Mood responses to athletic performance in extreme environments

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Abstract

Competition at elite level can require athletes to perform optimally in extreme environmental conditions. The present review focuses on mood responses in such conditions and proposes practical guidelines for those working with athletes. Different environments are considered, including altitude and extreme heat and cold. Performing in extreme heat, cold or at altitude can produce a stress response characterised by increased negative mood and relatively poor performance. Positive adaptations to extreme conditions can be accelerated but the rate of adaptation appears to be highly individualised. Monitoring mood responses to training under normal conditions provides a basis for identifying the psychological effects of extreme conditions. It is suggested that practitioners carefully monitor the interplay between vigour, fatigue, and depressed mood. Reductions in vigour and increases in fatigue are normal responses to hard training but other aspects of mood disturbance, especially symptoms of depressed mood, however small, may be indicative of a maladaptive response, and practitioners should consider intervening when such symptoms first appear.

Key words: Emotions, psychological skills, adverse conditions, applied sport psychology

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Introduction

Elite athletes may sometimes have to produce optimal performance in extreme environmental conditions. It is well documented that strenuous exercise in extreme environments such as altitude, heat and cold imposes increased physiological and psychological stress (Bolmont et al., 2000; Gleeson, 2000; Pyne et al., 2000; Acevedo and Ekkekakis, 2001). It has been suggested that the effects of environmental change tend to influence psychological functioning before they affect physiological factors (Kobrick and Johnson, 1991) and hence psychological monitoring may provide a useful early indicator of the adverse effects of environmental stress. Of several psychological variables that could be relevant in this context, mood responses have been found to reflect environmental change (Bahrke and Shukitt-Hale, 1993) and also predict of athletic performance (Beedie et al., 2000). Maintaining a functional mood profile when training and competing in adverse environmental conditions can underpin success, and thus teaching athletes strategies to regulate mood states that might threaten performance is an important role for applied sport psychologists (Terry, 1995). The present review focuses on mood responses in extreme environmental conditions and recommends practical guidelines based on theoretical proposals.

Given the very broad range of situational and environmental variables that impact upon the psychological effects of extreme environments, it is important to limit the scope of the present review. Having already established mood as the primary psychological variable of interest, the main activity of interest is competitive sport. It should be noted that a cogent body of knowledge on mood responses in adverse environments among athletes does not exist. Evidence and experiences from non-

competitive physical activities such as mountaineering are reviewed to draw inferences for competitive athletes who may need to compete in very demanding environmental conditions. Further, the present review focuses on altitude, heat and cold as the primary environmental conditions of interest rather than other extreme environments encountered, for example, during space flight or underwater activities. It is important to note that competition rarely takes place in truly adverse conditions, but tends to take place in conditions on the periphery of extreme environments. For example, The Winter Olympic Games in Salt Lake City 2002 were held at an altitude of 1800 metres, with certain events rising to above 2200 metres. Whilst such conditions do not represent extreme conditions when compared with those experienced by mountaineers, they can represent potential stressors for athletes who spend the majority of time at sea level under normal conditions and therefore tend not to develop strategies to cope with such environments as part of their normal training and competing routines.

A second limitation to the scope of this review is that we do not engage in a detailed debate on the nature of mood and emotion. We used Lane and Terry's (2000) definition in which mood is defined as a "set of feelings, ephemeral in nature, varying in intensity and duration, and usually involving more than one emotion" (p 16). A limitation of this definition is that, although mentioning 'emotion', it does not clearly define what emotion is in relation to mood and our later work offered clarification on the respective natures and functions of emotion and mood (Lane et al., 2001; Beedie et al., 2001, 2003). Lane and Terry (2000) argued that difficulties with resolving measurement issues prevent researchers from distinguishing mood from emotion, and that using current measures, distinctions between mood and emotions tend to be blurred. As the purpose of the present review is to develop a guide for practitioners

that use the Profile of Mood States model to assess psychological states of their athletes, and as it is impossible to determine whether reported responses to the POMS inventory (or any other single-item adjective check list) can distinguish mood from emotion, a clear distinction between mood and emotion is not possible. We use mood as an embracive term that can incorporate emotional responses in research designs where a distinction between mood and emotion is not possible. In research designs that attempt to assess transactional relationships between mood states, interpretation of situational variables and subsequent responses, we use the term emotion when describing an affective state that occurs as a direct consequence of a specific factor.

