APPROACHES TO COMPETITION: CHALLENGE AND THREAT STATES IN ATHLETES

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ABSTRACT

Athletes can approach competition positively, as a challenge, or negatively, as a threat. The theory of challenge and threat states in athletes (TCTSA) outlines that a challenge state, contrary to a threat state, is characterised by high levels of self-efficacy and perceived control, approach goals, positive emotions, a helpful interpretation of emotional state and a cardiovascular reactivity pattern of increased cardiac output and decreased total peripheral resistance. The aim of this thesis was to examine relations between these cognitive, affective, and physiological components of challenge and threat states in a sport setting; research in sport have mostly examined these components separately. Five studies were conducted to examine this aim. These comprised a qualitative analysis of athletes' interviews about an upcoming competition, a cross-sectional questionnaire study, two studies where self-report data were associated with cardiovascular responses to an upcoming competition or previous competition, and a case study. Overall, the cognitive and affective components are somewhat supportive of the TCTSA, with a positive relation between self-efficacy, perceived control and approach goals. Threat appraisal and anxiety were positively predicted by avoidance goals. Most of the physiological findings, however, were not in line with the predictions of the TCTSA. Specifically, participants who had high levels of self-efficacy appeared to be physiologically threatened by an upcoming competition. There was no consistent relation between the cognitive, affective, and physiological components regarding previous competitions. Temporal patterning may be one of the main confounding factors for the inconsistent findings as the relations between physiological, cognitive, and affective components all change in the lead up to competition.

This thesis makes an original contribution to stress research by exploring the combination of cognitive, affective, and physiological components outlined by the TCTSA using a holistic understanding of how athletes approach competition.

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PREFACE

Research reported in this thesis has contributed to the following publications and conference presentations.

Peer reviewed publications:

Jones, M. V., Meijen, C., McCarthy, P. J., & Sheffield, D. (2009). A theory of challenge and threat states in athletes. *International Review of Sport and Exercise Psychology, 2,* 161-180.

Conference presentations:

Meijen, C. (2010). *A test of the cognitive and affective components of challenge and threat states*. Oral presentation, Division of Sport and Exercise Psychology Conference 2010, London, United Kingdom, December 2010.

Meijen, C., Jones, M. V., Sheffield, D., & McCarthy, P. J. (2010). *Cognitive, emotional and cardiovascular responses when recalling a good and bad performance in sport*. Oral presentation, The European College of Sport Science 15th Annual Congress, Antalya, Turkey, June 2010.

Meijen, C., Jones, M. V., Sheffield, D., & McCarthy, P. J. (2010). *Challenge and threat states in athletes: Are your head and heart telling you a different story?* Oral presentation, The British Psychological Society Annual Conference, Stratford-upon-Avon, United Kingdom, April 2010.

Meijen, C., Jones, M. V., Sheffield, D., & McCarthy, P. J. (2009). *Is what you think you feel really what you feel? Challenge and threat states in sport*. Oral presentation, International Society of Sport Psychology 12th World Congress, Marrakech, Morocco, June 2009.

Meijen, C. (2009). *Psychological correlates of challenge and threat states in a sport setting.* Poster presentation, Springschool The ABC of Stress: Biopsychological Assessment, Basics and Consequences, Dresden, Germany, March 2009.

Meijen, C., Jones, M. V., McCarthy, P., & Sheffield, D. (2008). *Psychological correlates of challenge and threat perceptions in sport*. Oral presentation, The British Psychology Society: The Division of Sport and Exercise Psychology Inaugural Conference, London, United Kingdom, December 2008.

Meijen, C. (2008). *Approaches to competition*. Poster presentation, PsyPAG Annual Conference, Manchester, United Kingdom, July 2008.

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CHAPTER 1: LITERATURE REVIEW

1.1 Introduction

Sport is a demanding achievement setting in which athletes' performances are continuously evaluated; however athletes' perceptions of these demands vary amongst individuals. Some athletes might approach competition positively, whereas others approach competition negatively. These positive and negative approaches to competition can also be referred to as challenge and threat states. A challenge state occurs when an individual perceives sufficient resources to meet situational demands and a threat state occurs when an individual perceives there are not enough resources to meet situational demands (Blascovich & Mendes, 2000). To illustrate these differences in approaches to competition, imagine two tennis players who are about to play a final. One player experiences increased heart rate, believes he has the range of shots needed to perform well in this game and experiences feelings of excitement about playing on the centre court. The other player experiences increased blood pressure, is unsure if he has the ability to return the strong serve of his opponent over which he has no control, and he feels anxious about the media coverage and the audience. These two experiences can be explained in terms of challenge and threat, the first player represents a challenge state and the second player represents a threat state.

The example illustrates that cognitive, affective, and physiological components play a role in challenge and threat states. Challenge states are thought to result in positive emotions, increased energy levels, and dedication, resulting in improved performance, whereas threat states are thought to result in negative emotions, reduced effort and energy levels (Blascovich, Seery, Mugridge, Norris, & Weisbuch, 2004; Skinner & Brewer, 2004), which in turn debilitates performance (e.g., Wilson, Raglin, & Pritchard, 2002). Perceptions of an achievement situation such as a sport competition may result in different psychological and physiological responses toward competition, which in turn affect the performance outcome. Not much research has examined *both* psychological and physiological responses in sport; researchers have mostly examined psychological and physiological responses in an experimental setting, for example using mental arithmetic tasks (Schneider, 2008), and found that psychological and physiological responses affect performance. Challenge and threat states provide a platform to examine athletes' approaches to competition, using cognitive, affective, and physiological components.

This literature review will focus on approaches to competition and the psychological, affective and physiological responses that might arise as athletes approach competition. Most research examining psychological and physiological responses as athletes approach competition has focused on multidimensional anxiety theory (Martens, Burton, Vealey, Bump, & Smith, 1990). Multidimensional anxiety theory makes a distinction between somatic and cognitive anxiety: somatic anxiety is the perception of physiological arousal, such as tension, and cognitive anxiety refers to worries or negative expectations (Martens et al., 1990). Somatic anxiety and cognitive anxiety can influence performance differently. Multidimensional anxiety theory also examines the role of self-confidence in the anxiety-performance relation. The three main predictions made by Martens and colleagues are that there is a negative linear relation between cognitive anxiety and performance, an inverted-U relation between somatic anxiety and performance, and that somatic anxiety decreases once the individual commences the stressful event, whilst cognitive anxiety could remain high when the individual has low levels of self-confidence (Martens et al., 1990). These predictions have, however, received equivocal support (see Craft, Magyar, Becker, & Feltz, 2003, for a review). Although multidimensional anxiety theory takes into account both the cognitive and somatic aspects of anxiety, there are limitations in how somatic anxiety is measured. For example, increases in heart rate can be indicative of other emotions than anxiety (Cerin, Szabo, Hunt, & Williams, 2000), such as anger (Levenson, 1992), enjoyment (Frijda, 1986) or a combination of emotions. The focus of this thesis is on a more holistic approach to examine stress as athletes approach competition, rather than only focusing on the influence of anxiety on performance. This holistic approach included cognitive, affective, and physiological components. In this literature review traditional stress research (Cox, 1978; Lazarus & Folkman, 1984) will be outlined first before discussing the biopsychosocial model of arousal (Blascovich & Mendes, 2000) and the model of adaptive approaches to competition (Skinner & Brewer, 2004). In addition, current research in challenge and threat states will be discussed and applied to sport. This is brought together and expanded in the theory of challenge and threat states in athletes (TCTSA; M. V. Jones, Meijen, McCarthy, & Sheffield, 2009) addressing a unique combination of cognitive, affective, and physiological components of challenge and threat states.

