Chapter 5

# Stress, Emotions and Athletes’ Positive Adaptation to Sport: Contributions from a Transactional Perspective

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## Abstract

Stress is ubiquitous in sport, so understanding the causes and consequences of stress is an important endeavour. This chapter provides theoretical and research evidence for the transactional perspective of adaptation to sport, and is focused chiefly on the emergence of the Theory of Challenge and Threat States in Athletes (TCTSA). The TCTSA not only offers a structure for understanding how athletes react in performance situations, it also provides a framework for stress management with a view to enhancing athletic performance. We provide a historical account of the emergence of the challenge and threat concepts, then we provide a synthesis of the research relating to the TCTSA. This chapter also details a number of stress management strategies informed by the TCTSA, which involve adjustments and alterations to the athletes' environment, or the development of well supported psychological skills. Finally we introduce an effective strategy for promoting adaptation supported by past research and our consulting experience.

Nervousness took over first his mind, and then his body…The contrast between the commanding McIlroy of day three and the disconsolate McIlroy of day four came down to psychology – no more and no less. Between the first and the third day, he had convinced himself he could win; by the fourth, he feared he could not (Viner, 2011, p. 12).

## Introduction

The description of Rory McIlroy’s psychological state during the 2011 Masters Golf tournament illustrates the capacity for motivated performance situations, such as sport competition, to generate intense stress, and for that stress to significantly influence skilled performance. McIlroy was leading the field when he got to the 10th hole on the final day of the 2011 Masters. At the 10th McIlroy pulled his drive into the trees, chipped out of an awkward position for his second shot, but then pulled his third, and his fourth shot was a chip from under the green that rolled back towards him on landing. McIlroy scored seven in total at the 10th, and he dropped from first place to seventh, never regaining his previous form, and finished the round with 80. That McIlroy was able to win the next major golf tournament (the US Open) in such a resounding fashion, shattering the tournament scoring record and winning by eight strokes, illustrates the resilience of skilled performers under stress, and is a testament to the fact that stress is not always detrimental to performance. Sporting competition is stressful (Harrison et al., 2001; Salvador, 2005), and for elite athletes, competitive stress is intensified by the career implications of success and failure, and the scrutiny under which they perform (Jordet, 2009). The following chapter details and explores the notion that stress is a transaction between person and environment where perception plays a vital role, and crucially, that stress can help or hinder human performance depending on this perception.

The core theoretical themes of this chapter stem from the Theory of Challenge and Threat States in Athletes (TCTSA: Jones, Meijen, McCarthy, & Sheffield, 2009), which provides a framework to explore the human psychophysiological approach to motivated performance situations. Broadly, in the TCTSA a challenge state leads to superior performance compared to a threat state, and in our laboratory we have conducted a number of investigations testing the validity of the TCTSA. Our findings along with others', are explored in this chapter to provide a contemporary discussion concerning theoretical and practical developments in understanding how athletes can approach competition either adaptively (challenge state) or maladaptively (threat state). This chapter will first provide a historical account of the study of stress, then major advancements in stress research from cognitive and psychophysiological perspectives are outlined. We then focus on the sport-specific TCTSA. Finally, we outline the practical implications of theory and research for facilitating adaptation under stress.

## The Study of Stress: A Brief History

The term stress has been used to describe a variety of negative feelings and reactions in response to adverse or taxing situations. Largely, stress has been considered a hindrance to the quality of human life and performance (Cox, 1978), but not all stress is negative. Indeed a certain amount of stress is necessary for survival and stress can be viewed as an adaptive function (Franken, 1994), involving a complex relationship between cognition, neurology, and endocrinology. Specifically, stress reactions attempt to maximise the energy expenditure/mobilisation within an individual, aiding the body in its attempt to meet demanding situations. Some people may experience adverse effects on health and or performance, while others may experience no effects on health and maintain or improve performance.

Crucially, the transactional perspective of stress indicates that stress is a process, or more accurately, a transaction between person and environment where perception plays a vital role. In other words, when an event is perceived positively, negative health and performance consequences can be assuaged. The idea that it is our perception of events that predominantly determines our stress responses is well established, and the success of such cognitive therapies as Cognitive Behavioural Therapy and Rational Emotive Behaviour Therapy have capitalised on the notion that by altering perceptions one can alter the experience of stress. However, in the context of scientific thought, transactional ideas of stress have only been formalised in the past 50 years or so, inspired by early ideas and philosophies dating back to the ancient Greeks.

Ancient Greek philosophers explained the importance of perception on how humans interact with the external environment, and the effect this may have on the internal environment (the human body). For example, Protagaras (485-411BC) stated that “man is the measure of all things” (Hunt, 1993, p. 16) suggesting that each perception is true for each perceiver. Epictetus (60-120AD) considered that psychological and physical health may be determined by the view which humans take of events, which later helped form the basis of Rational Emotive Behaviour Therapy (Ellis, 1957). It is widely recognised that there was a great dearth in writings concerning the functions of the human mind up until the 17th century, where the writings of Descartes posed important questions about consciousness, and Robert Hooke (Hooke’s Law; Waller, 1705) proposed the analogy that the body is machine-like and is therefore also subject to wear and tear (Cox, 1978). So into stress discourse emerged ideas that stress experienced in human life may have adverse implications, and that just like a machine, the body needs energy to help it withstand this stress. As such, it was presumed that psychological dysfunction stems from depletion of nervous energy, nervous exhaustion, or a weakness of the nervous system, later posited by George Beard (1881). Echoing the mechanistic rules put forth by Hooke and Beard, Claude Bernard (1859) brought homeostatic principles to the fore by suggesting that the body’s internal fluid environment must be fairly constant in response to external changes; if not, illness and death would occur. Further, Bernard posited that external demands cause the overload of the nervous system leading to nervous exhaustion (including anxiety, fatigue, and irrational fears), with stress from the pressures of life now considered the precursor to homeostatic imbalance (Howard & Scott, 1965). It was thought that the occurrence of stress was a sign that an individual had failed to adjust to modern life (Abbott, 2001).

It was Walter Cannon that coined “homeostasis” to describe the relation of the autonomic system to the self-regulation processes (Cannon, 1939), paying tribute to its Greek routes (“homeo” and “stasis” meaning “same” and “steady” in Greek). Broadly, in response to environmental stressors, every external event must be met with an internal reaction to maintain stability, a process operated through the sympathetic arm of the autonomic nervous system (ANS). Two compensatory adjustments that are synonymous with Cannon’s work are flight and fight responses, supposedly developed through evolution for rapid service in the battle for survival (Cannon, 1929). Flight represents fear (to run and escape), and fight represents anger (to be aggressive and attack), instinctively activated in the face of a threat to survival. These two responses account for the efficient mobilisation of mental and physical resources to meet demands through the ANS in conjunction with catecholamines secreted by the adrenal medulla. The body’s needs in both flight and fight are similar (e.g., increased blood flow to the muscles, deepening respiration, pupil dilation), suggesting a typical bodily reaction to demands regardless of the relevance of the stimuli (Cannon, 1915). However, Cannon did not posit what may determine which of the flight or fight responses would be elicited in a given situation, leading to the further development of the flight or fight concept during the 20th and 21st centuries (Bracha, Ralston, Matsukawa, Williams, & Bracha, 2004).

In the mid-20th century Hans Selye developed the General Adaption Syndrome (GAS), suggesting that all stressors or demands deplete the finite adaptive energy of an organism, causing non-specific physiological reactions as an attempt to maintain a steady state (Selye, 1979), reflecting Cannon’s homeostasis concept. Over time, the GAS was reconceptualised to include two distinct stress responses; eustress and distress (Selye, 1976). Eustress was framed as stress that enhances human function (physical and mental), associated with positive emotions, and essentially meant good stress. Distress was framed as unhealthy, associated with negative emotions, and emerged when the demands of a situation exceeded the body’s capacity to maintain homeostasis. Distress is associated with anxiety, and was considered a reaction to a situation that could not be resolved through coping or adaption. Selye never formally recognised the part cognition plays in stress responses, apart from stating that “stressors, it should be noted, are not exclusively physical in nature” (Selye, 1982, p. 14). With the knowledge gleaned from contemporary research that the same event may produce a particular reaction in one individual and not in another (Cox, 1978), it is possible to see the inaccuracies of some of Selye’s postulations regarding a non-specific stress response.

