# FACTOR STRUCTURE OF MOTOR DIMENSIONS AMONG CHILDREN IN PRIMARY SCHOOL

**Marko Badrić[1] , Ivan Prskalo[1] , Goran Sporiš[2]**

[1]Faculty of Teacher Education University of Zagreb
[2]Faculty of Kinesiology, University of Zagreb

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***Abstract***
The aim of this research was to determine the latent dimensions of motor abilities among primary school boys enrolled in Grades 5 to 8. Students' age ranged from 11 to 15 years. The total number of students who participated in the study was 434 boys. The variables were defined on the basis of 15 motor tests. In order to identify the latent dimensions of motor space, inter-correlation matrices were subjected to exploratory factor analysis procedure. The obtained results indicate that in all age groups there is one latent dimension, which is mainly affected by the indicators of coordination and explosive and repetitive strength. This latent dimension may be interpreted as general or motor factor. The second latent dimension was mainly affected by the tests for the assessment of flexibility, and it is stable and homogenous in all age groups. The third latent dimension which can be interpreted is the one that was mostly affected by the tests for the assessment of the velocity of movement frequency. These results were mainly consistent with previous studies; however, because of the differences in children's development and different biological maturation conditions, further studies need to be conducted in the future.

***Key words****: factor analysis, measuring, motor abilities, students*

## Introduction

Research shows that kinesiological stimuli can and should have a positive impact on the level of motor abilities, and this is particularly emphasized when referring to primary school students (Prskalo & Sporiš, 2016). In literature, there is a number of definitions of motor skills. Findak (1995, p. 14) defines them as "latent motor structures that are responsible for virtually infinite number of manifest reactions, and can be measured and described". According to Milanović (2013), motor abilities are defined as the abilities which enable all types of movements. The efficiency of organic systems, especially neuro-muscular system responsible for the intensity, duration and regulation of movement is in their basis. These abilities contribute to strong, quick, long-lasting, precise and coordinated performance of different motor tasks. Milanović (2013) stated that according to Zatsiorsky (2002), motor abilities are those aspects of intensity (strength and velocity) and extensity (duration and number of repetitions) of motor activity that could be described with the same parametric system, measured with identical number of measures and in which analogous physiological, biochemical, morphological and biomechanical mechanisms are present. Motor abilities can be characterized as a complex system, which is reflected in human movement. Characteristics of motor abilities primarily depend on their level of development, and they are present in everyday lives of all generations. Motor abilities are important in performing daily activities as well as various other activities which are connected to physical exercise, sports and recreation. Development of an individual is reflected in quantitative and qualitative changes, which result from the lowest to the highest developmental stages with specific functional organization (Kovač & Strel, 2000).

Malacko and Popović (2001) state that motor abilities are of latent character and could not be measured directly, but indirectly, that is, direct measurement can be applied only to motor reactions or manifestations using different metric system. Motor reactions are recorded using various motor tests or measuring instruments which must be standardized. Kurelić et al. (1975) defined basic motor abilities as "*conditio sine qua non*'' (an indispensable condition) in any learning of motor tasks of a specific technique and it could be stated that they represent the basic value it the total space of human motor skills. Motor abilities represent a composite of inter-related rules which are integrated in the same biological and motor area (Ružbarská & Turek, 2007). Kondrič (2000) observed that motor abilities are defined as inter-related system of dimensions responsible for successful performance of motor tasks. They are part of psychophysical ability which refers to a specific level of development of basic latent dimensions of human movement. Motor abilities create the basis for human motor structures. They represent complex, multi-layered and dynamic systems of internal relations among different elements in an entity (Ružbarská & Turek, 2007). An important segment of motor development is the development of motor abilities which continues during childhood and adolescence although there are also occasional periods of stagnation, with a decline in individual's abilities (Pišot & Planinšec, 2005).

