

DETERMINATION OF THE MOTOR TYPES OF YOUNGER CHILDREN BY CLASSIFICATION INTO GROUPS

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DOLOČANJE MOTORIČNIH TIPOV MLAJŠIH OTROK NA OSNOVI RAZVRŠČANJA V SKUPINE

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Abstract

The purpose of the present study is to determine the motor types of younger children and find out the most important characteristics of the individual motor types. The children were 138 girls and 125 boys 5 years of age, from the city of Maribor and its surroundings. For the assessment of motor abilities twenty-eight tests were used. Ward's hierarchical method was used for the classification of children into groups. Both genders have achieved similar results. On the basis of these results we conclude that for boys and girls there are three groups with the following characteristics: a) above-average general motor efficiency, c) below-average general motor efficiency, b) average general motor efficiency. For 5 year-old children it is primarily the general motor ability, defined by the informational and energy components of movement, which has the most influence on the prevailing motor types. Results obtained in this way could help us to plan a transformational process within the framework of the sports activities, which is adapted to the needs of individual groups of children.

Key words: pre-school children, motor types, cluster analysis

Izveček

Namen pričujoče raziskave je določiti motorične tipe mlajših otrok in ugotoviti njihove najpomembnejše značilnosti. Vzorec obsega 138 deklic in 125 dečkov iz Maribora in okolice, starih 5 let. Za ugotavljanje motoričnih sposobnosti je uporabljenih osemindvajset testov. Za razvrščanje otrok v skupine je uporabljena Wardova hierarhična metoda. Pri deklicah in pri dečkih smo dobili podobne rezultate. Na osnovi teh rezultatov ugotavljamo, da so se v obeh primerih oblikovale tri skupine z naslednjimi značilnostmi: a) nadpovprečna v celotni motorični učinkovitosti, c) podpovprečna v celotni motorični učinkovitosti, b) povprečna celotna motorična učinkovitost. Pri petletnih otrocih predvsem generalna motorična sposobnost, ki jo opredeljujeta informacijska in energijska komponenta gibanja, najpomembneje vpliva na prevladujoče motorične tipe. Na temelju tako dobljenih rezultatov lahko v okviru športnih dejavnosti načrtujemo transformacijski proces, ki je prilagojen značilnostim posameznih skupin otrok.

Ključne besede: predšolski otroci, motorični tipi, razvrščanje v skupine

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INTRODUCTION

Classification into groups enables finding individuals with similar characteristics and placing them into groups accordingly. This process consists of breaking up the whole, more specifically, of breaking up a sample of children into a small number of groups with common characteristics. In other words, it is a selective formation of groups according to a chosen criterion.

The criteria on the basis of which classification into groups is carried out can be various. The present study shows some of the indicators of the child's motor efficiency. The formation of groups according to this criterion enables us to determine the prevailing motor type for groups of younger children.

The determination of motor types is one possible aspect of the study of human motor abilities, which has a wide application. Motor types can be determined on the basis of human motor abilities. Some authors (Gallahue, & Ozmun, 1998; Schmidt, & Lee, 1999) find that there are several motor types, in which basic locomotive, manipulative and stability abilities are intertwined and complement each other.

Two studies on adults (Novak, 1981; Momirović, Hošek, Metikoš, & Hofman, 1984), have determined that motor types are distinguished primarily on the basis of general motor ability. This ability is widely defined and involves the informational and energetic parts of motor efficiency. In addition, there is a distinction between individuals with a more strongly marked ability of movement trajectories regulation and synergetic regulation and those with a more strongly marked regulation of intensity and duration of the energetic output. It therefore seems that in the classification of motor types, the most important is the general motor ability, whereas the distinction between individuals with a better ability of movement coordination and those who are stronger is of smaller significance. So far we have no motor types determined specifically for children.

The purpose of the present study is to determine motor types of younger children and find out the most important characteristics of individual motor types. According to the developmental characteristics and the level of differentiation of motor abilities of smaller children (Pišot, 1997; Planinšec, 1995; Rajtmajer, 1993; Thomas, & French, 1985), we can predict that the motor types in children will be defined more widely than in adults.

Many researchers (Momirović et al.; 1984; Bala, 1986) have established that the method of classification into groups is the appropriate procedure for determining motor types. There are several methods of classification into groups. The taxonomic analysis is a geometric method of classification into groups, but is

in general only rarely used (Katić, Zagorac, Živičnjak, & Hraski, 1994; Momirović et al., 1984; Novak, 1981).

