International Journal of Applied Sports Sciences
2016, Vol. 28, No. 2, 213-225.

ISSN 2233-7946 (Online)
ISSN 1598-2939 (Print)
http://pms.sports.re.kr/ijass.jsp

The effects of attention training techniques on stress and performance in sports

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Abstract

The main aim of the present study was to investigate any effects from attention training techniques (ATT) on junior elite athletes' perceived level of stress, perceived performance in sports, and perceived performances in school. Fifty-eight athletes from various sports such as alpine skiing, cross-country skiing, handball, biathlon, ski-jumping and Nordic combined completed an ATT training program over a period of 12 weeks. A pre-test/post-test control group design was used to investigate any effects from the ATT training program. The results from this study showed that there was a decreased level of perceived stress, and a positive change in perceived performances in sports, but not in school performances, among the athletes in the experiment group. There were no positive changes in the control group. The implications are discussed according to the changes in the athletes' attentional awareness and control.

Key words: attention training, stress, performance

Introduction

It is well known that the relationship between the amounts of time spent on deliberate practice is important when developing an athlete's talent into performance in sports (Ericsson, Krampe, & Tesch-Römer, 1993). However, as athletes are constantly exposed to a variety of stimuli, often in a rapidly changing environment, the high-quality and strenuous effort that is required to become competitive in their sports might be a challenge (Faubert, 2013). To gain enhanced performances from deliberate practice requires attentional resources from an athlete (Csikszentmihalyi, 1990; Perna, Antoni, Baum, Gordon & Schneiderman, 2003). Thus, athletes' ability to take executive control of their attentional resources is important if they want to effectively develop their performance in their sports (Faubert & Sidebottom, 2012).

Training programs that aim to improve athletes' attentional resources are therefore of interest to the field of sports psychology (Faubert & Sidebottom, 2012). In the sports context, several studies point out the importance of attentional resources for succeeding in sports (Bernier, Thienot, Codron, & Fournier, 2009; Kaufman, Glass, & Arnkoff, 2009; Kee & Wang, 2008; Moen & Firing, 2015). However, most attention modification techniques have not been based on a model for the regulation of unhelpful thoughts and emotions. One exception to this is attention training techniques (ATT), which have been developed

Submitted : 12 July 2016, revised: 13 October 2016
accepted : 23 November 2016
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from an information-processing model of self-regulation (Wells & Matthews, 1994, 1996). ATT has been designed to help individuals to reallocate their attention away from self-attentional processing with a view to increasing flexible control over processing.

Traditionally, ATT has had success in reducing such clinical symptoms as anxiety and depression in therapy (Wells, 1990). However, to our knowledge there are still no studies investigating the use of ATT in sports to reduce stress and enhance performance.

This study aims to investigate any effects of ATT on junior athletes attending high-school programs specializing in sports when it comes to reducing stress and enhancing their perceived satisfaction with their sports performance.

Theoretical framework

An athlete's attention during practice can vary widely from being effectively absent (e.g. when daydreaming or distracted by intrusive thoughts and emotions) to intensely active alertness (Brown & Ryan, 2003; Brown, Ryan & Creswell, 2007; Koch & Tsuchiya, 2007; Wells, 2000). The ability to use attention as a tool to put specific aspects of the athletes' experience into focus gives them an opportunity to avoid becoming lost in superfluous information and to focus on the most beneficial stimuli related to performance (Csikszent-mihalyi, 1990; Wadlinger & Isaacowitz, 2011). The actual experience is shaped by the athlete's focus of attention, which can dictate the subsequent affective experience and behavioral trajectories (Wadlinger & Isaacowitz, 2011). Thus, athletes' ability to focus their attention on the aspects that are most relevant to their performance is essential (Csikszentmihalyi, 1990; Ericsson et al., 1993).

Attention

Concentration is an attentional process that involves the ability to focus on the task at hand while ignoring any distractions (Moran, 2012). Interestingly, focused attention is recognized as the most important key to affect performance, both in sports and in any other skilled field (Moran, 2012). Ericsson et al. also claim that focused attention is a key part of deliberate practice that is found to be the most consistent relationship with performance found in sports science (Ericsson et al., 1993; Ericsson, 2009; Ericsson, Charness, Feltovich, & Hoffman, 2006). Thus, the ability of athletes to focus their attention on the most relevant information during action is essential if they are to perform at their best (Ericsson et al., 1993).

