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Motor coordination and reactivity influenced by mental training in alpine skiing

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Abstract

The samples of subjects tested are aged 12±5 and 19±1. Athletes are components of alpine ski groups within School sports clubs. The experimental group comprises athletes from Gheorgheni, Baia-Sprie, and FEFS and the control group consists of athletes from Topliţa, Sibiu, Predeal, Sinaia. Through this study, we analyzed the influence of mental training on the increase in focused attention and manual response in skiers. It is known that motor coordination and reactivity are very important in alpine skiing, (Chiș & Havatzelet, 2008). If the two components are not developed until they are fully mastered, it is impossible to achieve great results in alpine skiing. We recorded and tested the coordination between segments and the hand coordination within this study. In the experimental group, mental training techniques were applied, but not in the control group. The difference between the results is due to our intervention consisting in applying mental imagery in the most important technical elements within alpine skiing, (Akyürek, Schubö & Hommel, 2013).

Keywords: coordination, skiing, mental imagery, manual response.

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1. Introduction

In this research we applied the CMR (motor coordination and reactivity) test, which provides information on the ability of motor coordination – the adequacy and synchronizing of movements, speed and accuracy of complex reactions, motor learning, emotional balance - self-regulation, in activities with imposed pace and dynamic field of observations, specific to alpine skiing, (Master, 2010). We conducted these tests after applying the mental training techniques in the experimental group and comparing the scores with those of the control group.

We used the *CMR test* (motor coordination and reactivity) for determining the motor coordination capacity (Brugnoli, 2005) and the reactivity of alpine skiers, as well as the mental control of fatigue. We present below the values of the following indicators: IM-motor learning; CMC-coordination of movements; ER-accuracy of reactions; RR-rapidity of reactions; CMD-coordination of movements - synchronization, dissociated movements; CMS-coordination of movements-synchronization, associated - dissociated movements; AR - self-regulation (Havârneanu, 2007).

Indicators - Adjustment: Motor learning (IM) - number of stimuli required for adaptation. For the test, (downhill) the following explanations are provided: Motor coordination-number of correct reactions (CMC); Accuracy of reactions-number of wrong reactions (ER), Rapidity of reactions - number of omissions (RR). For executing exercises for the development of motor coordination and reactivity, we started with mental training on *pivot turn*. A ski on the edge in direct falling starts a triple movement in the plane of the field: translation; passive pivoting uphill, due to a couple of forces: braking force at the spatula level and pressing force on the centre of the ski, provided by its weight; pivoting (bending) around its own longitudinal axis, which augments the effect of uphill pivoting by increasing the braking on spatula level. The aforementioned aspects concern the support of the longitudinal ski profile (an arch made by the two lateral margins). “The piloting” of skis on the loop arch depends on maintaining a curve-like trajectory of the skis; it is mainly the effect of the relation between the centrifugal and the centripetal force.

The mechanisms of the rotational gestures made by the skier are supported by the coxofemoral, knee, and ankle joints, which enable two types of pivoting: around the vertical axis, represented by the tibia, (adduction and abduction movements) and around the sole, (pronation and supination). In flexion, the pivot turn is obtained by the conjugated intervention of the quadriceps that fixes the flexion angle and of the traction executed by the posterior thigh muscles (internal and external rotator muscles, which also fix the thigh on the sides for transmitting the pivot movement dictated by the hips and for maintaining the ski on the edge).

Both types of pivot turns serve the mechanisms of boot canting/decanting; both associate, generally, to those of the knee. The muscles that cause these pivot turns have a limited power; they are effective when skis are on their edges and their edges have the role of lateral fixation:

- the spine joints are mobilized - during pivoting - in the same sense as the pivoting of leg joints - rotations, (Grigoraș, 2013) or vice-versa - levorotations;

- the lumbosacral joint - the pivot turns of the joint are almost always associated with the pivot movements of L5, L4, or L3; sometimes, pivoting at this level totally replaces thigh pivoting (Fellows, 2011).

The first four stimuli are manually administered: Ms, Md, Ps, Pd. Observation: depending on the case, the subject will be told to press just once and then to wait for the first stimulus to disappear and for the subsequent one to emerge. The wrong reaction is pinpointed in both visual and auditory terms (“Wrong!”). After providing explanations, the examiner will repeat the stimulus. “As follows, you will see two yellow rectangles: one for the hand and one for the leg. You must push the corresponding buttons, at the same time if it is possible. Attention!”

The four stimuli are manually administered: MsPs - left hand/ left leg, MdPd - right hand/ right leg, MsPd - left hand/right leg, MdPs - right hand/left leg. The subsequent part of the drill comprises series

of eight paired-stimuli each, administered automatically. Upon each wrong reaction, the stimulus is repeated until the right reaction is achieved, then the series is reprised. It is considered that the subject managed to adjust when he completes an entire series without error.

2. Methodology

The analysis was performed using SPSS 15.0. For the comparison of means between the groups of subjects, we applied ANOVA for the IM, CMC, ER, RR, CMD, CMS and AR pretest measurements in order to assess whether the (control and experimental) groups are similar before the intervention. The intervention consists in the application of mental imagery techniques on certain components of alpine skiing technique based on hand-eye coordination. In addition, we calculated a t test for dependent samples for IM, CMC, ER, RR, CMD, CMS and AR both pretest and posttest, to assess whether the intervention produced any modifications. The results ranged between 1 and 5, where 1 = very low value, and 5 = very high value.

