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Motor Coordination and Reactivity Influenced by Mental Training in Alpine Skiing

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Abstract

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Problem statement: The purpose of this research is to show that the implementation of mental training techniques improves the performance in alpine skiing. Scientific originality is determined by the adaptation and implementation of a mental training program for skiers of 12-19 years, children, small and big juniors, consisting in a complex technique and psychological preparation program, during three competition years (October 2012 - March 2015).
Aim: The goal of this research is to identify certain psychological factors that will help along with the relevant physical ones in obtaining skier's performance behaviour and achieving sport performance; especially to increase in the capacity of motor coordination and reactivity response in certain alpine skiers.
Practical value of the paper is characterised by the development of an experimental model that includes the way in which the structure is implemented and the development of the program's content in ski sport training, accomplishment of all the required techniques and enhancement in the technique of mountain ski descending, in both series.
Conclusions: The difference between the results is due to our intervention consisting in applying mental imagery in the most important technical elements within alpine skiing. In order to teach athletes certain skills to control their own study behaviour, one needs knowledge and abilities concerning the processes and mechanisms that play a direct role in personal management.

Keywords: Mental training, alpine skiers, motor coordination, reactivity action, motor development.

1. Introduction

We used the CMR test (motor coordination and reactivity) for determining the motor coordination capacity and the reactivity of alpine skiers, as well as the mental control of fatigue. In order to determine motor coordination and reactivity, psychomotor capacity in alpine skiing, in this research we used a device called Computer – assisted, created by Management Design SRL Iasi, (Hãvârneanu, 2007). This device provides the possibility of obtaining indicators of information. According to the term "vigilance" as understood by Bonnardel (Hăvârneanu, 2011), we study some components of coordination like: execution and self-regulation capacity – indicators of safe behaviour.

The process of self-regulated learning is assimilated to the interaction between several factors – personal (motivational, strategic and related to self-control), behavioural and contextual – with an impact upon the athletic performances of students (Zimmerman, 2002).

Especially when the sportsman fails to achieve a certain level of competition, mental imagery is used to focus on an image of desired reality, to develop techniques abilities. Certain strategies aim to obtain not only high performances, but also the development of autonomous learning capacity (of planning activities by priorities, of mobilizing oneself to attain the objectives, of organizing the learning process and the context of study, etc).

The development of self-regulating abilities can be achieved within the instructive process, by increasing the importance of certain activities, cited by Crotty that mediate the experiences enabling the athlete to: explore systematically a learning situation; self-monitor the cognitive processes, the learning activity per se and the means of organizing the knowledge; plan the learning behaviour; reflect upon the personal method of learning/ understanding; generate personal meanings, which will represent filters for interpreting the study material.

Within *new tasks,* they generally cover *the following steps* (Tirri & Nokelainen, 2011): analyse the task and interpret its requirements; determine objectives specific to task fulfilling; select and adapt strategies by these objectives; monitor the progress made for attaining the proposed purposes; adjust the strategies and effort made after monitoring; use motivational strategies to persist in the task when encountering difficulties or the presence of distracters.

2. Purpose of study

The aim of this study was to track changes and overall coordination components after applying mental training techniques. Of these components we can include various indicators that were tested at the beginning and end of the experiment in both groups: control and experimental. These indicators were measured by the following: IM – motor learning; CMC – movement coordination; ER – reaction accuracy; RR – reaction speed; CMD – dissociate movement synchronization; CMS – associate – dissociate movement synchronization; AR – self-regulation .(Grosu & Grosu, 2015)

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). Executive functioning represents an umbrella concept that circumscribes the high level coordination

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of a series of cognitive processes used for regulating and directing behaviour towards the purpose, in new or difficult situations (Hughes and Graham, 2002).

According to Grosu (2012), by following proprioceptive and kinaesthetic processes, specific to the mental training, we can increase the ability to combine and recombine mental images.

In literature there are different terms that refer to mental training. Among them we can mention: mental rehearsal, practice mental visualization and repetition representation imagery. (Grosu,1999).

After applying the mental training techniques in the experimental group, we also observed significant changes on the motor coordination parameters and reactivity.

The applied tests aim to observe several aspects of the speed and precision of the perception together with the efficiency of the operational thinking. The information regarding reactivity are filled by observing the speed reaction and time reaction (Egan, D., 1996)

During the mental training interview we have asked our athletes to five us more information about the movement techniques in alpine skiing.

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. (Grosu, 2015) 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 coxo-femoral, 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).

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. (Grosu, 2015a)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.

3. Methodology and results

For the purpose of this study we have requested and received the approval from the Etic Committee in accordance with Helsinki Declaration. Moreover, we have also received the acceptance of the tutors of the athletes who participated in the experiment.

There is also informed opinion of the subjects participating in research. Subjects received notice underage parents to participate in research.

Research design: The experiment took place at different places: Cluj-Napoca, Gheorgheni and Baia-Sprie between 1.10. 2014 – 31.03.2015. Subjects and groups – constituted by junior athletes in alpine skiing with age old between 11 ± 5 and 15 ± 3 years. One group was from the sportive clubs: CSS Baia-Sprie, Maramureş District, CSS Gheorgheni, Harghita district. The other group was form by juniors from different ski clubs: CS Sinaia (PH), CS Predeal (BV), C Crazy – Bike Sibiu (SB), C Piatra – Neamt (NT), CS Miercurea-Ciuc (HR).

We applied the CMR test (motor coordination and reactivity) test. These initial tests were used as starting points in our research, in which we want to increase sports performance through the application of mental training techniques. The assumption of this research: by applying a mental training programme on the selected group, the athletes were capable to maintain their calm, mobilize the energy during the competition and capable of self-control. We have also observed that the athletes know how to define the control sensation.