The working memory is a system in the brain that operates closely together with attention, and both systems are critical aspects of athletes' cognitive capacities. Attention gives athletes the ability to selectively process the aspects in the situation that are most relevant, and working memory is important to retain this information in an accessible state (Fougnie, 2008). Working-memory tasks require monitoring (i.e. manipulation of information or behaviors) as part of completing goal-directed actions in the setting of interfering processes and distractions (Conway, Cowan, & Bunting, 2001). The cognitive process athletes need to follow includes the ability to take executive control of their attention and in that way give working memory access to essential information that automatically responds to the stimuli in their environment (Hardy, Mullen, & Martin, 2001). Thus, attention is defined as a complex, cognitive system containing three independent, but related network stages: orienting to sensory events, detecting signals for focal (conscious) processing, and maintaining information in a vigilant alert state (Posner & Petersen, 1990). Importantly, working memory and attention do not have unlimited capacity, on the contrary, the capacity is limited (Fougnie, 2008). As a consequence, athletes in sports can only have a limited amount of information in their working memory at any point in time. Self-attentional processing, such as anxiety, worries, ruminations, and explicit/conscious information, therefore has the potential to serve as distractions and to occupy the limited space in working memory during action (Maxwell, Masters, & Eves, 2003). Distractions are defined as experiences that refer to the capturing of one's attention

by task-irrelevant stimuli that occur most often involuntarily (Wells, 2000). For young athletes in sports, intrusive thoughts and emotions might represent such distractions (Gold, Marx, Soler-Baillo & Sloan, 2005).

Hence, athletes' performances are influenced by their ability to operate within the capacity of their working memory with information that is important for their performance (Gucciardi & Dimmock, 2008). Attention is the tool that effectively handles distractions and makes the task-relevant information accessible to the working memory (Fougnie, 2008).

Stress versus performance

Young athletes who attend high schools specializing in elite sports are exposed to several stressors that have the potential to develop symptoms caused by stress, such as intrusive thoughts and negative emotions (Gold et al., 2005). According to the metacognitive theory of psychological disorder, the style of thinking called the Cognitive Attentional Syndrome (CAS) is claimed to be responsible for psychological disorders (Wells, 2009). This style is linked to internal metacognitions that control thinking and attention, and lock the individual into persistent patterns of negative thinking that are difficult to control. CAS can contribute to negative emotions such as anxiety and depression (Wells, 2009).

Seen in a performance perspective, the flip side of high ambitions might be performance anxiety, ruminations, and worries when faced with challenges in training, competitions, social life, and academic work (Hardy, Mullen, & Martin, 2001). Such self-attentional intrusive thoughts and emotions have the potential to occupy their attention during action and therefore affect their performance negatively (Eysenck, Derakshan, Santos, & Calvo, 2007; Gardner & Moore, 2007; Rumbold, Fletcher, & Daniels, 2012).

Even explicit information itself has the potential to disturb the athlete during action. Explicit information is a conscious process based on explicit knowledge of how a certain thing works, for example how to ski or play golf (Beilock, Bertenthal, McCoy, & Carr, 2004; Masters, 2000; Rotella, 2001 & 2012). Several studies claim that an explicit attentional focus during performance affects performance negatively (Beilock, Carr, MacMahon, & Starkes, 2002; Ford, Hodges & Williams, 2005; Gray, 2004; Wulf, 2007). Thus, an athlete's attention is continually and often extremely fast and variably exposed to salient sensory, emotional, and mental information that is filtered, processed, and analyzed through various attentional processes that are neither automatically nor consciously regulated (Calvo & Nummenmaa, 2007; Faubert & Sidebottom, 2012). Therefore, attention is found to be a valuable capacity that serves as a lens through which we select, bring into focus, and magnify the stimuli we experience in our world (Wallace, 1999).

