Metric Characteristics of the Coordination and Precision Test

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Abstract

The paper aims to establish metric characteristics of the test of coordination and precision "Ball – leg – wall" on a sample of female students in the early childhood and preschool education program of study. The sample consisted of 25 female students in the first and second year of the Faculty of Teacher Education – Petrinja branch. Along with the descriptive statistics, the normality of distribution was tested, as well as reliability coefficients and average correlation between items. A factor structure was checked through a component analysis.

The results obtained indicate satisfactory values in coefficients of reliability. The isolated factor "covers" 72.19% of the total value of the matrix of item correlation and indicates an existence of a common subject of measurement – in this case coordination and precision skill. Although the test is intended for use in the 6-11 age period for checking the ability of students at the Universal Sports School, its application with older participants showed good metric characteristics and possibility for application in practice with this group of participants.

Considering the relatively small number of participants in the research, further testing of its metric characteristics on a larger sample is recommended.

Key words: *early childhood and preschool education; female students; motor skills.*

Introduction

Regardless of the imposing number of research on coordination (Badrić, & Tomac, 2009; Cvenić, 2007; Ćaćan, Vlahović, Lulić, & Drenjak, 2016; Kolić, 2015; Lorger, 2011; Lorger, Tomac, & Bokor, 2011; Nešić, 2008; Tukić, Marie-Buotić, & Rogulj, 2015), this skill has still not been sufficiently researched (Prskalo & Sporiš, 2016). The definition of coordination, although presented by various authors, implies biomotor ability of performing fast complex movement of the entire body or part of

the body in space and time (Bompa, 2006; Foretić, Rogulj, & Čavala, 2010; Milanović, 2010; Sekulić & Metikoš, 2007). Interest for researching coordination, as perhaps the most important skill from the point of view of total efficiency of a person's motor behavior (Crnokić, 2011) is found in various areas of kinesiology. In the area of sport, Vučetić, Sukreški, Zuber, and Sporiš (2011) deal with various diagnostic procedures of athlete coordination, Milanović, Šalaj, and Gregov (2011) research the effects which transformational procedures generate in the area of coordination, while Lorger (2011) researches factors of coordination of young, successful female handball players in school sport with respect to the position they play. In the area of education, Lorger and Kunješić (2014) research students' coordination skills and define metric characteristics of the applied measuring instruments, while Kovačević and Babajić (2011) emphasize the complexity of diagnostic procedures in the area of coordination. Cesarec, Pavlec, and Štimec (2011) focus on the issue of compatibility of tests of motor skills where the main issue is whether the tests measure that skill for which they were developed or the general motor factor. Authors' interests are evident in construction and validation of new measuring instruments in the area of coordination (Badrić & Tomac, 2009; Foretić, Rogulj, & Čavala, 2010). As opposed to coordination, which is, although insufficiently researched, "covered" by a relatively large number of papers, the precision skill, according to the authors' knowledge, does not intrigue interest in authors in our country (Čižmek & Peršun, 2011; Ivković & Kuliš, 2011; Leko, Jantolek, & Behin, 2016; Romić, 2011; Tomaško, Šokičić, & Bašić, 2011) and, as stated by Isaković (2013, p. 31), "along with coordination, represents the least researched area of motor space". Precision is defined as the ability to hit a static or moving target by throwing or aiming (Milanović, 2010), i.e. the ability to hit an external object with a guided or thrown projectile (Sekulić & Metikoš, 2007). When referring to precision, we differentiate between basic and specific precision, which are dependent of each other. Factors of precision are under great influence of genetic inheritance so the entire development of this skill asks for different stimulation with a broad range of motor movement (practice) which must start early enough at a very young age. If content is "poor", development of basic precision will not be possible (Sekulić & Metikoš, 2007). Complex motor tasks in this measuring instrument (Crnokić, 2011) with the purpose to assess coordination and precision according to the structure of motor skills belongs to the mechanism for movement regulation (Sekulić & Metikoš, 2007), which is divided into mechanisms for structuring movement (body coordination - 180° rotation with previous ball throw with two arms and catching the ball upon rotation), and mechanism for synergy regulation and regulation of tonus (Sekulić & Metikoš, 2007) (precision in ball throw with two hands). Considering that the importance of diagnostics and validation of metric characteristics of measuring instruments has been mentioned earlier, examining metric characteristics on a different sample can contribute to better validation of the measuring instrument and in the case of satisfactory metric characteristics enable its "wider" implementation. The aim of this

paper is to establish the metric characteristics of the test of coordination and precision "Ball – leg – wall" (Bös, 2001 as cited in Crnokić, 2011) on a sample of female students in the early childhood and preschool education program in the first and second year of study at the Faculty of Teacher Education – Petrinja branch, for the purpose of applying it on the student population.

