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MOTOR IMAGERY PERSPECTIVE IN CROSS-COUNTRY SKIERS WITH VARIOUS TECHNICAL SKILL LEVELS

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Abstract

Motor imagery is widely known to be an effective tool commonly used in sport settings to enhance motor coordination. However, differences between first- and third person imagery in terms of its effects on performance and underlying psychological mechanisms as well as conditions in which using of each perspective should be considered optimal are still not well understood. At the same time, current options to adjust mental imagery for individual need and, in particular, special strategies for imagery use depending on athletes' level of expertise are limited. To investigate potential features of imagery perspective related to athletes technical expertise, we have tested 54 cross-country skiers (40 males and 14 females) aged from 11 to 31 (M = 16.3) and ranked from third-class junior to merited master of sport. To determine athletes' technical skill levels dual-task methodology with following video analysis and expert technique assessment were implemented. Then, by using cluster analysis, the participants were divided into 4 groups according to their expertise. The national team members were assigned to the fifth group as best-skilled performers. Based on imagery perspective for 11 ski technical elements, groups with predominant use of first-person, third-person or switching perspective were formed by means of cluster analysis. Cross-tabulation revealed gradual rise of the third-person imagery use across motor skill development with a secondary increase in the first person images frequency in most-skilled performers. Possible explanations and applications of the obtained data are discussed.

Keywords: Sport psychology, mental imagery, motor imagery, imagery perspective, first person imagery, third person imagery,

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1. Introduction

It is widely recognized that the main feature of sport is a continuous pursuit for best performance and this creates the conditions where improvement simply by means of an increase in amount and intensiveness of training is going eventually to hit the limits. Therefore, interventions enabling to influence the quality of training are the most valuable ones to implement at an elite sport level.

Among tools for such interventions, one of the most extensively used is mental imagery (Morris, Spittle & Watt, 2005; Murphy & Martin, 2002). According to Paivio (1985), impact of mental imagery on sport performance is mediated by motivational or cognitive mechanisms acting at general or special level. As a result, Paivio identified 4 functionally distinct types of imagery:

- Motivational general imagery conveys emotions and somatic arousal,
- Motivational special imagery represents a goal individual is aimed at or an event that stands for such a goal (e.g., winning a large-scale competition, getting on a podium, going through a medal ceremony, etc),
- Cognitive general imagery is used to create possible tactical plans for future performance,
- Cognitive special imagery is involved in motor skills practice.

The last type of imagery is more often referred to as motor imagery and recommended for use as a powerful supplementation to traditional technical training. Up to date, motor imagery has proven to be effective in facilitating new motor skills acquisition as well as perfection of already mastered techniques in sport settings (Driskell, 1994). The process or method of implementing imagery to improve motor skills performance is called mental practice. For the same reason as traditional training methods, latter is known to be an object of continuous research on optimization of its use to yield most pronounce effect on performance.

Among such efforts, one of the most consistent was made by (Holmes and Collins, 2001) who introduced the PETTLEP model. The main idea proposed in the model was to enhance benefit from motor imagery for a performer by trying to reach equivalence between real and imagined action on the following 7 parameters:

- “Physical” is a degree of arbitrary force use and background somatic arousal,
- “Environment” is perceived properties of surroundings and objects being intended to interact with,
- “Task” is features of imagined exercise such as being directed by endo- or exogenous stimuli,
- “Timing” is a tempo of imagined action (e.g., slow, real or accelerated),
- “Learning” is the actual competence in a skill being imagined,
- “Emotion” is emotional response for exercising a skill,
- “Perspective” is a point of view in the mind’s eye, which can be the first- or the third-person view.

Despite only the first-person imagery can be congruent to a picture perceived during real action (Olsson, 2008), authors do not explicitly recommend to use only the first-person perspective taking into account the results obtained by (Hardy and Callow, 1999) showing advantage of the third-person imagery to practice certain types of skills. Later, Callow et al., 2013 suggested that the third-person imagery underlying processes could be equivalent to some of the activities involved in control of real actions. In

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any case, influence of imagery perspective on mental practice and corresponding motor skill performance is yet not well understood.