Mood responses are proposed to provide a barometer of the personal resources required to cope with prevailing demands (Batson et al., 1992; Parkinson et al., 1996; Bless, 2001; Gendolla and Krusken, 2002). Therefore, as perceptions of demand increase and/or perceptions of personal resources diminish, it can be anticipated that these changing perceptions will be reflected in some degree of mood disturbance, which may be measurable from self-reports. For example, it has been shown that failure to recover adequately from repeated sessions of intense exercise is clearly reflected in reports of reduced vigour and increased anger, confusion, depressed mood, fatigue and tension (Morgan et al., 1987; Raglin, 2001). It has been argued recently that affective responses to exercise during extreme or adverse environments are heavily influenced by the cognitive appraisal of information from physiological cues (Acevedo and Ekkekakis, 2001) and thus it appears likely that mood responses may be particularly sensitive in detecting environmental stress.

Acevedo and Ekkekakis (2001) developed a model to explain the transactional psychobiological nature of the cognitive appraisal that occurs during exercise in environmentally stressful conditions. They framed their model in the context of a

stress response whereby perceptions of the psychophysical demands imposed in extreme environments are aligned against perceived capability to cope with these demands. Their central thesis was that the stress response associated with perceived discrepancies between demand and ability to cope could “dramatically alter the intensity and the emotional concomitants of the ensuing physiological activation” (p.48). Although their model has not yet been tested empirically, considerable support already exists to support the notion that adverse environments produce a stress response.

Of particular interest to our review are research findings outside the realm of sport that have shown an association between negative mood states and physical performance in hot and cold environments (Kobrick and Johnson, 1991). Research findings have also shown negative mood is linked to hypoxia (Elmore and Evans, 1983; Banderet and Burse, 1991; Bahrke and Shukitt-Hale, 1993; Shukitt-Hale et al., 1998; Piehl Aulin et al., 1998; Bonnon, et al., 1999; Bolmont et al., 2000). It should be noted that some studies have not reported these effects (e.g., Bonnon et al., 1999; Lane et al., 2003a), something that can be explained by a range of variables, including individual differences in reactivity to environmental stressors. For example, Bolmont et al. (2000) investigated mood states during a 31-day gradual decompression in a hypobaric chamber from sea level to an equivalent altitude of 8848 m, the height at the peak of Mount Everest. Results showed a general increase in anxiety and fatigue as altitude increased but noted considerable individual variation in mood state responses.

Mood and altitude

A review of the effects of altitude on mood, behaviour and cognitive functioning by Bahrke and Shukitt-Hale (1993) provided compelling evidence of the

psychological alterations and other debilitating effects that can occur at high altitude, especially above 4000 m. It has long been recognised that hypoxic effects at high altitude can include increases in euphoria, irritability, hostility and neuropsychological impairment. The effects of lower altitudes on mood responses, where athletes would more typically train or compete (< 3000 m), are less well understood and appear to be influenced by variables such as relative speed of ascent, experience of the effects of altitude, and personality. Bonnon et al. (1999) tested an ascent programme designed for ideal psychological adaptation to high altitude among a group of mountaineers on a Himalayan range. Participants reported mood and completed cognitive tasks under conditions of normoxia, and acute hypoxia at 3500 m and 5400 m. Few cognitive or emotional effects were shown, suggesting that the majority of participants acclimatised successfully. The authors proposed that the mechanisms of psychological adaptation seem to rely on a gradual acclimatisation process that meets the requirements for speed of ascent and length of time spent at each stage of altitude change. The length of time that each person would need to spend at each stage varied between individuals, and so careful monitoring of mood states responses is important.