Research Methodology
Sample of Participants

The sample of participants included female students in the first and second year of the Early childhood and preschool education program at the Faculty of Teacher Education in Petrinja (N=25). The research aim was to test the coordination and precision skill using the "Ball – leg – wall" test (Bös, 2001, as cited in Crnokić, 2011). The task was carried out in three series with three attempts. The result of one series is the sum of points from the three attempts. In the original version, the task was carried out in two series of five throws.

Measuring Instrument
"Ball – leg – wall"

Aids: handball, A4 paper, masking tape.
The aim of the test is to check whole-body coordination and precision.
A line is placed three meters from the wall, from where the throw will be performed. Half a meter (50cm) in front and behind that line, two lines are placed creating a square meter. The subject cannot leave the marked square meter while performing the task. The wall must be a smooth surface and not lower than 3 meters. At the height of 1.20 meters (120 centimeters) an A4 size paper (or a rectangle can be marked using masking tape) is placed as a mark where the ball should be thrown. The area around the place where the ball will be thrown must be unhampered in order for the task to be executed with ease.
The subject turns the back to the wall holding a handball in his hands. The subject makes a forward bend in order to see the target on the wall through his spread legs.
The task is to throw the ball through the legs towards the marked target, turn 180 degrees (half a circle) and catch the ball that bounces off the wall without the ball touching the floor.
The point system used for the purpose of this research was modified on a three-point scale (original scale of evaluation was 0 to 5).
3 points – subject carries out the task in entirety.
2 points – subject does not hit the target on the wall, everything else is done well.
1 point – the ball bounces off the floor and the subject catches it in the marked space, everything else is well done.
0 points – the ball bounces off the wall uncontrollably far from the marked rectangle and the subject cannot catch the ball in the marked area (runs after the ball).
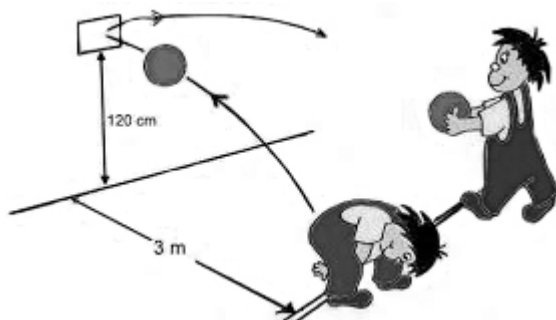
Image 1. The "Ball – leg – wall" test (Source: Crnokić, 2016)

Data Analysis Methods

For the purpose of this paper, the results of descriptive parameters of items are shown. The normality of result distribution was tested and coefficients of reliability were calculated in addition to the calculation of the average correlation among items. At the second level, a factor structure of the test was checked with a componential analysis.

Results

Table 1

Descriptive parameters of items, coefficients, normality of distribution and reliability

Variable	N	M	Min	Max	SD	Max D	K – S	Correlation between items	Alpha
		Descriptive statistics				Normality of distribution		Item reliability	
BHL 1	25	5.64	2.00	9.00	1.55	0.15	p > .20	0.60	0.79
BHL 2	25	5.56	3.00	9.00	1.92	0.13	p > .20	0.67	0.70
BHL 3	25	5.88	1.00	9.00	2.19	0.14	p > .20	0.72	0.66
Cronbach alpha (Cα)									0.80
Average correlation between items									0.59

Values of arithmetic means (M) shown in Table 1 are very similar in all three series of motor task performance. Still, the values of the results achieved in the third series are somewhat greater, while they are the lowest in the second series, which can indicate that throughout the second series a lack of concentration may have occurred or some easiness among the participants. The results of standard deviations (SD) show an increase in the dispersion of results from the first towards the third series, which means that the smallest homogeneity of results is shown in final series, confirmed also by the range of results from 1.00 to 9.00. Values of items are normally distributed,

which can be seen from the Kolmogorov-Smirnov test. The correlations of particular items with others are of satisfactory values while coefficients of reliability alpha, which indicate reliability after extracting a particular item, are somewhat lower than the usual line of reliability of 0.80 (Horvat, 1978; Momirović, Štalec, & Wolf, 1975). Considering that some authors take lower values as satisfactory, e.g. Biddle, Akande, Armstrong, Ashcroft, Brooke, and Gaudas (1996) take the range of values from 0.73 to 0.76, Nunnally (1978) states that reliability is a necessary but not a sufficient condition for validity since the coefficient of internal reliability increases as the number of items increase, but also depends on how the measure of reliability is used. In the early phase of the research of reliability, measures of 0.70 will be considered satisfactory, while in applied projects where a lot depends on the accuracy of the results, reliability of 0.90 is the minimum, while a desirable reliability coefficient is 0.95 (Nunnally, 1978). Given that the coefficient of internal reliability of this test (Cα) in the early research phase was 0.80, which is seen as a common degree of reliability (Horvat, 1978; Momirović, Štalec, & Wolf, 1975), it can be said that the coefficients of reliability are of satisfactory values as is the average correlation of items of 0.59.