Beyond sport settings, imagery perspective has been extensively studied by Libby and Eibach, (2011) who believed that an imagery perspective adopted by individual depended on the way he or she defines the imagined event. So, a concrete interpretation of imagined actions (in terms of its constituent steps or movements) is considered to be linked to the first-person perspective imagery, whereas an abstract interpretation (in relation to action's broader context – e.g., its causes or consequences and actor's characteristics or motivations, etc) is regarded as associated to the third-person perspective. E.g., a neutrally described action like "locking the door" may correspond to either "putting a key in the lock" (concrete, imagined from the first-person perspective) or "securing the house" (abstract, imagined from the third-person perspective) representation.

In turn, Vallacher and Wegner, 1987 note that individuals tend to use the most concrete interpretations when talking about actions that failed to be easily performed and thus an individual had to put conscious efforts to analyze, plan and monitor each step of the action. E.g., an individual first time riding a bike can think of his or her actions simply as of attempts to keep balance. Further analyzing action demands, an individual starts to emphasize significant elements of the action, which are currently critical to monitor to avoid failure, and while riding a bike he or she can attend to smooth pedal pushing and holding a steering wheel in a right direction. But after the action became automated, intense control is not anymore needed and released attention allows to think of the performing action in a more abstract manner. As for the example with a bike riding, action's meaning may change to "seeing the neighborhood", "unwinding from a hard day" or, for instance, "getting exercise" (Vallacher and Wegner, 1987). Given example clearly illustrates that an action interpretation alters while the corresponding skill performance experience is gained. In line with the findings of Libby and Eibach (2011), the same can be the case for that skill image perspective.

2. Problem Statement

Mental practice is widely used to learn or perfect motor skills in both beginners and experienced athletes. However there is a growing practical demand to develop an approach to adjust motor imagery use for optimal results in certain types of tasks and at various skill levels. From theoretical point of view, currently, there is lack of data on the role of perspective in motor imagery.

3. Research Questions

We expect that at the beginner level substantial percentage of athletes would be prone to adopt the first-person perspective while imagining a set of specific skills, whereas more skilled performance would be associated with rise in percentage of athletes inclined to the third person perspective imagery.

4. Purpose of the Study

The purpose of the study was to define the profile of imagery perspective use in relation to level of expertise in cross-country skiers. Latter were considered since cross-country skiing is a cyclic sport

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which, on the one hand, is technically demanding and, thus, expected to keep beginner skiers attending to skill details (assumed to be associated with the first-person perspective) and, on the other hand, allows experienced athletes to develop highly automated movements (assumed to be associated with the third-person perspective).

5. Research Methods

5.1. Assessment of athletes' technical expertise

As stated by (Abernethy et al., 1998), dual task allows observing inter-individual differences in skill performance otherwise undetectable and achieving an accurate ranking of athletes on account of their technical expertise. Each of 46 athletes was captured on video (camera - *Sony HDRSR*12*E,* resolution – 1920.1080 pixels, 12-fold optical zoom, speed – 50 frames per sec) in two roller-ski skating trials, one of which was designed according to dual-task methodology. The trials were performed on a straight flat-terrain 100 m-course situated after the turn.

At the trial #1, skiers were instructed to use open field ski skating technique at self-estimated individual average competitive speed for 5-kilometer distance. During the trial #2, athletes were performing a specially designed secondary task while skiing. This strategy was intended to distract skiers' attention from movement control to diagnose individual skill stability under cognitive load, which is largely dependent on automatization of corresponding motor repertoire (Shiffrin and Schneider, 1977).

For demonstration through the trial course, stimuli applied on sheets of A0-size were placed on paperboards at the distant in relation to the camera side of the trail at each 20 m from the beginning of the test section. The paperboards were turned to the side opposite to the starting position, so there was no opportunity to see the stimuli before getting onto the test section of the trial course.