Elmore and Evans (1983) tested the influence of acclimatisation in a study of runners in the Himalayan Mountains. Elmore and Evans (1983) found that well-trained endurance runners reported little or no significant adverse psychological or physiological effects. Training at moderate altitude has been used by athletes to prepare for competition both at altitude and sea level. Piehl et al. (1998) found that living indoors in hypoxia for 12 hours per day and maintaining a training load in normoxia, did not seem to affect the athlete's mood states negatively among a sample of 15 participants exposed to an altitude of 2000 m (6 participants) or 2700 m (9 participants) above sea level. It is worth noting that improved performance at sea level

has been reported after living at moderate altitude (2500 m) and training at low altitude (1300 m) for four weeks (Levine and Stray-Gundersen, 1997).

A study of elite athletes preparing for Olympic competition showed that training in a hypoxic chamber was associated with successful acclimatisation (Whyte et al., 2002; Lane et al., 2003a). Biathletes completed mood measures each morning for a five-day period at sea level before going to a training camp at altitude of 1800 m. Following this, before a second training camp, the biathletes pre-acclimatised for seven days by exercising for 75 minutes daily at “lactate threshold” at a simulated altitude of 2400 m in a normobaric hypoxic chamber. Results showed that pre-acclimatisation training accelerated the rate at which mood states at altitude were consistent with mood scores reported at baseline. It should be noted that the research design failed to control for a number of potentially confounding variables. It is possible that the improved mood observed following “pre-acclimation” was due to residual benefits of altitude from the first camp. In addition, positive effects might not be physiologically based but explained by biathletes anticipating negative moods in the early stages of a camp and thus reducing training intensity accordingly.

Although these results (Lane et al., 2003a; Whyte et al., 2002) provide some support for the notion that acclimation to altitude can be achieved by training in normobaric hypoxia chambers, Bahrke and Shukitt-Hale (1993) noted that methodological issues between studies complicate generalisations of the effects of altitude on mood. Many altitude studies have been conducted in chambers where the effects of altitude are simulated, and these results do not always corroborate results found on a mountain (Bahrke and Shukitt-Hale, 1993). Thus, given the limitations in controlling for internal validity in Lane and co-workers’ (2003a) study, there is clearly a need to cross-validate these findings before firmer conclusions can be drawn.

Personality has also been shown to influence the extent to which adverse environment conditions are associated with negative mood (Bolmont et al., 2001; Lane et al., 2003b). Given that personality and mood tend to be linked under normal environmental conditions (Costa and McCrae, 1980; Meyer and Shack, 1989; McFatter, 1994), this is not surprising. Theoretical proposals suggest that personality variables predispose individuals to experience certain mood states, which interact to influence emotional and cognitive processing (Rusting, 1998; 1999). Research shows that individuals low in self-esteem are prone to developing negative psychological states (Brown and Mankowski, 1993; Heimpel et al., 2002; Dodgson and Wood, 1998). The association between self-esteem and mood changes during hypoxic conditions was explored in a laboratory study in which participants cycled for two hours (simulated 50 miles, i.e., 80 km). Lane et al. (2003b) found individuals low in self-esteem tended to report symptoms of depressed mood during performance.

The consistent influence of personality on cognitive processing of information is important as strenuous exercise in extreme conditions should be perceived as harder than the same intensity of exercise performed under normal environmental conditions. It is postulated that the development of a negative mood profile associated with depressed mood might be more prevalent among individuals low in self-esteem. The de-motivating nature of depressed mood is associated with poor performance (Lane and Terry, 2000), and thus such individuals are at risk of under-performance in adverse conditions.

Mood in the hot and cold

Performing in hot and cold environments is associated with negative mood states (Kobrick and Johnson, 1991). Evidence for this link is strong enough for researchers to use cold conditions as a means of inducing negative mood in

experimental studies (Alden et al., 2001; Willoughby et al., 2002). Equally, hot conditions have been used to explore the effects of acclimatisation strategies with the assumption that performing in the heat induces physiological and psychological stress (Cian et al., 2000). Cian et al. (2000) found that performance could be maintained in the heat providing participants were sufficiently hydrated and wore appropriate clothing. Studies of military personnel where physical performance in hot conditions is often unavoidable and where a reduction in clothing is not possible due to a need to wear protective clothing have indicated mood deterioration and reduced cognitive performance (Taylor and Orlansky, 1993). Caldwell et al. (1997) conducted a review of clothing used by military personnel to combat heat stress, although their focus was on strategies designed to counter physiological effects of heat. The general finding was that performing in the heat leads to impaired performance unless strategies to cope with heat are implemented.