Attention training techniques

Research and experience from clinical psychology show that cognitive behavioral theory (CBT) is a major approach in the treatment of repetitive self-attentional processing (Ellis, 2008). Metacognitive theory is an extension of CBT as it focuses directly on cognitive processing (Hofmann, Sawyers & Fang, 2010). Metacognitive theory focuses on two aspects of metacognition: the first aspect is the information individuals have about their own cognition and about task factors or learning strategies that affect it, and the second is the range of executive functions such as the allocation of attention, monitoring, checking, planning and detecting of errors in performance (Wells, 2000). The first aspect refers to metacognitive knowledge and the latter to metacognitive regulation (Wells, 2000). From metacognitive theory we learn that the Cognitive Attentional Syndrome (CAS) is responsible for psychological disorders, such as anxiety and depression (Wells, 2009). The ATT was developed on the basis of the CAS. Instead of changing cognition, such as in the CBT, metacognitive theory focuses on changing how the person relates or thinks about the cognition (Wells, 2009). The ATT is supposed to help participants in their ability to switch their attention and selectively focus it on beneficial stimuli (Wells, 2005). Thus, ATT focuses on both metacognitive knowledge and

regulation.

The ATT is based on the framework of metacognitive theory and uses three auditory tasks (sound files) to develop attentional resources (Wells, 1990). In the original ATT, participants are first asked to focus and sustain their attention on one environmental cue (e.g. clock ticking) whilst trying to maintain selectivity and reduce distraction from other sounds or thoughts. This exercise is classified as selective attention (Wells, 1990). The second phase involves tasks where participants are taught to selectively shift their attention to more remote sounds with increasing noise interference (e.g. sound of traffic, church bell, and so on) and to alternate their attention between two sounds (Wells, 1990, 2000). This exercise is classified as attention switching (Wells, 1990). Young athletes in sports who occupy their attention with anxieties, worries, ruminations, or explicit thoughts during action need to use their attentional resources to complete an attention switch and select their attention for beneficial stimuli that automatically release learned responses (Beilock et al., 2002; Ford, Hodges & Williams, 2005; Gray, 2004; Wulf, 2007). Thus, attention switching and selective attention can work as a disruption, moving from self-attentional information to beneficial stimuli. In the ATT training, these stimuli are external (sounds) to the athlete. Finally, to improve their divided attention, participants are instructed to focus on several sounds simultaneously (Wadlinger & Isaacowitz, 2011). This last phase is classified as dividing attention (Wells, 1990). Thus, attention is a skill that may be developed through training.

The aim of the training is to follow the attention instructions that are given irrespective of what may or may not be noticed in the participant's mind and body. Inner events are supposed be treated as additional sources of noise that are not given attentional priority. The aim of the procedure is not to avoid or suppress thoughts, feelings, or emotions. They should be allowed to occupy their own inner space and awareness if they occur as one trains (Nassif & Wells, 2013). Wells and Matthews (1994) define this as detached mindfulness. Detached mindfulness is a type of awareness of internal events, such as thoughts and emotions, but with the absence of conceptual analysis and goal-directed responses (Wells, 2005). In this state thoughts are seen as objects in the mind that are separate from reality. Young athletes in sports will experience intrusive thoughts and emotions on their path towards elite sports and their abilities to have a divided attention and be aware of internal events are a prerequisite for having complete detached mindfulness (Wells, 2005). Thus, meta-awareness and detached mindfulness are related constructs (Wells, 2005).

The current study

During the last two decades deliberated training has been established as the gold standard for developing talent into performance in sport. However, living in a hectic context, the athletes' abilities to mobilize their attentional resources might be a challenge. In the current study we investigate the ATT on junior athletes attending high-school programs specializing in sports with the aim of reducing stress and enhancing their performances in their specific sport. Since there are theoretical arguments where focused attention is a key for performances in any skilled field, we also aim to investigate any effects of the ATT on academic school performances (Moran, 2012). Bearing in mind this aim and the theoretical review presented above, we developed the following hypotheses for this study:

Hypothesis 1: The attention training technique will reduce the athletes' perceived level of stress.

Hypothesis 2: The attention training technique will enhance the athletes' perceived performances in their sports.

Hypothesis 3: The attention training technique will enhance the athletes' perceived performances in their school subjects.

