METRIC CHARACTERISTIC TESTS FOR ASSESSING COORDINATION IN RHYTHM

Dodi Malada, Josefina Jukić and Marijana Čavala

Faculty of Kinesiology, University of Split, Croatia

Original scientific paper

Abstract
The aim of this paper was to establish metric characteristic tests for assessing coordination in rhythm. The study was conducted on a sample of 40 students of the second year of study at the faculty of kinesiology in Split from the ages of 20-22. The experimental group of subjects consists of 10 students attending regular rock n 'roll classes twice a week. A control group of 30 subjects consists of regular students of the second year of the Faculty of Kinesiology. All the tests showed satisfactory reliability. Significant correlations between three measurement items in all three tests as well as high values of Cronbach alpha coefficients indicate good reliability. The sensitivity of the tests was analyzed after the condensation of results with a rough arithmetic medium. Pragmatic validity was tested using the variance analysis method. The differences between the experimental and control groups of the respondents were analyzed through all three newly-constructed tests. We can conclude that all three newly-constructed tests showed good metric characteristics since they are coordination tests. The advantage of these tests is simplicity of performance as well as little energy load.

Key words: *coordination, metric characteristic, rhythm, test.*

Introduction

Contemporary sport at every level requires thorough and successive monitoring and verification of the complete anthropological status of athletes. One of the most frequently tested segments of anthropological status is the athlete's motor skills. Sports can without a doubt be classified into such a pattern of motor activities in which these characteristics come to full expression (Metikoš et al., 1989). The most frequently tracked motor skill is coordination which is part of the ability to regulate movement. Coordination significantly correlates with a large number of other motor skills that often limit it.

Coordination is not only determined by one factor. It consists of a large number of "manifestations" (Sekulić, 2007). Authors Metikoš and Hošek (1972) defined coordination as rhythm and performing a movement in a given or arbitrary rhythm. The physiological basis of coordination lies in the coordination of nerve processes of the central nervous system. The human body is composed of various organs, systems and functions. The central nervous system continually regulates and coordinates the complexity of the organs and systems functions.

One of its main functions is the selection and transmission of rapid and accurate response to stimulation via effective nerve pathways to certain effectors (Mitra and Mogos, 1980). In sports activities, coordination is divided into general and specific. General coordination monitors the rational performance of various motor exercises, regardless of sport specialization. In sports, a well coordinated athlete is considered to be capable of performing a task perfectly biomechanically or quickly and efficiently solving an unexpected task.

Each athlete should, after multidisciplinary development, achieve the appropriate level of general sports coordination, which is the basis for the development of the specific sport. Specific coordination reflects the ability to perform different movements in the chosen sport quickly, but also with impeccable ease and accuracy. This segment of coordination is closely related to the specificity of motor skills. Specific coordination is achieved as a result of numerous repetitions of specialized skills or technical elements during sports training and competitions. It involves the development of coordination with other biomotor capabilities in accordance with the characteristics of the chosen sport (Bompa, 2001).

Pechtl (1982) says that all athletes need to continually learn new skills from their specific sport or other sports, otherwise coordination capacities, and thus learning, are reduced. Many authors find new tests to check the motor abilities and recommend them for use in practice (Grubbs, Russell & William, 1997; Wareham et al, 2002; Lolland, 2002; Treuth et al., 2003; Wyon et al., 2003; Milton, Bull & Bauman, 2010). Tests for assessing coordination in rhythm have a prominent place in sports disciplines so in this paper we will try to analyze the metric characteristics of the newly-established coordination tests in order to achieve the prerequisites for proper planning and programming of a training plan and to improve the quality of work in sport disciplines. The objective of this research is to determine the metric characteristics of three newly-constructed tests to evaluate coordination in rhythm. This paper will analyze the metric characteristics: reliability, homogeneity, sensitivity, factor and pragmatic validity.

Methods

Subjects
The study was conducted on a sample of 40 students in the second year of study at the Faculty of Kinesiology in Split ages 20-22. The experimental group of subjects consists of 10 students attending regular rock n 'roll classes twice a week.

A control group of 30 subjects consists of regular students in the second year of study at the Faculty of Kinesiology. All students are clinically healthy.

Variables
For this research, three tests have been constructed which would, in the opinion of the author test coordination in rhythm.

Clapping test (R +N).

1	2 ♫	3 ♫	4 ♩ ♩
♫ R L near at hand 180º turn	♫ R L hands up	♩ R near at hand	♩ L hands up

The examinee is standing with both feet in field 1. On the command "GO", the subject steps with the right foot into field 2, and shifts his weight onto the left foot and at the same time conducts both actions with the hands. The subject does the same in field 3 (two steps with both feet, one step with both hands).