Analysis and interpretation of the CMR test: We applied a ***t*** test for independent samples for IM, CMC, ER, RR, CMD, CMS, and AR, in order to pinpoint possible differences between the control group and the experimental group. The female athlete L.E. finished first at the National Championship of School Sports Clubs (CSS) organized in March 2015. She is a very good athlete; at four indicators (CMC -coordination of movements, CMD-coordination of movements-synchronisation, dissociated movements CMS-coordination of movements-synchronisation, associated-dissociated movements, AR -self-regulation) she scored 4 out of 5; and at RR-rapidity of movements, she scored 5.

3. Results

Results show that the intervention had effects on the experimental group compared to the control group in case of IM t (46) = 3.206, p = 0.02<0.05, with average effect value of 0.42 and CMD t (46) = 3.275 p = 0.2<0.5, with average effect value of 0.43. For the other CMC, ER, RR, CMS, and AR, we cannot posit that it was our effect and not pure chance, because the differences between the two groups are not statistically significant (see Table 2).

Table 1. Descriptive statistics, CMR test

	Grup	N	Mean	Std. Deviation	Std. Error Mean
IM	**control**	**24**	**40.0833**	**20.35536**	**4.15502**
	experimental	**24**	**25.25**	**9.96625**	**2.03435**
CMC	control	24	65.6667	15.79396	3.22393
	experimental	24	72.7917	10.97023	2.23929
ER	control	24	13.2917	7.52664	1.53637
	experimental	24	9	6.6004	1.3473
RR	control	24	10.1667	11.5971	2.36725
	experimental	24	5.9583	8.21705	1.6773
CMD	**control**	**24**	**21.9758**	**12.06017**	**2.46177**
	experimental	**24**	**11.8188**	**9.23983**	**1.88607**
CMS	control	24	17.7163	7.62702	1.55686
	experimental	24	9.4958	6.50256	1.32733
AR	control	24	65.2917	14.59148	2.97847
	experimental	24	78.8333	15.68901	3.20251

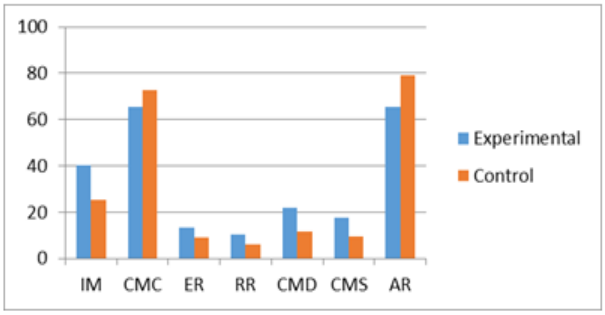

Figure 1. The CMR test in the two groups, Lc and Le

Table 2. T test for independent samples, CMR test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
IM	EVA	10.949	0.002	3.206	46	0.002	14.8333	4.6263	5.5210	24.1456
	EVNA			3.206	33.428	0.003	14.8333	4.6263	5.4256	24.2410
CMC	EVA	1.513	0.225	1.815	46	0.076	-7.125	3.9253	-15.026	0.7762
	EVNA			1.815	41.002	0.077	-7.125	3.9253	-15.052	0.802
ER	EVA	0.419	0.521	2.1	46	0.041	4.2916	2.0434	0.17843	8.4049
	EVNA			2.1	45.229	0.041	4.2916	2.0434	0.17654	8.4067
RR	EVA	2.016	0.162	1.451	46	0.154	4.2083	2.9012	-1.6315	10.0482
	EVNA			1.451	41.445	0.154	4.2083	2.9012	-1.6489	10.0656
CMD	EVA	10.844	0.002	3.275	46	0.002	10.1570	3.1012	3.9146	16.3995
	EVNA			3.275	43.082	0.002	10.1570	3.1012	3.9032	16.4109
CMS	EVA	1.062	0.308	4.018	46	0	8.2204	2.0458	4.1022	12.3385
	EVNA			4.018	44.877	0	8.2204	2.0458	4.0995	12.3413
AR	EVA	0.003	0.954	3.096	46	0.003	-13.5416	4.3734	-22.345	-4.7383
	EVNA			3.096	45.7	0.003	-13.5416	4.37348	-22.346	-4.7370

**EVA- Equal variances assumed; **EVNA-Equal variances not assumed*

4. Interpretation of results

We investigated the following variables (Havârneanu, 2007):

- Motor coordination, which involves the assessment criteria of global test results, and the following indicators: Total Correct Reactions (CMC) and Synchronisation (CMS).
- Mobility, which involves the assessment criteria of Easiness of acquiring the stereotype, Working tempo, and Self-regulation, and the following indicators: number of stimuli required for adaptation (IM), Percentage of omissions, and Resume after error (AR), (Frank, Land & Schack, 2013).
- Balance with reactivity control, with assessment criterion. Indicators: Percentage of omissions in relation to the number of stimuli required for adaptation and the percentage of omissions related to

the number of omissions made downhill and Behaviour in intense stimulation situations (especially on V3 speed).

- Operational thought efficiency, with the following assessment criteria (Dilts & Epstein, 2011): Learning capacity and the progress made after the drill. Indicators: Understanding the assignment and Number of stimuli required for adaptation (IM).

5. Conclusion

Considering the comparative analysis of scores to the tests applied to the groups of our study and the statistical significance, it can be posited that mental training through mental imagery improved outcomes in IM – motor learning (number of stimuli required for adaptation) and CMD – coordination of movements – synchronization (sync indicator dissociated movements) in the experimental group. These findings determine, in their turn, increased athletic performance in the groups studied, as it is obvious from the analysis of competitions that took place in January 2015.

6. Special acknowledgment

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