In a review, Kobrick and Johnson (1991) reported that environmental stress tends to impact on psychological factors before they influence physiological factors, although a great deal of variation between studies was noted. The general trend is that athletes report higher perceived exertion in the heat, and lower in the cold in comparison to exercising at the same workload in neutral conditions (see Acevedo and Ekkekakis, 2001 for a review). Further, Acevedo and Ekkekakis suggested that performing intense exercise in the cold might facilitate performance among highly motivated athletes, although this benefit might be a function of the cold serving as a heat reduction strategy.

The effects of heat and the cold on physiological responses tend to be more predictable than their influence on psychological state variables. For example, performing a given task in the cold will elicit a greater $V\dot{O}_2$ when compared to the

identical task completed in a thermally neutral condition (Nadel et al., 1974). Although physiological effects in extreme conditions are more predictable, the impact of these on performance still varies. For example, channel swimmers experienced in exposure to cold water are likely to persevere for longer than novice swimmers, despite similar physiological responses to the cold conditions (Hollander and Acevedo, 2000). Thus, it is possible that psychological states might buffer, or lead to a re-interpretation of negative physiological states induced by hot and cold conditions. It should be noted that maladaptive psychological and physiological states tend to co-occur, and studies that do not elicit a significant physiological stress tend to be associated with low psychological stress (Mylona et al., 2002).

It is common for individuals to experience mood alterations when competing and training in adverse conditions. It is suggested that variations in negative mood are explained to one or a combination of factors: 1) some personality types are more prone to developing negative mood than others, 2) previous experience and successful acclimatisation can offset these negative effects, 3) in the heat and cold, careful adherence to strategies designed to regulate the expected physiological effects.

Mood theory, mood changes over time, and mood-regulation

Key to understanding how to use mood as an early indicator of potential negative adaptation of an athlete is the notion that mood changes are transactional. For example, negative mood induced by hypoxia will influence perceptions of ability, and reduce efforts made to attain performance goals. Where effort is low, the likelihood of goal attainment is reduced, which may exacerbate negative mood. It is important that practitioners acknowledge the unfolding relationship between environmental factors, maladaptive coping strategies and mood changes. Ensuring mood responses to exercise performed in adverse conditions match baseline scores

should be key for successful acclimatisation. Changes to mood can also be used as an early indicator of overtraining and staleness (Morgan et al., 1987) for individuals performing in adverse conditions.

A recent theoretical model of mood was used to argue that researchers should investigate the interaction among mood states (Lane and Terry, 2000). Lane and Terry claimed that depressed mood was the most important mood dimension due to its de-motivating nature. Research has shown that depressed mood scores are associated with higher scores on anger, confusion, fatigue, and tension coupled with low vigour in a number of different sports and activities including running (Lane, 2001; Lane et al., 2001, 2002), aerobics (Lane and Lovejoy, 2001), kickboxing (Lane et al., 1999) and tennis (Owens et al., 2000). Research concurs that this effect occurs at altitude (Lane et al., 2003a; 2003b) and in cold conditions (Lane et al., 2003c).

Research into mood responses to extreme conditions has tended to investigate the effects on discrete dimensions rather than examine combinations of mood changes. Bolmont et al. (2000) acknowledged the importance of examining the interplay among mood dimensions when assessing mood and performance at altitude, although they did not analyse data using Lane and Terry's model. Participants reported low depressed mood scores in the study by Bolmont et al. An examination of Bolmont and colleagues' data suggests that depressed mood interacted with other mood dimensions. Increases in fatigue and other unpleasant mood states were coupled with increases in depressed mood. As Bolmont et al. (2000) did not find a significant effect for depressed mood, little was made on the effect of depressed mood in the discussion. It is possible that this explanation of non-significant findings could be attributed to lack of variance in depressed mood scores, which are typically low among exercise participants. Normative data for the POMS (McNair et al., 1971,

