	.068	
ITLELI	.148	-.014	.004	
ITSITU	-.074	.019	.248	

Table 4: Structure of second canonical factors

<i>VARIJABLA</i>	<i>Boys</i>		<i>Girls</i>	
	f1	f1	f1	f2
SPEECH	.557	.485	-.038	
REASON	.389	.333	.623	
GRAPFO	.676	.505	.436	
AMOUNT	.286	.632	-.648	

The first motor canonical factor is general motor factor, without significant involvement of energetic component (manifestation of strength) in boys and girls. In the structure of second motor canonical factors of girls there is certain specificity, which is in good coordination, balance, and isometric contraction of arm muscles.

The first school readiness canonical factor is also general type, in both, boys and girls. The specificity of the second factor is rather illogical, because of the tendency that girls with good reasoning have lower ability to understand the amounts. Due to really big specificity of both second motor and school readiness canonical factors of girls, the authors consider that the appearance of significance of the second pair of canonical factor was random. That was the reason that the authors didn't take this pair of canonical factors into consideration in discussion of the research results. Contribution to such conclusion was also found in the reliability coefficients beta1 and beta2 in table 5. In the same table there are also the values of redundancies (red1 and red2) for both sets of variables in boys and in girls.

Table 5: Redundancies (red) and reliabilities (beta) of the first set (motor) factors

<i>B o y s</i>			<i>G i r l s</i>		
	red1	beta1		red1	beta1
f1	.063	.655	f1	.045	.484
			f2	.019	.166

second set (school-readiness) factors

<i>B o y s</i>			<i>G i r l s</i>		
	red2	beta2		red2	beta2
f1	.244	.668	f1	.275	.644
			f2	.062	-.055

DISCUSSION

The results of canonical correlation analyses pointed to a tendency of general motor and cognitive development in preschool children just about to enrol in the first class, i.e. the development of abilities which define the readiness for beginning school.

That tendency is present in boys, as well in girls. It is also evident that there are some differences, but not so significant, in the structure of these general abilities. Representativeness of boy's structure of general motor factor was mostly accounted for by performance of fast simple motions, maintaining balance and motions which need energetic components. In girls the generality of motor factor was obtained mostly in performance motor tasks in the domain of coordination and flexibility.

In the structure of general school readiness factor in boys the most important role is that of graphomotor abilities and speech, and to a lesser extent reasoning and understanding the amounts. In girls, this general factor was manifested mostly with understanding the amounts and graphomotor abilities, then with speech and reasoning. It is obvious that graphomotor abilities in preschool children are very important, as indicated by some other complex researches in that field (e.g. Del Giudice, Grossi, Angelini, Crisanti, Latte, Fragassi, and Trojano, 2000).

Obtained relation showed that in boys, as well in girls, general motor ability is in positive correlation with general school readiness. This conclusion is concordant with the researches mentioned before (Planinšec, 2002; Dolenc et al., 2002; Pistotnik et al., 2002) which pointed to positive and significant associations of motor and cognitive abilities for boys and girls alike. According to the same results, the motor dimensions with the strongest associations with the cognitive abilities are those of coordination and the speed of movement.

Of course, all this points to importance and need of the motor ability development in the entire development of preschool children. Children with better motor abilities can better adapt to different problem situations, activities, and tasks at the beginning and during their schooling.

On the basis of redundancy values it could be concluded that general school readiness has more important role than general motor ability in explanation of common variance of two variable sets. This means that the beginning of schooling can be predicted with general motor ability, but better prediction is achieved by means of POŠ test battery.

Because of statistical significance and positive correlation between the set of motor variables and the set of school readiness variables, the authors suggest to give more attention to motor exercising in preschool age, as well as putting the children in the situation where they will solve different motor problems. In such a way small children will develop their motor and cognitive components of motor behavior, what will contribute to children's readiness for school and later for the entire schooling.

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