The subject then takes a step with the right foot into field 4 and drops his hands down – turns 180º on the spot – shifts his bodyweight on to the left leg and lifts both hands up from the near at hand position. It counts as an exact sequence of motion. The same moves run from field 4 to field 1 which counts as the second correct sequence of motion. The result is the number of exactly executed motion sequences in 15 seconds. Only the exact sequence of movement is counted.

Test for leg rhythm (N)
The examinee is standing with both feet in field 3. On the command "GO", the subject touches field 4 with the right foot, returns the left leg into field 3, simultaneously shifting the weight to the right foot. With his left foot steps into field 2, the right leg is then pulled to the left leg and switches the center of mass to the right leg. This is counted as an exact sequence of motion. Move left leg sideways from the body and touch the ground with the left foot into field 1, return the left leg into field 2 simultaneously shifting center of mass onto the left leg. With right foot stepping into field 3, pull left foot to right leg and move center of mass to the left foot. This is counted as the second accurate movement sequence. The result is the number of exactly executed motion sequences in 15 seconds. Just the exact sequence of movements counts.

1	2	3	4
R	♩ R	♩ L	♫ R
	♩ L	♩ L	♫ RL

Cross leg test (R+P)
The examinee is standing with both feet in field 1. On the command "GO", the subject steps with the left foot into field 2. The subject then steps with his right foot into field 3 and shifts his center of mass onto the left leg and then performs a clap with the hands. It counts as an exact sequence of motion. In addition the subject then steps over the left leg with the right leg into field 2 and with the left leg steps into field 1 thus shifting center of mass to the right leg performing a clap with the hands. This is counted as the second accurate movement sequence. The result is the number of exactly executed motion sequences in 15 seconds. Just the exact sequence of movements counts.

1	2	3
	♩ L	♩ ♩ ♩ R L
	♩ L over D	♩ ♩ ♩ R L hands clap

Data processing methods
Measurements were made in the hall of the Faculty of Kinesiology in Split. After the measurement was performed, the data was entered into the "Statistica for Windows" version 7.0. For the purposes of this paper, the following are calculated:

- Reliability of measuring instruments: - the intercalibration matrix between the matrices for each test was calculated as well as Inter-item correlation and Cronbach alpha coefficients for all three tests,
- Homogeneity of measuring instruments: descriptive statistics parameters for all three items per test and for average values of individual test results, namely: arithmetic mean (AS), standard deviation (SD), minimum and maximum score (MIN and MAX);
- Sensitivity of measuring instruments: - descriptive statistics parameters for each test and for average values of results: arithmetic mean (AS), standard deviation (SD), minimum and maximum score (MIN and MAX) as well as symmetry and curvature distribution (SKEW and KURT). Normality distribution was tested by Kolmogorov – Smirnovljev.

Normality distribution was tested by Kolmogorov - Smirnov's procedure and the limit value of the KS test for each sample size is at the bottom of the table,
- Factor validity: For the purposes of determining the factor validity of the newly constructed test, the matrix of intercorrelation of all tests is transformed into the matrix of the main components and the given projections of the variables - tests on the first major component (Guttman - Kaiser 's criterion).
- Pragmatic validity: multivariate variance analysis - (ANOVA) was used to evaluate pragmatic validity.

Results and discussion

Reliability

The reliability of the measuring instrument indicates how far into the final result there are errors, and how much the result obtained by testing of the measuring instrument is the real measurement result. For the purposes of determining the reliability, the correlation matrices between the matrices in all the tests and the two reliability test indicators, the inter-item correlation and the Cronbach alpha coefficient will be analyzed. The results are presented in Tables 1 through 3. Significant correlations between three measurement items in all three tests (Table 1 - 3) as well as high values of Cronbach alpha coefficients (Table 1 - 3) indicate good reliability. From these results we can determine that the measuring instruments have satisfactory reliability and that the measurement error is minimized. Foretic et al. (2010) had an aim to determine the metric characteristics of three newly constructed tests and a standard coordination evaluation test.

Of the three newly constructed tests, two tests showed satisfactory reliability while the third test showed poor reliability. Such test results are the consequence of its spatial limitation. The test is constructed in a way that in the case of an error in running, the examinee must reach the ball over which he lost control of and continue the test. Since the test is performed on a large area handball court, the error-guided subjects have a great time lag. This resulted in large differences between the measurement items that manifested through poor reliability of the test, which is not the case in this work. Namely, satisfactory reliability has been obtained in all three tests in this research. High values of correlation coefficients in all three tests, in the author's opinion, are probably the product of well defined and well described tests. As already mentioned, exceptionally high correlation values between the ratios confirmed by average intercorrelation (IIR) and Cronbach alpha coefficients (Cr Alp) indicate good test reliability (Tables 1 to 3). Furthermore, such high results can be explained by detailed instructions or educated subjects and surveyors regarding measuring procedures as well as the warming up of the subjects that preceded the experiment.

