

Review

Psychological skills training as a way to enhance an athlete's performance in high-intensity sports

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The importance of psychological skills training (PST) in the development of athletic performance is widely recognized. This paper is a comprehensive review of PST in elite sports, with a special focus on high-intensity sports (HIS). The reviewed literature showed a lack of convincing evidence and theoretical underpinning concerning traditional psychological skills to enhance performance in HIS. Therefore, a model with three conceptual levels (psychological demands, skills and techniques) is presented. The model facilitates the identification of the psychological demands of a specific sport, which in turn enables distinguishing which psychological skills are required. This allows an expert to choose psychological techniques to improve the athlete's psycholo-

gical skill. Considerations based on our model and the limited HIS-related literature available revealed self-skills, personal development and life skills, arousal-regulation skills, volitional skills, motivational skills and recovery skills as the most important skills to address in order to enhance performance. Development of harmonious passion, in-practice integration of volitional strategies, use of associative attentional techniques, pain management techniques, use of the mindfulness-acceptance approach and the facilitative interpretation of cognitive and somatic sensations are regarded as suitable to meet the psychological demands of HIS. They are recommended for systematic application by athletes and coaches.

In today's professional and semi-professional sports, the thin line between winning and losing is becoming progressively thinner. At the Beijing Olympic Games in 2008, the difference between first and fourth places in the men's rowing events averaged 1.34%, with the equivalent for women being a mere 1.03%. This increasing performance density creates massive pressure. Thus, it is not surprising that in recent years, the importance of psychological skills training (PST) has been recognized, and the number of athletes using psychological training strategies has increased.

This paper aims to address the effect of PST on an athlete's performance progress, with a special focus on a group of sports involving a high-intensity load. High-intensity sport (HIS) is characterized by an impact duration between 1 and 8 min, with a very high-impact intensity and a continuous power output throughout the performance phase. Typical examples of HIS are rowing, swimming, 800 and 1500 m track and field running, track cycling and flat-water canoeing. While some authors (e.g. Mujica, 2009) state that high-intensity exercise is also crucial in team sports, this paper focuses merely on individual sports because the psychological demands in these two sport forms are very different. This paper argues that in attempting to achieve outstanding performance, PST

should be adapted to the psychological and physiological demands of each discipline. Therefore, it introduces the systematization of PST and proposes a model for the identification of the psychological demands of a specific sport. With this focus and the few available research findings, this review addresses the psychological demands of HIS and describes how these specific demands can be met through the systematic development of different psychological skills and the application of psychological techniques.

Systematization of PST

"Psychological skills training (PST) refers to the systematic and consistent practice of mental or psychological skills for the purpose of enhancing performance, increasing enjoyment, or achieving greater sport and physical activity self-satisfaction" (Weinberg & Gould, 2007, p. 250). Therefore, PST should be systematic, goal-oriented, planned, controlled and evaluated (Seiler & Stock, 1994). In recent years, the literature on the use of psychological skills has become rapidly available. Most literature on PST use the expressions "psychological skills" and "mental techniques" more or less

interchangeably, whereas some authors (Seiler & Stock, 1994; Vealey, 2007) differentiate between psychological skills as the desired outcome (e.g., increased self-confidence and enhanced attentional focus) and psychological methods or techniques (e.g., imagery and self-talk) as the means to promote the desired outcomes through the systematic application of these techniques. In this context, a skill is the learned capacity (or ability) to carry out a specific task. A technique is the procedure used to enhance that capacity in order to be able to complete this task. Imagery, goal-setting, self-talk and physical relaxation techniques are named as the four basic mental techniques predominantly used in sport psychology interventions, supplemented with multimodal PST, which incorporates a combination of these basic techniques (Vealey, 2007). However, there are numerous additional techniques used to enhance the psychological skills of an athlete, e.g., cognitive restructuring. Sometimes, the term “psychological strategies” is used for the application of psychological techniques. In this paper, the term “strategies” is used to refer to the means or the plan of action used to achieve the enhancement of psychological skills by using one or more psychological techniques. In this context, it is important to note that the same psychological technique can be used for the development of different psychological skills, depending on the specific application.