In contrast to Selye, Harold Wolff proposed that stress is the result of the way a situation is perceived (reminiscent of the ancient Greek views), indicating an interaction between the external and the internal environment in response to a demand. Wolff realised that the human response to a perceived demand, supposedly developed through evolution (e.g., Cannon, 1929), is inappropriate and can actually harm survival due to its adverse health implications (Wolff, 1953). Wolff concluded that the “common denominator in psychosomatic illness is the interpretation of an event as threatening” (Wolff, 1950, p. 1090), with the stress response providing an unsuitable protective and homeostatic function (Wolff, 1953). Wolff’s most important contribution to the field of stress was the recognition that irrespective of its scale, the potential for a given event to evoke a protective reaction is dependent on its significance to the individual (Wolff, 1950, 1953).

In sum, the transactional perspective that stress, and all its psychophysiological associates, is determined by the perception of an event has been developed over centuries of philosophical thought and scientific endeavour. In more recent times, the transactional perspective has been formalised and studied empirically, and in the next section we provide an empirical background for the main themes of this chapter.

## Conceptual and Empirical Findings

To gain a full understanding of the transactional perspective, we must first begin with the ideas of Richard Lazarus, who was one of the first to formalise the transactional perspective with regards to cognition in stress and emotion research.

### The Work of Lazarus

Lazarus proposed that stress occurs when a particular situation threatens the attainment of some goal, and more importantly, that increases in stress are related to more variability in mental performance (Lazarus, Deese, & Osler, 1952; Lazarus & Eriksen, 1952). That is, some participants experience a performance improvement while others experience a performance decline. Lazarus realised that there may be a critical point in the amount of stress beyond which disruption occurs (Lazarus & Eriksen, 1952). Moreover, performance disruption may be dependent on an individual’s ability (or inability) to cope with stressful situations, which depends on the nature of the cognitive appraisal made regarding the significance of a stressor (Speisman, Lazarus, Mardkott, & Davison, 1964). Put another way, the meaning of an event determines the stress response, not the event alone (Lazarus & Alfert, 1964). To illustrate, Lazarus and Alfert (1964) found that stress responses (measured using skin resistance and heart rate) were attenuated when a film depicting primitive rituals (including footage of surgical procedure) was contextualised as harmless and benign in its introduction.

Lazarus’ formative experimental works informed his first formal conception of a comprehensive appraisal theory (Lazarus, 1966). Although the appraisal concept was introduced into emotion research by Arnold (1960), Lazarus elaborated it with regard to stress (Lazarus, 1966; Lazarus & Launier, 1978). Lazarus’ theory has had several revisions (Lazarus, 1991; Lazarus & Folkman, 1984; Lazarus & Launier, 1978). In the latest version (Lazarus & Folkman, 1984), stress is considered a relational concept whereby stress refers to a relationship between an individual and an environment mediated by primary and secondary appraisals. Primary appraisal is concerned with whether something occurs that is relevant to the individual’s well-being, and secondary appraisal is concerned with an individual’s coping options in a given situation. Importantly, particular patterns of primary and secondary appraisal lead to different kinds of stress, namely harm, challenge, and threat (Lazarus & Folkman, 1984). Harm refers to psychological damage that has already occurred, whereas threat and challenge refer to future events relevant to the individual. Challenge occurs when an individual feels confident about mastering situational demands and threat occurs with the anticipation of potentially imminent harm. For example, Lazarus (1991) maintained that for stress to be experienced, there must be some goal relevance to the encounter, goal incongruence must be high (e.g., personal goals thwarted), and ego-involvement must be concentrated on the protection of personal meaning against threats. Challenge is experienced when secondary appraisal indicates that an individual’s coping potential is sufficient, thus deeming harm less likely. Therefore, threat is experienced when secondary appraisal indicates that an individual’s coping potential is not sufficient, thus deeming harm potentially imminent. Therefore, for Lazarus the constructs of challenge and threat represent two distinct appraisal processes which have implications for stress responding. Lazarus’ appraisal theory informed much cognitive psychology research in the mid to late 20th century, and neuroendocrine research conducted separately from Lazarus, further illuminated the variation in individuals’ experiences of stress. It is to this research we now turn.

### Psychophysiological Perspectives

The notion that there are adaptive and maladaptive ways to respond to stressors is evidenced in neuroendocrine research. Physiological measurements of psychological stress offers insights into the mechanisms through which performance is influenced and health consequences emerge. In particular, much attention has been given to the Sympathetic Adreno Medullary (SAM) system indicated by catecholamine excretion, and Pituitary Adreno Cortical (PAC) system indicated by cortisol excretion, by numerous investigations led by Scandinavian researchers in the second half of the 20th century.

Frankenhaeuser and colleagues have distilled two distinct possible responses to a given stressor. In stressful situations, distressed individual experience negative emotions, excrete cortisol (indexing PAC activity), and experience disrupted performance, while less distressed individuals experience positive emotions, excrete catecholamines (indexing SAM activity) and experience maintained or enhanced performance (Frankenhaeuser, Mellis, Rissler, Bjorkvall, & Patkai, 1968; Lundberg & Frankenhaeuser, 1980). In addition, increases in catecholamines are met with decreases in cortisol, suggesting the dominance of SAM over PAC in situations permitting controllable and self-paced performances (Frankenhaeuser, Lundberg, & Forsman, 1980).

Holger Ursin and colleagues undertook an extensive investigation of behavioural and physiological parameters following repeated exposure to a highly demanding situation (Ursin, Baade, & Levine, 1978). Blood and urine samples were collected from a large number of parachute trainees in the Norwegian Military prior to and after training drills of increasing fear provocation. Initially the trainees jumped from a 12m-high mock tower and slid down a long steel wire, a task that is highly fear provoking for the first several jumps (according to the officials and prior trainees). Ursin et al. highlighted that all physiological variables were significantly higher when fear level was high, with performance improving as fear diminished. Also, upon repeated exposure, all variables, except heart rate, followed the pattern that is referred to as the coping effect, signified by a reduction in activation. This indicated that the situation alone did not stimulate activation, but the subjective evaluation of it. Additionally, two consistent factors emerged through the data; the catecholamine factor and the cortisol factor. The major distinguishing feature between the two factors was that the catecholamine factor was clearly positively associated with successful performance, and the cortisol factor was associated with defence mechanisms and poor performance throughout the training program. Therefore, as well as a better understanding of the coping process, two distinct branches of the stress response were identified, one driven by PAC activation, and one by SAM activation, that related to performance in highly stressful situations.

In effect, two distinct stress responses, one adaptive and one maladaptive, had emerged within psychological research (e.g., Lazarus) and neuroendocrine research (e.g., Frankenhauser, Ursin) separately. However, the interaction between psychological and neuroendocrine factors had not yet been formalised into a coherent theoretical framework. Richard Dienstbier (1989) took theory-driven approach toward explaining the cognitive elements of SAM and PAC reactivity by drawing on Lazarus’ (1966) appraisal theory. Drawing from the Scandinavian research and Lazarus’ (Lazarus & Folkman, 1984) work, Dienstbier distinguished between challenge and threat responses, referring to two distinct responses to a stressor characterised by cognitive appraisal and associated neuroendocrine activity.