The current study uses Ward's hierarchical method of classification into groups. This method is considered more appropriate than other methods, because it enables a search for internally homogeneous and at the same time externally isolated groups - exactly what is required by a good method of classification (Ferligoj, 1989). Hierarchical methods of classification are often used, as they are simple and the final number of groups does not have to be determined in advance, but only after we get the results. Before the data analysis it is very hard to predict how many groups are in the structure of the data at our disposal. Therefore it is more appropriate to choose from several possible methods and use the simplest solution, which is both sensible and consistent with our research goals.

A relatively big problem with preschool children is posed by the implementation of testing, which causes more complications at this age than with older subjects. Preschool children make a relatively great number of mistakes on tests especially the more demanding motor tasks. It can be concluded that certain problems in the implementation of tasks by preschool children simply cannot be avoided. This has also been established by other authors (Rajtmajer, 1993; Zimmer, 1981). Problems in the collection of data on motor abilities of preschool children certainly have a direct effect on the test scores and require that the results should be treated with caution.

METHODS

Subjects. The children were 138 girls and 125 boys age 5 years, from the city of Maribor and its surroundings. The selection of children for the sample was random. 59 % of the children attended the kindergarten, whereas the others had other forms of child-care. The subjects are divided according to gender. In addition, it has to be noted that their age is closely determined, because it is known that in preschool period there are significant differences in motor activities according to gender and age (Krombholz, 1997; Morris, Williams, Atwater, & Wilmore, 1982; Rajtmajer, 1993). All children were healthy in the time of the testing.

Variables. For the assessment of motor abilities 28 tests were used (Rajtmajer, & Proje, 1990). The motor tests were created especially for age group of preschool children and had been thoroughly verified in others studies (Rajtmajer, & Proje, 1990; Planinšec, 1995). The tests cover various motor abilities and belong to both the information and energy blocks. A

more detailed description of the tests is provided in Planinšec (1995).

- **whole-body co-ordination** (rolling the ball around the hoop - KKOTZO, walking on rungs backwards - KLILEN, walking through hoops backwards - KHOONA, polygon backward - KPOLNA, crawling under the bench - KPLAKL, crawling with a ball - KPLAZO, running after crawling - KTEKOT);
- **hand co-ordination** (circling the ball around the body KROZOT, rolling the ball around the feet - KKOTZS, leading the ball with two hands in a standing position - KUDARZ, building a tower from big foam rubber cubes - KOCPV7, insertion hollow cubes - KOCKVO, building a tower from small wooden cubes - KOCLM8);
- **agility** (stepping sideways - KBOTEK, running with changing directions - KTEKSS, running in a zigzag - KTEKCC);
- **explosive strength** (standing long jump - EXMSDZ, standing triple jump - EXMSD3, standing high jump - EXMSVI);
- **repetitive strength** (stepping on a bench - VDMKLO, sideways jumps - VDMBPO, sideways jumps with hand support - VDMBPR);
- **speed of simple movements** (hand tapping in two fields - HITAR1, foot tapping - HITTAN, hand tapping in 4 fields - HITAR2);
- **balance** (standing on a block longitudinally - RSLKV, standing on a block crosswise - RSLKVP, standing on a vertical block - RSPKVA).

Procedure. The measurements of motor abilities were always carried out before noon in especially prepared rooms. The subjects carried out each test three times. The entire testing of one child did not exceed two hours.

The measurement of motor abilities was carried out in the framework of the project *The structure of and relations between psychomotor and cognitive abilities and social and morphological characteristics of preschool children* (Rajtmajer, Praper, & Kancler, 1990), which is undertaken in cooperation between the Maribor Faculty of Education and the Maribor Health clinic.

Data analysis. The computer analysis of the data was carried out with the statistical package SPSS. Ward's hierarchical method (Ward, 1963) was used for the classification of children into groups. According to this method, the classification of children into groups is based on the maximal internal similarities inside a group and maximal external differences among the groups. The formation of groups occurs at different levels, with the level of formation being proportionate to the measure of differences among the groups. The data was analysed separately according to gender.

RESULTS

The analysis of the data shows that the most appropriate solution is the one with 3 groups, the one also given interpretation here. The determination of the group characteristics was carried out on the basis of the comparison of the means of the groups for each motor test. The results shown give the actual values (Tables 1 and 2).

In girls, 16 were classified into group A, 68 into group B and 54 into group C. The comparison of the means of the 3 groups shows (Table 1) that on all the motor tests, with exception of EXMSVI and KKOTZS, the highest results were achieved by the girls from group A, while the values of the means were lower in group B and the lowest in group C. The values of the means of group A are considerably higher with the variables VDMBPO, HITAR1, RSLKV and RSLKVP, while the means of group C show significantly lower values with the variables EXMSD3, EXMSVI, KKOTZO, KOCKVO, KOCLM8, KPOLNA, KPLAZO, KTEKOT, KTEKSS and KTEKCC.