A possible impact on the motor abilities characterized by a higher level of heredity is commonly lower and vice versa - the impact on the motor abilities characterized by lower level of heredity is higher. Otherwise, they are considered permanent and difficult to change in adulthood (Haibach, Reid, & Collier, 2011). In order to impact the abilities with a higher level of heredity, it is necessary to initiate the process of transformation as early as possible respecting sensitive phases for the development of individual traits and abilities (Findak, Metikoš, Mraković, & Neljak, 1996; Mraković, 1997). Consequently, the abilities that are more hereditary (velocity, coordination, explosive strength) need to be developed earlier, possibly in the early childhood, because their development finishes earlier, most often at the end of secondary school education (Findak, 2003). On the other hand, the abilities that are less hereditary also need to be developed in childhood and youth, but the impact on them is possible even at a later age, practically during a person's entire life (Mraković, Findak, Metikoš, & Neljak, 1996). An example of a positive impact of exercise on the level of motor development in the youngest age categories needs to be mentioned (Graf, Koch, Kretschmann-Kandel, Falkowski, Christ, et al., 2004). A composite of the same elements in different combinations represents the basis for different abilities, whereas different dispositions create the basis for identical abilities. Therefore, systematic approach in the research of motor abilities is important (Ružbarská & Turek, 2007).

Milanović (2013) observed that research has confirmed that it is impossible to describe motor abilities with one or several latent dimensions. According to Meinelu (1977, as cited in Milanović, 2013), latent dimensions refer to a complex structure of quantitative (strength, velocity, endurance, flexibility) and qualitative (coordination, agility, balance and precision) motor abilities. A characteristic of the current condition among children and youth is a decline in motor and functional abilities, so instead of an increase in the ability occurring proportionally with children's age, there is a decline caused by an increasing limitation of muscle work (Barnett et al., 2016; Findak & Mraković, 1998; Lopes, Stodden, Bianchi, Maia, & Rodrigues, 2012; Robinson et al., 2015; Stodden et al., 2008).

The aim of the research is to determine the latent structure of dimensions of motor abilities among primary school boys enrolled in grades 5 through 8.

## Methods

### Sample

In this research, a stratified sample of boys from grades 5 through 8 of primary school was used. Age of students ranged from 11 to 15 years and the total number of participants in the study was 434 boys. Data on the participants' age (12.69±1.17 year), height (169.68±10.36 cm), weight (54.27±14.41 kg) and BMI (20.78) were also obtained.

Subsamples defined by age (grade) were as follows:

- 5th grade - 103 students
- 6th grade - 121 students
- 7th grade - 108 students
- 8th grade - 102 students

The entire sample was perfectly healthy at the time of the research. The research was conducted in accordance with the Code of Ethics in research with children, prepared by the Council for Children's Affairs as an advisory body of the Croatian Government. For each participant, parents' written informed consent for participating in research was obtained. The principals of the schools where the research was conducted had also given their approval for the research. The sample comprised students who territorially belong to the urban area of Sisak and Moslavina County, and live and attend school in the towns of Petrinja and Sisak. In each town two schools were selected on condition that they have a gymnasium where the tests for assessing the levels of motor skills could be conducted.

### Methods of data collection

The research was conducted with the help of previously trained testers who measured the same groups of tests. The motor abilities were measured during Physical Education classes. During the measurements of motor tests, the order of the tests was considered so that the possibility of tiredness among the participants could be completely avoided.

Motor abilities were measured using a set of 15 motor tests. The following tests were used to estimate the velocity of simple movements: 1) hand tapping, 2) foot tapping, 3) foot tapping against the wall. For the assessment of explosive strength, the following tests were used: 1) standing long jump, 2) throwing the medicine ball lying on the back, 3) 20m running. The following tests were used to estimate the repetitive strength: 1) sit ups, 2) trunk lift back muscles, 3) squats, and for the assessment of coordination, the following tests were used: 1) obstacle course backwards, 2) side steps, 3) slalom run. Finally, for the assessment of flexibility the following tests were used: 1) sit and reach, 2) bending the torso forward while on the bench, 3) arm thrust behind the back up the mast. The measurement procedure for each test was repeated three times, except for the tests of repetitive strength which were conducted only once. A detailed description of the tests can be found in previous studies (Badrić, 2011; Findak et al., 1996; Metikoš, Hofman, Prot, Pintar, & Oreb, 1989; Metikoš et al., 2003).

**Data processing**

Data processing was performed with the program STATISTICA for Windows version 7.1. and the statistical program SPSS (Statistical Package for the Social Sciences 11.5). In processing the data for all of the studied variables central and dispersion parameters were calculated: arithmetic mean (AS), standard deviation (SD), minimum (MIN), maximum (MAX). Normality of distribution of the variables was tested by Kolmogorov-Smirnov test. In order to identify the latent dimensions of motor space, intercorrelation matrices were subjected to exploratory factor analysis procedure. Applying the PB criteria (Štalec & Momirović, 1971) the extraction of factors for determining the latent dimensions of motor space was done. Significant components were transformed into oblique ortoblique solutions so that the structure of the space was interpreted on the basis of the matrix of the set, the matrix of the structure and the matrix of the correlation among factors.