Much research examining individual's responses to demanding situations has its grounds in early stress research. Early stress research identified positive and negative approaches to demands (Cox, 1978). This notion of positive and negative approaches to demands has been introduced by Selye (1956), who described stress as a nonspecific physiological response of the body to a demand. He noted that these demands could be positive stressors (eustress), negative stressors (distress), or neutral. Even though Selye focused on physiological responses to demands, his research has been an inspiration for further stress research focusing on the interaction between the person and environment (Cox, 1978). Demands can relate to what is at stake in a competitive situation, for example accomplishing a goal. Cox outlined that stress is “part of a complex and dynamic system of transaction between the person and his environment” (p. 18) where stress is defined as a negative imbalance between the demands and perception of coping abilities, this occurs when an individual perceives insufficient coping abilities to deal with the demands of a situation. This transaction between the person and environment includes a feedback component, which indicates that this transaction is cyclical (Cox, 1978). Based on this feedback the person might approach the next demand differently, so for example an individual, who has beaten her opponent four times previously but lost the last time, might approach the next competition as an increased demand. The transactional model of stress (Cox & Mackay, 1976) comprises five stages. Stage one comprises of situational demands and this is different for each person. Stage two entails the person’s perception of the demand and his/her ability to cope with the demand, if there is an imbalance between the *perceived* demands and the *perceived* capability stress arises. This stage emphasises the importance of cognitive appraisal of the perceived demands of the situation and the perception of available coping resources. Stage three entails the subjective (emotional) experience of stress as a result of a negative imbalance between demands and capabilities. These subjective experiences are accompanied by psychological (cognitive and behavioural attempts) and physiological changes aiming to decrease the nature of the demand which was part of the imbalance. Stage five concerns feedback and comprises physiological responses, behavioural responses (which can change the original demand), and the effectiveness of the coping response. If this coping response is ineffective, this can increase or prolong the stress experience. In summary, stress occurs when there is a negative imbalance between demands and perceived coping options and the situation is important to the individual; the transactional model of stress outlines this dynamic nature of the transaction between the person and his environment (Cox, 1978).

1.2 Appraisal Theory

As noted earlier, cognitive appraisals are central to the stress process (Cox, 1978; Lazarus, 1966) and influence the perception of a situation as a challenge or a threat. The process of appraising can be deliberate and largely conscious, or intuitive, automatic and unconscious and is often described as primary and secondary appraisal (Lazarus, 1966, 1999). Primary appraisal refers to whether a situation is relevant to a person, in terms of their goals, and entails goal relevance, goal congruence or incongruence, and type of ego involvement (Lazarus, 2000a). Goal relevance pertains if there is something important at stake; if an athlete perceives that there is nothing at stake, it is unlikely he/she will experience an emotion (Lazarus, 2000a). Goal congruence or incongruence describes the extent to which an event is appraised as helpful or unhelpful; when there is incongruence between the event and the athlete's goals the athlete is likely to experience negatively toned emotions (Lazarus, 2000a). Type of ego involvement (also referred to as goal content; Lazarus, 2000a) reflects the type of goals that are at stake; these are enhancement of the self, maintenance of moral values, ego-ideals, meaning and ideas, other persons and their well-being, and life goals (Lazarus, 1991). Lazarus (2000a) suggested that the type of goal relates to the emotion that is experienced, however, an athlete might experience numerous emotions when they have more type of goals in a particular situation (Uphill & Jones, 2004).

Secondary appraisals refer to an individual's perceived coping options, and include blame or credit, coping potential and future expectations. This is a cognitive-evaluative process (Lazarus, 1999). Within appraisal theory, challenge is regarded as having a potential of gain and threat is regarded as having a potential outcome of loss (Lazarus, 2000a) and both are regarded to be primary appraisals. Challenge and threat appraisals are accompanied by a state of uncertainty, as challenge and threat appraisals occur prior to or in anticipation of a stressful situation, of which the outcome is usually unknown (Lazarus & Folkman, 1984). A sport competition is an example of such a situation. Appraisals can occur just seconds before the actual situation happens, for example just before taking a free throw in basketball, a penalty kick in football, or seeing competitors in a relay race in swimming. Challenge and threat appraisals can occur in the same situation; however one usually dominates the situation (Lazarus, 1999). Cerin (2003) reported that athletes who were asked about their pre-competitive emotions and appraisals reported various challenge and threat patterns; 51% of the participants reported a mixed pattern of challenge and threat appraisals. Forty two percent perceived the competition solely as a challenge, three percent reported to perceive the competition as a threat, and three percent reported neither challenge nor threat appraisals.

Various factors can influence appraisals, such as expectancies. Elite athletes who participated in the Commonwealth games were asked about their most stressful experience, and to indicate if this stressful experience was expected (planned or prepared for) or unexpected (Dugdale, Eklund, & Gordon, 2002). Athletes faced with an expected stressor reported different cognitive appraisals compared to unexpected stressors; unexpected stressors were appraised as more threatening. In addition, unexpected stressors were related to more avoidance behaviours, like holding back or hesitating from responding to the stressor, compared to expected stressors.

In summary, how an athlete appraises the demands and available coping options influences challenge and threat states; expectancies of the situation is an example of a factor that can influence these appraisals. Unexpected stressors have been appraised as more threatening than expected stressors. Demand appraisals and available coping resources have mostly been measured using self report items, there are limitations using this approach which are discussed next.

1.2.1 Measurement Issues

There are some problems with measuring challenge and threat appraisals in sport. First, how challenge and threat appraisals are defined varies between studies. Some researchers have considered challenge and threat appraisals to be affective states (Burton & Naylor, 1997; Smith & Ellsworth, 1985), or considered challenge appraisals to be similar to self-confidence (e.g., Burton & Naylor, 1997). Most challenge and threat appraisal research have used Lazarus' (1991) definition of challenge as an opportunity for growth and threat as an opportunity for failure or damage (e.g., Drach-Zahavy & Erez, 2002). An issue with measuring challenge and threat appraisals this way is that this definition does not take the interaction between primary appraisals (the demands of the situation) and secondary appraisals (perceived available resources) into account with challenge and threat states being measured using a single item. Second, the measurement of challenge and threat appraisals varies between studies. Some researchers have used a measure of stress (i.e., "how stressful do you think the upcoming task will be") where challenge and threat states were considered as opposites along a continuum, whereas others have measured challenge and threat appraisals as separate items, such that a mixed pattern of challenge and threat could occur (Campbell & Jones, 2002; Cerin, 2003; Lonsdale & Howe, 2004). In addition some researchers have included single-item measures to examine perceived available coping options (i.e. "how able are you to cope with the mental arithmetic task?"; Tomaka, Blascovich, Kibler, & Ernst, 1997).

In conclusion, some of the research might not have measured challenge and threat appraisals as outlined by Lazarus (1991), also the instruments to measure challenge and threat appraisals varied across studies. One way of addressing this measurement issue is to measure physiological responses in addition to cognitive appraisals, to provide a holistic understanding of athletes' approaches to competition. The biopsychosocial model (Blascovich & Mendes, 2000) is an example of a theory that includes both cognitive appraisals and physiological responses to demanding situations.

1.3 Biopsychosocial Model

The biopsychosocial (BPS; Blascovich & Mendes, 2000) model of arousal of challenge and threat builds on Lazarus and Folkman's (1984) concept of challenge and threat appraisals and Dienstbier's (1989) toughness model. The BPS model addresses some of the issues emerging from cognitive appraisal research by also describing the physiological responses to demands. In the BPS model the conditions under which challenge and threat states occur are described and the relating physiological aspects and emotions are outlined. In the context of the BPS model challenge and threat are characterised by motivational performance states including cognitive, affective, and physiological components (Blascovich & Mendes, 2000). Cognitive appraisal is the initial mediator in the goal relevant situation-arousal component (Blascovich & Mendes, 2000; Blascovich & Tomaka, 1996). Thus how an individual appraises the situational demands influences how relevant the situational demands are for his/her goal. Goal relevancy characterises the general domain of the BPS model and challenge and threat states only occur in goal relevant situations and refers to a situation that has perceived consequences for the psychological or physical well-being of the individual; goal relevant situations usually occur in two types, a passive situation or a motivational performance situation (Blascovich & Tomaka, 1996). In the BPS model, the emphasis is on a motivational performance situation, where something is at stake. For example in a sport setting, the outcome of a competition can be at stake. How individuals appraise the demands of a competition and their resources to cope with these demands influences if someone perceives the situation as a challenge or a threat.