1992) from 2,086 athletes showed that participants report low scores for depressed mood (Terry and Lane, 2000). Recent research has tended to dichotomise depressed mood scores into a depressed mood and no-depression group (Lane and Terry, 2000) based on scores on a four-item depressed mood scale (Lane, 2001; Lane et al., 2001; Lane and Lovejoy, 2001). This dichotomy is based on evidence that shows that it is the norm to report zero for depressed mood items, and the proposal that small indicators of depressed mood have a much larger impact on other mood states. Regardless of environmental condition, Lane and Terry (2000) suggested that individuals in achievement settings would try to self-regulate feelings of depressed mood. When participants are asked to respond to depressed mood items on psychometric scales such as the Profile of Mood States (McNair et al., 1971, 1992) or its derivatives (Terry et al., 1999, 2003), they tend to report zero for all items. Research into direct relationships between depressed mood and performance using tests of association is limited by the lack of variance in depressed mood scores, an explanation that could apply to the study of Bolmont et al.

The proposed de-motivating nature of depressed mood suggests that careful attention should be given to depressed mood scores. Given the likelihood that negative mood will be experienced in hypoxic conditions, we suggest that reports of even minor symptoms of depressed mood are likely to be associated with reports of fatigue, confusion, tension, and anger. The attendant impact of tension and anger on performance is influenced by whether these moods are experienced simultaneously with depressed mood. It is suggested that depressed mood will influence current interpretations of how an individual is feeling. As performing work in adverse conditions will feel harder, athletes in a negative mood will access negative information more readily than if they were in a positive mood.

This notion that depressed mood acts as a catalyst for increases in other negative moods is based on mood changes over time being transactional in nature. Research has generally supported the notion that the ambient mood colours perceptions of situational and personal factors, possibly by selecting information from memory that is consistent with the ambient mood (Beck, 1976; Teasdale and Fogarty, 1979; Bower, 1981; Forgas and Bower, 1987). However, this area has produced equivocal findings as some research has supported the notion of mood-incongruent cognition, where participants are consciously selecting positive thoughts to repair a negative mood (Parrott and Sabini, 1990; Erber and Erber, 1994; Sedikides, 1994). It is suggested that awareness of the mood state is the primary moderating factor for congruent or incongruent cognition (Parrott and Sabini, 1990). It should be noted that mood repair requires effort (Muraven et al., 1998), thus mood repair becomes an additional task when performing in adverse conditions.

In terms of a transactional study of mood in adverse environmental conditions, coping strategies and the relative importance of self-set goals are the key variables. Carver and Scheier (1990) proposed that mood changes are based on an individual monitoring the rate of progress towards achieving his or her goals. If the perceived rate of progress towards goal attainment is faster or slower than the internally expected standard, the authors proposed a concomitant change in positive and/or negative responses. The intensity of the affective state that results from goal success or failure is dependent upon the size and direction of the discrepancy between actual performance and the desired rate of progress towards the goal (Crocker and Graham, 1995). Although two athletes competing in adverse conditions may appraise the experience in a similar manner, their appraisal of the situation and their perceived ability to cope effectively will influence their mood and performance-related

cognitions. Coping can be emotion-focused or problem-focused. Emotion-focused coping aims to regulate the emotional response to an event, while problem-focused coping attempts to address the cause of the person-environment interaction (Folkman, 1984). Evidence suggests that using both or either problem-focused or emotion-focused coping strategies are associated with changes in mood states (Gross, 1998).

Acevedo and Ekkekakis (2001) emphasised the crucial role of appraisal in cognitive and affective responses to adverse environments. Appraisal is identified as taking part in two stages. Primary appraisal asks “what is at stake for me?” while secondary appraisal asks, “what can I do about the cause of the problem?” (Lazarus and Folkman, 1984). Primary appraisal is proposed to be immediate and often subconscious. It is associated with the initiation of an emotional episode. It links to the control process theory, as any unexpected interruption in progress towards goal attainment will initially cause a negative response (Carver and Scheier, 1990). Secondary appraisal is the point at which the individual decides on the course of action to counteract the effect of the person-environment interaction.