**Results**

The exploratory factor analysis was used to determine the latent structure in the area of motor abilities, and it was applied to all subsamples defined by age.

***Table 1.*** The main components, their eigenvalues, percentage of explanations of variance and the cumulative percentage of the explained variance of variables for the assessment of motor abilities among 5th grade male students

| **Components** | **Eigenvalues** | **% of variance** | **Cumulative** |
|---|---|---|---|
| **1** | 5.73 | 38.21 | 38.21 |
| **2** | 1.87 | 12.50 | 50.70 |
| **3** | 1.69 | 11.25 | 61.95 |
| **4** | 1.16 | 7.74 | 69.69 |

By analysing Table 1 it can be seen that there were four significant main components extracted among the fifth grade male students. Significant main components explained 70% of the total variability in the fifth grade students' motor measures. The first principal component explained almost 38%, the second component explained 13% and the third 11% of the analysed motor skills. The fourth major component explained 8% of the area of motor abilities for the fifth grade students.

***Table 2.*** Matrix of parallel projections (matrix of a set) of manifest variables with factors - 5th grade male students

| | **Components** | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| Obstacle course backwards-MCPB | **-0.87** | 0.09 | 0.10 | 0.15 |
| Side steps-MCSS | **-0.65** | -0.28 | -0.02 | -0.35 |
| Slalom run-MCSR | **-0.78** | -0.24 | 0.22 | -0.15 |
| Bent on a bench-MFBB | -0.01 | **-0.88** | -0.16 | 0.10 |
| Sit and reach-MFBF | 0.09 | **-0.84** | 0.15 | 0.02 |
| Arm thrust-MFRH | -0.03 | 0.09 | **0.81** | 0.05 |
| Hand tapping-MSHT | -0.06 | 0.24 | 0.18 | **0.82** |
| Foot tapping-MSFT | 0.21 | -0.25 | -0.12 | **0.61** |
| Foot tapping against the wall-MSFTW | -0.02 | -0.21 | 0.04 | **0.77** |
| Long jump-MELJ | **0.83** | 0.10 | 0.15 | 0.10 |
| 20 metres run-ME20MR | **-0.84** | 0.12 | -0.05 | 0.17 |
| Throwing a medicine ball-METMB | 0.08 | -0.08 | **0.85** | 0.04 |
| Sit ups-MRPRT | **0.58** | -0.24 | 0.15 | 0.22 |
| Squats-MRPSQ | **0.59** | -0.08 | -0.21 | 0.35 |
| Raise body from the back MRPST | **0.65** | -0.17 | 0.14 | -0.05 |

Based on the results in the matrix of a set presented in Table 2, we can see that the largest projections on the first factor were for the following variables: obstacle course backwards (MCPB), slalom run (MCSR), long jump (MELJ), running 20 meters (ME20MR), side steps (MCSS), squats (MRPSQ) and sit ups (MRPRT) in the range of -

0.65 to -0.87. Significant projections on the second factor was observed for the tests: bent on the bench (MFBB) and sit and reach (MFBF) where values ranged from -0.84 to -0.88. The third factor was determined by the significant parallel projections of the variables: arm thrust (MFRH) and throwing a medicine ball (METMB) where values ranged from 0.81 to 0.85. On the fourth factor the biggest projections were recorder for the variables: hand tapping (MSHT) and foot tapping against the wall (MSFTW).

***Table 3.*** The main components, their eigenvalues, percentage of explanations of variance and the cumulative percentage of the explained variance of variables for the assessment of motor abilities among 6th grade male students

| **Components** | **Eigenvalues** | **% of variance** | **Cumulative %** |
|---|---|---|---|
| **1** | 5.15 | 34.32 | 34.32 |
| **2** | 1.87 | 12.45 | 46.76 |
| **3** | 1.54 | 10.25 | 57.01 |
| **4** | 1.25 | 8.32 | 65.33 |

Analysing Table 3, it is clear that the four significant main components in sixth grade male students were extracted. Significant main components explain 65% of the total variability in motor measures in sixth grade students. The first principal component explained 34%, the second component explained 12% and the third 10% of the analysed motor skills. The fourth main component explained 8% of motor skills among sixth grade male students.