Appraisals may involve affective processes, cognitive processes or both (Blascovich & Mendes, 2000). During performance episodes, the situation and individual react to each other, and external events may interfere, to create a dynamic process (Blascovich & Mendes, 2000). To explain how cognitive processes play a role in appraisal, a situation may start challenging, but as the event progresses it may become threatening, or vice versa. For example a swimmer has the fastest personal best in a 200m free stroke final and believes she can perform well. During the race, however, the swimmers in the lanes next to her are swimming the first 50 meters much faster than she expected and she turns as one of the last swimmers, this makes her uncertain about the outcome and she is not sure if she has the energy to catch up. In the BPS model challenge occurs when an individual perceives (nearly) sufficient resources to meet the situational demands. Threat, on the other hand, occurs when an individual perceives to have insufficient resources to meet the situational demands (Blascovich & Mendes, 2000). Challenge and threat appraisals are idiosyncratic, what is perceived as a challenge by one may be perceived as a threat by another (Blascovich & Mendes, 2000). The definitions of challenge and threat appraisals are grounded in the concepts of demands and resources. Blascovich and Mendes (2000) described demand appraisals as the "perception of danger, uncertainty, and required effort inherent in the situation" (p. 63) and referred to demand appraisals as similar to the concept of primary appraisals. Resource appraisals are the perception of the knowledge and skills applicable to the situational performance. Resource appraisals are similar to secondary appraisals because they reflect perceived available coping resources. Non-conscious demand or resource appraisals can also contribute to challenge or threat appraisals without the awareness of the appraisals themselves (Blascovich & Mendes, 2000).

Affective cues also play a role in demand appraisals. For example, prior learning of associated affective cues (like a hostile voice or a certain accent) can lead to a challenge or threat (Blascovich & Mendes, 2000). Affective cues also influence uncertainty; in general individuals prefer items they feel familiar with. If these items or objects are not available, this may lead to uncertainty. If feelings of familiarity are available, this may reduce task uncertainty, and benefit the task at hand (Blascovich & Mendes, 2000). For example, an athlete who is familiar with a cross country track might experience less task uncertainty compared to an athlete who has not competed at the track before. The role of affective cues in resource appraisals is not (yet) clearly understood. To summarise, the BPS model states that demands and resources are influenced by cognitive appraisals and affective cues. This influences challenge and threat states. In addition physiological aspects influence challenge and threat; the physiological aspects of the BPS model are discussed next.

1.3.1 Physiological Responses to Demands as Outlined in the BPS Model

The BPS model has outlined cardiovascular reactivity patterns that categorise challenge and threat states. The physiological principles of the BPS model are mainly based on Obrist's (1981) work on cardiovascular psychophysiology and Dienstbier's (1989) physiological toughness model. The toughness model implies that triggering central and peripheral arousal does not necessarily have to result in a negative outcome. Two neuroendocrine systems are central to toughness; sympathetic nervous system adrenal medullary (SAM) arousal and pituitary adrenal cortical (PAC) arousal. SAM arousal is thought to be responsible for the release of norepinephrine and epinephrine. PAC arousal results in the release of adrenocorticotropin (ACTH) into the blood, resulting in the release of cortisol. Challenge and threat states are thought to relate to the degree of difference between the sympathetic-adrenomedullary (SAM) and pituitary-adrenocortical (PAC) axes. Blascovich and Mendes (2000) proposed that challenge generates increased SAM activation, and threat results in increased

SAM and PAC activation, this inhibits vasodilation -mediated by the release of epinephrine- that would otherwise take place (Blascovich & Mendes, 2000).

The blood supply, oxygen and glucose consumption by the brain increase significantly when an individual is confronted with a potential stressor, such as an important competition, compared to the values when at rest (Dienstbier, 1991). Glucose availability and metabolism are influenced by epinephrine (EPI), norepinephrine (NE), and cortisol, whereas EPI levels mainly regulate glucose levels. Individuals who are toughened (being exposed to numerous situations that might be potentially taxing, for example playing in front of a large audience) produce more EPI when confronted with a mental stressor, such as an important competition. As a result, there is more energy to cope with the situation in the short term (Dienstbier, 1991). When taking challenge and threat into account, the anticipation of success and feelings of control (associated with a challenge) prevents CNS catecholamine depletion, through an arousal balance that favours catecholamines over cortisol. Feelings of energy are generated by EPI responses resulting in increased blood glucose. On the other hand, high cortisol levels are related to feelings of tension and fear (Dienstbier, 1991). The toughness model further suggests that the tough get tougher by increasingly enhancing their goals (Dienstbier, 1991); these individuals may perceive more demanding situations as a challenge.

A non-invasive way to assess these changes in PAC and SAM activity is by measuring cardiovascular responses. Challenge states are reflected by greater cardiac reactivity (increased cardiac output) and a decrease in systematic vascular resistance (less total peripheral resistance; Blascovich & Mendes, 2000; Blascovich & Tomaka, 1996). The release of epinephrine in this situation can cause vasodilation (widening of blood vessels resulting from relaxation of the muscular wall of the vessels), resulting in a decline in vascular resistance. Threat patterns of cardiovascular reactivity are represented by an increase in cardiac and vascular resistance in healthy individuals. The release of epinephrine is inhibited by parasympathetic-adreno-medullary (PAM) activity. In combination with increased sympathetic-adreno-medullary (SAM) activity, this may lead to (high) increases in blood pressure. Challenge patterns of cardiovascular reactivity are similar to patterns of an individual who is physically exercising (Tomaka, Blascovich, Kibler, & Ernst, 1997).

Challenge and threat patterns of cardiovascular reactivity have been identified by measuring heart rate (HR), preejection period (PEP), cardiac output (CO) and total peripheral resistance (TPR) using impedance cardiography (Blascovich et al., 2004; Quigley, Feldman Barrett, & Weinstein, 2003; Tomaka et al., 1997). Impedance cardiography estimates stroke volume (used to calculate cardiac output) and assesses systolic time intervals (e.g. preejection period). Studies using impedance cardiography typically use aluminium coated Mylar band electrodes to measure impedance (measure of resistance) and estimate stroke volume and systolic time intervals. Two voltage electrodes are placed around the base of the neck and around the chest at the level of the xiphisternal junction. The xiphisternal junction is located near the bottom of the sternum. Two current electrodes are placed at least three centimetres away from the voltage electrodes (Sherwood et al., 1990). Figure 1.1 illustrates the placement of the electrodes. A current of 4 mA at 100 kHz is passed through the outer electrodes and impedance is measured from the inner electrodes (Sherwood et al., 1990).

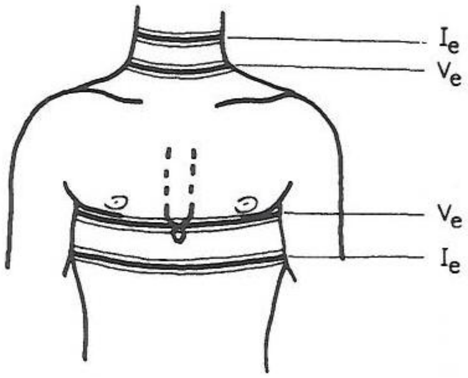

Figure 1.1. Band electrode placement (reprinted from Sherwood et al., 1990)

Cardiac output (CO) measures the amount of blood ejected from the left ventricle into the atrial system, usually measured in litres per minute. Total peripheral resistance (TPR) refers to the overall systematic vascular resistance summed across all the major arterial trees (brain, muscle, skin, lungs, mesentery). TPR is calculated by dividing mean arterial pressure (MAP) by CO and multiplying by 80 (Sherwood et al., 1990). Multiplying by 80 is required to express TPR in metric units (dyne-second X cm^{-5}; Sherwood et al., 1990). Changes in blood pressure can be caused by relative changes in CO, TPR, and/or HR. Heart rate is a measure of cardiac chronotropic (contraction of the heart) performance and measured in beats per minute. The heart rate reflects the total of antagonistic activity between the parasympathetic nervous system (negative chronotopic influence) and sympathetic nervous system (refers to positive chronotropic influence). Preejection period is an index of isovolumic contraction (the ventricular muscle continues to contract, whilst increasing the ventricular pressure but with no change in the ventricular volume) time directly related to the degree of cardiac contractile force (this can be the heart beating or inotropic – alters the force or energy of muscular contractions- performance).

The cardiovascular reactivity characterising the challenge pattern can be observed by an increase in HR, CO, and PEP and a decrease in TPR. The threat pattern is observed by an increase in HR, PEP, and TPR and no changes or a slight increase in CO (Tomaka et al., 1997). These changes are outlined in Table 1.1 and illustrated in Figured 1.2.