Situations that occur during competition but are expected to be already accounted for should produce no change in mood or performance cognitions provided the individuals believe they could cope. Thus, once an individual has become accustomed to effects of adverse environmental factors, this should cease to alter mood. It is only when unexpected events take place, which alter the perceived rate of progress towards goal attainment and require a coping reaction, that mood will change. The effects of performing in extreme environmental conditions may not be fully expected by performers who have not fully acclimatised or are relatively inexperienced in such environments, thus increasing the likelihood of experiencing an unexpected person-environment interaction.

It may be intuitive to assume that mood responses will vary from situation to situation, and thus attempting to identify individuals at risk of developing negative moods states when exposed to adverse environmental conditions is difficult. However, it has been suggested that intra-person mood variability is predictable, and should not be attributed to the change in the situations individuals encounter (Penner et al., 1994). An individual who experiences an event that causes a negative discrepancy between the rate of perceived progress and the internal standard for progress toward the goal will tend to react in a similar way, regardless of the event causing the actual discrepancy. Since the potential range of negative interactions when competing in extreme environmental conditions is vast, from increasing perceived exertion, to mood disturbance, to lowering the pain threshold, this intra-person stability is encouraging for sport psychologists. A thorough education programme, teaching individuals to identify interactions and to implement adaptive coping strategies will reduce the additional negative effects brought on by extreme conditions.

It is important to recognise that individuals have a hierarchy of goals. The most important are goals that purport to the global sense of the ideal self, and the goals set at the lower levels contribute to this 'system concept'. For example, an athlete might have a system concept related to being one of the best competitors in his or her sport. At the 'principle' level, the individual will be highly motivated to train at an intensity that will allow him/her to compete at the desired standard. At the lowest meta-monitoring level (program), the athlete will undertake competition that will help measure the progress made. Mayer and Gaschke (1988) suggested that people also monitor mood itself. This 'meta-experience' is characterised by the cognitions that monitor mood ("I know that I am feeling anxious"), evaluate it ("This could be

detrimental to my performance"), and try to change it ("I have been in this situation before, I know I can meet the demands of the task"). A performer who perceives such a discrepancy or undesirable mood will usually employ coping strategies, which may be adaptive or maladaptive to the situation (Giacobbi and Weinberg, 2000). A moderate relationship between coping disposition and situational coping styles has been reported (Carver et al., 1989; Carver and Scheier, 1994; Giacobbi and Weinberg, 2000). The effectiveness of any coping strategy used in a competitive situation will undoubtedly influence mood and performance-related cognitions.

Studies that use a transactional design to assess mood changes in relation to an ongoing perception of attaining important goals are rare. The following example explains the effects of how mood changes over time unfold. A performer competing at Olympic competition (an important goal) at high altitude may experience increased feelings of anxiety. This individual might appraise these feelings as a lack of ability to meet the demands of the environment and the task, altering his/her performance cognitions, and might employ coping strategies. If the individual adopted emotion-focused coping behaviours, such as wishful thinking, self-blame, or venting of emotions, there will be no change to the performance-related cognitions because the individual will still believe that he/she is able to meet the demands of the task. An individual who adopts problem-focused coping, such as planning strategies or increasing effort will limit the discrepancy between the internal standard and the progress toward the goal and so limit the change in mood. Anxiety will decrease and the individual will re-evaluate the performance-cognitions to reflect the more positive state.

The ephemeral nature of mood means that athletes will experience negative moods, which may or may not be caused by events within the sport. It has been

435 suggested that ‘mood is not something that will run its own course in response to
436 internal and external events out of our control’ (Parkinson et al., 1996, p. 129). Mood
437 management requires conscious recognition of the mood (Mandler, 1984; Parkinson et
438 al., 1996). Changes from normal to adverse environments are likely to increase
439 sensitivity to changes in physiological and psychological conditions, and thus it is
440 likely that individuals will be sensitive to changes in mood.
441 Once an athlete has recognised that a mood warrants changing, there are
442 numerous cognitive and behavioural strategies that could be used (Thayer et al.,
443 1994). Thayer et al. (1994) investigated how people attempt to change bad moods.
444 Common strategies included relying on social support, such as talking to someone,
445 cognitive strategies, such as thinking positively or redirecting attention, distraction
446 techniques, such as listening to music or engaging in pleasant activities, or exercising.
447 The most effective strategies for changing a bad mood were assessed by the sample,
448 and by a panel of 26 psychotherapists. Both groups agreed that active mood
449 management strategies, which included relaxation, stress management, engaging in
450 cognitive activities, and exercise, were most effective strategies. In addition, both
451 groups judged seeking pleasurable activities and distraction as the second most
452 effective category.
453 Stevens and Lane (2001) used the methodology developed by Thayer et al.
454 (1994) on a sample of 107 athletes. Consistent with findings of Thayer et al. (1994),
455 Stevens and Lane (2001) found that individuals use a range of behavioural and
456 cognitive techniques to alter their mood. Although strategies such as ‘change
457 location’, ‘exercise’, and ‘listen to music’ were strategies common to each mood
458 identified in the POMS, there is a great deal of variation within each of these