According to the trial's #2 instruction, skiers had to imagine 3x3 square grid (just as it was on stimulus material) and mentally draw a curved line connecting locations of 5 successively demonstrated dots while skiing. Immediately after the trial #2 was finished, each athlete had to reproduce the resulting curved line within the blank 3x3 square grid lain on the table. General instruction for the trial #2 was to use open field ski skating technique, paying maximal attention to correct performance on secondary task while skiing at the same speed as it had been defined for the trial #1. Immediately prior to the trial #2, each athlete filled Spielberger state anxiety scale (adapted by Yu. Hanin) to preclude influence of anxiety as a potential confouder for finally obtained results (Glencross, 1978).

Resulted video records were given to two independent experts evaluated technical expertise of the athletes based on 7 pre-determined elements (poles recovery, poles plant, knee bend with skate-push, upper body drop down onto the poles, ski landing and balancing weight on gliding foot, the end phase of pole-push, hip joint extension) considered to be critical in differentiating rational open field ski skating technique performance. Thus, each athlete received 2 rows of 7 expert marks per trial (1 mark for 1 technical element) according to 10-point grading scale. The remainder after subtraction of the total score on expert marks for the trial #2 from the total score for trial #1 was taken for deautomatization index.

Apart from expert scoring, amount of movement cycles was taken into consideration for further determination of athletes' technical expertise as one of the most important indicator for skier's movement

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features. As it has been established, skating stroke length increases (i.e. amount of cycles to cover the same distance decreases) with experience gain while cycle frequency remains unchanged. As for skating techiniques, this is largely attributed to improvement of technically related aspects such as pole-push effectiveness [20] and body weight movement from one ski to the other (Novikova, 2014).

5.2. Assessment of athletes' motor imagery perspective

A specially developed inquiry schedule consisting of 11 repeated sections (see Appendix 2) was used to diagnose athletes' motor imagery perspective. Each section addresses one of the technical elements of open field ski skating technique. The list of technical elements was created in collaboration with the experts and contained all the same movements used to evaluate athletes' expertise and, in addition to these, maintenance of the elbow joint at the same angle while initiating a pole-push which could not be assessed on video (the whole list is provided at figure 4). Moreover, poles recovery was presented in two versions: (1) "not lower than the top of the head" and (2) "up to the eyes height". The end phase of pole-push was presented in two versions with different emphasis on modality in description: (1) "a pole acts as an arm projection" – stressing kinaesthetic modality, (2) "full extension of the elbow joint" – neutral and (3) "pole forms a straight line with the shoulder" – stressing visual modality.

Subjects were explained the exact meaning of the first- and third-person imagery perspective terms and then imagined several times as they were performing ski technical elements themselves according to each of the resulted 11 descriptions. With prompts of the researcher, athletes filled corresponding 11 sections of the inquiry schedule, individually or in small (up to 6 responders) groups, identifying their preferred image either as stable from first- or third-person perspective or as switching between them while imagining a movement. In this latter case, subjects had to indicate their preferred perspective with a corresponding mark on a special analogous scale (Spittle, 2001). Therefore, in the further analytical procedures, the the first- and third-person perspectives were assigned 0 and 10 units, respectively. Perspective switching value was expressed by an athlete in terms of score reflecting temporal relationship of third-to first-person imagery (e.g., 3 units equal to a movement to be imagined 30% of time from third-person and 70% of time from first-person perspective)..

6. Findings

6.1. The sample

We have tested 54 cross-country skiers (40 male and 14 female) aged from 11 to 31 ($\overline{M}$ = 16.3, *SD* – 5.26) and having had skiing experience from 1 to 24 years ($\overline{M}$ = 7.1, *SD* – 5.32). Athletes were qualified for the following ranks: from third-class to first-class junior (13%), third-class to second-class (44,4%), first-class to candidate for master of sports (24,1%) and master of sports (18,5%). Among latter, there were actual members of national cross-country skiing team (14,8%) assigned the titles of international-class master of sports and merited master of sports.