***Table 4.*** Matrix of parallel projections (matrix of a set) of manifest variables with factors - male 6th grade students

| | **Components** | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| Obstacle course backwards-MCPB | **-0.81** | 0.03 | -0.07 | 0.01 |
| Side steps-MCSS | **-0.58** | 0.28 | 0.25 | -0.24 |
| Slalom run-MCSR | **-0.80** | 0.29 | -0.01 | -0.10 |
| Bent on a bench -MFBB | 0.18 | **0.85** | -0.03 | -0.08 |
| Sit and reach-MFBF | -0.12 | **0.87** | -0.14 | 0.08 |
| Arm thrust-MFRH | 0.09 | 0.00 | **-0.86** | -0.11 |
| Hand tapping-MSHT | -0.06 | 0.01 | -0.16 | **0.85** |
| Foot tapping-MSFT | -0.02 | 0.02 | 0.18 | **0.86** |
| Foot tapping against the wall-MSFTW | 0.20 | -0.05 | -0.06 | **0.62** |
| Long jump-MELJ | **0.71** | 0.13 | -0.28 | 0.06 |
| 20 metres run-ME20MR | **-0.82** | -0.02 | 0.22 | 0.11 |
| Throwing a medicine ball-METMB | -0.04 | 0.20 | **-0.81** | 0.22 |
| Sit ups-MRPRT | **0.54** | 0.23 | 0.10 | 0.21 |
| Squats-MRPSQ | **0.54** | 0.16 | 0.25 | 0.10 |
| Raise body from the back -MRPST | **0.45** | 0.28 | 0.08 | 0.06 |

Table 4 shows the matrix of a set, and it is clear that most significant projections on the first factor were obtained by the variables obstacle course backwards (MCPB), slalom run (MCSR), long jump (MELJ), and 20 meters run (ME20MR) in the range of 0.71 to -0.82. On the second factor, the most significant projections were recorded for the tests: bent on the bench (MFBB) and sit and reach (MFBF) with values ranging from 0.85-0.87. The biggest projections on the third factor were for the variables: arm thrust (MFRH) and throwing a medicine ball (METMB) in the range of -0.81 do -0.86. The biggest projections on the fourth factor were for the variables: foot tapping (MSFT), foot tapping against the wall (MSFTW) and hand tapping (MSHT) in the range of 0.62 - 0.86.

***Table 5.*** The main components, their eigenvalues, percentage of explanations of variance and the cumulative percentage of the explained variance of variables for the assessment of motor abilities among 7th grade male students

| **Components** | **Eigenvalues** | **% of variance** | **Cumulative %** |
|---|---|---|---|
| **1** | 5.86 | 39.08 | 39.08 |
| **2** | 1.83 | 12.21 | 51.29 |
| **3** | 1.41 | 9.39 | 60.68 |
| **4** | 1.16 | 7.71 | 68.39 |

The analysis of Table 5 shows that four significant main components were extracted among the seventh grade male students' results. Significant main components explained 68% of the total variability in motor measures in seventh grade students. The first principal component explained 39%, the second component explained 12% and the third 9% of the analysed motor skills. The fourth major component explained 8% of the motor skills among seventh grade male students.

***Table 6.*** The matrix structure of parallel projections (matrix of sets) of manifest variables with factors - male 7th grade students

| | **Components** | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| Obstacle course backwards-MCPB | **-0.70** | -0.09 | 0.22 | -0.26 |
| Side steps-MCSS | **-0.68** | 0.26 | -0.17 | -0.13 |
| Slalom run-MCSR | **-0.66** | 0.11 | 0.08 | -0.31 |
| Bent on a bench -MFBB | 0.10 | **0.88** | 0.12 | -0.11 |
| Sit and reach-MFBF | -0.07 | **0.90** | 0.01 | 0.20 |
| Arm thrust-MFRH | -0.13 | 0.03 | **0.92** | 0.05 |
| Hand tapping-MSHT | 0.01 | -0.04 | 0.23 | **0.67** |
| Foot tapping-MSFT | 0.02 | 0.24 | -0.18 | **0.81** |
| Foot tapping against the wall-MSFTW | 0.13 | -0.10 | 0.15 | **0.70** |
| Long jump-MELJ | **0.62** | 0.06 | 0.24 | 0.26 |
| 20 metres run-ME20MR | **-0.73** | 0.12 | -0.04 | -0.19 |
| Throwing a medicine ball-METMB | 0.34 | 0.15 | **0.71** | 0.06 |
| Sit ups-MRPRT | **0.78** | 0.11 | 0.10 | -0.18 |
| Squats-MRPSQ | **0.69** | 0.31 | -0.10 | 0.01 |
| Raise body from the back -MRPST | **0.69** | -0.01 | 0.01 | -0.11 |