Table 1.1

Proposed Changes in Cardiovascular Reactivity in Challenge and Threat States

	Challenge	Threat
Heart rate	↑	↑
Preejection Period	↑	↑
Total Peripheral Resistance	↓	↑
Cardiac Output	↑	↔↑

Blascovich and his colleagues outlined that for a challenge and/or threat pattern to occur the task should be goal relevant and evaluative, this is measured by an increase in heart rate compared to a baseline measure of heart rate (Blascovich & Mendes, 2000; Blascovich & Tomaka, 1996).

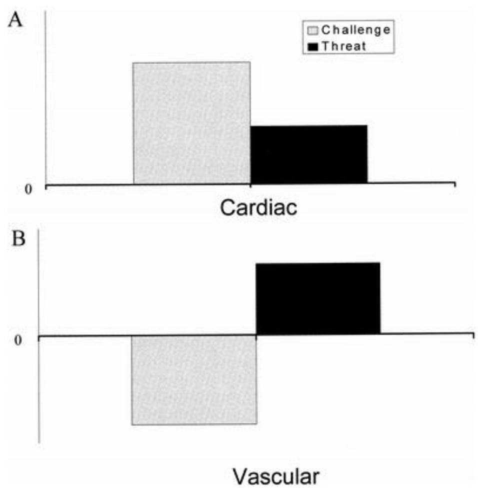

Figure 1.2. Theoretical pattern of cardiac and vascular activity (reprinted from Blascovich, Mendes, Hunter, & Salomon, 1999)

1.3.2 Determinants of Neuroendocrine Responses

Neuroendocrine responses include the release of norepinephrine, epinephrine, and cortisol. The relevance of neuroendocrine research to challenge and threat states is to better understand the mechanisms that underlie the cardiovascular changes characterising challenge and threat states. Numerous factors can influence the neuroendocrine responses, such as age, gender, time to an event, physiological mediators (e.g., Rimmele et al., 2007 & 2009), performance (Suay et al., 1999), temperament and personality characteristics (Kudielka, Hellhammer, & Wüst, 2009), as well as affect (Filaire, Alix, Ferrand, & Verger, 2009; Frankenhaeuser, 1979) and cognitive appraisals (Salvador, Suay, González-Bono, & Serrano, 2003). For example, explanatory style or how individuals explain the outcome of an event can influence the cortisol response. Male students who were optimistic about their performance on an upcoming exam revealed increased cortisol responses compared to pessimistic students who did not demonstrate increases in their cortisol responses (Ennis, Kelly, & Lambert, 2001). It appeared that pessimistic students gave up and did not put anymore effort in the exam, and therefore they did not demonstrate a cortisol response, the pessimistic students appraised the exam as uncontrollable and disengaged from the exam, whereas the participants that felt they could do well in the exam would need energy to perform well (Ennis et al., 2001). Furthermore, anticipatory cognitive appraisals are suggested to be an important determinant of the cortisol response, the anticipation of a potential stressor can increase the release of cortisol (Gaab, Rohleder, Nater, & Ehlert, 2005). Because the consequences of hypothalamic-pituitary-adrenal (HPA) axis (helps to produce cortisol and regulate energy) activation are active until about an hour after the perceived stressor, cortisol stays in the body for approximately 90 minutes, HPA axis activation has a stronger association with anticipatory appraisals compared to retrospective stress appraisals (Gaab et al., 2005).

In addition, experience seems to influence the neuroendocrine response. The physiological toughness model (Dienstbier, 1989, 1991) suggests that physiological toughness can be trained and toughened manipulations can create resistance to catecholamine depletion, peripheral catecholamine responsivity, increased beta-sensitivity, as well as cortisol suppression. These physiological responses related to toughness can lead to positive performance (Dienstbier, 1989, 1991). A tough individual is more likely to experience a challenge state in the prelude to competition, because he/she perceives sufficient (physiological) resources to cope with the demands of the competition.

Neuroendocrine Research in Sport. Neuroendocrine responses have received increasing interest in sport competition research. Some increase of cortisol is “normal” and prepares athletes for performance (Filaire et al., 2009; Kivlighan, Granger, & Booth, 2005). Studies have reported an increase in cortisol in anticipation of a stressful event (Bateup, Booth, Shirtcliff, & Granger, 2002; Filaire et al., 2009) small increases in cortisol are useful to prepare for a stressful event because this initiated a greater availability of energy which is part of the physiological preparation before the start of competition (Arthur, 1987; Salvador et al., 2003), small increases also indicate engagement with the task (Ennis et al., 2001; Tops & Boksem, 2008). Large increases of cortisol, however, can negatively influence performance (Bateup et al., 2002; Filaire et al., 2009) because it hinders cognitive processes such as attention, perception, and emotional processing (Erickson, Drevets, & Schulkin, 2003).

The relation between cortisol and performance has been examined across many sport settings. To measure psychophysiological stress of tennis players, anxiety and cortisol measures were taken during the first match of a tournament (Filaire et al. 2009). The highest cortisol levels were found in tennis players who lost their match. Similar findings are reported in research examining judo players (Salvador et al., 2003) and wrestlers (Elias, 1981, as cited in Filaire et al., 2009). A study examining cortisol levels in women’s rugby found that cortisol increased in anticipation of competition. The outcome did also have an influence on cortisol levels; cortisol increases were lower for winners than for losers (Bateup et al., 2002). The influence of competition outcome on the cortisol response has been examined in other studies (e.g. Suay et al., 1999). It was found that judo competitors who won displayed higher levels of cortisol change compared to competitors who lost. It must be noted though, that this is based on a change score comparing the ten minutes before competition with ten minutes after competition; the anticipatory appraisal differences between winners and losers were not clearly reported. Not all studies have found differences in cortisol between winners and losers (e.g. Edwards, Wetzel, & Wyner, 2006; Oliviera, Gouveia, & Oliviera, 2009). Using winning and losing as a measure of performance is more difficult in team sports, where an individual's performance is not directly accountable. A player might have had a "good" game, yet lose the game or a player might have performed below their "usual" standard, but the team still won the game, both Edwards et al. and Oliviera et al. studied team sports and used soccer players in their studies and perhaps this is a reason they did not find differences in cortisol between winners and losers. Other measures, such as perceived performance ratings or performance ratings such as observations by experts in the field might prove to be more valuable to examine the relation between cortisol and performance. For example, research examining the relation of basal nocturnal catecholamine excretion (dopamine, epinephrine, and norepinephrine) before competition on performance in cross-country skiers used expert judgments of performance in addition to results in competition (Knöpfli, Calvert, Bar-Or, Villiger, & Von Duvillard, 2001). Knöpfli et al. found that athletes who had their best competition results and highest expert judgments had higher levels of norepinephrine and dopamine concentrations compared to those who performed at a lower level.

In summary, small increases of cortisol in anticipation of a stressful event have been reported in many studies. These studies underline the relevance of examining neuroendocrine responses in sport because high increases in cortisol might influence performance negatively and no increase in cortisol at all might indicate disengagement with the situation. The CVR responses as outlined by the BPS model indicate neuroendocrine changes and provide a non-invasive way of measuring physiological responses as athletes approach competition.

1.3.3 Early BPS model Research

Research examining the BPS model has been conducted across many domains, varying from social identity threat (Scheepers & Ellemers, 2005), performance feedback (Seery, Blascovich, Weisbuch, & Vick, 2004), social facilitation (Blascovich et al., 1999) to the athletic domain (Blascovich et al., 2004). Tomaka, Blascovich, Kelsey, and Leitten (1993) conducted one of the earlier studies in challenge and threat appraisals and cardiovascular responses. They examined the subjective, physiological and behavioural effects of threat and challenge appraisal in three studies. The first study examined the relations between cognitive (challenge and threat) appraisals, physiological and subjective responses when performing active coping tasks. Cognitive appraisals were measured using two questions: “How stressful do you expect the upcoming task to be?” to measure primary appraisal and, “How able are you to cope with this task?” to measure secondary appraisal. These questions were rated on a seven-point Likert scale and an index of cognitive appraisal was calculated as a ratio of primary and secondary appraisal. These cognitive appraisals were measured after the instructions for the mental arithmetic task were given; subjective stress (“How stressful was the task you just completed?”) was measured following the mental arithmetic task. Skin conductance responses, pulse transit time, and heart rate were recorded continuously for the duration of the experiment. The participants took part in the task twice, with different subtraction intervals. The results showed that cognitive (challenge and threat) appraisals predict subjective and physiological responses to a mental stressor. The findings for cognitive appraisals and subjective stress were in line with Lazarus and Folkman’s (1984) stress theory, threat appraisals were associated with greater subjective stress compared to challenge appraisals. Participants who portrayed cognitive appraisals representing a challenge showed more physiological reactivity compared to participants who appraised the situation as a threat (Tomaka et al., 1993). Specifically, those who appraised the task as a challenge had higher pulse transit times, which is an indicator of cardiovascular reactivity. Tomaka et al. suggested that this was consistent with Obrist (1981) indicating that the participants who were challenged by the task mobilised more physiological resources to execute the task.