Specifically, an individual’s ability to cope is associated with the system through which arousal is elicited. Broadly, SAM activity accompanied by catecholamine release is associated with positive secondary appraisal and positive emotions, representing a challenge response. Therefore, arousal is adaptive if coping resources sufficiently outweigh situational demands. Conversely, PAC activity accompanied by cortisol release represents insufficient coping resources and therefore suggests maladaptive arousal, or a threat response. To explain, in a threat response to an acute stressor (e.g., imminent sporting competition) it is not that cortisol directly disrupts performance, rather that PAC activity tempers the positive effects of SAM activity. Further, SAM activation is correlated with successful performance, and PAC activation is correlated with unsuccessful performance in research utilising a variety of tasks ranging from the lab to the field (Dienstbier, 1989, 1992). Dienstbier considered the challenge response to be a “toughened” response, where the energy (glucose) needed for successful performance is released into the blood, and can reach the brain efficiently due to decreased vascular resistance and enhanced blood flow. To summarise, a challenge response (toughened) is associated with increased catecholamines, decreased vascular resistance, positive emotions, and successful performance, compared to a threat response, which is associated with increased cortisol, negative emotions, and unsuccessful performance.

### Theories of Challenge and Threat

The BioPsychoSocial (BPS) model of challenge and threat (Blascovich & Mendes, 2000; Blascovich & Tomaka, 1996), built on Dienstbier's work and offers an integrative, interdisciplinary approach to the understanding of the human stress response. The BPS model builds on Lazarus and Folkman's (1984) work and is informed by the work of Obrist (1981) and Dienstbier (1989) in proposing two distinct ways that humans respond to stressors. The BPS model forms the backbone of the TCTSA (Jones et al., 2009) which adopts a transactional approach to understanding athletic performance by proposing a framework for psychological, emotional, and physiological reactions in motivated performance situations.

The TCTSA proposes that in competitive situations athletes can approach their performance either adaptively in a challenge state, or maladaptively in a threat states. At the core of the TCTSA is the notion that some athletes excel in motivated performance situations while others fail to perform, and more specifically, an athlete approaching a competition in a challenge state is more likely to fulfil his or her potential than an athlete approaching a competition in a threat state. The ability to approach performance adaptively is critical for elite athletes, with the inability to do so often a driving factor in long term performance impairments. For example, Ricky Ponting (2012; former captain of the Australia national cricket team between 2004 and 2011) on his retirement stated that “I have put a lot of pressure on myself to perform… I have not been able to deal with it as well of late as I would have liked to. Normally for me when those big moments come around I have been able to find something within and go out and score runs. I have not been able to do that for a while now and that was when the alarm bells started to ring.” The TCTSA offers a framework for understanding why some athletes thrive under pressure while some fail, and ultimately for helping athletes to approach performance adaptively in a challenge state.

In the TCTSA Jones et al. (2009) adopt the idea that a challenge state is experienced when sufficient, or nearly sufficient, resources to meet the demands of a situation are perceived, whereas a threat state is experienced when insufficient resources to meet the demands of a situation are perceived (Blascovich & Mendes, 2000; Blascovich & Tomaka, 1996). Cognitive appraisals can occur consciously and unconsciously (Blascovich & Mendes, 2000). In the TCTSA the demand appraisals comprise perceptions of danger, uncertainty and required effort in a situation, taken from the BPS model. Resource appraisals relate to perceived ability to cope with the demands of a situation. Resource appraisals in the TCTSA are more specific than the resource appraisals put forth in the BPS model (Blascovich & Mendes, 2000) and comprise three interrelated constructs: self-efficacy, perceptions of control, and goal orientation (Jones et al., 2009). The resource appraisals are extended from the BPS model (Blascovich & Mendes, 2000), the model of adaptive approaches to competition (Skinner & Brewer, 2004), and the model of debilitative and facilitative competitive state anxiety (Jones, 1995). More precisely, self-efficacy is important in all three models, control is important in the BPS model and the model of debilitative and facilitative competitive state anxiety, and goal orientation is important in the model of adaptive approaches to competition. Jones et al. (2009) suggest that high levels of self-efficacy, high perceived control and a focus on approach goals, represent sufficient resources to cope in a motivated performance situation and are therefore indicative of a challenge state. Conversely, low levels of self-efficacy, low perceived control and a focus on avoidance goals, represent insufficient resources to cope in a motivated performance situation and are indicative of a threat state. Crucially, whether an individual perceives sufficient resources to meet demands or not is reflected in two distinct patterns of CV reactivity that distinguish challenge and threat. The TCTSA is shown in Figure 1.

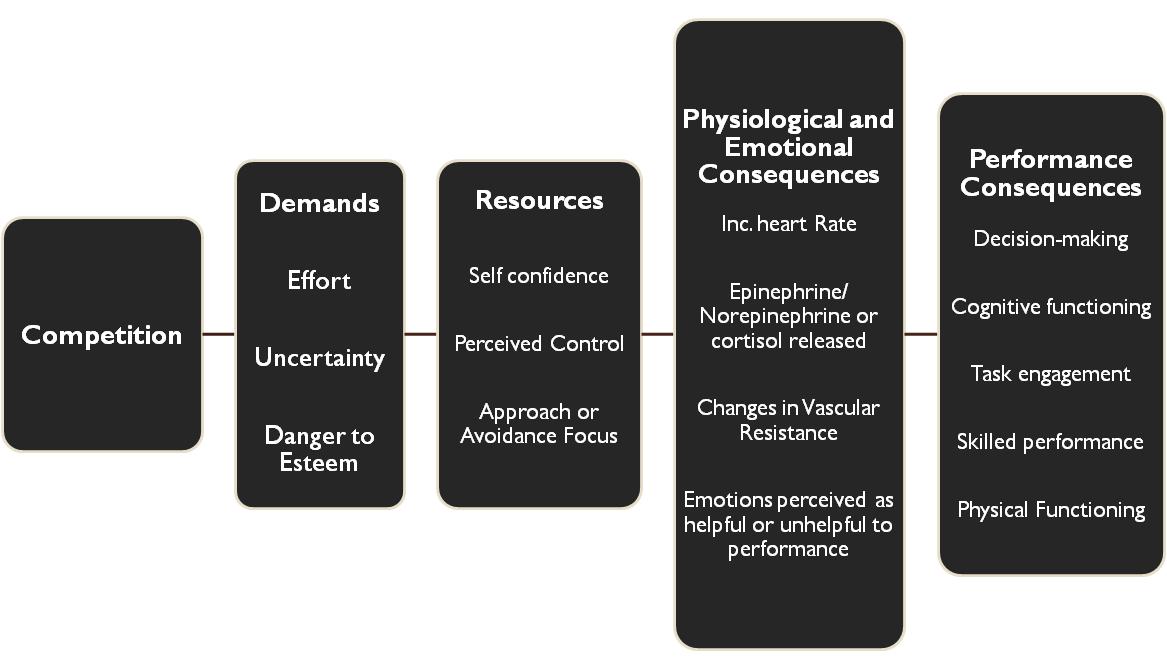


Figure 1. The theory of challenge and threat states in athletes (Jones et al., 2009).

The TCTSA adopts the psychophysiological indicators of challenge and threat as proposed in the BPS model (see Figure 2). In motivated performance situations a challenge state is accompanied by increased SAM activity accompanied by catecholamine release (epinephrine and norepinephrine). The physiological response exhibited in challenge is indexed by changes from resting baseline (reactivity) in four CV variables; increased heart rate (HR; heart beats per minute[bpm]) and cardiac output (CO; litres of blood pumped from the heart per minute[l/min]), attenuated preejection period (PEP; time interval from beginning of electrical stimulation of the ventricles to the opening of the aortic valve[ms]), and decreased total peripheral resistance (TPR; sum of the resistance of all peripheral vasculature in the systemic circulation[dyn.s.cm-5]). Increased HR and attenuation of PEP from baseline indicate motivation to engage in the task (e.g., Obrist, 1981). A challenge response is proposed to promote efficient energy use through increased blood flow to the brain and muscles, higher blood glucose levels (fuel for the nervous system) and an increase in free fatty acids that can be used by muscles as fuel (e.g., Dienstbier, 1989).