Current state of knowledge regarding traditional PST in HIS

Psychological skills are posited as effective for attaining optimal athletic performance (Hardy et al., 1996), and the benefit of PST is widely reported (Vealey, 2007; Weinberg & Gould, 2007). Although considerable scientific evidence is available regarding the efficacy of traditional psychological performance-enhancement methods, some authors claim that sport psychology interventions have not been critically examined, and most studies investigating the efficacy of PST do not meet the criteria for evidence-based empirical support (Gardner & Moore, 2006). Gardner and Moore analyzed 104 empirical studies investigating the efficacy of PST by using objective measures of athletic performance. Of these, only four studies involved HIS, met the criteria for adequate design and methodology, used competitive athletes as participants and therefore enable generalizing the results onto skilled or elite athletes. Only one of these studies showed performance enhancement.

This study was conducted with triathletes and showed a performance increase in two out of three participants in a 1600 m run by using a multimodal psychological intervention package (self-talk,

imagery and relaxation) (Patrick & Hrycaiko, 1998). Although triathlon is not regarded as HIS, this study is reported here because the performance investigated had the characteristics of HIS. Additionally, literature searches using different search engines (PsycINFO, Psynindex plus, SPORTDiscus) with “PST,” “mental skills training” or “HIS” as search terms detected no articles. We found only six related studies (one for rowing and five for swimming), when using HIS-identified sports (rowing, track cycling, swimming, canoeing and 800–3000 m track and field) combined with “PST” or “mental skills training” as search words. One of the studies was not reported in the Gardner and Moore analysis. Sheard and Golby (2006) showed with 36 young elite swimmers a significant post-PST performance enhancement after a 7-week PST training program (goal-setting, imagery, relaxation, concentration and thought stopping) in three separate swimming strokes, each over 200 m. The 200 m swimming distance would be defined as a typical HIS discipline. Unfortunately, the study lacks a control group.

Nevertheless, the reported scientific evidence provided by studies using randomized controlled between group design or single-case design with intervention comparison and the target population (competitive athletes) is sobering. It has to be recognized that information concerning the utility of PST for skilled elite athletes in general and in HIS remains limited.

Psychological demands of HIS

Although numerous applied sport psychology books are available today, the recommended training programs usually are quite generic in form, and sport-specific PST programs are more the exception than the rule. This is remarkable, bearing in mind that the performance-relevant tasks of say a soccer player and a 200 m breaststroke swimmer are very different. However, to systematically support the performance outcome in a specific sport, it is important to know what demands an athlete has to meet in order to choose the most promising and best-adapted intervention. However, the literature addressing the psychological demands of HIS is very rare. Kellmann et al. (2006) discussed the psychological aspects of rowing. In their discussion, they proposed that the critical skills are motor skills (the ability to balance the boat and pull the oars and skulls in an efficient and effective manner), volitional skills (to overcome fatigue and maintain the rhythm of the boat despite high fatigue and lactate concentration), regulation of stress and pressure (anxiety – the fear of being replaced by highly motivated rowers and the anxiety of performing in the competition and being able to

maintain the rhythm of the boat), coordination/communication skills (to proactively avoid potential sources of conflict) and recovery (to speed up recovery process and being open to new training impulses). Elbe and Wenhold (2009) report that training and competing in HIS require specific motivational and volitional demands. It appears that elite HIS athletes differ from non-elite athletes in their understanding of the motivational concepts *hope for success* and *fear of failure*. From the perspective of volitional demands, the authors further report that elite HIS athletes appear to have a lower *loss of focus* and a lower *lack of activation* compared with non-elite athletes (Elbe & Wenhold, 2009). Apart from the reported literature, there is little knowledge available about psychological demands in HIS.

Another way to identify demands of a specific sport is to systematically gain insights based on theoretical considerations using a comprehensive model. Unfortunately, the models suitable for systematic analysis of the psychological demands of a specific sport are limited. Therefore, the following sections will try to outline a preliminary model suitable for the systematic identification of psychological demands of a sport. The sections will also identify the most important psychological demands in HIS based on this model and suggest which psychological skills might have a performance-enhancing effect. The suggestions will be based on these theoretical considerations as well as the sparse literature addressing psychological requirements of HIS.