The second study was similar to the first; the primary appraisal item was changed to, “How threatening do you expect the upcoming task to be?”. The physiological measures in this study were HR, CO, PEP, and TPR. Consistent with study one, threat appraisals were related to more subjective stress than challenge appraisals. The cardiovascular responses showed that participants who appraised the task as a challenge displayed increased cardiac responses compared to those who appraised the task as a threat. In addition, the participants appraising the task as a challenge showed decreased vascular resistance compared to those appraising the task as a threat (Tomaka et al., 1993).

The third study tested the reliability of the vascular reactivity found in the second study. The influence of the nature of the task (active compared to passive coping task) on appraisal and physiological reactivity was also examined. The procedure, physiological measures (HR, CO, PEP, and TPR), and active coping task were similar to the second study. For the passive coping task, the participants watched graphic morgue photographs of victims of car accidents and violent crime and cancer patients undergoing head, throat, and neck surgery. The physiological measures obtained for the passive task were HR, CO, PEP, and skin conductance responses instead of TPR. The participants were randomly assigned to one of the tasks. The participants in the passive coping condition were divided into high and low primary appraisals groups, whereas the participants in the active coping tasks were divided into challenge and threat groups similar to the previous two studies. For the active coping task, the results were similar to study two. The findings for the passive task demonstrated that the high primary appraisals group displayed greater subjective stress and had greater cardiac and skin conductance responses compared to the low primary appraisals group. These studies demonstrated that challenge appraisals were related with increased cardiac reactivity and decreased vascular resistance (i.e. TPR), whereas threat appraisals were associated with an increase in cardiac reactivity and vascular resistance (i.e. TPR). These studies further emphasise that stress is not necessarily negative; it can also be appraised as a challenge that might benefit performance (Tomaka et al., 1993).

Another series of studies examined causality issues regarding challenge and threat appraisals and cardiovascular reactivity. These studies examined whether instructional sets could be used to induce challenge and threat and whether challenge and threat appraisals emerge from physiological activation patterns (Tomaka et al., 1997). In the first study examining whether instructional sets could elicit challenge and threat appraisals, participants were asked to perform a mental arithmetic task after hearing a threat instruction (emphasising accuracy and prospect of evaluation) or a challenge instruction (emphasising effort and focus on “do your best”). Challenge and threat appraisals were measured by asking “how threatening do you expect the mental arithmetic task to be” (primary appraisal) and “how able are you to cope with the mental arithmetic task" (secondary appraisal) on a six point Likert scale. Challenge and threat appraisals were calculated as the ratio of primary appraisal to secondary appraisal, such that high scores (high threat and a low score on coping options) represent a threat and lower scores (low threat and a high score on coping options) represent a challenge. No differences were found regarding task performance. Participants in the threat condition appraised the task as a threat, displayed increased vascular resistance and moderate increases in cardiac activity, consistent with a threat pattern. Participants in the challenge condition appraised the condition as a challenge and displayed a cardiovascular pattern characterising a challenge. In the next study physiological reactions consistent with challenge were triggered by asking the participants to pedal on an ergometer or sit on it without pedalling. After a few minutes, a mental arithmetic task was administered. In the third study the participants were asked to hold one hand in cold water or in warm waters for the control condition. The results for both studies revealed that activating cardiovascular patterns indicative of a challenge or threat do not produce the appraisal of the upcoming stressor (the mental arithmetic task) as consistent with the cardiovascular manipulation. Additional analyses showed that subjective pain ratings of the cold pressor task were positively associated with threat appraisal; the participants who reported more subjective pain appraised the mental arithmetic task as a threat (Tomaka et al., 1997). This suggests that cognitive appraisals mediate the cognitive, affective, and physiological components of challenge and threat (Tomaka et al., 1997) and not the other way around.

Cardiovascular research about challenge and threat appraisals has been extended by assessing whether appraisals continue to be associated with cardiovascular response patterns within an individual as these appraisals change (Quigley et al., 2002). Quigley et al. examined whether the relation between pretask appraisals and task-related cardiovascular responses is idiographic, thus if new appraisals are made within the individual. Participants took part in four mental arithmetic tasks and appraisals were made by the participant before and after each task. Measures of primary ("please rate how stressful you think the upcoming task will be on a scale of 1 to 5 where 1 is not at all stressful and 5 is very stressful") and secondary appraisals ("please rate how well you think you can cope with the upcoming task on a scale from 1 to 5 where 1 is I cannot cope at all with the task, and 5 is I can cope very well with the task") were taken to assess appraisals. When individuals became more challenged, they displayed greater cardiac reactivity, consistent with the BPS model. It was further demonstrated that when making reappraisals, individuals may use information from multiple sources (Quigley et al., 2002). However, Quigley et al. did not measure if participants' psychological responses changed when new appraisals were made and thus it is not clear if the information individuals may use to make new appraisal derived from psychological responses. In short, appraisals do change and these changes are associated with changes in cardiovascular responses.

In summary, early challenge and threat research (e.g. Tomaka et al., 1993, 1997) used different instructions to manipulate challenge and threat, but this research did not account for perceived coping resources. The main strengths of the BPS model are the cardiovascular reactivity patterns characterising challenge and threat states, as well as the dynamic interaction between demand and resource appraisals. While the BPS model provides a promising avenue for research, it has been critiqued. This critique related to the definition of demand, the definition of goal-relevant and evaluative situations, the contention of primary and secondary appraisals as determinants of challenge and threat states, and the cardiovascular response patterns (Wright & Kirby, 2003). They argued that the proposed demand components of danger and uncertainty have been paid little attention to in the BPS model. In addition, challenge and threat groups were purely distinguished on demand-to-resource ratio rather than their cardiovascular responses, in addition the physiological responses in the three studies by Tomaka et al. (1993) were inconsistent (Wright & Kirby, 2003). In a response to these criticisms, Blascovich, Mendes, Tomaka, Salomon, and Seery (2003) outlined that in the BPS model goal relevance is restricted to motivated performance situations where something is at stake and defined in general terms to account for the idea that a wide variety of factors can influence or create goal relevance (i.e. audience, rewards like money, importance of the domain). In addition, performance situations are approached deliberately and consciously, as well as automatically and unconsciously. Therefore the BPS model cannot provide an exact algorithm as desired by Wright and Kirby. Further, the demand-resource relationship is dynamic, and may change over the course of a task (Blascovich et al., 2003). Despite these criticisms, the BPS model still provides a valid approach. Recent BPS research has focused on different stressors such as social interactions with the opposite sex (Mendes, Reis, Seery, & Blascovich, 2003) and expectancy-violating partners (Mendes, Blascovich, Hunter, & Lickel, 2007). Recent BPS studies have also included perceived coping resources or have changed the situational demands (Blascovich et al., 2003). In addition, in some recent research the participants are assigned to challenge and threat conditions based on their cardiovascular reactivity patterns (Blascovich et al., 2004), as opposed to the demand-to-resource ratio used in early BPS model research.

1.3.4 Recent BPS Model Research

More recent BPS research has focused on different stressors and factors influencing challenge and threat states. Not only can challenge and threat states be affected by aspects of the task/stressor itself, external factors such as the potential for gain or loss or the person who provides feedback can influence challenge and threat states (Mendes, McCoy, Major, & Blascovich, 2008; Seery, Weisbuch, & Blascovich, 2009). To examine the effects of outcome framing on cardiovascular responses used to obtain measures of challenge and threat, participants were given either an instruction focused on gain ("in order to encourage your best performance, we are offering an incentive"), loss ("you will begin with five dollars, but you will lose money for every incorrect item"), or no mention of an incentive (control condition) in relation to a remote association task (Seery et al., 2009). There were no differences in task engagement between the participants in the gain and loss conditions, both had higher task engagement than the control condition. Participants in the gain condition demonstrated TPR and CO responses indicative of a greater challenge state compared to participants in the loss condition. These results indicate that outcome framing can influence challenge and threat states.