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6.2. State anxiety scores

There were 3 skiers having had enhanced state anxiety based on the measures on Spielberger test. However, two of them showed the results which could be interpreted as boundary. For the third subject low technical scores were expected because his rank was third-class junior and his skiing experience was relatively too little. Furthermore, difference between the total scores on expert marks for the trial #2 and the trial #1 (i.e. deautomatization index) was not so substantial for all three as compared to the other results. Consequently, a decision to include all the results in further analysis has been made.

6.3. Results of the cluster analyses

6.3.1. Grouping according to level of expertise

Spearman correlation coefficient for the scores of the first and second expert was 0.93 ($p < 0.001$) and the scores were averaged and the average scores for each trial was calculated. Then the athletes (n = 46) were divided into 4 clusters according to the technical score for the trial #1, deautomatization index and amount of cycles at trial #1 and trial #2. The last fifth group was comprised of the national team members (n = 8) who were considered top-class athletes and did not participate in dual-task experiment. Percentage distribution on the resulted groups is shown at figure 1.

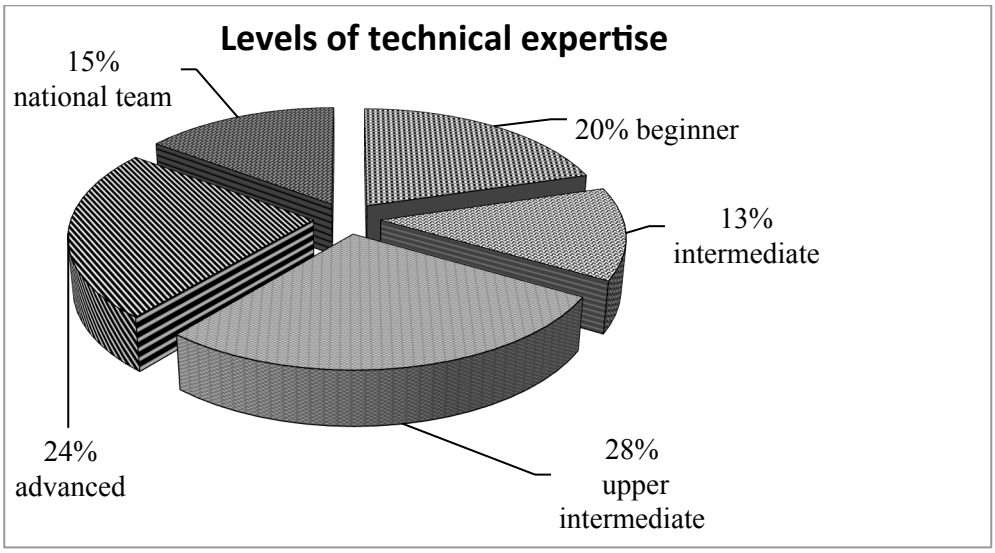

Figure 01. Percentage distribution of athletes on the obtained levels of technical expertise

Technical expertise evaluation seems to be plausible as the obtained grouping is noncontroversial to the athletes' qualification (see figure 2).