Schnabel et al. (2008) presented a framework to identify the psychological demands of a specific sport. This framework is one of the few attempts to summarize the psychological requirements in a sport, which we found worthwhile to develop further. In their model, demands such as *duration*, *intensity* and *continuity of the impact*; *complexity* and *variability of the action*; *movement pattern and movement complexity* and *cooperation between the athlete and all members of the party* dictate the psychological skills required for successful competing in the relevant sport. We complemented their model with the following demands: *training scope*, *training intensity* and *training years* [keeping in mind the 10-year or 10 000-hour rule in Ericsson et al. (1993)]; *psychosocial development* (that each sporting/non-sporting individual needs to fulfil) and finally the *injury* and *death risk* a sport can pose, because we believe that these demands are important for thorough analyses. Contrary to the original model in Schnabel et al. (2008), psychological skills (instead of unspecific psychological terms) are hypothesized to help to regulate the athlete's behavior to meet the demands of the specific sport. Following Baldassarre et al. (2003), the psychological skills addressed are *attention*, *motivation*, *volition*, *arousal regulation*, *perceptual cognitive*

functions and *motor control*. Additionally and in relation to the various *self* constructs in Vealey (2007), e.g., self-awareness, self-efficacy, self-worth, self-confidence, *personal development* and *life skills*, *coping skills*, *communication*, and *leadership skills* and finally *recovery skills* that are important for many sports are integrated in the expanded model.

Figure 1 depicts the adapted model. The two above-described conceptual levels (demands and skills) are complemented with the most used psychological techniques to enhance psychological skills. The most important hypothesized demands and skills are hallmarked in boldface. The following sentences will try to identify the demands of various HIS. Movement patterns and movement complexity differ from sport to sport, sometimes even between disciplines in the same sport. With the presented model in mind, rowing can be considered as a quite technically demanding sport, compared with the 800 m track and field running. In swimming, the movement pattern of 200 m freestyle demands a highly optimized movement pattern, whereas the movement pattern of 200 m breaststroke requires the same optimized movement pattern in addition to a very demanding movement complexity. Although there are differences, most HIS are cyclic sports, with the motion being repeated many times. Therefore, task complexity and variability of HIS can be regarded as low (competition always occur in the same or similar environmental conditions; distances are always the same and the only variability in action is tactical in nature). The impact duration differs from 1 to 8 min; intensity and continuity of the impact are very high throughout the performance phase, which involve near maximal energy supply for the sustained period (Laursen, 2009). The required cooperation for world-class performance is low in most of these sports. The exceptions are rowing and canoeing (team boats) and some track cycling disciplines. Generally, injury and death risk in HIS competitions can be viewed as low (no impact from opponents and no objective risks, with the possible exception of track cycling), whereas the overuse injury (and overtraining) risk due to very high training volumes and very high training intensities can be considered as high. The objective requirements for training and lifestyle of HIS persons are mostly influenced by the necessary training scope, training intensity and training years. Ericsson et al.'s (1993) rule of thumb can be regarded as relevant for all HIS, with tough, extensive training schedules and very high training intensities. Psychosocial developmental tasks can provide the background for failure, in conjunction with performance pressure and extensive training requirements.

In summary, taking into account theoretical considerations about the psychological requirements and the shortage of literature regarding the psychological