In a study examining the effects of competition and competiveness on cardiovascular activity, participants were asked to complete a competitiveness, goal orientation and win orientation questionnaire before taking part in a racing car game task, either alone, competing against the experimenter, or cooperating with the experimenter (Harrison et al., 2001). The results demonstrated that participants who were high in competitiveness and desire to win showed higher increases in blood pressure and shortening of PEP, partially representing a cardiovascular pattern characterising a threat, to competition compared to participants, low in competitiveness and desire to win (Harrison et al., 2001). This study shows that those high in competitiveness appear to engage more with the task, physiologically (increased HR) and cognitively (self-report measure of engagement). These studies show that the demands of a situation (such as outcome framing and uncertainty) and the resources (such as the desire to win and competitiveness) can influence cardiovascular responses characterising challenge and threat states.

Mendes et al. (2008) examined physiological and emotional responses to social rejection about attributional ambiguity. Black and White participants were asked to deliver a speech on why they make a good friend after which the same sex confederate (either Black or White) would provide them with either negative social feedback or positive social feedback. The participants also took part in a word finding task where they were asked to find words together with the person who provided feedback on their speech. The results showed that participants who received feedback from a same-race partner performed better on the word finding task, had more activational physiological responses and more positive emotions than participants who received feedback from a different-race partner. These findings showed that attributional ambiguity and who provides feedback can produce different emotional, physiological, and behaviour responses.

In short, recent BPS research has demonstrated that factors such as competitiveness can influence challenge and threat states, and external factors such as outcome framing and attributional ambiguity can also influence challenge and threat states.

1.3.5 BPS Model Research in Sport

To date, the only research explicitly examining the biopsychosocial model in an athletic setting involved baseball and softball players (Blascovich et al., 2004). Four to six months before the start of the season, 34 players from baseball (men) and softball (women) teams were asked to imagine a specific playing situation and provide a two minute speech about this situation, and to give a two minute speech about a sport-irrelevant situation. Impedance cardiography, electrocardiography, and continuous blood pressure were recorded to obtain readings of HR, PEP, CO, and TPR. At the end of the season, performance statistics were collected through created runs during the baseball and softball season.

The results showed that the players engaged with both speeches. Hierarchical regression analysis predicted batting performance with cardiovascular reactivity during the sports-related speech: athletes who experienced challenge during imagining and providing the sports-related speech performed better during the season compared to players who experienced threat during the imagining and sports-related speech. Blascovich et al. (2004) argued that better players were more challenged during the sports-related speech because they are more aware of their own abilities compared to other players. Higher levels of confidence could have influenced the results; those athletes with high confidence might have exhibited challenge during the study. Confidence was, however, not measured in the study. One possible explanation why challenged athletes may have performed better than the other players during the regular season is because of their skills and athletic ability (Blascovich et al., 2004). However, the way college teams, as in this study, are structured, they typically have a high turnover rate, with new players coming and leaving the team on annually. Thus no player is guaranteed a starting position at the beginning of the season. Of the 27 players with usable data, 17 had statistics of last season. Blascovich et al. argued that although there was a correlation between these two seasons, nearly 75 percent of the variance in the participants' season's statistics could not be predicted by statistics from the last season. Thus players would not know how well they would perform in the upcoming season compared to their team mates. In conclusion, knowledge, skills, and abilities alone are not sufficient to determine success and failure in athletic performance; motivational states, such as challenge and threat, may play a part in the influence on athletic performance (Blascovich et al., 2004).

Blascovich et al. (2004) did not measure confidence, therefore it is unknown if the players who were more confident in their performance displayed a challenge pattern and provided a better performance. Also experience and uncertainty of the situation could have played a role; players who have played in the team during previous years might know what to expect, and this can influence cardiovascular patterns of challenge and threatened, even though Blascovich et al. suggested that most of the statistics could not be predicted by the statistics from the last season, this was not specifically accounted for in the experimental design. Measuring confidence is an area for further research because confidence could influence how athletes respond to an upcoming competition.

1.4 Emotions

In addition to physiological responses and cognitive appraisals, emotions play a role in responses to competition. The model of adaptive approaches to competition (Skinner & Brewer, 2004) and the control model of debilitative and facilitative competitive state anxiety (G. Jones, 1995) are used to explain the role of emotions in approaches to competition**.**

1.4.1 Model of Adaptive Approaches to Competition

The notion that positive emotions are related to challenge appraisals and negative emotions are related to threat appraisals has been examined by Skinner and Brewer (2002, 2004), who introduced a model of challenge and threat appraisals, coping expectancies and emotions. This model states that the influence of trait threat and challenge appraisal styles on event-specific appraisals and emotion is mediated by event-specific coping expectancies. By indicating whether the goals associated with a challenge appraisal style or the fears related to a threat appraisal style will be obtained, these coping expectancies activate the underlying trait challenge or trait threat appraisals and emotion.

In the first of two studies examining academic performance, participants were presented with a hypothetical scenario (conference presentation or exam) and asked to complete a questionnaire measuring their emotions and cognitions on how they typically feel in this type of situations (Skinner & Brewer, 2002). They found that threat appraisals were associated with reduced coping expectancies, positive emotion, and beneficial perceptions of emotion. The ability to positively reappraise the environment or situation, central to challenge appraisal style, was associated with the beneficial perception of emotion, despite coping expectancies or the valence of emotion. Also, challenge appraisal style was related to higher levels of excitement (Skinner & Brewer, 2002). In the second study, participants' responses to an actual stressful event (university exam) were measured. Challenge and threat appraisals were negatively correlated. Coping confidence and coping expectancies were positively correlated with trait challenge appraisals and negatively correlated with trait threat appraisals. Also, a threat state appraisal was related to more negative emotions and more harmful perceptions of state appraisals and emotions, whereas a challenge state appraisal was related to positive emotions and more beneficial perceptions of appraisal and emotion. These latter constructs, challenge appraisals and positive emotions, were considered to have a positive effect on performance because of their adaptive functions (Skinner & Brewer, 2002), which could relate to the increasing coping options individuals may perceive to have in this scenario.

The model of beneficial and harmful perceptions was proposed to apply to sport competition (Skinner & Brewer, 2004). Skinner and Brewer reviewed evidence on the antecedents and adaptive consequences of positive emotions. It was suggested that the intensity of threat appraisals does not influence the perceived influence of performance. Further, only when the expected ability to avoid harm resulting from negative evaluation and worries about poor performance is low, this will have an unfavourable influence on performance. Thus when a tennis player is not returning the serves of her opponent, and does not perceive she has the range of shots necessary to return the serve, this may result in a poor performance. The findings of Skinner and Brewer's (2002) experiments in an academic setting that threat appraisals were related to lower coping expectancies are in line with previous research in sport psychology (Skinner & Brewer, 2004). Lower coping expectancies can in turn result in increased levels of anxiety (Skinner & Brewer, 2004).

Much research on anxiety and sport competition has been on the negative effect of anxiety on sports performance. Anxiety does, however, not necessarily have to be detrimental; rather it is the perception of one's abilities to be able to avoid potential harms that determines whether anxiety can become detrimental to performance (G. Jones, 1995; Skinner & Brewer, 2004). A dual threat/ challenge approach may be the most adaptive approach for athletes facing a stressful situation (Skinner & Brewer, 2004). This will enable the athlete to effectively cope with positive and negative emotions, and this may create optimal motivation and performance.

The notion that emotional states are more positive in challenge compared to threat states is underlined by the BPS model (Blascovich & Mendes, 2000). Appraising a situation as a threat, with a potential for loss, results in negative emotions, such as feelings of anxiety, whereas appraising a situation as a challenge, an opportunity for growth which may be difficult to gain, results in positive emotions (Lazarus, 1991). In a study examining social rejection, it was found that cardiovascular patterns characterising a challenge were associated with increased anger for participants who experienced social rejection (Mendes et al., 2008). G. Jones (1995), however, has suggested that anxiety is only detrimental for performance when individuals interpret anxiety as unhelpful for performance. He suggested that individuals can also perceive anxiety to be helpful for performance. How emotions act within the framework of the BPS model requires further exploration as it is unclear how emotions, not just anxiety, exactly influence challenge and threat states and interact with other aspects such as personality (for example optimism or perfectionism) or motivation.