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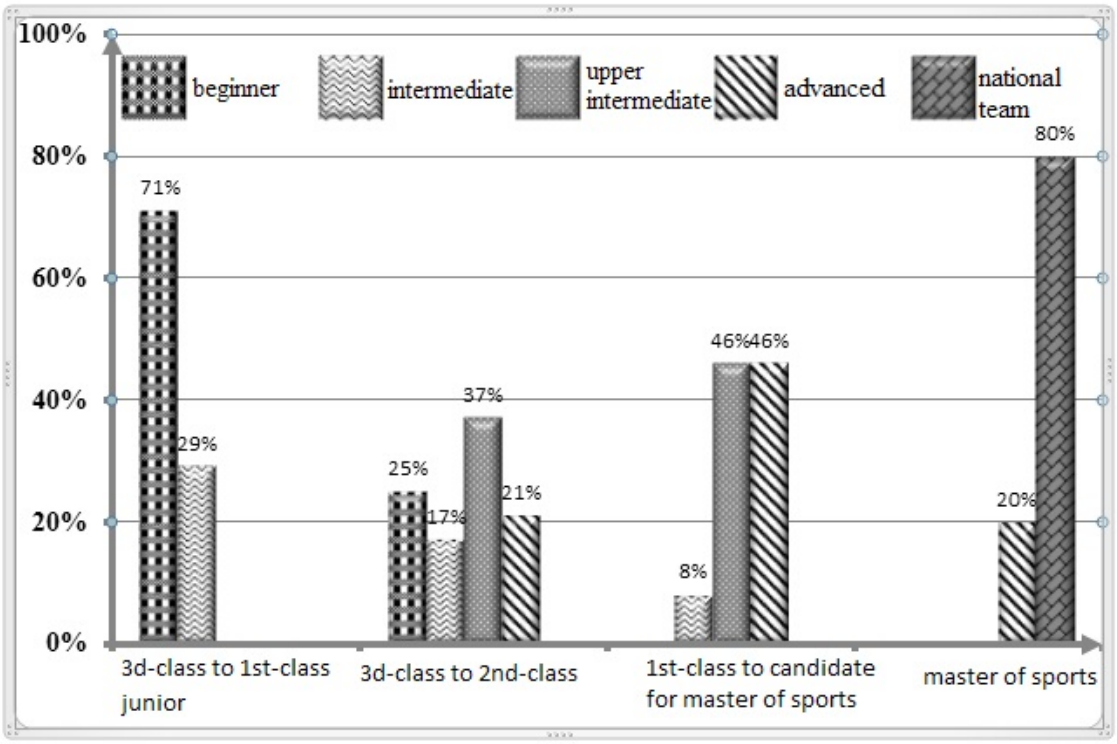

Figure 02. Distribution of technical expertise levels on athletic titles]

6.3.2. Grouping according to predominantly used imagery perspective

The sample (n = 54) was divided into 3 clusters according to the scores for imagery perspective. Centers of the resulted clusters are shown at figure 3.