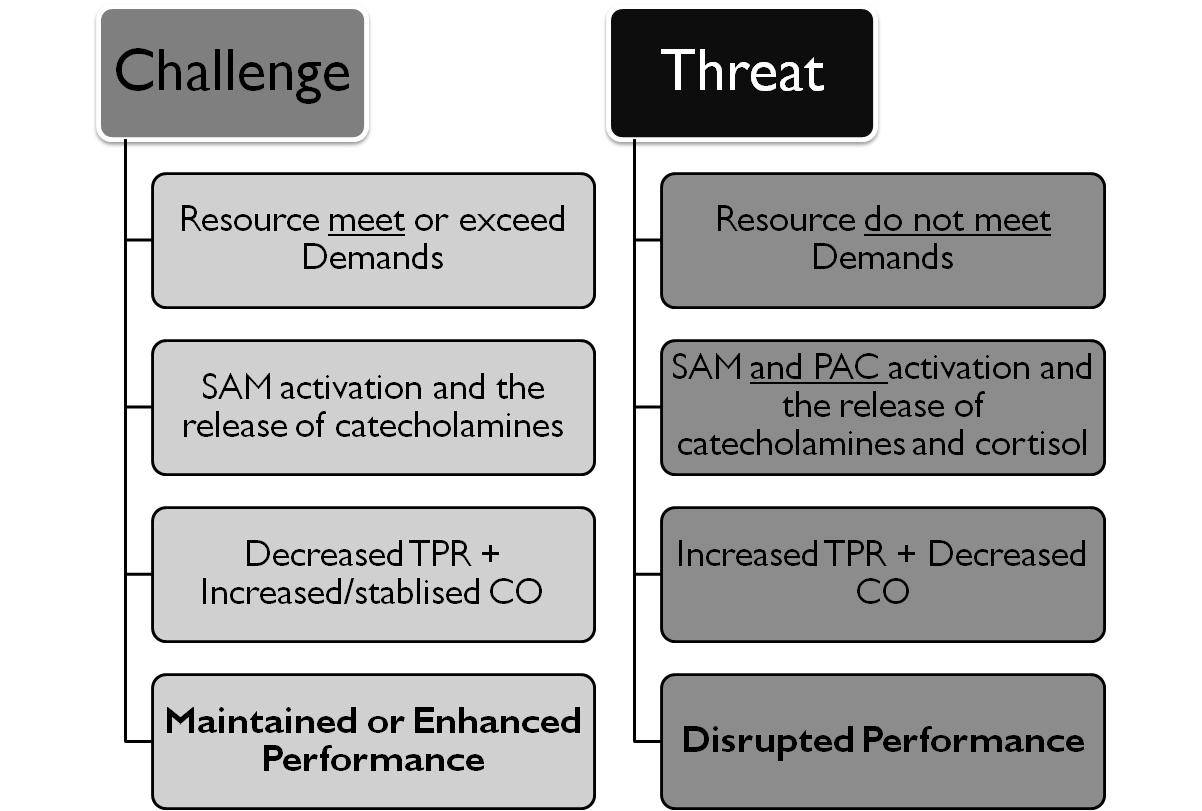


Figure 2. Psychophysiological patterns in challenge and threat states.

A threat state is similarly marked by increased SAM activity, but is also characterised by increased PAC activity accompanied by cortisol release. A threat state is also evidenced by changes from resting baseline in four CV variables, increased HR and attenuated PEP, but with a minimal change, stabilisation, or small decrease in CO, and an increase or stabilisation in TPR. Consequently, in a threat state PAC activity tempers the positive effects of SAM activity therefore the mobilisation of energy is less efficient than in a challenge state as blood flow (and therefore glucose) to the brain and muscles is restricted (e.g., Dienstbier, 1989). In short, both challenge and threat states are indexed by increased HR and decreased PEP reactivity, which are indicators of motivated performance. In a challenge state, the proposed underlying SAM activation is fast-acting and represents the efficient mobilisation of energy for action, reflected by increased CO and decreased TPR reactivity. A threat state reflects PAC (and SAM) activation and is considered a “distress system” reflected by decreased CO and increased TPR reactivity (Blascovich & Mendes, 2000). A threat state is considered maladaptive in modern motivated performance situations (e.g., interviews, exams, sports competitions), but may have served an adaptive function early in human history, for example by allowing energy production over long periods of time in order to cope with especially demanding circumstances (e.g., evading and escaping predators or natural disasters). In sum, increased HR and attenuation of PEP from baseline indicate motivation to engage in the task while changes from baseline in CO and TPR are the key indices of challenge and threat states (Blascovich & Mendes, 2000; Seery, 2011). A wealth of research has supported the CV indicators of challenge and threat states in response to motivated performance situations (see Blascovich, Mendes, Vanman, & Dickerson, 2011; Seery, 2011; Turner & Barker, 2013, for reviews).

In the TCTSA challenge and threat states not only have their own set of physiological and psychological associates, but also have differing performance consequences and outcomes in relation to sport. In essence, a challenge state promotes efficiency of energy (glucose) delivery (e.g., Dienstbier, 1989) and is therefore proposes to facilitate improved decision making, effective and maintained cognitive function, increased task engagement, decreased likelihood of reinvestment, efficient self-regulation, and increased anaerobic power; all of which are likely to lead to successful sports performance (Jones et al., 2009). In a threat state efficiency of energy use does not occur as blood flow to the brain and muscles is not increased and the mobilisation of usable energy is slower than in a challenge state (e.g., Dienstbier, 1989). Therefore, a threat state is proposed to lead to ineffective decision making and cognitive function, decreased task engagement, increased likelihood of reinvestment, inefficient self-regulation, and decreased anaerobic power (compared to a challenge state); all of which are likely to lead to unsuccessful sports performance (Jones et al., 2009).

### Challenge and Threat in Sport

With the challenge and threat concepts clearly relevant in athletic contexts, Jim Blascovich and colleagues (Blascovich, Seery, Mugridge, Norris, & Weisbuch, 2004) examined the relationships between challenge and threat CV reactivity and athletic performance. Blascovich et al. (2004) had varsity baseball and softball players (*N* = 27) give two speeches (baseball relevant and baseball irrelevant), with cardiovascular measures taken during the baseball speeches, and used to predict baseball/softball performance over the season. Participants who exhibited stronger challenge cardiovascular responses performed better (more runs created over a season) than those who exhibited threat cardiovascular responses (less runs created over a season). This study is of particular relevance to this chapter as it aligned the physiological patterns of challenge and threat states with competitive sport performance for the first time. This study also inspired some key predictions made in the TCTSA, that a challenge state should facilitate sports performance relative to a threat state. Therefore recent research has endeavoured to test the proposed predictive validity of challenge and threat states in a range of sport related tasks using the cognitive, emotional, and physiological indicators of challenge and threat states. We have conducted a number of investigations in our laboratory and in athletic settings to try to understand the relationship between CV indicators of challenge and threat states and performance. To record CV data we have used impedance cardiography, a well validated non-invasive method for monitoring the mechanical functions of the CV system (Sherwood, Allen, Fahrenberg, Kelsey, Lovallo, & van Doornen, 1990). Stroke volume (SV) is the actual parameter obtained via impedance cardiography, which measures thoracic electrical impedance changes, with CO a product of SV and HR (CO = SV x HR), and TPR derived from mean arterial pressure (MAP; average blood pressure) and CO (TPR = [MAP/CO] x 80). The protocol we have utilised is to collect baseline CV data before informing participants that they will be performing a task under pressure, that is, under conditions where their performance will be evaluated by coaches and peers, compared to other athletes, and in which they must exert high amounts of effort in order to prevail. The participants CV reactions to being informed about the pressured performance, and mentally preparing for the performance, is then compared to their baseline level to form CV reactivity values. We then examine the relationship between this CV reactivity and actual task performance. In our research investigating performance, we have not oriented participants to challenge or threat states using between groups methods, but rather have exposed participants to a stressor (description of an upcoming competitive situation) and have recorded self-reported resource appraisals (self-efficacy, perceived control, and goal orientation) and CV reactivity, as would typically occur in actual sports performance.