1.4.2 Interpretation of Emotional State and Temporal Patterning of Emotions

In addition to the conceptualisation of emotions as positive or negative, the interpretation and temporal patterning of emotions also play a role in challenge and threat states. The interpretation of emotions has gained increased attention over the last decade and is thought to influence challenge and threat states. How an individual interprets emotions directs their behaviours (e.g. Lazarus, 1999; 2000b). Although emotions are defined as being positive and negative, this does not mean that a negative emotion only influences performance negatively, or that a positive emotion only affects performance positively (Hanton, Neil, & Mellalieu, 2008; G. Jones, 1995; Mellalieu, Hanton, & Fletcher, 2006). G. Jones (1995) introduced the control model of debilitative and facilitative competitive state anxiety and suggested that athletes can interpret their emotional responses to an upcoming competition as helpful or unhelpful to performance. He stated that an athlete's perceived control over the environment and the self, a positive belief to cope, and the belief that the goal can be achieved can create a positive interpretation of anxiety symptoms.

Individual differences are evident in the way athletes perceive anxiety; some athletes can interpret anxiety as a negative feeling that hamper their performance, whereas other athletes interpret anxiety as a positive feeling about their performance. Burton and Naylor (1997) noted that defining anxiety as facilitative might confuse anxiety with other more positive emotions and that perhaps other positive emotions are measured as facilitative anxiety. M. V. Jones and Uphill (2004) noted, however, that although participants may *experience* the same emotion, their interpretation of these symptoms as helpful or unhelpful for performance only relate to the individual's belief of how the symptoms relating to a specific emotion might affect sport performance for that individual.

If interpreting a particular emotion as helpful towards performance can change the appraisals of athletes, this is worth examining because it may influence challenge and threat states and performance. That it is worth examining is also demonstrated in the increasing amount of attention that research on the direction of emotions has received over the last decade or so (for a review, see Hanton et al., 2008). In addition, sport psychologists can use tools such as imagery to help athletes to interpret anxiety symptoms as helpful rather than unhelpful for performance (Cumming, Olphin, & Law, 2007; Hale & Whitehouse, 1998). Hale and Whitehouse found that participants interpreted somatic and cognitive anxiety as more helpful when imaging taking a penalty kick whilst the word challenge was given during the task instructions than when the word pressure was given as part of the instructions. Cumming et al. examined the influence of imagery scripts on the interpretation of cognitive and somatic anxiety as helpful or unhelpful. They found that after anxiety imagery scripts the participants experienced the symptoms of cognitive and somatic anxiety as more unhelpful compared to other imagery scripts. This indicates that imagery scripts can influence the perception of anxiety as being helpful or unhelpful for performance.

Skinner and Brewer (2004) suggested that activation levels of emotions also play a role in performance. It is suggested that high activation positive emotions (e.g. excitement) facilitate motivation and effort, which in turn may benefit training and preparation. Low activation positive emotions (e.g. contentment) are thought to facilitate effective concentration on the task and as a consequence, low activation positive emotions may be most beneficial immediately before performance (Skinner & Brewer, 2004). This may, however, depend on the task and its requirements, as the 100m sprint might require different levels of activation positive emotions than a shooting competition. This is also found in research examining individual zones of optimal functioning (IZOF; Hanin, 2000). The IZOF model states that athletes have an optimal zone of emotions in which they experience their best performance. This optimal zone is different for each athlete. Support has been provided for the IZOF (e.g. Robazza, Pellizzari, Bertollo, & Hanin, 2008).

The timing of emotions can have an influence on its interpretation; when anxiety occurs before competition, it is more often appraised as positive, whereas during competition it is appraised as negative and interfering with performance (Burton & Naylor, 1997, Lazarus, 1991). In one of the few studies examining cognitive anxiety both pre- and during competition, Smith, Bellamy, Collins, and Newell (2001) examined cognitive anxiety in volleyball players during one season. They found that the score in the game influenced levels of cognitive anxiety, high trait anxious individuals scored higher on cognitive anxiety when the game was tied or when they were trailing. Preparatory anxiety is thought to have a motivational effect before a task (Eysenck & Calvo, 1992). The concerns about competition may cause an athlete to gather all perceived available resources to cope with the demands and concerns about competition. However, if an athlete experiences anxiety during the competition, this can turn in to threat, especially when he/she is high trait anxious and is tied or trailing in competition

(Smith et al., 2001); when an athlete experiences concerns during the competition or just before, this might interfere with the available coping resources (Burton & Naylor, 1997) and the athlete might perceive less control over the outcome of the competition (Smith et al., 2001). These are speculations, and a more holistic approach including physiological measures of challenge and threat and measures of self-efficacy, control, and achievement goals could be used to examine if athletes experience changes in resources during competition when they experience higher levels of anxiety. In addition, individuals may switch between challenge and threat appraisals and experience multiple emotions during sport performance (Lazarus, 1999).

The causal relation between challenge and threat appraisals and emotions is unclear. It is not only the interpretation of emotions that has an influence on performance, but also the interpretation of the person-situation relation, where physiological arousal symptoms are often used as a source of information, as a challenge or threat. Emotions are usually measured retrospectively, which adds to the difficulty of measuring causality. In addition, the effect on performance is not universal across sports (Woodman et al., 2009), tasks requiring fine motor control probably do not benefit from high levels of physiological arousal (e.g. Noteboom, Fleshner, & Enoka, 2001; Parfitt, Jones, & Hardy, 1990). It is argued that during a performance episode, an athlete can switch from challenge to threat appraisals, and vice versa (Lazarus, 1999). Cerin (2003) suggested that athletes can appraise a situation as both challenge and threat or demonstrate characteristics indicative of a dual challenge/threat appraisals style. For example, an athlete can be high in cognitive anxiety, but could still approach the competition as an opportunity for gain (Skinner & Brewer, 2004). In addition, Skinner and Brewer suggested that because a dual challenge/threat appraisal style raises the stakes associated with competition, this can benefit the athlete in terms of enhanced motivation compared to threat or challenge appraisals alone. However, it is unknown whether an athlete can experience challenge and threat states simultaneously and how this may influence cardiovascular responses.

1.5 Theory of Challenge and Threat States in Athletes

A theory bringing the cognitive, affective, and physiological components together and relating these components to sport is the theory of challenge and threat states in athletes (TCTSA, M. V. Jones et al., 2009). The TCTSA merges and extends the BPS model, the model of adaptive approaches to competition and the control model of debilitative and facilitative competitive state anxiety. The physiological component of the TCTSA is identical to that described in the BPS model, the BPS model does, however, not specifically outline which resource appraisals influence challenge and threat states. The TCTSA proposes three factors comprising resource appraisals, these are referred to as the cognitive component of challenge and threat states; self-efficacy, perceived control, and achievement goals. The TCTSA proposes that a challenge state is characterised by high levels of self-efficacy, high perceived control, approach goals, both positive and negative emotions, a helpful interpretation of emotional state, and a cardiovascular pattern of increases in cardiac activity and decreases in TPR (see Figure 1.3), whereas a threat state is characterised by lower levels of self-efficacy, less perceived control, avoidance goals, negative emotions, an unhelpful interpretation of emotional state, and a cardiovascular pattern of slight increases in cardiac activity and increases in TPR (see Figure 1.4). The TCTSA mainly focuses on athletes' approaches to competition and their preparedness for competition; in addition the TCTSA makes predictions about performance by focusing on the possible consequences of the cognitions and the neuroendocrine and cardiovascular responses related to challenge and threat states. The TCTSA proposes that, because the cognitive, affective, and physiological components of a challenge state are beneficial to performance and the components of a threat state a barrier to performance, a challenge state enhances performance and a threat state decreases performance.