Table 1. Reliability analysis Correlations between the R+N test.

	R+N1	R+N2	R+N3	IIr	Cronbach's Alpha
R+N1	1,00	0,85	0,72	0,79	0,91
R+N2		1,00	0,77		
R+N3			1,00		

Legend: R+N1-first item; R+N2-second item; R+N3 - third item and Inter-item correlation (II r) and Cronbach alpha coefficiente.

Table 2. Reliability analysis Correlations between the R+N test.

	N1	N2	N3	IIr	Cronbach's Alpha
N1	1,00	0,90	0,87	0,90	0,96
N2		1,00	0,92		
N3			1,00		

Legend: N1- first item; N2-second item; N3-third item and Inter-item correlation (IIr) and Cronbach alpha coefficiente.

Table 3. Reliability analysis Correlations between the R+N test.

	R+P1	R+P2	R+P3	IIr	Cronbach's Alpha
R+P1	1,00	0,81	0,73	0,81	0,92
R+P2		1,00	0,87		
R+P3			1,00		

Legend: R+P1-first item; R+P2-second item: R+P3-third item and Inter-item correlation (IIr) and Cronbach alpha coefficiente.

Homogeneity

The homogeneity of the measuring instrument should point to two test characteristics: correlation between the items - i.e. whether the subjects achieve approximately equal results in all three repetitions and the range of results in all three measurements - the range of results should be the same (there is no "trend" of worse or better results from one item into the other).

Table 4. Descriptive statistics and variance analysis results of all three tests – total subject sample

	AS	MIN	MAX	SD	F	P
R+N1	6	0	9	2,44	0,87	0,42
R+N2	6,2	0	10	2,42		
R+N3	6,33	0	10	2,26		
N1	16,75	0	25	5,04	2,42	0,09
N2	16,8	0	25	5,53		
N3	17,5	0	26	5,24		
R+P1	13,55	0	23	5,75	2,21	0,11
R+P2	14,15	0	22	5,94		
R+P3	14,75	0	24	5,49		

Legend: AS- arithmetic mean, SD - standard deviation, MIN - minimum measurement results, MAX - maximum results, F-results of F test, p-level of significance.

Table 4 show variance analysis results for each test with the calculated values F and the degree of significance p. From these graphs it is apparent that there is no statistically significant difference between the measurement items in any one test, indicating a satisfactory homogeneity of the measurement instrument, based on which the results will condense with the arithmetic mean. As a confirmation of good homogeneity it is clear that that the subjects in all three tests achieve uniform results since all three replications have reached the same range of results (no "trend" of worse or better results from one item to the other) we can also conclude that there is "no learning" for the test.

Sensitivity

Before determining the normality of the distribution, it is necessary to condensate the result. For the purpose of this paper, the results of all three measurement items are condensed using a rough arithmetic medium. The sensitivity of the tests is shown in Table 5 and histograms 1 to 3. The distribution normality is read by the K-S test. It is noticeable that there is no significant difference between the obtained and theoretical normal distribution of results since none of the obtained values of the K-S test exceeds the limit value. We can conclude that the measuring instrument distinguishes the subjects well, even though there is a visible platykurtic distribution at the N test or too much dispersion of the results. The tests are asymmetrically negative, probably because of the selected population. As for the subjects who passed the test of the rhythm test, it is logical that the results are grouped in the area of higher scores, so accordingly the distribution of results is asymmetrically negative. It is to be assumed that the N test is too prevalent for this population since the subjects achieve above-average results. This data indicates the probability of test hypersensitivity and should be modified in some way. If, for example, the subject of measurements in the population is normally distributed, and the results obtained by applying a measuring instrument constructed to evaluate this object of measurement have a positive asymmetric distribution, then it can be concluded that the measuring instrument is not appropriate to that population because the grouping of the subjects in the zone is below the average values, which indicates that the test is too hard. Conversely, if most subjects achieve above average results, then the test is too easy for that population.

From the author's opinion (Uljević, 2009), in order to increase the sensitivity, since he recorded a positive asymmetric distribution in his research, it is necessary to take the following actions: use a wider scale during the evaluation (1-10), more detailed description of the variables execution, and make extra effort in explaining the importance of the elements to students in grading.

Table 5. Descriptive statistics - total subject sample.