Table 6 shows a matrix of a set, which indicates that the largest significant parallel projections on the first factor were recorded for the variables: 20 meters run (ME20MR), long jump (MELJ), obstacle course backwards (MCPB), side steps (MCSS), slalom run (MCSR), sit upsnk (MRPRT) and squats (MRPSQ) in the range from 0.69 to -0.73. Significant parallel projections on the second factor were obtained for forward bent test on the bench (MFBB) and sit and reach (MFBF) ranged between 0.88 to 0.90. The largest projection on the third factor was for the arm thrust (MFRH) and throwing a medicine ball (METMB) ranging from 0.71 to 0.92. Foot tapping (MSFT), foot tapping against the wall (MSFTW) and hand taping (MSHT) had maximum parallel projections on the fourth factor with values ranging from 0.67 to 0.81.

***Table 7.*** The main components, their eigenvalues, percentage of explanations of variance and the cumulative percentage of the explained variance of variables for the assessment of motor abilities among 8th grade male students

| **Components** | **Eigenvalues** | **% of variance** | **Cumulative %** |
|---|---|---|---|
| **1** | 4.84 | 32.25 | 32.25 |
| **2** | 1.86 | 12.42 | 44.67 |
| **3** | 1.52 | 10.12 | 54.79 |
| **4** | 1.09 | 7.27 | 62.07 |

Table 7 shows that four significant main components were extracted from the results. Significant main components explained 62% of the total variability in motor measures in eighth grade male students. The first principal component explained 32%, the second component explained 12% and the third 10% of the analysed motor skills. The fourth major component explained 7% of the motor skills among eighth grade male students.

***Table 8.*** Matrix of parallel projections (matrix of a set) of manifest variables with factors - 8th grade male students

| | **Components** | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| Obstacle course backwards-MCPB | **-0.73** | -0.09 | -0.12 | 0.25 |
| Side steps-MCSS | **-0.79** | 0.14 | 0.14 | -0.11 |
| Slalom run-MCSR | **-0.86** | -0.01 | 0.31 | -0.11 |
| Bent on a bench -MFBB | -0.09 | -0.15 | **0.85** | -0.02 |
| Sit and reach-MFBF | -0.14 | 0.07 | **0.87** | 0.11 |
| Arm thrust-MFRH | 0.11 | **-0.84** | 0.04 | 0.05 |
| Hand tapping-MSHT | **0.42** | 0.12 | 0.27 | 0.20 |
| Foot tapping-MSFT | 0.35 | **0.60** | 0.17 | 0.16 |
| Foot tapping against the wall-MSFTW | 0.28 | 0.04 | 0.33 | **0.74** |
| Long jump-MELJ | **0.81** | -0.30 | 0.00 | -0.11 |
| 20 metres run-ME20MR | **-0.70** | -0.13 | -0.11 | -0.11 |
| Throwing a medicine ball-METMB | 0.31 | **-0.64** | 0.38 | 0.11 |
| Sit ups-MRPRT | 0.36 | 0.17 | **0.44** | -0.34 |
| Squats-MRPSQ | 0.31 | 0.11 | 0.35 | **-0.52** |
| Raise body from the back -MRPST | **0.39** | 0.05 | 0.22 | -0.08 |

The results presented in Table 8, show that the largest parallel projections on the first factor were recorded for the following variables: long jump (MELJ), obstacle course backwards (MCPB), slalom run (MCSR), side steps (MCSS) and running for 20 meters (ME20MR). Their correlation ranged from -0.70 to -0.86. The greatest projections on the second factor were for the variables: the arm thrust (MFRH). On the third factor, significant parallel projections were found for the variables: bent on the bench (MFBB) and sit and reach (MFBF) that ranged from 0.85 to 0.87. On the fourth factor the largest parallel projections were obtained on the variables foot tapping against the wall (MSFTW).