In one paper (Turner, Jones, Sheffield, & Cross, 2012) we conducted two studies to examine the relationships between challenge and threat states and changes in performance from baseline. In Study 1 participants completed baseline Stroop Tests after which we induced pressure using ego-threatening instructions and asked participants to complete the Stroop Test once again, but under competitive circumstances. Similarly, in Study 2 we had 21 female varsity netball athletes perform a netball shooting task at baseline (no pressure induced), after which we induced pressure and collected CV data. The athletes then completed the netball shooting task under competitive circumstances. In both studies we were able to calculated changes in performance from normal (baseline) levels. We found that CV reactivity was related to changes in performance from base levels in both studies. Specifically, challenge CV reactivity (decreased TPR and increased CO) was related to increased performance from baseline, and threat CV reactivity (increased TPR and decreased CO) was related to decreased performance from baseline. So challenge CV reactivity was related to increased motor skill performance and cognitive performance. In other words, we were able to predict performance changes using CV reactivity.

More recently, we examined the relationship between CV reactivity and the performance of 42 elite male cricketers in a pressured Batting Test (Turner, Jones, Sheffield, Slater, Barker, & Bell, 2013). The Batting Test required the cricketers to score 36 runs from 30 deliveries from a pace bowling machine set at 80mph. Athletes scored runs by playing shots between cones that marked out a typical field used in cricket, with the exact amount of runs allocated by a national coach. After baseline CV recording athletes were informed that their performance would be compared to all other cricketers, seen by all coaching staff, and that their score will be considered when future team selection is being made. The athletes' CV reactivity to being informed about the Batting Test was recorded as with the netball athletes. As previously found, challenge CV reactivity was related to superior performance compared to threat CV reactivity. That is, athletes who exhibited challenge CV reactivity recorded a better score in the Batting Test than athletes who exhibited threat CV reactivity.

Interestingly, there were some cricketers who responded in threat state but still managed to perform well in the Batting Test (*N* = 5), and some who responded in a challenge state but performed poorly (*N* = 6); opposite to the general data trend and counter to what we would expect. Interestingly, cricketers who responded in a threat state but performed well had significantly greater self-efficacy than those who responded in a threat state and performed poorly. In addition, cricketers who responded in a challenge state but performed poorly had significantly greater performance avoidance goals than those who responded in a challenge state and performed well (see Figure 3). That is, it would appear that the resource appraisals may be of particular importance in mediating the relationships between challenge and threat CV reactivity and sports performance in athletes. This finding is consistent with previous research outlining the interplay between psychological states and emotional responses such as Jones’ (1995) model of debilitative and facilitative competitive state anxiety and Hardy’s butterfly catastrophe model (Hardy, 1990). It is also consistent with previous challenge and threat research (Hoyt & Blascovich, 2010) which suggests that individuals who exhibit threat CV reactivity but report high self-efficacy may be reacting to the threat of the situation in a way that allows maintained or improved performance.



Figure 3. Performance avoidance and self-efficacy split by challenge and threat states and performance. Graphs illustrating the differences in self-efficacy between athletes who exhibited threat but performed well and athletes who exhibited threat and performed poorly, and the differences in avoidance goals between athletes who exhibited challenge and performed well and athletes who exhibited challenge but performed poorly.

Other researchers have also started to investigate challenge and threat states in relation to sport performance. A recent study (Moore, Vine, Wilson, & Freeman, 2012) assessed the cognitive appraisals, emotions (anxiety), CV reactivity (CO and TPR), visual gaze, putting kinematics, muscle activity, and golf putting performance of novice golfers. Moore et al. allocated participants to either a challenge or a threat condition (using instructional sets) and asked them to perform a golf putting task while the physiological measurements were taken (Moore et al., 2012). In line with the BPS model, participants in the challenge condition exhibited greater challenge CV reactivity and challenge appraisals compared to participants in the threat condition. Further, participants who exhibited challenge CV reactivity reported more favourable emotions, displayed more effective visual gaze, putting kinematics, and muscle activity, and performed more accurately in the golf putting task than participants who exhibited threat CV reactivity. Moore et al. concluded that the kinematic variables may be potential mechanisms for the relationship between challenge and threat CV reactivity and motor performance as posited in the TCTSA.

### Summary

In summary of the main conceptual and empirical findings that have informed this chapter thus far, the TCTSA has been drawn upon as a framework that describes and explains how individuals, and in particular athletes, react psychophysiologically in competitive situations. Predominantly building on the theoretical developments and research of Lazarus and Folkman (1984), Dienstbier (1989), and Blascovich and Mendes (2000), the TCTSA offers a transactional perspective in understanding how athletes adapt in competition situations, that encompasses cognitive, emotional, and physiological elements, captured in two distinct approaches to motivated performance situations: challenge and threat states.

## Practical Implications

The TCTSA predicts that an athlete in a challenge state should perform better than when in a threat state (Jones et al., 2009), an assertion based on previous theoretical approaches (e.g., BPS model) and empirical research findings (e.g., Blascovich et al., 2004). Emerging research has supported the link between a challenge state and superior sport performance in sub-elite (Moore et al., 2012; Turner et al., 2012) elite (Turner et al., 2013), and non-athletes (Seery, Blascovich, Weisbuch, & Vick, 2004; Seery, Weisbuch, Hetenyi, & Blascovich, 2010). Therefore, ways in which a challenge state can be promoted are valuable, and would be useful for psychology practitioners, coaches, and of course athletes. Research has identified various ways that a challenge state can be promoted, some methods represent psychological strategies that can be developed by athletes, some represent environmental alterations that can be employed by practitioners and coaches, and some reflect the often overlooked human capability to naturally adapt to demanding situations. In addition, using the TCTSA as a framework, we propose strategies that can enhance the resource appraisals that have not been tested in relation to the TCTSA, but are existing techniques that can be applied in motivated performance situations to promote a challenge state.

### Environmental Adjustments

In this section we outline how adjustments within an athlete’s performance environment can be manipulated with a view to promoting challenge states. By environmental adjustments, we refer to factors external to the individual approaching a motivated performance situation that can be modified usually by significant others supporting the athlete’s progress (e.g., sport psychologist, coach, parent). This section outlines the use of instructional sets and inoculation training.

**Instructional Sets.** Instructional sets have been used in research to manipulate challenge and threat states, which involves the use of audio instructions about an upcoming motivated performance that either promote perceived resources compared to perceived demands (challenge), or promote perceived demands compared to perceived resources (threat). Alternatively, research has focused challenge task instructions on potential reward for successful performance, and threat instructions on potential loss for unsuccessful performance (Hemenover & Dienstbier, 1996; Taylor & Scogin, 1992). Instructions have been adopted because previous research has validated a causal direction from challenge and threat appraisals to challenge and threat cardiovascular reactivity (Blascovich, Kibler, Ernst, Tomaka, & Varga, 1994; Tomaka, Blascovich, Kelsey, & Leitten, 1993; Tomaka, Palacois, & Lovegrove, 1995). This suggests that, in order to manipulate challenge and threat cardiovascular states, cognitive appraisals need first be manipulated. There is a consistent body of research demonstrating that modifying perceptions can alter psychophysiological responses to potentially stressful stimuli (e.g., Allred & Smith, 1989; Holmes & Houston, 1974; Koriat, Melkman, Averill, & Lazarus, 1972; Nisbett & Schachter, 1966; Speisman. et al., 1964) and specifically that it is possible to modify perceptions of challenge and threat (e.g., Hemenover & Dienstbier, 1996; Taylor & Scogin, 1992).