strategies. Listening to music can be used to increase energy or evoke feelings of relaxation depending on the music that is being listened to.

Gross and his colleagues (Gross, 1998; Richards and Gross, 2000; Gross and John, 2003) have consistently found that cognitive reappraisal is a more positive regulation technique than expressive suppression. Cognitive reappraisal is a deliberate cognitive change that involves interpreting a potentially emotion-eliciting situation in a way that will change the emotional experience and subsequent mood (Lazarus and Alfert, 1964). For example, an athlete training at altitude might view the training as a positive experience to benefit performance instead of dwelling on the difficulty of the task. Expressive suppression involves the inhibition of ongoing emotionally expressive behaviour (Gross, 1998).

Cognitive reappraisal is a more positive strategy to adopt as it is antecedent-focused and so acts as an early intervention, thus reducing the intensity of the experience and reducing the likelihood of a negative behaviour (Gross and John, 2003). Suppression is response-focused and so comes later in the process when mood (and often behaviour) has already changed. It may mask the mood, but may not actually help in reducing the intensity of the feelings. Suppression requires a conscious effort to direct cognitive resources to managing the response, which has been shown to decrease access to memory for the details of the unfolding emotion-eliciting situation while reappraisal was found to put no negative demands on cognitive capacity (Richards and Gross, 2000). Suppression has also been shown to have negative impact on positive moods, by decreasing the intensity of those experiences (Gross and Levenson, 1997).

Recent research has addressed how such strategies can be used to regulate mood. It has been proposed that possibly the most effective strategy for regulating

mood is to focus on events that will occur in the future rather than events that occurred in the past (Persson and Sjöberg, 1985; Totterdell, et al., 1997). For example, athletes who feels unusually fatigued following training at altitude is more likely to improve their mood by focusing on the process of acclimatisation rather than remembering how they felt after a similar session performed at in a normal training and competitive environment. Focusing on the future and setting achievable goals through acclimatisation should lead to improved mood (Carver and Scheier, 1990). Thus it is suggested that as well as discovering a baseline mood profile for each individual athlete, practitioners should attempt to establish which mood management strategies are favoured, and which are the most effective strategies for the athlete's different moods at different times.

A model for mood profiling

A key aim of the present review is to provide practitioners with a guide for using mood to assess the effects of adverse conditions so that interventions can be implemented to ensure functional mood states. The present model is depicted graphically in Figure 1. As Figure 1 illustrates, monitoring should include assessment of mood under normal and adverse conditions, the bi-directional relationship between self-set goals on mood, and the stable influence of personality of all variables. The first stage should be to assess personality, self-set goals, and mood states under normal conditions. To understand the effects of adverse conditions, it is crucial to be aware of normal mood responses to training and life stressors at sea level under normal conditions as these responses are likely to be highly individualised (see Terry, 1995). It is important to assess relatively stable constructs such as self-esteem and dispositional coping styles as these constructs might provide some indication of individuals at risk.

Assessment of mood at baseline should include identification of successful mood profiles and the effects of training on mood. Previous research has shown that mood and performance research is highly individualised (Terry, 1995). Terry (1995) illustrated two successful athletes with vastly different mood profiles. A key part of this approach is to identify athletes who use mood states such as anger and tension in a functional and motivating way (Lane and Terry, 2000). Research has shown that some individuals report anger and tension to be more facilitating than other athletes (Lane and Chappell, 2001).