	AS	MIN	MAX	SD	SKEW	KURT	KS test
R+N	6,17	0	9,67	2,19	-1,00	0,97	0,14
N	17,02	0,67	25,33	5,09	-1,8	4,23	0,19
R+P	14,15	0	21,67	5,34	-0,7	0,10	0,08

Legend: AS - arithmetic mean, SD - standard deviation, MIN - minimum measurement results, MAX - maximum results, SKE - skewness, KURT - kurtosis, KS test - Kolmogorov - Smirnov test.

Factor validity

For the purposes of this study, factor analysis using the main component method was used, using the Guttman-Kaiser's Extraction Criterion (λ>1) where λ is the largest inherent matrix correlation value among the tests. The results of the factor analysis are shown in Table 6. Three measuring instruments were included in the analysis. Of the three manifold variables, one latent dimension was defined, which according to the author's definition is defined by COORDINATION IN RHYTHM. The factor variance is high and is 2.20. All tests have a very high projection on a shared common factor. Such a result of factor analysis suggests that all tests measure the same motor dimension, in this case coordination in rhythm. We can conclude that the factor validity of the measured instruments is satisfactory. Although the R + P test factor is better than the previous two, which could be explained by the structural complexity of the said test.

Table 6. Factor validity Factor analysis results.

	F1
R+N	-0,77
N	-0,89
R+P	-0,91
Expl.Var	2,20
Prp.Totl	0,73

Legend: F1- significant factor by Guttman-Kaiser criterion, Expl. Var.- inherent value, Prp. The sum of the explained varients of all variables.

Pragmatic validity

Pragmatic validity is the usable value of a test. If we determine the difference between the groups on some ability, we prove this through an analysis to determine the differences between the groups (Miletić, 2002). We used univariate variance analysis (ANOVA) to determine differences between groups. The differences between the experimental and control group of the subjects were analyzed through all three newly constructed tests. Table 7 shows that there are statistically significant differences among the mentioned groups. From observing the arithmetic mean it is evident that the experimental group achieves better results in all three newly constructed tests. Such results are expected given that the students of the control group and the regular dance classes attend the elective dance classes twice a week. Additionally, students who have chosen RNR are naturally more capable of coordination in rhythm since it is possible that this is a very demanding activity.

Table 7. Pragmatic validity: Results of variance analysis in all three tests (group 1/N=30, group 2/ N=10).

	Regular study		Elective program RNR		ANOVA	
	AS	SD	AS	SD	F	P
R+N	5,62	2,24	7,83	0,74	9,23	0,004
N	16,01	5,32	20,03	2,74	5,18	0,028
R+P	12,72	5,32	18,43	2,26	10,71	0,002

Conclusion

Metric characteristics represent the basic qualitative value of a test (measuring instrument) for the evaluation of any anthropological dimension. In this research, some metric characteristics of three evaluation coefficients are presented for the assessment of coordination in rhythm. All the tests showed satisfactory reliability. Significant correlations between three measurement items in all three tests as well as high values of Cronbach alpha coefficients indicate good reliability. The variance analysis results for each test with the calculated values F and the degree of significance p show that there is no statistically significant difference between the measurement items in a single test, which in the end satisfies the homogeneity criterion of the measuring instrument. The sensitivity of the tests was analyzed after the condensation of results with a rough arithmetic medium. The distribution normality indicates that there is no significant difference between the obtained and theoretical normal distribution of results since none of the obtained values of the K-S test exceeds the maximum theoretical value. Although we can conclude that the measuring instruments differ considerably among the subjects, we can observe the platykurtic based distribution of the data of test result N in histogram 2. The measuring instrument is too sensitive for the subjects and the test should in some way be modified to reduce the dispersion of the results on test N. If we shorten the run time, we would disturb the time uniformity of the duration of all three tests for 15 seconds. Since the test is performed only with the given movement and rhythm of the legs, it may be necessary to limit the balancing of the hands in some way so that all subjects perform the test in the same way e.g. with the hands folded behind the back. Factor analysis, for the determination of factor validity of the tests, obtained a latent dimension, which, according to the author's opinion, can be called the coordinating factor in the rhythm. The results of the analysis indicate the high correlative correlation of all the tests with the factor. Pragmatic validity was tested using the variance analysis method. The differences between the experimental and control group of the examinees were analyzed through all three newly constructed tests. Observing the arithmetic environment, it is evident that the experimental group achieves better results in all three newly-constructed tests, as expected since it is a demanding dance activity and thus confirmed the usefulness of the tests. We can conclude that all three newly-constructed tests showed good metric characteristics since they are coordination tests. The advantage of these tests is simplicity of performance as well as little energy expenditure. In further research, correlation tests should be established with other coordination tests and on different populations of different age and sex.

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Received: January 19, 2018
Accepted: June 15, 2018
Correspondence to:
Marijana Čavala, Ph.D.
Faculty of Kinesiology University of Split
E-mail: mcavala@kifst.hr