In some studies, modifying the perceived importance of an upcoming task has been shown to manipulate challenge and threat appraisals. In one study (Alter, Aronson, Darley, Rodriguez, & Ruble, 2010) participants in a threat condition were instructed that an upcoming maths test would “show how good [they] were” and that “it would be able to measure [their] ability at solving math problems” (p. 167). In contrast, participants in a challenge condition were instructed that they “would learn a lot of new things” and that “working on these problems might be a big help in school because it sharpens the mind” (p. 167). Participants appraised the test (measured on a 7-point likert scale where 1 = challenging and 7 = threatening) in line with the instructions, and furthermore participants in the challenge condition performed better than those in the threat condition. In four studies Feinberg and Aiello (2010) used challenge instructions focusing on participants’ abilities to perceive a cognitive task “as a challenge to be met and overcome”, to perceive themselves as someone “capable of meeting that challenge,” and to try hard to do their best (p. 2079). Threat instructions focused on the difficulty of the task and the importance of working “as quickly and efficiently as possible” (p. 2079). Challenge instructions led to challenge appraisals and performance increments, while threat instructions led to threat appraisals and performance decrements. In short, four previous investigations have shown that task instructions can influence challenge and threat cognitive appraisals.

While the studies previously mentioned found that instructions can manipulate challenge and threat appraisals, they did not measure cardiovascular reactivity, a vital indicator of challenge and threat states. One study has examined CV reactivity alongside cognitive appraisals to test the assertions of the BPS model. Prior to a mental arithmetic task Tomaka, Blascovich, Kibler, and Ernst (1997) used threat instructions which emphasized the importance of completing the task “as quickly and accurately as possible” and that responses would be “scored for speed and accuracy” (p. 72), and challenge instructions which encouraged participants to “think of the task as a challenge” and to “think of yourself as someone capable of meeting that challenge” (p. 72). Participants given threat task instructions experienced threat CV reactivity and cognitively appraised a mental arithmetic task as threatening. Conversely, participants given challenge task instructions experienced challenge CV reactivity and cognitively appraised the task as challenging. This is an important study as it suggests that challenge and threat states can be manipulated and further validated the causal relationship between cognitive appraisals and cardiovascular reactivity.

Moore and colleagues (2012) also used instructional sets to create challenge and threat conditions, similar to Tomaka et al. (1997), but explicitly examined the performance effects of this manipulation. As in previous research, participants who received challenge instructions appraised an upcoming golf putting task as challenging and displayed challenge CV reactivity, compared to those who received threat instructions. However, the really interesting findings were that participants who received challenge instructions displayed more effective visual gaze, putting kinematics, and muscle activity, aiding performance in the putting task, compared to those who received threat instructions. This study further rationalises the benefits of promoting challenge states in performers, detailing the precise mechanisms through which performance may be enhanced, encouraged using instructional sets.

Past research has successfully manipulated challenge and threat states using a range of instructional sets that focus either on altering perceived demands of an upcoming task, or in one study, altering perceived demands and perceived resources (e.g., Tomaka et al., 1997). In addition, the differing tone in which instructional sets are delivered may have contributed to the manipulation of challenge and threat states in some studies (e.g., Tomaka et al., 1997). In our own research (Turner, Jones, Sheffield, Barker, & Coffee, under review) we have also adopted instructional sets to manipulate challenge and threat states, but have done so differently to past research. The instructional sets we used only altered the resource appraisals from the TCTSA to differentiate challenge and threat instructions, while maintaining task demands between conditions. Therefore, challenge instructions promote high self-efficacy, high perceived control, and a focus on approach goals, and threat instructions promote low self-efficacy, low perceived control, and a focus on avoidance goals. Both sets of instructions increase perceptions of danger, uncertainty, and effort, thus maintaining perceived demands and only altering perceived resources. For example, prior to completing a climbing task participants receiving challenge instructions were informed that “you can feel confident that you will be able to climb effectively” (high self-efficacy), “you have control over the skills required to climb well” (high perceived control), and to “try your best to stay on the wall and get as high as you can” (a focus on approach goals). Participants receiving threat instructions were informed that “you obviously can’t be sure that you will climb the wall effectively” (low self-efficacy), “how well you do on the task may be related to factors outside of your control” (low perceived control), and to “try your best not to fall off the wall at any point” (focus on avoidance goals). Results supported previous research and showed that challenge instructions led to challenge CV reactivity and threat instructions led to threat CV reactivity. Importantly, unlike past research (e.g., Tomaka et al., 1997) we showed that a challenge can be promoted using only the resource appraisals, maintaining task demands, reflecting actual motivated performance situations in which the task is usually considered important, effortful, and dangerous to esteem.

The findings from research showing that challenge states can be promoted using instructional sets have implications for stress management and leadership in motivated performance settings. In addition, we showed that a challenge state can be promoted without altering the importance and difficulty of an upcoming task, an important finding because influencing the task demands in actual performance settings is difficult. For example, convincing an academy athlete approaching a first team debut that they have worked hard for and may determine their career progression that it is not important is unrealistic and would require a significant amount of cognitive restructuring. In contrast, convincing them that they have the skills to succeed, have control over their performance, while encouraging them to focus on success, is simple and logical. From a leadership perspective this means that creating the climate for success under pressure could involve using challenge-framed instructions directly prior to an important event. It is well established that leaders can have an important influence on their subordinates’ responses to stressful situations (e.g., Baker, Côté, & Hawes, 2000; Smith, Smoll, & Weichman, 1998). For example, a coach could laden her team talk with references to confidence, control, and approach goals to promote a challenge state in her athletes, while retaining references to the importance of the occasion. Indeed, research suggests that speeches with high instructional content increase athletes’ functional emotions (Vargas-Tonsing, 2009). Importantly, as well as encouraging effective stress management, the promotion of challenge states may facilitate sport performance (e.g., Blascovich et al., 2004; Moore et al., 2012; Turner et al., 2013).

**Inoculation Training.** “I thrive on pressure now…In the past, maybe, the pressure might have got to me…But now it’s more exciting. You want to play in big games. You want to test yourself against the best in the world.” - James Anderson (cricketer who has represented England in over 50 Test matches and over 100 One Day Internationals; Brenkley, 2012).

Another way that challenge states could be promoted is by harnessing athletes’ ability to adapt to demanding situations by exposing them to controlled pressure in training. As the quote from England cricketer James Anderson highlights, many athletes find it difficult to handle the pressure of performing early in their careers, but through facing pressure many develop a resiliency allowing them to thrive when it matters most. In our research and consultancy work with elite athletes we have used “pressure testing” which involves setting up a highly evaluative, technically difficult, and well controlled scenario in which athletes must achieve a certain goal. For example, in cricket (Turner et al., 2013) we set up a Batting Test where athletes must reach a runs target of 30 runs off 36 deliveries from a pace bowling machine set at 80mph (technically difficult), with a set field (controlled). The athletes are video recorded, observed by coaching staff who will make selection decisions, and informed that their performance score will be seen by all other players (highly evaluative). Our research indicated that those facing the test in a challenge state perform better than those facing the test in a threat state, but also that athletes who had high self-efficacy and low avoidance goals performed well regardless of whether they were “challenged” or “threatened”. Given that the most powerful source of self-efficacy is past performance accomplishments (Bandura, 1997; Feltz & Lirgg, 2001), previous success under pressure, and the ability to draw on those experiences before future events, may allow even those who experience a threat state to still maintain their performance levels.