Table 1: Mean values of motor tests in girls (groups A, B, C and total)

Variables / Groups	A	B	C	Total
EXMSDZ ***	98.6	87.8	72.9	83.2
EXMSD3 ***	279.7	251.5	209.7	238.4
EXMSVI ***	14.1	15.9	11.4	13.9
VDMKLO *	11.7	9.8	8.4	9.4
VDMBPO *	16.1	10.5	8.8	10.5
VDMBPR *	14.6	12.0	10.8	11.8
HITAR1 *	28.6	23.9	21.8	23.6
HITTAN *	22.5	19.9	18.5	19.7
HITAR2 *	12.9	11.4	9.6	10.8
RSLKV **	10.2	5.4	5.0	5.8
RSLKVP **	5.6	3.4	3.3	3.6
RSPKVA **	3.0	2.6	2.1	2.4
KROZOT *	18.2	16.8	14.9	15.9
KKOTZS *	7.4	5.9	6.0	6.1
KKOTZO **	16.9	17.7	22.0	19.3
KOCKVO **	19.3	19.7	23.6	21.2
KOCLM8 **	10.7	11.7	14.5	12.6
KOCPV7 **	11.6	14.4	16.2	14.8
KLILEN **	9.9	11.1	12.9	11.7
KHOONA **	10.8	12.7	15.8	13.7
KPOLNA **	11.0	11.9	15.8	13.3
KPLAZO **	14.7	18.4	24.6	20.4
KTEKOT **	4.8	5.1	6.0	5.4
KTEKSS **	8.4	8.5	9.4	8.8
KBOTEK **	9.7	10.7	12.1	11.1
KTEKCC **	8.3	8.5	9.4	8.8
KUDARZ *	18.1	14.2	12.1	13.8
KPLAKL **	19.7	24.1	28.4	25.3

Note: * number of repetitions per 20 seconds; ** seconds; *** centimetres;

Table 2: Mean values of motor tests in boys (groups A, B, C and total)

Variables / Groups	A	B	C	Total
EXMSDZ ***	87,2	77,8	64,0	82,5
EXMSD3 ***	249,8	225,4	188,0	237,4
EXMSVI ***	14,4	13,1	9,6	13,6
VDMKLO *	9,8	8,4	7,4	9,2
VDMBPO *	11,2	8,4	7,0	10,0
VDMBPR *	13,0	9,8	9,0	11,7
HITAR1 *	23,7	19,2	16,3	21,7
HITTAN *	19,9	16,9	15,2	18,6
HITAR2 *	10,5	9,6	7,8	10,0
RSLKVV **	6,6	4,4	3,2	5,6
RSLKVP **	4,2	2,9	2,1	3,6
RSPKVA **	2,5	2,2	1,7	2,3
KROZOT *	16,4	13,9	14,5	15,4
KKOTZS *	6,2	5,5	5,2	5,9
KKOTZO **	17,1	19,7	26,7	18,7
KOCKVO **	19,7	23,8	27,3	21,6
KOCLM8 **	11,6	14,1	16,1	12,7
KOCPV7 **	12,9	14,8	19,5	14,0
KLILEN **	11,7	12,4	18,9	12,4
KHOONA **	11,3	13,3	18,4	12,5
KPOLNA **	10,6	12,8	18,9	11,9
KPLAZO **	14,9	19,8	23,2	17,1
KTEKOT **	4,8	5,5	6,6	5,1
KTEKSS **	8,5	9,2	11,2	8,9
KBOTEK **	10,9	12,8	13,9	11,8
KTEKCC **	8,3	9,0	13,4	8,9
KUDARZ *	14,7	11,5	10,2	13,3
KPLAKL **	20,4	26,1	34,8	23,3

Note: * number of repetitions per 20 seconds; ** seconds; *** centimetres

In boys, 75 were classified into group A, 41 into group B and 9 into group C. The comparison of the 3 groups shows that the highest values of the means are achieved in group A, lower values in group B and the lowest in group C - on all the 28 motor tests (Table 2). The values of the means of group A are significantly higher than in other groups with the variables VDMBPO, VDMBPR, HITTAN, RSLKVV, RSLKVP, KPLAZO and KUDARZ. Conversely, the means of group C are significantly lower with the variables EXMSD3, EXMSVI, RSPKVA, KKOTZO, KLILEN, KHOONA, KPOLNA, KPLAKL, KTEKSS, KTEKCC and KOCPV7.

DISCUSSION

Both genders have achieved similar results. On the basis of these results we conclude that in both cases there are three groups with the following characteristics: a) above-average general motor efficiency, c) be-

low-average general motor efficiency, b) average general motor efficiency.