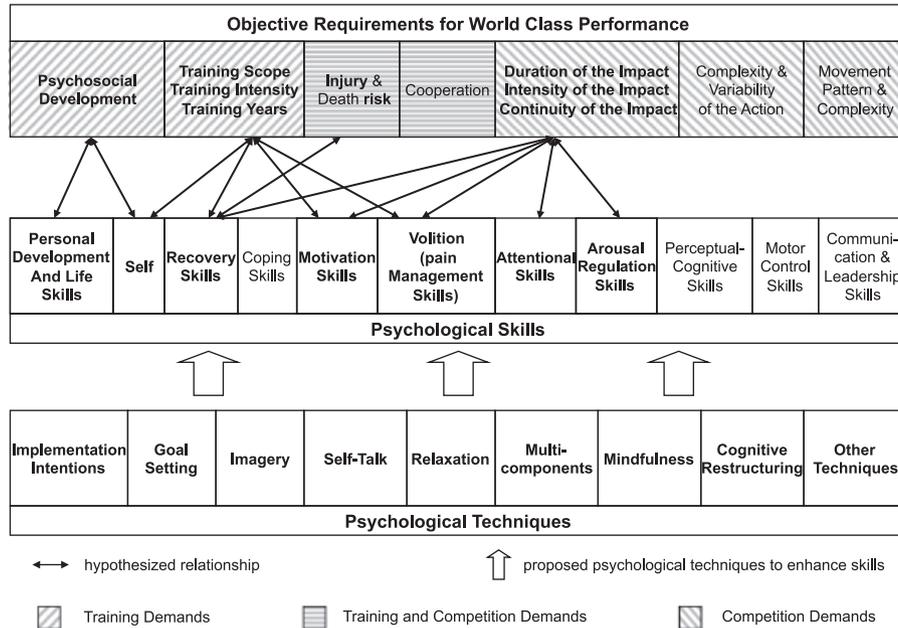


Fig. 1. Potential psychological skills to cope with the psychological requirements for world-class sport performance (hypothetical example for a high-intensity sports is in bold type: 1500 m running) and the psychological techniques to develop them (adapted from Schnabel et al., 2008).

demands of HIS, we have revealed the following psychological requirements. (1) Athletes training and competing successfully in HIS have to be able to cope with very high training volumes and training intensities over a period of several years. (2) Despite the high training volumes, they have to accomplish normal developmental tasks. (3) The complexity and variability of the action are low, but the movement pattern can be quite complex. (4) HIS athletes have a high overuse injury and overtraining risk due to very high training intensities and volumes. (5) The impact duration, intensity and continuity demand a maximal energy supply, which is linked with the rapid development of muscle fatigue. (6) The performance density evokes a high performance pressure and the potential for fear of failure. We suggest that the summarized psychological demands of HIS necessitate the systematic use of the following psychological skills: (1) self-skills, personal development and life skills (to fulfil the normal developmental tasks and to cope with high training demands); (2) arousal-regulation skills (to regulate stress and pressure); (3) volitional skills (to overcome pain and fatigue due to specific performance demands); (4) motivational skills and (5) recovery skills (to cope with high training and performance demands and minimize the injury and overtraining risk).

PST to meet the requirements of HIS

Scientific proof for the efficacy of traditional psychological techniques in HIS appears to be limited.

Therefore, the following paragraphs will focus mainly (with the exception of the few studies we found) on potentially important psychological requirements of HIS and how they can be supported by a systematic application of psychological processes based on theoretical considerations. Further the paragraphs will explore scientific evidence for interventions stemming from other HIS-related sports or general psychology. Although motivational skills have been identified as important to meet the demands of HIS, we have largely left them out, because a thorough discussion of them would have gone beyond the scope of this paper. Nevertheless, motivational issues are addressed in several paper sections and a summary of motivational training forms can be found in Birrer and Seiler (2006).

Self-skills, personal development and life skills

The development of various self-constructs appears to be a key issue in an athlete’s career. Self-efficacy (Bandura, 1997) has been one of the mainstream issues in psychology for the past 20 years. It describes the appraisal of a person for his capability of executing a specific task. Self-efficacy appears to be associated with performance success, and a lack of self-efficacy or self-esteem is associated with underperformance and unhealthy behavior such as eating disorders and drug abuse (Petrie & Greenleaf, 2007). Self-efficacy is closely related with other self-constructs such as self-awareness, self-consciousness, as well as self-concept and should be facilitated systematically. For an athlete to be aware of his or

her own strengths and weaknesses, desires and flaws are key factors in this process. Literally, to be aware of oneself is the first step in enhancing self-consciousness, and as a result, self-efficacy. To influence one's self-efficacy, multiple strategies are recommended. Many PST programs aiming to enhance the self-efficacy of athletes are predominantly using goal-setting techniques. Eberspächer (1995) suggested a psychological-oriented training method for the development of self-efficacy, where athletes have to predict their performance in a task during training. These sessions aim to improve self-efficacy through the development of realistic goals.

Self-concordance refers to the feeling of ownership that people have with regard to their goals. It describes goal congruency with implicit personal interests and values (Koestner et al., 2002). Findings suggest that people with high self-concordance are better able to attain their goals, leading to an increased psychological adjustment. Consequently, it is important that athletes' goals match their implicit interests and values. Enhancing self-awareness can help to explore one's implicit interests and values and identify a possible mismatch with personal goals. Unfortunately, no research is available that explores the influence of self-concordance or the use of goal-setting on the performance of elite HIS athletes.