Methodology

Participants and Procedure

This study comprised 78 Norwegian junior elite athletes

in sports who all voluntarily participated in an experiment over a period of 12 weeks. The junior elite athletes came from different elite training groups at their schools in alpine skiing, cross-country skiing, handball, biathlon, ski-jumping and Nordic combined. These various training groups were informed about the program individually and were then asked if they wanted to take part in an experiment that was testing for any effects from the ATT program. Athletes for all sports showed interest in participating in the study, and ski-jumping, Nordic combined and handball were randomly chosen for the experiment group in this study. The athletes from cross-country skiing, biathlon and alpine skiing were chosen for the control group. Twenty-seven elite athletes from the experiment group participated in the pre-test, while 51 elite athletes participated from the control group. The gender breakdown of the participants was 67% male and 33% female. Their average age was 18 and a half years old.

Pre-test/Post-test control-group design

After the junior elite athletes were assigned into either the experimental or control group, a pre-test was given through an online questionnaire that measured the psychological variables in this study. Then an ATT program was administered for a period of 12 weeks. Of the 78 elite athletes who participated in the project in the pre-test, 57 athletes participated in the post-test after 12 weeks (25 in the experiment group and 32 in the control group). This gives a response rate of 73%.

Attention training program

The ATT used in this study is the audio training technique developed by Wells (1990), where the aim is to strengthen mental control and flexibility (Fisher & Wells, 2009; Wells, 2000). The training is carried out through the use of a specific audio file that was translated into Norwegian from the original English version (Fisher & Wells, 2009; Wells, 2000). A professional audio staff completed the translation and audio recordings. The audio file lasts 12 minutes and comprises three auditory, externally focused attention tasks: selective attention, change of attention (attention switching), and divided attention.

An initial meeting with the experimental group was arranged to review the nature of the athletes' problems related to their attentional resources, as suggested by Wells (2000). Self-attentional processing such as anxiety, rumination, worries, or explicit thoughts were detected as common problems for the athletes during action. The rationale for the ATT was then presented. The elite athletes in the experiment group in this study were asked to listen to the audio file at least five times a week where the aim in using the ATT was to reduce self-attentional processing and to gain executive attention control (Fisher & Wells, 2009; Wells, 2000). The ATT training was followed up with group sessions with the participants every third week throughout the project period. The main reason for the group sessions was to stimulate reflections on how the ATT training could be brought into their sports or everyday context by detecting potential stimuli in their natural environment, again as described by Wells (2000).

The group sessions were completed in separate groups according to the three sports activities, and were conducted in a group room at the Norwegian Olympic Sports Center in central Norway. Each session lasted about 120-150 minutes. After the group sessions, a summary was sent to the elite athletes so they could agree or disagree with the summary. The elite athletes were stimulated to communicate openly about their thoughts and feelings relating to their experiences of the ATT, and about training and competition in their sports and their daily routines. The group sessions were conducted to provide deeper reflections, open new perspectives, and relate the attention training (the auditory training) to their sports and their natural environment. They consisted of two main sections. The first section focused on how the athletes were doing, both in their sports and personally, and the second focused on three main questions: a) did the elite athletes discover something new about their training process and/or their daily routines; b) based on their possible new discoveries,

what could they learn from them; and c) what actions were they going to focus on during the next training period based on any new discoveries they had made so they could improve their performances in their sport. All the elite athletes were given a notebook that they continually used to write down their own reflections during the entire project period. They brought their notebooks with them to the group sessions and shared their reflections in the group.

The variables used in this study

The variables examined here include such items and inventories as age, gender, type of sport, performance level, and type of school. All measurements used in this study were based on previously developed scales proven to provide both satisfactory validity and reliability. The measurements, originally in English, were translated into Norwegian and slightly adjusted for the purpose of this study by the authors.