## Discussion

Factor analysis of exploratory type was used to determine the latent structure of motor abilities among male primary school students. The latent structure of motor abilities among children and youth has been researched in previous studies (Bala & Popović, 2007; Delija & Mraković, 1993; Gredelj, Metikoš, Hošek, & Momirović, 1975; Herrmann, Gerlach & Seelig 2015; Kurelić et al., 1975; Metikoš, Gredelj, & Momirović, 1979; Metikoš, Mraković, Prot, & Findak, 1990; Pišot & Planinšec, 2005; Strel & Šturm, 1981; Wagner, Webster, & Ulrich, 2015). In the present research the latent structure of motor dimensions among children was tested for each age group individually. Based on the results obtained through factor analysis it can be seen that among male 5th grade students four factors were isolated. The highest correlation with the first factor was obtained for the tests used to assess coordination, explosive strength and repetitive strength. Based on these data, this factor may be called the general motor factor. The second factor was mostly defined with the tests which included assessment of flexibility, so this factor can be called factor of flexibility. The largest projections on the third factor were recorded for the assessment of arm flexibility in the shoulder joints and the test of explosive strength of the arms. Since the structure of the third factor was rather complex, it was impossible to meaningfully interpret it. Nevertheless, it was clear that the elasticity of the shoulder joints had an impact on the explosive strength of upper limbs. Tests used to assess frequency of movement had the greatest impact on the fourth factor, and this factor could be called the factor of velocity of simple movements. Analysing the correlation between factors it can be seen that they had very low values. The highest correlation was obtained between the first and the fourth factor, i.e. between the general motor factor and velocity of performing simple movements. Another significant correlation was obtained between general motor factor and flexibility factor. This relative correlation between these factors is understandable, because factors of velocity of simple movements and flexibility in its structure and activity belong to general motor space. The results of factor analysis among sixth grade boys showed that 65% of the valid common variance that explained four isolated factors was exhausted. The first factor exhausted the most information, and it is best defined by the tests for the evaluation of coordination, explosive strength and partly repetitive strength. Based on these data, this factor can be interpreted as a general motor factor. Significant projections on the second largest factor were found for the tests used to assess flexibility, while the third factor was best defined by measures of arm flexibility and explosive strength. The second factor can be interpreted as a factor of flexibility, because the biggest parallel projections on it were achieved for the assessment of that motor ability. The third factor could not be meaningfully interpreted because the greatest parallel projections on it were found for the variables which according to the structure of action could not be easily connected in a meaningful way. The fourth factor was defined exclusively by the tests of frequency of movement and therefore this factor could be called the factor of velocity of simple movements. By analysing the correlation between the factors, it can be seen that they had very low values except between the first and the fourth factor, i.e. between the general motor factor and velocity of performing simple movements factor. The analysis of the results of the latent structure for seventh grade boys, it can be seen that four significant factors were isolated and that they explained 68% of the variance. The results from the matrix structure showed that on the first factor, the highest correlations was found for the tests which assess coordination and repetitive and explosive strength. As this factor is defined by almost all variables, it can be interpreted as a general motor factor. The second factor had the largest parallel projection with tests that assess flexibility so it can be called the factor of flexibility. On the third factor the largest parallel projections in the matrix were determined for the tests assessing the flexibility of the shoulder joint and explosive strength of upper limbs. Because of the complexity of the third factor, it is impossible to meaningfully interpret it, although a major impact of elasticity in the shoulder joint on the result in a test that evaluated the explosive strength of the upper extremities can be indicated. The fourth factor that was best defined by the tests assessing the frequency of movement; therefore, this factor can safely be called factor of the velocity of simple movements. The highest intercorrelations between factors were obtained between the first and the fourth factor, that is, between the general motor factor and the velocity of movements factor. This kind of connection between these factors is understandable, because the factor of velocity of movements in its structure belongs to the general motor space. Other intercorrelations between isolated factors had relatively low values. The results of factor analysis in eighth grade boys showed that 62% of the common valid variance was explained and four factors were isolated. The first factor explained the most information, and it was best defined by the tests assessing coordination and explosive strength. Based on these data, this factor can be interpreted as the factor of coordination and explosive strength of the lower extremities. Tests assessing the flexibility of the shoulder joint and explosive strength of the arm had the largest significant projections on the second factor. Due to its complex structure the second factor cannot be meaningfully interpreted. The third factor was mostly impacted by the tests for assessing flexibility, and partly by those for repetitive strength of the upper body, and due to its complexity it was impossible to interpret it. The fourth factor was defined exclusively with the test of frequency of leg movement, while the other projections of the variables on this factor were relatively small and difficult to meaningfully interpret. Correlations between factors were very low and almost zero values. The only slightly higher correlation was visible between the first and the third factor.