Teaching life skills to young athletes recently came in the focus of applied sport psychology. There are two studies reporting the effectiveness of a life skill-training program. In a randomized controlled between group design, the effect of a predominantly goal-setting-based intervention of eight 15-min sessions on performance and self-beliefs was shown (Papacharisis et al., 2005) with 32 young female volleyball players and 32 male soccer players. In another study, Curry and Maniar (2003) investigated the effect of a semester-long life skills education program, using a non-randomized control design, on 62 student athletes playing various sports. The course was a combination of the practice of classic performance-enhancement strategies, including arousal/affect control, goal-setting, imagery and flow and a life skill training program targeting confidence, trust, on-/off-field problem solving, sports nutrition, transitions and drug/alcohol issues. Performance, measured by the coach's rating, significantly improved in the life skill group but not in the control group. The effect size was moderate to high, suggesting that a life skill program is helpful in increasing the performance of university athletes. Another worthwhile concept is the approach of harmonious and obsessive passion (Vallerand et al., 2008). Obsessive passion refers to controlled internalization of an activity in one's identity that creates an internal pressure to engage in the activity. Harmonious passion refers to an autonomous internalization that leads individuals to choose freely to get involved in an

activity they like. Harmonious passion promotes healthy adaptation, whereas obsessive passion prevents it by causing negative effect and rigid persistence. Findings with high-school basketball players, synchronized swimmers and water-polo players suggest (Vallerand et al., 2008) that harmonious passion is conducive to high levels of performance and well-being. Obsessive passion can facilitate or inhibit (when related to performance-avoidance goals) performance attainment and appears unrelated to happiness. Consequently, the development of harmonious passion could have an influence on both personal development and performance enhancement.

Arousal regulation: overcoming pressure and fear

Arousal is defined as the cognitive and somatic reaction to an internal or external stimulus. It is generally supposed there is an optimal state of arousal for high performance. The optimal level of arousal is defined through situational factors, the combination of cognitive and affective sensations (Hardy et al., 1996), individual preferences (Hanin, 2000) and the requirements of the particular task or sport. Therefore, the state of arousal can be influenced through control of the situation, appraisal of situational factors, and transformation of cognitive and affective sensations (Seiler, 1992). What appears to be crucial in this context is the presence of fear of failure (Kellmann et al., 2006; Elbe & Wenhold, 2009). The psychological and physical impacts of fear are numerous. It affects athletes' affective state, can reduce athletes' motivation to train and compete, affects athletes' self-confidence and their volitional and attentional skills, produces feelings of anxiety and increases muscle tension, which can lead to loss of coordination.

A number of strategies have been proposed for performers to modify their arousal state: psych-up psych-down techniques involving self-talk, imagery, physical activity, short or cued relaxation; pre-performance and performance routines; mental rehearsal strategies; stress management and mood-enhancement strategies (Hardy et al., 1996). Most research shows that these strategies can reduce anxiety or reduce the interpretation of symptoms of performance anxiety as debilitating (e.g. Page et al., 1999). Almost all studies have failed to show a clear impact on performance (Gardner & Moore, 2006). One reason might be that it is still not clear whether and when anxiety or fear exerts a beneficial effect, what arousal level is performance facilitating and under which conditions the same level might be debilitating. Hardy et al. (1996) commented that the "early recognition and control of anxiety symptoms were associated with superior performance in elite athletes" (p. 171). This statement indicates that two factors are important for competitive athletes:

(1) athletes have to know their individual performance-facilitating state of arousal before and during the competition. (2) Athletes have to be aware of their current state of arousal and how they can influence it in the direction of the performance-facilitating state. Both notions highlight the importance of self-awareness processes.