Repeatedly assessing mood states shortly before competition can be used to identify individualised mood profiles. To obtain a sufficient range of scores, data are needed from approximately ten different competitions. Identification of the variation in mood scores is important (Penner et al., 1994). An alternative method of developing an individualised mood profile for best and worst performance is to assess mood retrospectively. This approach has been used in applied research in a number of research domains (see Devonport et al., in press). A limitation of this approach is that retrospective mood scores are influenced by the ambient mood. Thus, this approach should be used at the start of an individualised programme, with multiple mood assessments taken shortly before competition being preferred. The key point is that interventions designed to ensure an athlete is in the appropriate mood state should be grounded on solid evidence that shows that mood states reliably influence performance.

It is important to assess the effects of hard training on mood scores and the time it takes to recover to pre-training levels. This should involve assessing mood before and after training. The intensity and duration of the training should be assessed. Identification of how athletes cope with hard training is crucial to coping with adverse

conditions. Identification of training volumes that bring about increased depressed mood is critical (Lane and Terry, 2000). Increased fatigue and reduced vigour are expected responses to hard training. High fatigue in the absence of depressed mood following hard training could be indicative of acknowledging the difficulty of the session. Provided fatigue reduces relatively quickly and returns to pre-training levels, this could be indicative of positive adaptation to training. By contrast, increases in fatigue and depressed mood can indicate that the individual feels unable to cope with training. The de-motivating nature of depressed mood, and the association with other negative mood states (see Lane and Terry, 2000) make early identification and intervention important. Clearly, adverse environment conditions make performance feel harder, and so some tailoring of training needs to be done, especially in terms of a reduction in intensity until acclimatisation has occurred. One strategy for ensuring that participants acclimatise successfully is by reducing training intensity so that an individual maintains a mood profile consistent with baseline values. Elite athletes often feel uncomfortable about reducing training intensity, and so the strategy for this approach would need to be tackled sensitively.

It is suggested that practitioners assess mood states on a regular basis during initial exposure to environmental stress. Lane et al. (2003a) assessed mood each morning in their work with biathletes acclimatising to altitude. Mood data were triangulated with physiological data and information from the coach to identify athletes at risk of a maladaptive response. Mood scores often served as early indicators, especially scores of the depressed mood. The initial response taken by the support team was to reduce training intensity. An athlete was given a goal to keep heart rate below certain levels, something that was possible to regulate as heart rate data were recorded. In the sport of biathlon, this control can be possible as daily

559 training can be altered so that the athlete performs a shooting session rather than a ski
560 session and thus exercise intensity is reduced. The above example hints at the need for
561 cohesion among the support team. We suggest that mood monitoring should be done
562 in conjunction with a number of other indicators of adaptation and corroboration of
563 evidence is important and mood measures, which are typically obtained via self-report
564 could be seen as transparent. Athletes who struggle to cope with adverse conditions
565 might wish to remain undetected if they believe selection is based on performance in
566 environmental extremes.

567 There are multiple methods of assessing mood. The Brunel Mood Scale
568 (BRUMS: Terry et al., 1999, 2003) has been comprehensively validated and takes
569 athletes seconds to complete as the scale has only 24 items and validation ensured
570 adolescents easily understand mood descriptors. It is especially important to ensure
571 that the measure is short, as participants will need to complete the measure multiple
572 times. Alternative approaches could include using mood diaries although it is difficult
573 to develop individualised databases or to compare data with normative data. Recent
574 research efforts have initiated the development of scales that distinguish mood from
575 emotion (Beedie et al., 2001). Measures that distinguish mood from emotion would
576 facilitate examination of the influence of environmental factors on the interplay
577 between mood and emotion.

578 In conclusion, adverse environments should be conceptualised as potential
579 stressors. Monitoring of mood is proposed to be an approach towards identifying
580 maladaptive responses. It is recommended that mood is assessed daily in the initial
581 stages during acclimatisation and particular attention is placed on depressed mood
582 scores. It is hoped that assessment of mood responses to adverse conditions forms the
583 basis for applied research in the future.

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816

817 Figure 1

818 Model for mood monitoring in extreme conditions