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RELATIONSHIP BETWEEN RHYTHM AND LEARNING ALPINE SKIING TECHNIQUE

INTRODUCTION

Alpine skiing is quite unique motor activity in a way that skier uses different elements of ski technique during downhill sloping. Sometimes one is able to master the ski terrain by only traversing or straight gliding, but more often configuration of ski terrain dictates the need for use of different types of continuously associated ski turns. During this downhill sloping, skier continuously needs to adjust the rhythm of movement, as well as the direction and speed of motion. This is also affected by current snow conditions, inclination of slope and the level of alpine ski expertise. Hence, the primary aim of every ski beginner or recreational level skier is to be safe, i.e. to have control over speed while continuously coordinating alpine ski turns and to secure a stable balance on skies (Matković et al. 2004). Alpine ski technique includes different elements, among which basic elements such as snowplough, gliding straight, traversing and uphill turn have a special role. In fact, when one masters those basic elements, he or she will more readily enrich the current ski knowledge with elements important for dynamic association of ski turns in corridors of different width. This is especially true for the short turn, which enables movement in narrow corridors, by continuously connecting short, unfinished parallel turns close to slope line, and for which a skier has to have developed rhythm. More importantly, short turn is a type of element that can be used on almost any type of terrain, regardless of crowdedness or quality of snow. To be able not only to correctly perform all phases of one turn, but also successfully connect turns in a whole, among other, a skier has to have a good sense of rhythm, which enables a timely movement. Adjusted contractions and relaxations of different muscle groups are a chief criterion for continuous movement. Rhythmicity not only facilitates and organizes movements (Horvatin-Fučkar, 2002; Persichini and Capranica, 2004) but also contributes to timely performance of particular phases of ski turn (Matković et al., 2004). Effectiveness of alpine ski learning is a net result of instructor's expertise, on-terrain conditions and abilities of individual ski beginner.

Some motor abilities more than others contribute to successful learning. Current investigations have shown connection between balance and acquisition of alpine ski knowledge (Malliou et al., 2004; Ružić et al., 2008). Moreover, ability contributes significantly to success of alpine ski competitors (Bosco et al., 1997; Kostelić, 2005). In the same context the association was proved between explosive strength of legs and achievement in alpine ski competition for both young and senior level skiers (Bocco, 1997; Reid, et al., 1997; Lešnik and Žvan, 1998). On the other hand, literature data on correlation of rhythm with alpine ski learning is scarce. We hypothesized that ski beginners with more pronounced rhythmic coordination would be more successful during process of learning different elements of alpine ski technique, especially short turns.

METHODS

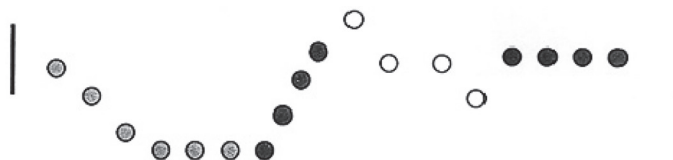
For the purpose of this investigation 108 alpine ski beginners (74 males and 34 females) were tested, all third year students of the Faculty of Kinesiology, University of Zagreb. Mean age of participants was 22.8 ± 1.33 years. Investigation was conducted during academic year 2010/2011 and it included on-field testing in ski resort Sappada in Italy, as well as indoor rhythm testing. We used non-rhythmic drumming (MKRBUB), drumming with hands and feet (MKRBNR) and Oreb's rhythm test (MOREBR) in order to evaluate participants' sense of rhythm. All the mentioned tests were used in previous investigations which confirmed their good metric characteristics (Metikoš et al., 1989; Vlašić, 2006), allowing the conclusion that they all measured participants rhythmic coordination.

Non-rhythmic drumming (MKRBUB) is a test performed from a sitting position, and repeated three times. The examinee sits in the upright position with left hand to the left, and right to the right of the line and has to continuously perform as many uninterrupted movements in 20 seconds as possible. The task consists of the following: hit twice with the left palm to the left side of the panel and leave it there, then with the right palm crossover the left-hand and hit the panel twice, raise the right palm and once touch the forehead, put the right palm down on the right side of the table to the starting position. Test result is a number of correctly repeated tasks during the three 20-seconds repetitive cycles.