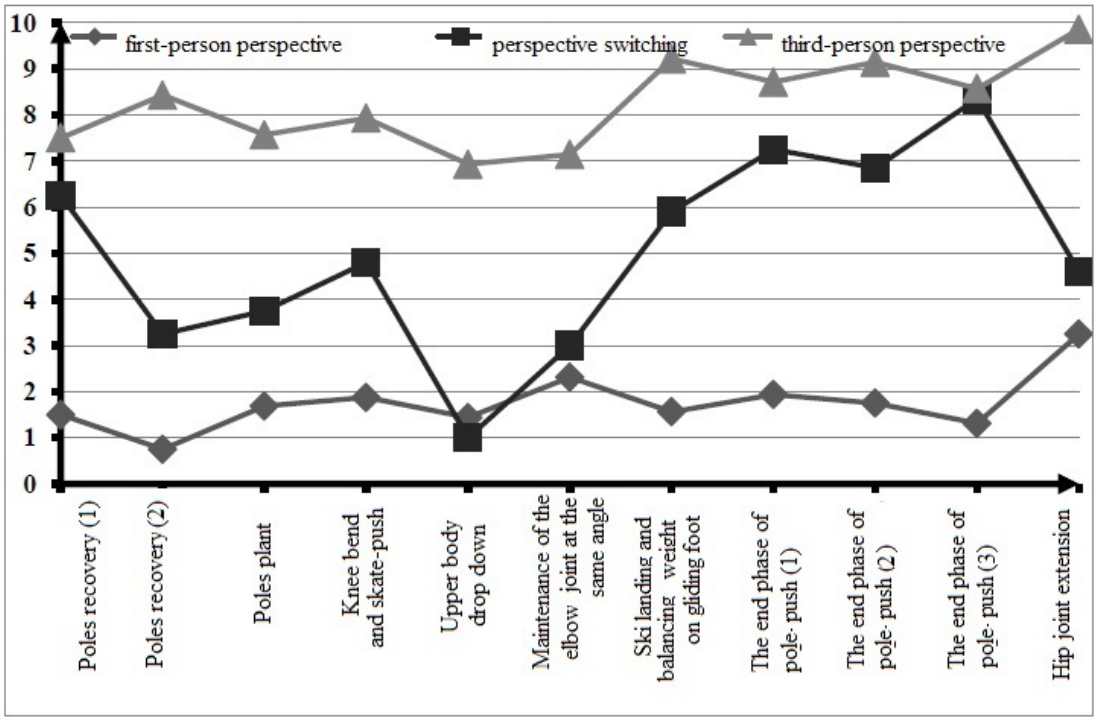

Figure 03. Centers of the clusters corresponding to predominantly used imagery perspective

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The first cluster (33%) includes subjects who are prone to imagine almost all given actions from the first-person perspective. The second (40%) comprises of the skiers who tends to switch perspective while imagining the actions. The third (27%) involves participants who imagine the actions mainly from the third-person perspective.

6.4. Comparison of various levels of expertise on predominantly used imagery perspective

The data on the use of various imagery perspectives depending on skill level are depicted at figure 4 showing distribution of athletes with predominant use of first-person, switching or third-person perspective on distinct levels of technical expertise.

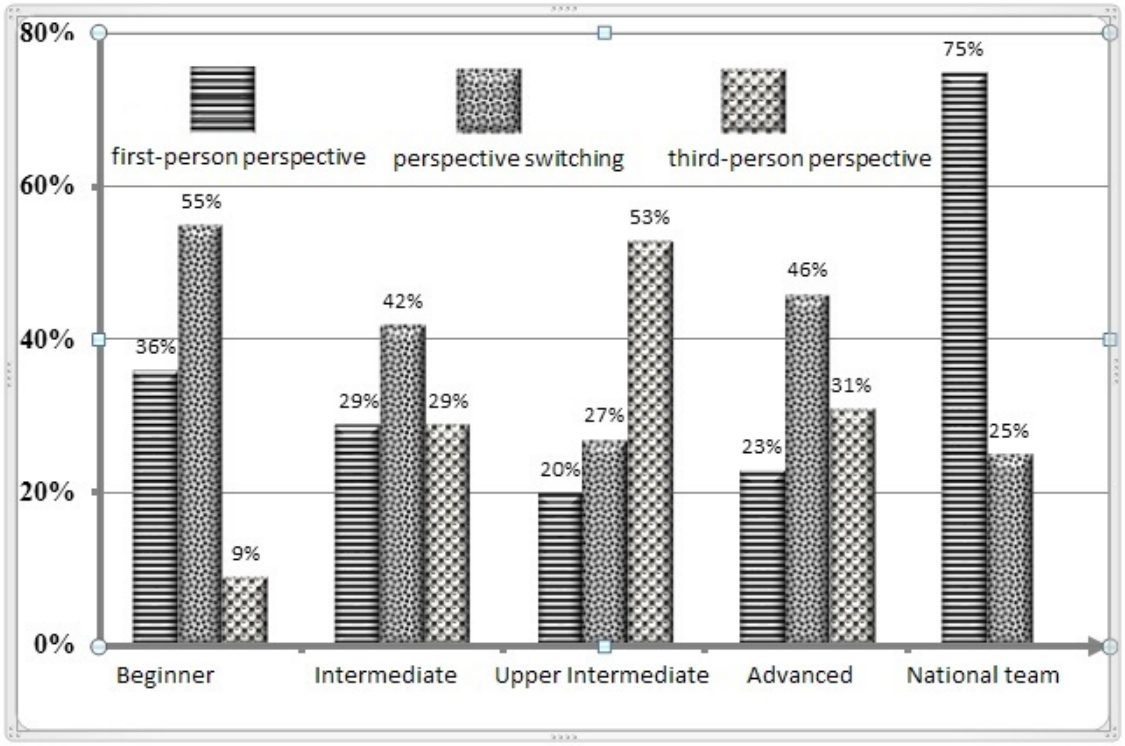

Figure 04. Distribution of athletes predominantly using one or the other imagery perspective on levels of expertise