The Perceived Stress Scale

The Perceived Stress Scale was used to measure self-appraised stress (Cohen, Kamarck & Mermelstein, 1983; Gustafsson & Skoog, 2012). Th---is consists of a 14-item scale with items that are general in nature and relatively context-free (e.g. “During the past month, how often have you felt that you were unable to control the important things in your life?”, and “In the last month, how often have you been upset because of something that happened unexpectedly?”). Thus, the questions measured conditions that were central to the stress experience, such as the degree to which the athletes experienced that their lives were unpredictable, uncontrollable, and overloaded (Cohen et al., 1983; Cohen & Williamson, 1988). The perceived stress scale consists of a 14-item scale that is rated on a five-point Likert-type scale from zero (never) to four (very often). The validity construct is reported to be good for the perceived stress scale (Cohen et al., 1983; Cohen & Williamson, 1988). The reliability for the measurement was .79 (pre-test) and .83 (post-test).

Perceived satisfaction with progress in sports and school

Individual performance from the Athlete Satisfaction Questionnaire was used to measure the athletes’ perceived satisfaction with their own progress in their sport (Riemer & Toon, 2001). This subscale aims to measure the athlete's perceived satisfaction with his/her own task performance. Task performance includes a perception of absolute performance, improvements in performance, and goal achievement. An example of an item is: “I am satisfied with the degree to which I have reached my performance goals during the season.” The athletes were asked to consider four items and how satisfied they were with their own progress in sports during the last year on a seven-point scale ranging from one (not at all satisfied) to seven (extremely satisfied). The Cronbach’s alpha for the measurement was .96 (pre-test) and .97 (post-test). The athletes were also asked to consider four items and how satisfied they were with their own progress in school on the same liking scale. The reliability for this measurement was .97 (pre-test) and .95 (post-test).

Data analysis procedures

The data were first analysed by examining the correlations between variables by using the Pearson correlational coefficient. Then the data were analyzed by means of a covariance analysis (ANCOVA). ANCOVA, an extension of the variance analysis (ANOVA), opens for exploration of differences between groups while statistically controlling for an additional continuous variable. In the present study, the covariate is the participants’ scores on the variables perceived stress, perceived performance in sports, and perceived performance in school subjects at the pre-test. By considering these as the covariates, it is possible to account for pre-existing differences between the experiment and control group on these variables. In this study, ANCOVA used a regression procedure to remove the variation in the dependent variable that was due to pre-existing differences between the experiment group and

the control group before the normal analysis of variance techniques was completed according to the adjusted/ corrected scores. By removing the influence of pre-existing differences, the ANCOVA increases the power or sensitivity of the F-test (Pallant, 2010). Thus, the ANCOVA increased the likelihood that any differences between the experiment group and the control group with respect to perceived stress, perceived performance in sports, and perceived performance in school subjects were detected.

Results

Descriptive statistics

Table 1shows correlations between the study variables (measured for the pre-test) as well as the number of items, statistical means, standard deviations, and Cronbach's alphas for both the pre-test and post-test. The zero order correlations between the study variables vary from zero (.09) to medium (-.25 to -.36) relationships (Cohen, 1988).

Table 1. *Correlations between the variables (pre-test) and descriptive statistics from the pre-test and post-test (both experiment and control group)*

Variable	1	2	3
1. The Perceived Stress Scale	-		
2. Perceived Performance in Sports	-.36**	-	
3. Perceived Performance in School	-.25*	.09	-
Number of items	14	4	4
Mean (SD) (pre-test)	2.67 (.44)	4.64 (1.22)	4.58 (1.16)
Mean (SD) (post-test)	2.64 (.53)	4.77 (1.42)	4.60 (1.04)
Cronbach's alpha (pre-test)	.79	.96	.97
Cronbach's alpha (post-test)	.83	.97	.95

Note. * $p < .05$. N=78.

We found medium negative correlations between the perceived stress variable and both performance variables (perceived performance in sports and perceived performance in school subjects). The descriptive statistics also show that there is no correlation between perceived performance in sports and perceived performance in school subjects. The Cronbach's alphas of the variables in this study varied from excellent to acceptable for the pre-test and post-test. We also calculated means and standard deviations for each of the study variables sorted according to pre-test/post-test, and experiment-group/control group. The results are presented in Table 2.