However, considering the amount of research that has been conducted in this area, there is surprisingly little sports-specific knowledge regarding the individual optimal level of arousal. Studies by Hanton et al. (2005) might represent a considerable advance in the understanding of competitive anxiety and performance-facilitating arousal state. They found that athletes can interpret the intensity of anxiety-related symptoms or arousal as either facilitative (athletes are termed “facilitators”) or debilitating (athletes are termed “debilitators”) toward performance and that this differentiation might be critical in the coping efficacy before a competition. Facilitators and debilitators experience more or less the same feelings in phases before a competition, but the intensity is less in facilitators. Facilitators appeared to be capable of using a repertoire of psychological skills, which enabled them to reinterpret negative cognitive and somatic sensations as performance facilitating. In contrast, debilitators tried to use the same psychological skills but were not able to internally control these skills and experienced a loss of control (inability to attain a positive pre-performance state), lower confidence and an ongoing debilitating interpretation of the sensory input (Hanton et al., 2005). Thomas et al. (2007) showed that it might be possible to restructure athletes’ interpretation of anxiety and confidence symptoms with a multimodal intervention (imagery, rationalization, cognitive restructuring, goal-setting and self-talk), with positive effects on their confidence and anxiety appraisal as well as their performance. Unfortunately, the limitation of this research is the lack of a control group.

Despite these promising results, there appears to be a great number of athletes who experience difficulties in controlling their cognitive processes. This might be explained by ironic mental processes (Janelle, 1999). In the last two decades, intervention techniques that target acceptance instead of the direct control of cognitive and affective processes were suggested. They have been recommended as alternatives to change-based traditional cognitive-behavioral treatment. Mindfulness-based cognitive therapy (Segal et al., 2002) and his sport-specific adaptation, the mindfulness-acceptance-commitment approach (Gardner & Moore, 2006), are two of the proposed interventions. These mindfulness techniques emphasize the non-judging awareness and acceptance of present cognitive, affective and sensory experiences, including external stimuli and internal

processes. Stimuli that enter awareness are observed but not judged, and internal experiences (thoughts, feelings and sensations occurring through internal or external stimulation) are instead accepted as natural, transient facets of human existence.

Numerous studies support the effectiveness of mindfulness-based interventions with clinical and non-clinical populations (e.g. Grossmann et al., 2004). Again, these studies are rare in sports. Nevertheless, the use of the mindfulness approach appears to be fruitful for HIS athletes, because it supports the need for meta-cognitive attention to external cues, performance-enhancing openness to options, as well as contingencies. Therefore, it can be hypothesized to have an impact on several psychological skills, for example, arousal regulation, attentional skills, volitional skills, personal development and life skills. The first promising research findings regarding mindfulness and athletic performance are available (Gardner & Moore, 2006; Kee & John Wang, 2008), but unfortunately, not regarding HIS.

Volitional and pain management skills: overcoming fatigue and pain

Athletes normally possess high performance motivation. In duels or very exhausting activities, there are often unexpectedly high psychological and physical inner and outer resistances to overcome. Then, high motivation is frequently inadequate. In these situations, it is helpful to possess implementation intentions (Koestner et al., 2002) and shielding intentions. Implementation intentions dictate when, how and where activities should be implemented. Shielding intentions are used to conquer obstacles that occur during activities. In dependence on implementation intentions, shielding intentions’ (Birrer & Seiler, 2006) purpose can be understood as an “if-then” relationship, e.g., “If someone attacks me, then I will easily enhance my step-rate and will orientate myself forwards.” This means that possible obstacles that could occur during an activity are anticipated and linked with a specific activity plan to overcome them. The goal of implementation and shielding intentions is to maintain a pursued activity or even enhance effort despite the inner (pain) and outer (headwind) resistance. According to Mathesius (1993), conscious and purposeful intervention is thereby the crucial criterion for volitional regulation processes. By focusing on performance-relevant processes, the performance becomes actively aligned, and the distraction of performance obstacles is reduced. Self-talk, imagery and relaxation techniques can be used separately or in combination to control the focus on relevant processes during sporting activity. These techniques are used during tough training sessions in terms of psychological-orientated training, e.g.,

through neck-and-neck races or in sessions where the athlete reaches his limit. They are also embedded into tapering and pre-competition routines.