In the test *drumming with hands and feet (MKRBNR)* examinee stands in the upright position with face turned to the corner of the wall. While in this position he/she has to perform as many continuous uninterrupted movements in 20 seconds as possible: hit the left side of the wall with dorsal part of the left foot above the horizontal line, then hit the right side of the wall with the right palm, followed by hitting the left side of the wall twice by left palm and then with right foot right side

of the wall just above the horizontal line. The task is performed three times, and the final test result is the number of correctly performed and completed cycles during the 20 seconds.

Oreb's rhythm test (MOREBR) is performed on the hard, flat surface. Between the start and finish line removed 14.5 m from each other there are eighteen circular differently coloured marks 25 cm in diameter (Picture 1). The task consists of running through first eight marked fields, then step and jump on the fields number 9, 10, 11 and 12, after which one has to go through last six fields jumping with joint legs and finish the test by landing past the finish line. The test is repeated three times with a rest following each performance and measured in seconds. All test results are entered.



Picture 1. *Oreb's rhythm test (MOREBR)*

The acquired alpine ski knowledge was assessed after 10 days teaching period by grading four different elements of ski technique: snowplough turn, basic turn, parallel turn and short turn. Participants learned alpine skiing in small groups during four hours daily by previously strictly defined programme and controlled conditions according to altitude, ski terrains, equipment, number of participants per group, and expertise of ski instructors. Two independent judges graded the participants alpine ski knowledge of aforementioned four elements. Prior to grading process, the judges were informed in detail about the grading criteria, and their metric characteristics (objectivity and homogeneity) showed that they were autonomous in assessing alpine ski knowledge. Grades ranged from one to five and were expressed on Likert's scale (Mejovšek, 2003, prema Supek, 1981). Alpine ski knowledge was assessed at the same time and place for all participants.

RESULTS AND DISCUSSION

Table 1 gives basic descriptive statistics parameters for tests: evaluating rhythmic coordination and four elements of alpine ski technique

Table 1. Descriptive statistics (Min-minimum, Max-maximum, Range, M-arithmetic mean, SD-standard deviation) for rhythmic coordination tests and elements of alpine ski technique

Variable	Valid N	Min	Max	Range	M	SD
MKRBUB	94	14,00	25,00	11,00	18,73	2,558
MKRBNR	87	9,00	21,00	12,00	14,51	2,865
MOREBR	102	5,42	8,92	3,50	6,57	0,633
Snowplough turn	108	2,00	5,00	3,00	3,53	0,642
Basic turn	108	2,00	5,00	3,00	3,15	0,664
Parallel turn	108	1,00	5,00	4,00	2,98	0,904
Short turn	108	1,00	5,00	4,00	2,75	0,790

MKRBUB-non-rhythmic drumming; MKRBNR-drumming with hands and feet; MOREBR-Oreb's rhythm test

Table 2. shows correlation coefficients between results on three rhythmic coordination tests and grades obtained for demonstration of four ski technique elements

Table 2. Correlation coefficients between rhythmic coordination and alpine ski knowledge

	MKRBUB	MKRBNR	OREBMR	Snow-plough turn	Basic turn	Parallel turn	Short turn	Mean KS
MKRBUB	1,00	0,43*	-0,31*	0,27*	0,20	0,25*	0,29*	0,31*
MKRBNR		1,00	0,02	0,07	-0,00	0,04	0,04	0,04
OREBMR			1,00	-0,09	-0,26*	-0,20	-0,15	-0,22
Snowplough turn				1,00	0,49*	0,48*	0,30*	0,66*
Basic turn					1,00	0,77*	0,58*	0,87*
Parallel turn						1,00	0,64*	0,91*
Short turn							1,00	0,80*
Mean KS								1,00

* p<0.05,

MKRBUB-non-rhythmic drumming; MKRBNR-drumming with hands and feet; MOREBR-Oreb's rhythm test;