Table 2

Results of the component analysis: characteristic roots (L), percentage of explained variance of the intercorrelation matrix (%), cumulative percentage of variance (cum%)

Factor	L	%	Cum%
1	2.17	72.19	72.19

Using the main component method, one factor with values above 1.00 was isolated, which points to the existence of a common subject of measurement. In the case of this research, it is the testing of the coordination and precision skill. The extracted factor covers 72.19% of the total value of the inter-correlation item matrix. Table 2 shows that the main part of the variance is distributed in the first component (72.19%) and therefore it is the holder of the majority of information on coordination and precision skills.

Table 3

Projections of values of items on the factor

Factor	Ordinal item number	Projected value
Factor 1	1	-0.81
	2	-0.85
	3	-0.89

Values of items projected on the factor show good saturation of factors particularly in the third (final) series. It can be concluded that the structure of the isolated factor matches the factor of coordination and precision, which is the foundation of the motor structure of the given test "Ball – leg – wall", which is based on throwing, aiming, body

turn and ball catching. Precision is expressed through aiming the rectangular shape on the wall, and coordination by throwing, controlling and catching the ball bounced off the wall and turning and moving the body in a limited space.

Discussion and Conclusion

The "Ball – leg – wall" test is the constituent part of the battery of measuring instruments dedicated to measuring anthropological characteristics AST 5 – 11 which are carried out in the Universal sports school (Crnokić, 2011). Considering that the metric characteristics of measuring instruments are very important in carrying out scientific research, but also for diagnostics and selection (Mejovšek, 2016), it is good to use many tests for measurements on students in education in order for them to be able to apply them in practice according to the material work conditions and age of children they will be working with. According to the authors, to date, this test has not been used on a sample of female students (nor male students) and in order for them to use it during professional practice, it is important for them to know the structure, manner of carrying out the test and its evaluation. Although the mentioned measuring instrument is anticipated for application among children and pupils from 6 to 10 years of age, it is very complex in its motor structure, and for its successful application it demands a high level of whole body coordination with a burdening factor of manipulation, ball control and hitting the target. Considering its high complexity, during application in diagnostics with children and pupils it is necessary to prepare them well through analysis and acquisition of various elements of coordination and precision. Considering that these are skills highly influenced by genetic inheritance (Sekulić & Metikoš, 2007), complete development of these skills demands early and broad stimulation of participants in the education or training process. The analysis of metric characteristics of the test (on this group of participants) confirmed that it can be applied on adult participants as it has satisfactory values. However, as the sample of participants was rather small (N=25) it is necessary to observe results of this test on a greater sample in order to more clearly determine its metric characteristics or confirm the results obtained with the present research.

Testing metric characteristics of the "Ball – leg – wall" was the basic aim of this research. The results confirmed satisfactory metric characteristics and the possibility of its application on an adult population. However, testing its metric characteristics on a greater sample is recommended.

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Metrijske karakteristike testa koordinacije i preciznosti

Sažetak

Cilj je rada utvrditi metrijske karakteristike testa koordinacije i preciznosti „Lopta – noga – zid" na uzorku studentica ranog i predškolskog odgoja i obrazovanja. Uzorak sudionica u istraživanju činio je 25 studentica prve i druge godine Učiteljskog fakulteta Odsjeka u Petrinji. Uz deskriptivnu statistiku testiran je normalitet distribucija, izračunati su koeficijenti pouzdanosti i prosječna korelacija među česticama. Faktorska struktura provjerena je komponentnom analizom.

Dobiveni rezultati pokazali su zadovoljavajuće vrijednosti u koeficijentima pouzdanosti. Izolirani faktor „pokriva" 72,19% ukupne vrijednosti matrice korelacije čestica te ukazuje na postojanje zajedničkog predmeta mjerenja, u ovom slučaju sposobnosti koordinacije i preciznosti. Iako je test namijenjen primjeni u dobi od 6 do 11 godina, za provjeru sposobnosti polaznika Univerzalne sportske škole, njegova je primjena kod starijih ispitanika pokazala dobra metrijska svojstva i mogućnost primjene u praksi kod navedene skupine studentica.

S obzirom na malen broj sudionika u istraživanju preporučuje se daljnja provjera njegovih metrijskih karakteristika na većem uzorku.

Ključne riječi: *motoričke sposobnosti; rani i predškolski odgoj i obrazovanje; studentice.*