The ability to manage pain with psychological processes has been of interest since the 1970s (Flor, 2009). Pain is defined as an “unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such tissue damage” (International Association for the Study of Pain, 2009). Pain during physical effort is often not pathologically contingent. It can be interpreted as a threat to the individual’s somatic integrity and is associated with increased arousal and anxiety (Flor, 2009), which makes it even more uncomfortable. The body tightens, which makes the physical effort even less effective and more painful. However, what HIS athletes experience during training and competition can be regarded as discomfort and not pain. They can always control pain by slowing down or stopping the physical activity. Findings from pain research show that exposure to pain can directly lead to habituation through decreased surprise, insecurity, and threat. This implies that an athlete can prepare himself for pain. The predominant thoughts are very important in this process. Negative thoughts such as “I am not able to sustain it” accompany less pain tolerance, whereas managing thoughts such as “I can do it” enhance pain tolerance and minimize the pain sensation (Flor, 2009). There is also a close relationship between the self-efficacy beliefs regarding pain tolerance and the release of endogenous opioids. The first findings in the field of exercise psychology with cycling ergometer tasks could confirm this proposal (Motl et al., 2007).

The findings of pain research suggest that the appraisal and interpretation of pain sensations are crucial to pain tolerance. Athletes can actively develop their pain tolerance. Therefore, the strength of the pain stimuli should be increased very slowly, enabling the athlete to gradually habituate to the increasing pain. The volitional strategies identified above, linked with shielding intentions, appear to be suitable to overcome pain. In a randomized control study, Whitmarsh and Alderman (1993) showed that athletes in a stress-inoculation training program showed significantly better performance times and a higher pain tolerance while performing a physical task. Unfortunately, research exploring pain management among athletes is rare. However, there is a research body (Masters & Ogles, 1998) investigating associative or dissociative attentional strategies in athletes, including pain.

Associative and dissociative attentional strategies

Associative and dissociative attentional strategies for influencing performance, enhancing endurance,

moderating perceived exertion and managing pain have been addressed since the late 1970s (Morgan & Pollock, 1977). Most research was conducted with endurance sports, e.g., marathon running. The general findings are more or less consistent: associative strategies, where the athlete focuses on bodily sensations (such as muscle tension and breathing) and performance-specific cues (such as stroke rate in rowing or the round treadle in cycling), relate to faster performance. Dissociation strategies, where athletes focus on say music or the landscape in order to distract themselves from say muscle pain, relate to lower perceived exertion and possibly greater endurance (Masters & Ogles, 1998). In their review, Masters and Ogles (1998) claimed a lack of definitional clarity of association/dissociation, and crude dichotomies appear to be too simplistic to account for the full spectrum of an athlete’s cognitions. Therefore, Stevinson and Biddle (1999) proposed a two-dimensional system to classify the thoughts of (competitive) endurance athletes, including task relevance (task-irrelevant/dissociation vs task-relevant/association) and the direction of attention (internal vs external).

Studies investigating the effect of associative and dissociative strategies in HIS confirmed the findings from other sports. Internal as well as external associative strategies resulted in a higher rating of perceived exertion levels (Stanley et al., 2007). Couture et al. (1999) showed that swimmers using an associative strategy (thinking the word *air* when inhaling) swam significantly faster than the control group. Two further supporting studies were conducted in a rowing task (Scott et al., 1999; Connolly & Janelle, 2003). In Scott et al. (1999), the mean performance enhancement between pre- and post-intervention tests was 3.76% for the internal association strategy (“feel the burn” and “listen to your breath”) group, and in Connolly and Janelle (2003), the improvement was 1.9% for the internal association strategy group.

Recovery skills

One of the important requirements of HIS is the combination of high-volume and high-intensity training (Laursen, 2009). This necessitates very good recovery capabilities in order for the training to be most beneficial. Harmonious passion (Vallerand et al., 2008) and high self-awareness should have a positive impact on athletes’ recovery. Furthermore, in general sports psychology literature, relaxation techniques are highlighted as being helpful to hasten the recovery processes after training or competition (e.g. Kellmann et al., 2006). However, so far, there has been a lack of convincing evidence that relaxation techniques are really effective in enhancing the recovery quality, reducing recovery time or

enhancing athletes' performance. Moreover, different relaxation techniques [e.g., progressive muscle relaxation (PMR), autogenic training, and self-hypnosis] are usually recommended for athletes, without taking into account individual differences in personality and the requirements of the particular sport. Indeed, relaxation techniques have their own unique effects (Lehrer, 1996), which should be considered. PMR might have an influence on immunoenhancement (Pawlow & Jones, 2005). However, preliminary results from an intervention study with long-distance runners suggest that PMR is detrimental when used directly after training in the attempt to enhance the recovery quality, whereas the use of self-hypnotic relaxation might have the desired recovery-enhancing effect (Schneider, 2007).