Mean KS-arithmetic mean of alpine ski knowledge

We observed significant correlation between non-rhythmic drumming and acquired knowledge of snowplough ($r=0.27$; $p<0.05$), parallel ($r=0.25$; $p<0.05$) and short turn ($r=0.29$; $p<0.05$). Positive correlation also existed between mentioned test for rhythmic coordination and mean grade of chosen ski elements ($r=0.31$; $p<0.05$). Pearson correlation coefficient also points to the significant correlation between Oreb's rhythm test and success on basic turn ($r=-0.26$; $p<0.05$). Although not very strong, obtained correlations are statistically significant. Results confirm the importance of rhythmic coordination for short turn performance. As expected, growing importance of this ability is noticed during more complex elements of alpine ski technique, which are based on implementation of ski elements in continuous cycles. The true impact of the mentioned is found in everyday practice, where different methodological exercises based on acoustic rhythmic stimuli are used in teaching elements of ski technique (Pišot and Vidamšek, 2004). The exercises are constructed in such a way that instructor suggests correct rhythm in which a ski beginner has to burden or disburden skies by verbal signals „hop-hop” or „up-down”. Obtained results for this study were interesting from the aspect of positive correlation between non-rhythmic drumming (performed only by hands) and parallel and short turns, while one would perhaps expect correlation between tests requiring engagement of the whole body, such as drumming with hands and feet, because performance of parallel and short turn requires coordination of the whole body movements. Our results primarily suggest importance of coordinated hand movements during ski rod use for the proper performance of particular elements of alpine ski technique. Current investigations in the field of recreational alpine skiing are primarily oriented towards injury prevention (Hunter, 1999; Koehle et al., 2002; Horterer, 2005; Steinar et al., 2007), while the process of alpine ski knowledge transmission is not so well covered. So, investigations aiming to determine correlation and contribution of different abilities for the success of alpine ski learning are scarce. The sense of rhythm and rhythmic coordination were much more investigated in physical activities such as dance, rhythmic gymnastics or synchronized swimming, which are performed with musical background (Horvatin-Fučkar, 2002; Kostić, 1996; Pollatou et al. 2005). However, investigations such as this one suggest importance of rhythm even in physical activities not requiring musical background, especially during learning phases. Although the presented results do not establish cause-effectiveness but rather correlation, one can assume connection between the tests of rhythmic coordination and acquisition of alpine ski knowledge. This is especially important for dynamic and coordinated use of acquired knowledge, so we speculate that rhythmic coordination has an important place during continuous connecting of all types of ski movements and therefore needs to be imported in the learning phases of alpine skiing. In order to be more successful in teaching alpine ski techniques, ski instructors should implement broader spectrum of upper-body coordination exercises with marked rhythmicity.

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ABSTRACT

Although many ski instructors logically assume continuous integration of individual ski turns during skiing to be conditioned by a rhythmical movement, there is not much published research investigating the influence of rhythm on ski knowledge acquisition. In order to assess the influence of rhythm and success of alpine ski learning we included 108 ski naive participants (74 male, 34 female; age 22.8 ± 1.33) and tested them on three different indoor tests: non-rhythmic drumming, drumming with hands and feet and Oreb's rhythm test. Acquired alpine ski knowledge was assessed through grades obtained for demonstration of four elements of alpine ski technique: snowplough turn, basic turn, parallel turn and short turn. Statistically significant correlation was detected between results on non-rhythmic drumming and degree of acquired knowledge on elements snowplough turn, parallel turn and short turn ($r=0.27$, $r=0.25$, $r=0.29$; $p<0.05$ respectively), as well as with mean grade obtained for the mentioned elements ($r=0.31$; $p<0.05$). Moreover, statistically significant correlation was observed between success on Oreb's test and knowledge of basic turn ($r=-0.26$; $p<0.05$). According to results, rhythmic coordination plays an important role in successful alpine ski learning. As expected, the importance of this ability grows during more demanding learning phases, which require enforcement of alpine ski in alternating cycles. In order to be more successful in teaching alpine ski beginners how to ski, it is desirable to use rhythmical coordination exercises.

Key words: *rhythm, coordination, learning process, ski beginners*