Since the aim of the research was to determine the latent structure of motor dimensions, the tests that were used were taken from previous studies (Delija & Mraković, 1993; Gredelj et al., 1975; Kurelić et al., 1975; Metikoš et al., 1990) defined according to the hypothetical model of motor abilities. Formed subsamples were defined on the basis of age to obtain the most precise information about the structure of the latent motor dimensions. Looking at the results, it can be concluded that across all age groups, there was one latent dimension which was the most impacted by indicators of coordination, and explosive and repetitive strength. This latent variable can be interpreted as a general or universal motor factor. Tests hat assess flexibility had the greatest impact on the second latent dimension which was stable and homogeneous in all age categories. The third latent variable that can be meaningfully interpreted is the dimension on which the tests assessing frequency of movement had the greatest impact. Most studies that have examined the structure of motor abilities in a sample of children indicate that younger respondents show certain differentiation of motor abilities, but it is far from the one that is measured in adult subjects. Often, there is an impact of the general motor factor, which mainly involves the coordinating and information component in general. The structure of motor abilities changes with age (Pišot & Planinšec, 2010). These results were consistent with the results of previous research (Bala, 2002; Bala & Madić, 2002; Delija & Mraković, 1993; Gredelj et al., 1975; Kurelić et al., 1975; Mandić, Martinović, & Pelemiš, 2017; Metikoš et al., 1990; Novak, 2010; Strel & Šturm, 1981; Videmšek & Cemič, 1991) of motor space for children and adolescents. Research (Herrmann, Gerlach & Seelig 2015; Pišot & Planinšec, 2005; Planinšec, 2001; Wagner, Webster, & Ulrich, 2015) showed different results from the results obtained in this research.

## Conclusion

Factor analysis helped determine the latent structure of motor abilities of the 5th - 8th grade students. Structure of the obtained factors was homogeneous and stable across all age groups with minimal fluctuations caused by the laws of growth and development. The first obtained factor was determined in all samples, and it was named the general motor factor. The only stable factor that, in addition to the first, extended across the whole research period was the factor of flexibility. This paper used a battery of tests in which all tests were standardized and implemented in previous research of motor space. Although the tests have been arranged according to the hypothetical model of previous research, the results which were used to determine the latent structure did not fully confirm the hypothetical motor dimensions. The battery of tests should certainly be arranged according to the structure of motor abilities, but this structure must primarily be established for each age group in future research of motor space.

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## FAKTORSKA STRUKTURA MOTORIČKIH DIMENZIJA DJECE U OSNOVNOJ ŠKOLI

***Sažetak***

Cilj ovog istraživanja bio je utvrditi latentne dimenzije motoričkih sposobnosti kod dječaka od 5. do 8. razreda osnovne škole. Dob učenika kretala se od 11 do 15 godina. Ukupan broj ispitanika koji su sudjelovali u istraživanju je 434 dječaka. Uzorak varijabli sadržavao je 15 motoričkih testova. Kako bi se utvrdile latentne dimenzije motoričkog prostora matrice interkorelacija podvrgnute su eksplorativnom postupku faktorske analize. Kada se pogledaju dobiveni rezultati, vidljivo je da kroz sve dobne skupine postoji jedna latentna dimenzija na koju najveći utjecaj imaju indikatori koordinacije, eksplozivne snage i repetitivne snage. Ova latentna dimenzija može se interpretirati kao generalni ili opći motorički faktor. Na drugu latentnu dimenzije najveći utjecaj imaju testovi za procjenu fleksibilnosti i ona je stabilna i homogena u svim dobnim kategorijama ispitanika. Treća latentna dimenzija koju je moguće smisleno interpretirati je dimenzija na koju najveći utjecaj u njenom definiranju imaju testovi za procjenu brzine frekvencije pokreta. Ovi rezultati bili su vrlo konzistentni s drugim istraživanjima iz prošlosti, ali s razvojem djece i različitim biološkim uvjetima sazrijevanja, u budućnosti je potrebno provesti nove studije.

***Ključne riječi***: *faktorska analiza, mjerenje, motoričke sposobnosti, učenici*

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**Corresponding information:**

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*Correspondence to: Marko Badrić*
*University: University of Zagreb*
*Faculty: Faculty of Teacher Education*
*E-mail:marko.badric@ufzg.hr*