The use of pressure testing like the Batting Test may be a useful way of introducing athletes to pressure in a training context when used regularly and systematically. Desensitisation research suggests that repeated exposure to these types of activities could help athletes to adapt to stressful situations more easily (Wolpe, 1973), thus becoming better prepared for actual competitive pressure. To explain, as the athlete is subjected to stress regularly and systematically, they acclimatise to the experience of stress and develop or learn personal and often implicit resources for performing under pressured conditions. To allow the assessment of challenge and threat states the athletes’ progress through desensitisation could be measured using CV reactivity. Hypothetically, one would expect repeated exposure to a stressor, and more importantly multiple experiences of successfully coping under pressure, to promote challenge CV reactivity as demand appraisals, particularly uncertainty, become weaker compared to resource appraisals, accelerated by the addition of stress management techniques. In fact previous research has shown that prior exposure to stressful conditions which promote self-consciousness (explicit monitoring of task processes and procedures), help to inoculate against future stress, resulting in maintained and even improved performance (golf putting; Beilock & Carr, 2001). The notion that through stressful experiences one could better adapt to future stressors is akin to the idea of resiliency, a concept put forth in relation to challenge and threat states by Mark Seery (2011). In brief, resiliency is evidenced by the experience of a challenge state, and potential positive (or less negative) outcomes, during motivated performance situations. Importantly, Seery makes it clear that individuals with a history of *some* adversity should exhibit greater resiliency than individuals with either a history of no or high adversity. Therefore it is important to bear in mind that pressure testing should not be too traumatic for athletes, and does not need to be, in order to help enhance resiliency for future performance situations.

So, creating training environments that are highly evaluative may be a useful strategy in helping athletes to cope in motivated performance situations. In a study exploring challenge and threat states, participants either performed a learned task or a novel task, in front of an audience (Blascovich, Mendes, Hunter, & Salomon, 1999). Participants performing the learned task, thus having knowledge of their abilities, exhibited challenge CV reactivity, whereas participants who performed the novel task, thus having no knowledge of their abilities, exhibited a threat CV reactivity. The evaluative nature of having an audience most likely increased the perceived demands, with perception of danger, uncertainty, and required effort all potentially augmented beyond perceived resources. Similarly, a within-subjects analysis was used to examine how challenge and threat appraisals change over multiple tasks (Quigley, Barrett, & Weinstein, 2002). Results indicated that the repeated exposure to the task led to participants becoming more challenged, with changing cognitive appraisals determining changing physiological responses. Thus, a situation that becomes more familiar is purported to promote a challenge appraisal and challenge CV responses due to enhanced coping perceptions (Blascovich et al., 1999; Quigley et al., 2002). These findings echo Ursin et al’s (1978) research where repeated exposure to stressful tasks led to the development of a coping response.

In sum, there are environmental adjustments that can alter challenge and threat states. In particular, instructional sets can be used by significant others to promote challenge states, and the use of training that exposes athletes to stressful situations can help athletes to inoculate against the influence of threat states on performance. The strategies discussed thus far require the explicit influence of coaches, parents, and sport psychologists, on the training and or performance environment, but there are ways in which athletes can promote a challenge state through developing personal psychological skills.

### Psychological Skills

In this section we outline psychological skills that athletes can develop in order to promote a challenge state. By psychological skills, we refer to existing techniques and strategies that can be used by athletes prior to or during motivated performance situations. This section outlines the use of reappraisal and imagery.

**Reappraisal.** Reappraisal has emerged as an important strategy for regulating emotions (see Gross, 1998, for review). Reappraisal typically refers to an antecedent-focused strategy where an individual attempts to construe a potential emotion-eliciting situation in non-emotional terms (Gross, 2002). For example, some of the instructional sets discussed previously (e.g., Tomaka et al., 1997) encouraged participants to perceive a task to be low in difficultly thus removing the stressful nature of the situation. Indeed, Lazarus' early studies where a film was rendered harmless using instructions (e.g., Lazarus & Alfert, 1964), thus leading to less stress reactivity, is also relevant here. Recent research (see Jamieson, Mendes, & Nock, 2013) suggests that reappraisal can also be considered a response-focused strategy where an individual attempts to alter emotional responding once the emotion has been generated (Gross, 2002). That is, a student approaching an examination may experience feelings of anxiety. A response-focused re-appraisal strategy would encourage the student to perceive this anxiety as potentially beneficial for their performance. In contrast, an antecedent-focused re-appraisal strategy would encourage the student to perceive the exam as less threatening thus attenuating the generation of anxiety.

The central theme of this chapter is the idea that cognitive appraisal (unconscious or conscious) determines the experience of challenge and threat states (cognitive change; Gross, 2002). However, individuals can reappraise their emotional and physiological reactions to stressful situations as more helpful for performance, reflecting a response-focused strategy (Gross, 2002), subscribing to the idea that perceptions of bodily signals influences psychophysiological responses to acute stress (Gross, 2002; Hofmann & Smits, 2008). Two recent studies have used the BPS as a framework to examine the use of reappraisal on challenge and threat states. In one study (Jamieson, Mendes, Blackstock, & Schmader, 2010), participants in a reappraisal condition were told prior to an exam that “recent research suggests that arousal doesn’t hurt performance” and that “people who feel anxious during a test might actually do better.” They were also encouraged to “simply remind yourself that your arousal could be helping you do well.” (p. 2). In this response-focused strategy participants were encouraged to perceive their anxiety as helpful, in contrast to an antecedent-focused strategy, requiring the individual to perceive the situation as non-stressful. Participants in the reappraisal condition exhibited higher catecholamine levels, indicative of SAM activity, perceived their anxiety as helpful, were more confident about performance, and performed better in the subsequent exam compared to a control group.

In a second study (Jamieson, Nock, & Mendes, 2011), prior to a speech task participants in a reappraisal condition were educated about the functionality of physiological arousal during stress and informed that increased arousal during stressful situations has evolved to help humans successfully address stressors and therefore increased arousal actually aids performance in stressful situations. Again, participants were not encouraged to perceive the speech task as any less demanding or stressful. Results showed that participants in the reappraisals condition reported higher perceived resources, and exhibited higher increases CO as well as lower increases in TPR compared to the control group; indicating a more psychophysiologically adaptive response.

The two studies by Jamieson and colleagues offer partial support for the notion that reappraisal can promote a challenge state in motivated performance situations, and that reappraisal may facilitate motivated performance. Importantly, Jamieson et al. (2013) point out that the aim of reappraisal is not to decrease or dampen arousal, but rather to reshape how arousal is construed. Therefore, in contrast to the instructional sets discussed previously which promoted challenge appraisals over threat appraisals via an antecedent-focused strategy (Gross, 2002), reappraisal as used by Jamieson et al. encourages individuals to perceive their reactions to stress as helpful, a key characteristic of a challenge state (Jones et al., 2009), via a response-focused strategy (Gross, 2002).

Emotion regulation strategies such as reappraisal are evidently useful ways to promote challenge states and ultimately help individuals to better cope in stressful situations. However, a growing body of research suggests that one should exercise caution when attempting to employ emotion regulation strategies that include self-regulation under stressful conditions. That is, research consistently shows that after an initial bout of self-regulation (the process by which individuals consciously attempt to constrain unwanted thoughts, feelings and behaviours), subsequent self-regulation is disrupted, regardless of the sphere (Baumeister & Tierney, 2011). In other words, it matters little whether the initial bout of self-regulation task involves the control of thoughts, feelings, or behaviours; subsequent self-regulation in the same or different sphere is disrupted. Therefore, there may be a cost attached to regulating emotions via reappraisal which is yet to be fully explored in sport (Beedie & Lane, 2012; Jones & Turner, in press).

**Imagery.** Another way to promote a challenge state is to use a psychological skill such as imagery. Imagery involves realistically and usually intentionally (though it can occur involuntarily) recreating or creating events in the absence of physical practice. Imagery can be used to practice skills, for motivational purposes (e.g., Callow & Hardy, 2001), to regulate emotions (e.g., Hecker & Kaczor, 1988), to enhance self-confidence (Callow, Hardy, & Hall, 2001), and to promote coping under stress (e.g., Vadocz, Hall, & Moritz, 1997; for reviews, see Cumming & Ramsey, 2008; Martin, Moritz, & Hall, 1999). The mechanisms through which imagery is proposed to work has been debated for decades in literature, with Neuromuscular, Attention-Arousal, Self-Efficacy, and Bio-informational theories, being put forth to explain imagery (Moran, 2004). In brief though, by using imagery future performance is facilitated by allowing the individual to achieve a desired psychophysiological state, and by allowing the rehearsal of skills whilst avoiding fatigue.