Table 2. *Descriptive statistics from the pre-test and post-test for each group*

	Pre-test				Post-test			
	Experiment		Control		Experiment		Control	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1. The Perceived Stress Scale	2.83	.48	2.58	.39	2.58	.54	2.69	.52
2. Perceived Performance in Sports	4.17	.79	4.88	1.33	4.94	.73	4.63	1.78
3. Perceived Performance in School	4.39	1.35	4.68	1.01	4.62	1.10	4.58	1.02

Note. Experiment group N=25, Control group N=32

The perceived stress variable was higher in the ATT condition than in the control condition on the pre-test, whereas the variable for the perceived performance in sports was lower. The post-test showed only small differences between the ATT and the control condition on the perceived stress variable. The variable for the perceived performance in sports was higher in the ATT condition group on the post-test. The variable for the perceived performance in school subjects was higher in the control condition for the pre-test, whereas only small differences were found between the two groups for the post-test. These inequalities are likely to have been compounded by block randomisation methodology but indicate the need to control for pre-treatment differences. To address the need to control for pre-treatment differences we therefore conducted ANCOVA analyses.

Table 3. Results from ANCOVA executives controlling for pre-test scores

Source	Sum of Squares	df	Mean Square	F	Partial Eta Squared
The Perceived Stress Scale					
Pretest	1768.40	1	1768.40	76.65**	.587
Method	302.55	1	302.55	13.11**	.195
Error	1245.91	54	23.07		
Perceived Performance in Sports					
Pretest	288.62	1	288.62	10.43**	.162
Method	140.97	1	140.97	5.10*	.086
Error	1493.91	54	27.67		
Perceived Performance in School					
Pretest	264.60	1	264.60	20.22**	.272
Method	6.26	1	6.26	.48	.009
Error	706.52	54	13.08		

Note.**p<0.01and*p<0.05

ANCOVA Analyses

ANCOVA analyses were conducted to adjust for pre-treatment differences on the outcome variables in this study when testing for group differences on the same outcomes at the post-intervention.

For post-treatment there was a significant difference between the groups with the ATT group showing lower stress scores than the control group ($F(1,54)=13.11$, $P=.001$, $n_p^2=.20$), whereas performance in sports scores ($F(1,54)=5.10$, $P=.028$, $n_p^2=.086$) were higher. The performance in school subjects score showed no significant differences between the two groups after controlling for pre-treatment differences. The eta squared (n_p^2) indicates that the effect sizes are large with respect to the significant variables (according to Pallant (2010)). The partial eta squared can be divided into small (.01), medium (.06), and large (.138)).

Discussion

The main aim of the experiment in the present study was to explore the effects of the ATT on junior elite athletes' perceived stress and their perceived performance in school and sports. Our analyses and results supported two out of the three proposed hypotheses. Hypothesis 1 proposed a positive change in the elite athletes' perceived level of stress as a result of the experiment. The analyses found that the ATT decreases the perceived level of stress among the elite athletes in the experiment group (see Tables 2 and 3). Hypotheses 2 and 3 posited an increased tendency to perform better in both sports and school, respectively. These hypotheses were only partly supported, while the elite athletes' perceived performances in sports significantly changed, their perceived level of performance in school did not (Tables 2 and 3). There were no positive changes in the control group (Table 3).

One of the main effects that are found from the use of the ATT is that individuals learn to disengage their attention from internal intrusive thoughts (CAS) and reengage their attention on beneficial stimuli, such as more neutral information (Papageorgiou & Wells, 2000; Papageorgiou & Wells, 1998; Siegle, Ghinassi & Thase, 2007; Wells, 1990, 2005; Wells, White, & Carter, 1997). Thus, the ATT is found to reduce self-attentional processing, such as anxiety, rumination, and worries (Papageorgiou & Wells, 2000). The ability to deal with such intrusive self-attentional processes should also be relevant in sports (Lemyre,