Possible explanations and applications of the obtained data are discussed further.

7. Conclusion

The beginner skiers inclined to imagine their movements from the first-person perspective (see figure 4) that is being consistent with the present hypothesis. We consider that first-person imagery predisposes to adopt a narrow attentional focus, which allows to more deeply analyze a movement being imagined. According to N. Bernstein, 1967, such imaging strategy can significantly accelerate sensory corrections accumulation, which is being a crucial mechanism of skill acquisition at its first stages. It is possible, that the beginner athletes' first person imagery is a manifestation of their adaptation to the activities demand through which they could find a suitable way to concentrate on the details of imagined actions and achieve correct performance.

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Imagining an action from the third-person perspective, a subject can see it more generally and does not tend to deeply analyze its constituent movements. According to Vallacher and Wegner, 1987, an individual is naturally inclined to see actions within its broader context unless some of the current conditions requires the opposite. We think this could be true in relation to motor tasks as well. After a movement has become automated, there is no need to thoroughly control its elements and athletes more frequently adopt a broad attentional focus, which is believed to be associated with third-person imagery. It corresponds to the abilities of experienced athletes such as multitask performance, quick attention switching and orientation in competitive environment. Consciously thinking of automated movement mechanics has been confirmed to have a destructive influence on performance (Beilock et al., 2002).

Perhaps, at some point, first-person imagery can block further automatization process and therefore some of the athletes move to presumably more productive third-person perspective (see figure 4). Secondary rise in the number of skiers using predominantly first-person perspective imagery on advanced and national team levels (see figure 4) was not expected within the current hypothesis and is considered to be attributed to other factors becoming dominant when technical perfection comes out to be less crucial. It could be assumed, that technical and even tactical actions are becoming fully automated at these stages. At the same time, many of the advanced athletes already think of sports as of their career option and, hence, they begin to be more oriented on competitive results. In contrast to taking exercises as a hobby, when athletes can fully enjoy their technical perfection, aiming at highly competitive activity in skiing entails subjects to be concentrating on maximal movement speed and strength and a conscious emphasis on these attracts person's attention back to movement itself. If this is the case, similar changes has to take place in person's imagery that can result in adaptive shifting back to the first-person imagery as a more suitable way to concentrate on various aspects of imagined movement itself. This could be especially substantial for the national team members as all of them were specialized in ski sprint which is being the most demanding cross-country skiing subtype.

As a result, there could be additional increase in emotional load of imagery and its association with somatic reactions used by athletes to estimate their forces at the distance (Hanin, 2008). Correspondingly, several studies (Abelson, 975; Fiske, et al., 1979; McIsaac and Eich, 2002) have shown first-person imagery to be associated with emotional feeling and interoceptive sensations which again can be considered conditions predisposing to adopt a narrow attentional focus (Nideffer, 1990).

At last, national team level often imposes new strict requirements to athletes' technical performance, completely different from the former ones (Novikova, 2014). This involves continuous practice to adjust technique to sharply increased demands causing an athlete to relearn movements imagining from first-person perspective. It is worth mentioning, that athletes' conscious thinking of movements structure can also be mediated by a couching style, which is able to encourage or suppress such an activity through directing athletes' attention.

In conclusion, the Present results have potential application in mental practice, suggesting to use the first-person imagery at the stages of intense motor learning and the third-person imagery to facilitate further progress in cases when it detained by conscious examination of movement structure.

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