Although the mechanisms may still be under debate, imagery is a well-known and well researched psychological strategy with a host of benefits for use prior to and during motivated performance situations (Durand, Hall, & Haslam, 1997). In addition to the well-established benefits of using imagery, three studies (Hale & Whitehouse, 1998; Williams & Cumming, 2012; Williams, Cumming, & Balanos, 2010) have used directed imagery to manipulate challenge and threat cognitive appraisals and CV reactivity in line with the BPS model (Blascovich & Mendes, 2000) and TCTSA (Jones et al., 2009). In Hale and Whitehouse (1998), a within-subjects' design was adopted in which 24 experienced soccer players randomly received an imagery-based video and audio-taped manipulation of their appraisal of taking a hypothetical match-winning penalty kick under either a “pressure” or “challenge” appraisal emphasis. That is, the video was identical in both conditions apart from the accompanying caption “pressure situation” or “challenge situation.” Results revealed that the challenge condition produced less cognitive anxiety, less somatic anxiety, and more self-confidence, but in line with the TCTSA's predictions, symptoms were perceived as facilitative for the challenge situation and debilitative for the pressure situation.

In Williams et al. (2010) some athletes received a challenge imagery script, that emphasized that athlete’s resources met demands of the situation (challenge appraisals), and promoted high self-efficacy (e.g., “you have confidence in your own ability to perform”) and perceived control (e.g., “demonstrating your sporting competence”), and emphasized potential gain (e.g., “there is real potential to achieve everything”; p. 347). The other participants received a threat imagery script that emphasized a threat appraisal, low self-efficacy, low perceived control, and emphasized potential loss. It was found that challenge imagery led to less threat appraisals, positive emotion perceptions, and higher confidence, while threat imagery led to more threat appraisals, negative emotion perceptions, and lower confidence. However, CV data revealed no differences between challenge and threat imagery conditions. Similar scripts were used by Williams and Cumming (2012) who found that the challenge script led to challenge appraisals and the threat script led to threat appraisal. CV data were not recorded, but it was found that those who received the threat script reported their emotional responses as more debilitating for performance compared to those who received the challenge script.

In sum, imagery may be a useful strategy through which athletes can promote a challenge state prior to motivated performance. In particular, athletes able to realistically rehearse events in their minds while focusing on high self-efficacy, high control, and approach goals (the resource appraisals in the TCTSA) may be able to engender a challenge state, leading to adaptive emotional and physiological reactions to stress. Therefore sport psychologists and coaches may wish to promote the systematic use of imagery in their athletes, for particular use in pressure situations.

### Concluding Remarks on Practical Implications

The agents of stress management can be both individuals approaching the motivated performance situation, and individuals responsible for a performer’s training and performance environment. That is, environmental adjustments made by individuals responsible for a performer’s training and performance environment can promote challenge states, primarily by exerting an influence on the performer’s cognitive appraisals. The use of instructional sets aimed at either reducing the significance of the event, or preferably increasing perceived resources while maintaining the significance, can be adopted by leaders, team mates, and significant others (e.g., parents, coaches). Inoculation training can also be driven by parents and coaches, but ideally in consultation with psychology practitioners who can ensure that the performer is exposed to controlled pressure and supported with stress management skills, for example by encouraging the athlete to reflect on the experience of succeeding in these pressured situations.

Whilst the promotion of successful adaptation can be driven by others, the most powerful agent of change is obviously the individual approaching the motivated performance situation, namely the athlete. Therefore, helping athletes to develop psychological skills such as reappraisal and imagery ensures that the athlete is able to self-regulate across situations regardless of changing support networks (e.g., coach, psychologist). Allowing athletes to have autonomy over the psychological skills required in order to cope with stressful situations may also add to the control aspect of the resource appraisals. For example, by developing personal psychological strategies to cope with stressful situations athletes can experience a sense of control over their psychophysiological responses to pressure. In all, employing strategies that mediate the transaction between stressor, perception, and response is key to promoting adaptation in motivated performance situations. By exerting an influence on the transactional process outlined in the TCTSA, challenge states can be promoted. More specifically, by increasing resource appraisals concerning motivated performance situations through the use of environmental adjustments and psychological sills, adaptive reactions to stress can be promoted.

### Key Points to Enhance Adaptation

I am always fascinated to watch how a guy handles a pressure situation… the true greats keep their self-belief, trust themselves and continue to work away, knowing that if the foundations have been established, good form will come -Steve Waugh (in his 2005 Autobiography).

In this chapter we have adopted the TCTSA as our core framework through which a transactional perspective of stress in performance settings has been explored. The quote by Steve Waugh highlights the importance of maintaining self-belief amongst other things, which throughout this chapter has emerged as a key psychological component of positive adaptation. From the research concerning challenge and threat theory (TCTSA, BPS model, model and adaptive approaches to competition) and the investigations in to the factors that can promote a challenge state, the resource appraisals within the TCTSA are critical. Having high self-efficacy, high perceived control, and a focus on approach goals can set into motion not only particular adaptive CV reactivity, but also a host of psychological and emotional consequences known to facilitate performance in competitive settings. In addition, as practitioners in the field working with high-level performers, we see the resource appraisals emerge again and again as the key factors in determining performance when it counts. Therefore, we suggest that the decisive ways to encourage a challenge state, and subsequent positive adaptation, are strategies aimed at promoting high self-efficacy, high perceived control, and a focus on approach goals. A challenge state reflects an adaptive psychophysiological approach to motivated performance situations, associated with more efficient physiological reactivity, more efficient attentional deployment, more effective kinematics, and of course, superior performance. So promoting the resource appraisals is highly important for athletes to fulfil their potential, especially under pressured performance circumstances.

To promote perceived control, from the research and our applied work, we would advocate the use of a pre-performance strategy that helps the performer to focus only on the things they can and need to do to perform well, that are under their control. We call this a "Challenge Strategy" and it encompasses imagery as way to first evoke feelings of confidence, but chiefly to facilitate an intense focus on key aspects of the performance. In practice, the athlete is encouraged to recognise what they need to do in the first five minute of a performance that can allow them to build momentum and perform with confidence. For a soccer athlete this might be: (a) make one positive run down the wing, (b) make one strong tackle, and (c) make one positive pass up field (e.g., through ball or long ball). Then, the athlete strongly harbours the intention to carry out these aspects and only focuses his mind on achieving this in the lead up to performance. To achieve this focus, the athlete engages in imagery to visualise performing the key aspects successfully, drawing on past performance accomplishments. The important thing here is that the key aspects are aspects the athlete has done before successfully, and are controllable by them. We sometimes call this "The Michael Johnson Approach" which is based on a quote from Johnson's (2012) book, where he said prior to a race “I started my automatic default mechanism of visualising myself running the race… I thought about the things I needed to do in the race.” Johnson also make another good point that relates to the challenge strategy that “It's not enough to say ‘don't think negative thoughts’, you have to replace them with something else.” The challenge strategy works not only because it allows the athlete to focus on what they need to do, but also because while they are visualising, they are not thinking about failure or dwelling on the importance of the occasion.

## Conclusion

In this chapter we have given a historical account of the theoretical and research underpinnings of the transactional perspective with regards to stress in sport. In doing so, we explored the notions of challenge and threat and in particular, we have detailed the TCTSA and supporting research conducted by us in our laboratory and by others. We have also provided well supported psychological strategies and techniques for promoting adaptation for use with, and by, athletes. Lastly, we have given an account of the key strategies we feel can enhance adaptation, used in our consultancy work and supported by research presented previously in the chapter.

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