These findings show that all three groups are distinguished primarily on the basis of general motor efficiency. This also confirms the prediction that motor abilities in preschool children are not yet so differentiated as to be able to influence the formation of specific motor types, contrary to what is the case in adults (Momirović et al., 1984; Novak, 1981). It is obvious that in 5 year-old children it is primarily the general motor ability, defined by the informational and energetic components of movement, which has the most influence on the prevailing motor types.

The results undoubtedly show that the differentiation of motor abilities in 5-year children is not completed, i.e. children are in a dynamic development phase, which does not enable the differentiation of abilities, otherwise characteristic of adults (Noth, 1994). The process of differentiation develops from general, global abilities toward more specific abilities. Obviously, this direction is also reflected in motor development. Human motor behaviour is regulated by complex functional mechanisms of the central nervous system. Studies of onto-genesis show that the most developed areas of the central nervous system, which are responsible for the highest forms of human behaviour, including motor abilities, do not reach maturation until the period between the ages of 7 and 12 (Luria, 1983).

A more detailed comparison of the means of individual groups shows that for girls, group C differed from the others more significantly mainly by attaining lower values on the tests of the coordination of movement, which belong to the informational block, and on two tests of explosive strength. Therefore, group C is characterised by a lower ability of the co-ordination of movement. This ability is mostly dependent on the mechanisms for the structuring of movement, which, in turn, plays a dominant role in the general motor efficiency of younger children (Strel, & Šturm, 1981). It is thus not surprising that the average test scores from group C are the lowest on all the motor tests. Likewise, the tests for measuring explosive strength have significant correlations with many other motor tests in the preschool period (Pišot, 1997; Planinšec, 1995; Rajtmajer, 1993), mainly with the tests for measuring the coordination of movement. Explosive strength is thus important for the general motor efficiency, which is reflected in a negative way in group C.

On the other hand, group A characteristically differs from others with better results on two tests of balance, jumping sideways and hand tapping. This shows that group A is characterised by better balance, repetitive strength and the speed of simple movement. The tests of balance were the most difficult for 5-year-olds. It is a fact that balance tasks are very demanding

for the children of that age. They are also influenced by other motor abilities, which is the reason the children from the group with the highest level of motor efficiency were the most successful on these tests. There are findings that the test of repetitive strength and the speed of movement are connected and also dependent on the ability of coordinated rhythmical movement (Planinšec, 1995; Rajtmajer, 1993). This is a complex ability (Roth, & Winter, 1994), which is better developed in children with a better motor efficiency.

The same is true for boys. In group C the values of means are particularly low for several tests of the coordination of movement and two tests of explosive strength. Here we also conclude that the lower general motor efficiency is the result of a lower ability of movement structuring. The influence of explosive strength on the general motor efficiency is the same as in girls. Group A is characterized by better results on two tests of balance, two tests of jumping sideways, leading the ball and foot tapping. On the basis of these facts we conclude that this group is distinguished by better abilities of the speed of simple movement, repetitive strength and balance, similarly as in girls.

Group B of both genders has means placed between the other two groups for almost all tests.

The above findings show that the greatest influence on the determination of motor types in 5-year-olds comes from general motor ability. The motor type of group A is, in addition to having a better general motor efficiency, particularly characterized by better balance, repetitive strength and the speed of simple movement. On the other hand, the motor type of group C is, in addition to having a lower general motor efficiency, characterized by a lower ability of the coordination of movement and explosive strength. There is also the motor type of group B, which has average motor efficiency and does not stand out through any motor ability.

In the classification into groups there are no significant differences between the genders. However, the results show that girls achieve a bit higher mean values, except in the case of test tasks demanding co-ordinated movement of the whole body, where boys normally show better performance. It is known that there are small differences in motor efficiency between the genders in the preschool period, which are caused not by biological factors but primarily by the social environment (Thomas, & French, 1985). The differences between the genders are to a great extent a consequence of the differences in movement activities, which are typically chosen by boys and girls (Gallahue, & Ozmun, 1998).

On the basis of classification of younger children into groups with Ward's method we can determine the

characteristics of the prevailing motor types. Such a methodological approach to classification can be applied in different ways. Results obtained in this way could help us to plan a transformational process within the framework of the various sports activities, which is adapted to the needs of individual groups of children. In addition, this kind of classification into groups could be used in detecting accelerated or slow motor development of children.

Similar suggestions can be found in some other studies using a different method of classification into groups (Katić et al., 1994). However, not sufficiently defined motor types yielded by other methods of classification into groups could hardly be used as a basis for a program of transformational process. From this perspective, Ward's classification into groups has the advantage of giving useful results which can easily be transferred into practice, which is more than can be claimed for other methods. And this is particularly true with regard to the age group of younger children.

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