To accomplish the statistical work we have applied the SPSS 15.0 software. As a process we have made the comparison of averages between subjects and applied ANOVA to all indicators: AI, CMC, ER, RR, CMD, CMS and AR during the pre-test measurements. On both groups the results were similar before the experiment.

The intervention programme consists in applying several imagination exercises on specific components of the downhill driving in alpine skiing, based on general coordination. We have also calculated the *t* test on the specific groups both before and after the intervention program in order to observe if any change occurred.

The results ranged between 1 and 5, where 1 = very low value, and 5= very high value, 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), (CMD), (AR), she scored 4 out of 5; and at (RR), she scored 5.

Table 1. Descriptive statistics, CMR test

	Group	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

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	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

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 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	14.83333	4.62631	5.52105	24.14562
	EVNA			3.206	33.428	0.003	14.83333	4.62631	5.4256	24.24106
CMC	EVA	1.513	0.225	1.815	46	0.076	-7.125	3.92532	-15.02626	0.77626
	EVNA			1.815	41.002	0.077	-7.125	3.92532	-15.05233	0.80233
ER	EVA	0.419	0.521	2.1	46	0.041	4.29167	2.04344	0.17843	8.4049
	EVNA			2.1	45.229	0.041	4.29167	2.04344	0.17654	8.40679
RR	EVA	2.016	0.162	1.451	46	0.154	4.20833	2.90124	-1.63156	10.04823
	EVNA			1.451	41.445	0.154	4.20833	2.90124	-1.64893	10.0656
CMD	EVA	10.844	0.002	3.275	46	0.002	10.15708	3.10122	3.91464	16.39952
	EVNA			3.275	43.082	0.002	10.15708	3.10122	3.90321	16.41095
CMS	EVA	1.062	0.308	4.018	46	0	8.22042	2.04588	4.10228	12.33855
	EVNA			4.018	44.877	0	8.22042	2.04588	4.0995	12.34134
AR	EVA	0.003	0.954	3.096	46	0.003	-13.54167	4.37348	-22.34503	-4.73831
	EVNA			3.096	45.76	0.003	-13.54167	4.37348	-22.34627	-4.73706

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

4. Discussions and findings

We investigated the following variables (Hăvârneanu, 2011). 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).

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: 1. the spine joints are mobilized – during pivoting – in the same sense as the pivoting of leg joints – rotations (Grigoraș, 2013), or vice-versa - laevorotations; 2. 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).

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). As you move ahead, internalize the motions and visualize the action of the carving ski (Dilts, Epstein, & Dilts, 2011).

Operational thought efficiency, with the following assessment criteria (Egan, 1996). Learning capacity and the progress made after the drill. Indicators: Understanding the assignment and Number of stimuli required for adaptation (IM). So far the only fundamental element of high performance alpine skiing remains the equipment technique and the execution techniques. (Master, 2010)

Especially, when the athlete does not manage to execute technically a movement he is asked to concentrate on a key aspect that triggers the specific movement (this can be either an image or the entire aspect). Accordign to some researchers (Unsworth, McMillan, Brewer & Spillers, 2012), elite athletes are characterized by the following qualities: they are more devoted, more motivated and have more self-esteem and know how to concentrate on what is essential or not. These athletes know how to overcome the obstacles and compete with maximum efficiency in stress conditions. Others researchers created specific surveys to test the athletes.

In order to test their mental abilities keeping into account different competition and sports standards (Schack, & Hackfort, 2007). After them opinion, psychological variables and abilities which consist the base of top performances, were examined mostly through qualitative interviews or through a combination of questionnaires and interviews. Specialists can use such information for planning, implementing and optimization of psychological interventions, helping this way expert sportsmen and also novices to achieve the highest possible level (Filho, & et. al., 2015; Sadeghi, & et. al., 2010). Strategies are learning techniques used intentionally in order to reach certain objectives. An important aspect of these strategic programs is represented by information concerning when and how one must use newly acquired strategies (Schraw and Brooks, 1999).

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5. Conclusions

By analysing the scores of the tests applied on the selected groups, we can say that the mental training through mental imagery can improve the results of the athletes, especially in the components: IM – motor learning (number of stimuli required for adaptation) and CMD – coordination of movements – synchronization (sync indicator dissociated movements)

In the experimental group we have observed an increase of the performance as it results from the analysis of the competitions that took place in session: Dec 2014 - March 2015. We can also point out the role and objective of the mental representation by using mental images together with sensations and perceptions. These come along with the movement during the imagery moment in order to execute the mental technique closer to the real action.

Consequently, the skills enumerated below differentiate students who self-regulate the learning process from those who do not (Boekaerts, M., Corno 2005, Zimmerman, 2002): familiarization with a series of cognitive strategies, knowing when and how to use them (through repetition, organization, elaboration and organization); organization, control, directing mental process towards attaining personal goals; the presence of a set of motivational beliefs and adaptive emotions, such as the following: high sense of obtaining school efficiency; establishing clear learning objectives; channelling positive emotions towards fulfilling certain tasks (e.g., joy, satisfaction, enthusiasm); planning and control of time and resources necessary to initiate and finalize a task; mobilization and effort to control and regulate training tasks; application of voluntary strategies.

Cognitive concern both mental processes and specific behaviours of students while acquiring new knowledge. The adjustment of cognitive strategies to the current task is the result of the so-called procedural knowledge, namely the knowledge of the most effective techniques for acquiring and assimilating notions (MacLean, 1997).

Conflicts of interests

We declare no conflicts of interest. Research capitalizes partial results from the PhD thesis of the first author, presented on 18 June 2015, at the "Babeş - Bolyai" Cluj-Napoca, Faculty of Physical Education and Sport.

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