Treasure & Roberts, 2006). Interestingly, our results show that the ATT has the potential to reduce athletes' level of perceived stress, whereas the junior elite athletes under the ATT condition reduced their level of perceived stress during the experiment. One possible explanation might be that the ATT has the potential to disrupt the CAS and help athletes to strengthen their awareness of attentional control (Callinan, Johnson, & Wells, 2015; Yilmaz, Gencoz, & Wells, 2011). Intrusive thoughts and emotions are potential symptoms from stressors that cause stress reactions in athletes (Gold et al., 2005). The components that characterize the ATT training, such as selective attention, attention switching, and divided attention, seem to collaborate on producing this beneficial outcome (Weinstein & Ryan, 2011). Selective attention, switching attention, and divided attention have the potential to influence athletes' meta-awareness, i.e. their awareness of thoughts and emotions (Wells, 2005). The athletes are also trained to accept inner thoughts or emotions that can appear during training to prevent conceptual processing (analysis to create meaning) or goal-directed coping (goals to remove or avoid thoughts and emotions). Importantly, athletes' abilities to accept such potentially disrupting thoughts and emotions are influenced by their meta-awareness to begin with (Marks, 2008). Thus, athletes cannot accept disrupting thoughts and emotions and avoid conceptual analysis or goal-directing coping if they are not aware of their inner experiences.

Enhancement of sustained attention and inhibition of alternative disruption reduces anxiety, rumination, and worries, and facilitates a shift of the attentional focus to the desired targets (Marks, 2008). Thus, the ATT seems to influence athletes' meta-awareness, which gives them the opportunity to put specific aspects of their experiences into focus by taking control of their attentional resources. This should be a beneficial tool for preventing stress since it impedes possible elaborations of unpleasant thoughts and feelings (Wells, 2009). This explanation is supported by the Cognitive Activation Theory of Stress (CATS), which claims that it is the cognitive activation of possible outcome expectancies that might stimulate a negative stress response (Ursin & Eriksen, 2004). Interestingly, this means that if the elite athletes are trained to take executive control of their attention, they can perform the same number of tasks as they did before while at the same time their perceived level of stress is reduced because of less time spent on anxiety, rumination, and worries.

The results in this study also show that the junior elite athletes in the experiment group perceive that they perform better in sports, but not in school, as a result of the experiment. One possible explanation for this result might be the challenge they meet where potentially their attention might be occupied by intrusive self-attentional processing because they are focusing on explicit thoughts during action (Beilock et al., 2002; Ford, Hodges & Williams, 2005; Gray, 2004; Wulf, 2007). Such an explanation might indicate that the junior elite athletes in the experiment group have improved their abilities to selectively focus their attention on targets that are effective in order to unleash their real potential and enhance their performances. This explanation is supported by at least two theories: a) First of all, Ericsson et al. claim that deliberate practice is the key factor in developing athletes to reach high levels of performance (Ericsson et al., 1993). The ability to focus attention on specific aspects of an athlete's performance is an essential element in deliberate practice. Secondly, theories about cognitive systems claim that attention and working memory do not have unlimited capacity, and that attention is an essential tool for selecting the most important information so that working memory has this information in an accessible state (Fougnie, 2008). As a result, the most important information is accessible in the working memory so that it is possible to automatically execute inherent potential (Gucciardi & Dimmock, 2008). Importantly, when an athlete is focusing on beneficial stimuli and not explicit thoughts about how to perform specific actions, it will start automatic responses, e.g. release motoric patterns that athletes have learned after years of training. The non-significant changes in perceived performances in school can be explained by a lack of motivation to use their attention intensively and with active alertness on schoolwork.

Implications and limitations

This study shows that ATT has the potential to improve performances in sport and reduce junior athletes perceived level of stress. Thus, junior elite athletes should train their attentional resources regularly. Importantly, the ATT training lasts for only 12 minutes. To gain effect from the ATT training athletes should also spend time to reflect about how the ATT experience can transfer to their sport specific contexts.

Although the results in the study are interesting, the potential effect of the ATT will benefit from further research. The present study contributes to ATT research and extends the literature on empirical studies with an experiment and control group design. However, the present study has several limitations. The athletes were randomly chosen according to group level (sports) and not randomly chosen individually across their sports. The mean scores in the experiment and control group (Table 3) indicate that the experiment group in general would gain more benefits from the experiment. Individual randomized designs should be preferred in future studies. Sample size may also have influenced the results. Experiments with a larger number of participants are therefore called for in future research. Moreover, it should be noted that the collected data is based on self-reporting measures and it is not known to which extent these self-reports accurately reflect the variables under study. Conducting studies that combine self-reported data with data obtained in a more objective manner could further develop this line of research, for instance, through longitudinal studies that incorporate both quantitative and qualitative methods.

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