RELIABILITY AND VALIDITY OF TESTS AIMED AT EVALUATION OF RHYTHM – COORDINATION

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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 aged 20—to-22 years. Of the total sample of respondents, ten students were actively engaged in dance (G1), while others were regular students of the second year of undergraduate study at the Faculty of Kinesiology in Split (G2). Significant correlations between three testing items in all three tests as well as high values of Cronbach alpha coefficients indicated good reliability. Discriminative validity was tested using the one-way analysis of variance by differentiating G1 from G2. The differences between groups were significant with better results in G1. 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 low energetic demands.

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

Introduction

Contemporary sport 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 ability. 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 ability is coordination which is part of the overall capacity of movement regulation. 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 (Kamandulis et al., 2013). 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, as well as 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-related coordination. 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) stated that all athletes need to continually learn new skills from their specific sport or other sports, otherwise coordination capacities, and thus learning, is altered. Many authors develop new tests to evaluate the motor abilities and recommend them for use in practice (Grubbs, Russell & William, 1997; Wareham et all, 2002; Lolland, 2002; Treuth et al., 2003; Wyon et al., 2003; Milton, Bull & Bauman, 2010).

The objective of this research is to determine the reliability and validity of three newly-developed tests aimed at evaluation of coordination in rhythm.

Methods

Participants

The sample of participants consisted of 40 students in the second year of study at the Faculty of Kinesiology in Split ages 20-22. Ten of them had practised dance for more than 5 years. All students were clinically healthy.

Variables

For this research, three tests have been constructed as it follows

CLAPPING TEST (R +N)

The examinee is standing with both feet in field 1. On the command "GO", the examinee 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 examinee 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 180ºon 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.

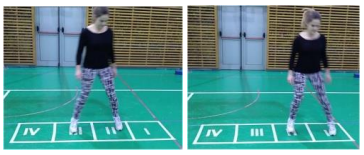
The result is the number of correclty executed motion sequences in 15 seconds.

TEST FOR LEG RHYTHM (N)

The examinee is standing with both feet in field 3. On the command "GO", the examinee 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 correclty executed motion sequences in 15 seconds.



CROSS LEG TEST (R+P)

The examinee is standing with both feet in field 1. On the command "GO", the examinee 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 examinee 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 correctly executed motion sequences in 15 seconds.

Statistical analyses

After assessing the normality (by Kolmogorov – Smirnov test), the means and standard deviations were reported for all variables. For all three tests, the reliability was checked using Cronbach's alpha coefficients (CA) and Intra-item correlations (IIRs) (Sattler et al., 2012).

An ANOVA for repeated measures test were used to detect any systematic bias between the individual trials of each test (Sattler et al., 2012).

To establish the factorial validity of the tests, factor analysis with a Guttman-Kaiser criterion of extraction was employed.

The discriminative validity of the tests was evidenced by calculation of the differences between groups of subjects (i.e. dancers. vs. non-dancers). For this purpose one-way ANOVA was calculated. The statistical significance of $p<0.05$ was applied. Statistica ver 7.1 (Statosft, Tulsa OK) was used for all analyses.

Results and discussion

Reliability

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.

The problem of test construction is frequent withing the field of sport science (i.e. kinesiology). In their study Foretic et al. (2010) aimed to determine the metric characteristics of three newly constructed tests andcompared it with a widely accepted standard test of coordination. Of the three newly constructed tests, two tests showed satisfactory reliability while the third test showed poor reliability. In expaining such findings authors highlighted the problem of test complexity (i.e. the examinee must reach the ball, which directly affected the body control and consequently impaired the test results, and had great impact on achievement across testing trials). Oppositely, here presented tests showed proper reliability, which is most probably a result of standardized execution of all three tests (please see Methods for more details on testing and instructions given to subjects).

More precisely, authors are of the opinion that proper decription and standardization of all three tests applied herein, are the most important determinants of proper reliability, which is recently suggested in other investigations where reliabiltiy of the sport-specific tests was evaluated and reported (Hammami et al. 2017, Pehar et al 2017). Furthermore, proper reliability obtained herein can be explained by detailed instructions or educated subjects and surveyors regarding measuring procedures as well as the systematic warm-up of all subjects prior to testing.