Implications and recommendations

This paper reviews the current knowledge on the effective use of PST in HIS. Convincing scientific evidence from the widely used PST programs and theoretical underpinnings regarding the psychological demands of HIS are not available. Research on HIS has provided limited empirical evidence, and hence, this paper's reflections are largely based on theoretical considerations and research from other areas. We present a preliminary model that appears suitable to systematically determine the psychological demands of a sport. This model can be used to identify the psychological requirements of HIS in competition and training such as, e.g. the capability to maintain maximal energy expenditure despite rapid increase of muscle fatigue and muscle pain. Based on the identification of the relevant psychological skills, we suggest that PST programs in HIS focus on the following psychological skills: self-skills, personal development and life skills, arousal-regulation skills, volitional skills, motivational skills and recovery skills.

PST should help athletes train hard, compete aggressively, maintain or sophisticatedly adjust strategic plans and choices and take care of the "self." Therefore, establishing life skills programs, including the development of harmonious passion (Vallerand et al., 2008) and a thorough elaboration of personal goals along with the enhancement of self-concordance, might be a cornerstone. In this context, Birrer and Seiler (2006) proposed the systematic use of multiple goal-setting strategies in order to change avoidance motivation into approach motivation.

Another cornerstone appears to be training volitional skills, which would integrate the findings concerning associative and dissociative attentional strategies, the findings from pain management research, as well as those from the mindfulness ap-

proach. In this context, the concept of ironic mental processes (Janelle, 1999) should be considered.

A third cornerstone might be the in-practice integration of psychological techniques, carefully chosen to meet the requirements of the task at hand. Psychological techniques must support the automatic engagement of developed athletic skills, respond to contextual cues, and help athletes focus on the necessary aspects of competition or training. These include focusing on the present and coping with internal and external experiences. Again, the mindfulness approach can be valuable in this endeavour.

Although some scientists have raised the notion that research on the effectiveness of PST revealed only low treatment effects, if at all (Gardner & Moore, 2006), a minimal performance enhancement of 3% can make a significant difference at the elite level between winning a gold medal and not winning even an Olympic diploma. Therefore, the systematic and purposeful application of PST can make an important contribution. In this attempt, sport psychologists and coaches are advised to reflect on the following considerations. One of the targets of PST should be to initiate small improvements or progress in small steps, and it should aim to enhance training quality as well as competitive performance. Additionally, PST techniques are not universally applicable without considering individual differences between athletes and the specific function of the technique used. For example, self-talk can be used in different forms and functions and therefore also has different effects (Hatzigeorgiadis et al., 2007). Most importantly, before implementing a PST program, applied sports psychologists should first address the psychological requirements of the sport as well as the level of the athlete. Furthermore, to be effective, the intervention should be adapted to the specific training and competition phase of the season (as, e.g., demonstrated in Thomas et al., 2007). Therefore, the concept of periodization could also be adapted to PST (Holliday et al., 2008). Finally, although associative attentional strategies are considered to have a performance-enhancing effect, the question of when an athlete should associate and dissociate in training and how much time to spend on this or whether the excessive use of associative strategies is associated with the risk of the athlete over-reaching himself and over-training is not clear.

Perspectives

There is a lack of scientific research on PST in HIS. Knowing this, some additional points should be borne in mind and addressed here. Future research should focus on the relationship between the specific demands of HIS and specific PST interventions.

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These interventions should be designed especially for HIS. Particular attention should be given to newly established interventions such as, e.g. the mindfulness approach or the periodization of PST. The outcome variable of interest should be preferably performance. A further important consideration is related to the research requirements of applied sport psychology, especially when high-performance athletes are involved. It should be agreed upon which research design is regarded as appropriate to identify empirically supported interventions for elite performers. Although it is important that an academic discipline show empirical support that meets

the highest scientific standards, the difficulty of evaluating the efficacy of an intervention with a target group of elite athletes must be recognized and considered.

Key words: mental skills training, mindfulness, rowing, cycling, swimming, elite sport.

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