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 coefficient

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

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 ANOVA results for each test with the calculated values F and the degree of significance p. In brief, it is evdent that there is no statistically significant difference between the measurement items in any one test, indicating a good homogeneity (no bias) for the measreument tools. Based on these results the final achievement was evidenced as the average trial-result for each subjects. As an additional confirmation of proper homogeneity it must be stated that subjects in all three tests achieved uniform results since all three trials have reached the same range of results (no "trend" of worse or better results from one item to the other). Consequently, we may highlight that there is neithero „fatigue-effect", nor „learning-effect" for the applied tests .

The sensitivity of the tests is shown in Table 5 and histograms 1 to 3. As evidenced, all tess were normally distributed which confirmed their parametric nature. Also, on a basis of these results, we can emphasize that the measuring tools 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 fact that we actually tests relatively selected population (i.e. trained subjects – physicial education students). 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.

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 measured tests (manifest variables), one latent dimension was defined, which could be defined as COORDINATION IN RHYTHM. The factor variance is high and is 2.20. All tests have a very high projection on a shared common factor. We can conclude that the factor validity of the applied tests is satisfactory. However, we must note that the R+P test is most strongly correlated to factor, and this could be explained by the structural complexity of the said test.

Table 6. Factor validity of the tests – results of factor analysis

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

Discriminative validity

The only valid test is the one that discriminate the groups of interest (Pehar et al. 2017, Kontic et al 2017). In our study, the discriminative validity is evidenced by identifying differences between two studied groups (i.e. former and current dancers vs. non-dancers), which is in accordance to other studies which examined the problem on a same way (Miletić, 2002). We used one-way ANOVA to determine differences groups of interest. (Table 7). Evidently, groups differed at all three tests ($p < 0.05$), and for all three tests group 2 ("dancers") achieved better results than group 2 (i.e. "non-dancers")

In general, obtained results should be judged as being expected. Briefly, "dancers" are better trained (and better educated) in different rhythmic structures, which consequently resulted in their better achievement in tests obtained in this study.

Table 7. Discriminative validity of the tests – one way ANOVA results between students involved in dance (Group 2) and those non-involved in dance training (Group 1)

	Group 1 (n = 30)		Group 2 (n = 10)		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 proper reliability

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.

Discriminative validity was tested using the one-way ANOVA, and results showed proper disciminative validity of the applied tests with better results in grouo of dancers

The advantage of these tests is simplicity of performance as well as little energy expenditure. In further research, correlation of the proposed

measuring procedures should be established with other coordination tests and on different populations of different age and seks.

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POUZDANOST I VALJANOST NOVKONSTRUIRANIH TESTOVA KOORDINACIJE U RITMU

Sažetak

Cilj ovog rada bio je utvrditi metrijske karakteristike testova za procjenu koordinacije u ritmu. Istraživanje je provedeno na uzorku od 40 studenata druge godine studija na Kineziološkom fakultetu u Splitu od dobi od 20 do 22 godine. Od ukupnog uzorka ispitanika, deset 10 studenata se aktivno bave plesom, a ostali su redovni studenti druge godine preddiplomskog studija Kineziološkog fakulteta u Splitu. Značajne korelacije između tri čestice u sva tri testa, kao i visoke vrijednosti Cronbach alfa koeficijenata pokazuju dobru pouzdanost mjernih instrumenata. Osjetljivost testova analizirana je nakon kondenzacije rezultata grubom aritmetičkom sredinom. Diskriminativna valjanost testirana je primjenom metode analize varijance utvrđivanjem razlika između dvije skupine; studenata plesača i studenata neplesača. Utvrđene su značajne razlike te su studenti plesači postigli bolje rezultate od neplesača u sva tri testa. Može se zaključiti da su sva tri novokonstruirana testa pokazala

dobre metrijske karakteristike obzirom da se radi o testovima koordinacije. Prednost ovih testova je jednostavnost izvođenja kao i malo energetsko opterećenje.

***Ključne riječi**: koordinacija, metrijske karakteristike, ritam, test.*

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Accepted: 01 December 2017
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