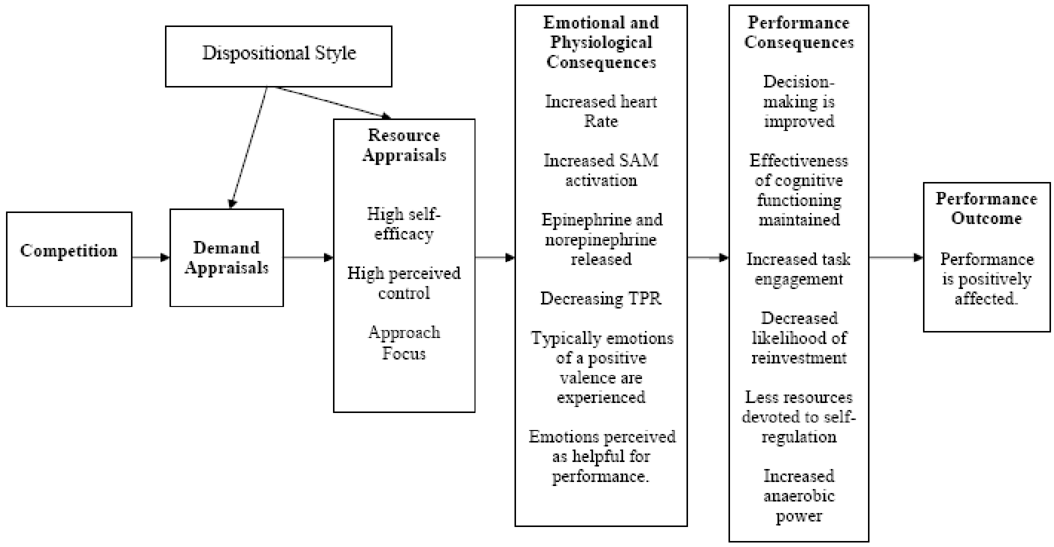

Figure 1.3. The challenge state (reprinted from M. V. Jones et al., 2009)

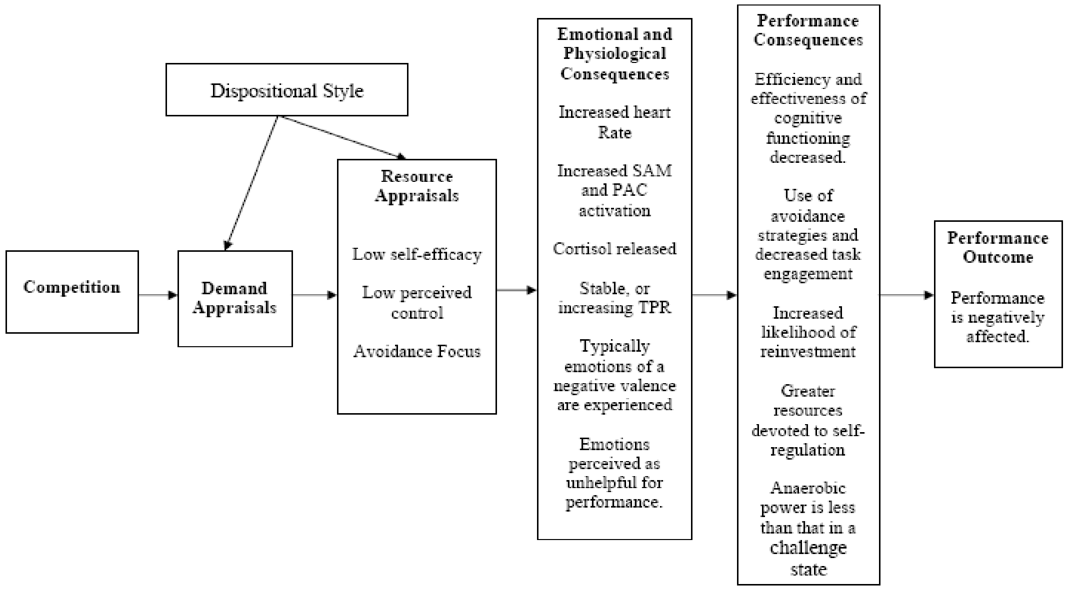

Figure 1.4. The threat state (reprinted from M. V. Jones et al., 2009)

1.5.1 Cognitive Components

Cognitive components influence available resources. The TCTSA identifies three cognitive components, self-efficacy, perceived control, and achievement goals.

Self-efficacy. Self-efficacy is a fundamental factor in how an individual perceives a competitive situation. The TCTSA proposes that self-efficacy is positively related to challenge and negatively related to threat (M. V. Jones et al., 2009). Bandura (1986) defined self-efficacy as the judgment of an individual in his/her capability to successfully perform a task. Individuals need to have the belief that they are in control, and that they intentionally execute their actions, for self-efficacy to develop (Bandura, 1997). Self-efficacy cognitions include level, strength, and generality. Level refers to an individual's beliefs in their capability to achieve a task, strength refers to the degree of certainty that an individual can successfully accomplish a task and generality refers to the ability of efficacy expectations to predict behaviour in (related) tasks or areas that require similar skills (Bandura, 1997). Self-efficacy theory is based on social cognitive theory. Social cognitive theory discriminates between mechanisms of change and procedures of change. Mechanisms of change are primarily cognitive and mediate explanatory processes. Procedures for change provide opportunities for people to employ new and more efficient behaviour, and thus are primarily behavioural. Cognitive and affective changes are instigated by these behavioural changes (Feltz, Short, & Sullivan, 2008).

Self-confidence is a related construct of self-efficacy, and often used in similar contexts (Feltz et al., 2008; McAuley, Peña, & Jerome, 2001). There is, however, a difference between these two constructs. Self-efficacy is related to beliefs about one's capabilities in a specific situation, rather than having a belief in one's abilities to be successful over a broad range of situations in unrelated areas (McAuley et al., 2001). Therefore, self-efficacy is a more specific and better predictor of behavioural outcomes (McAuley et al., 2001). Various elements are critical to understand how an athlete develops self-efficacy, namely performance accomplishments, vicarious experiences (comparisons), verbal persuasion, physiological states, emotional arousal, and imaginal experiences (Feltz et al., 2008). The first four components are based on Bandura's (1986) work, emotional states and imaginal experiences were later proposed by Maddux (1995). It is argued that the most important and powerful source of self-efficacy emerged from performance accomplishments (Bandura, 1986). High self-efficacy does increase the likelihood that an athlete will perform well in the aspects of control that are within his/her personal control (Duda & Treasure, 2001).

Self-efficacy is recognized as an important element of peak performance (Feltz et al., 2008; Krane & Williams, 2010; Maddux, 1995). Self-efficacy beliefs determine how much effort is used to complete a task and the time one perseveres when faced with obstacles or barriers. Effort and perseverance are important elements of motivation: if an individual has a strong belief in his/her capabilities to complete the task, or be successful in competition, the higher and more persistent his/her efforts to successfully complete the task will be (Bandura, 1986). Research has found that there is a positive relation between self-efficacy and performance (for an overview see Feltz et al., 2008). This relation can be reciprocal, when an athlete experiences high self-efficacy to perform a skill in competition, this will benefit the skill, resulting in good performance, which in turn leads to higher self-efficacy (Krane & Williams, 2010; Maddux, 1995). For example, past performance cannot be excluded as an imperative predictor of future performance (Feltz et al., 2008). Past performance is suggested to be the most important one of the six elements comprising self-efficacy (Feltz et al., 2008). Success leads to success. Further, athletes high in self-efficacy are not afraid to pursue difficult goals, whereas athletes low in self-efficacy tend to avoid difficult goals (Bandura, 1986). Athletes with low self-efficacy also worry about injury, apply less effort, and tend to give up in the face of failure, where athletes with high efficacy cope with pain, and fight through setbacks (Feltz et al., 2008).

Challenge and threat states relate to the thought patterns of an athlete. In the framework of self-efficacy, research on thought patterns focused on attributions, optimism versus pessimism, and decision making. Individuals with low self-efficacy may want to avoid difficult situations that could result in negative self-evaluations (Bandura, 1986). Beliefs about success are an important factor in challenge and threat responses (Lazarus, 1999). Although beliefs about success are not the same as the belief that the skills are available to perform a skill in self-efficacy theory, they are similar concepts. If people are confident in their ability to overcome barriers and difficult situations, the more likely they are to appraise situations as a challenge rather than a threat. On the other hand, if people perceive they are unable to cope with the situation, this will lead to threat appraisals (Lazarus, 1999). Levels of self-efficacy vary between individuals, and as a result people differ in whether they are prone to experiencing situations as a challenge or threat. The concept of self-efficacy applies to this idea (Lazarus, 1999). Self-efficacy can be enhanced by using psychological strategies, such as self-talk and imagery (Feltz et al., 2008).

Only limited research has examined the relation among challenge and threat states and self-efficacy. In a study examining the effects of academic self-efficacy on academic performance, challenge and threat evaluations were examined as moderators of the self-efficacy and adjustment relation. A strong relation among academic self-efficacy/optimism and performance and adjustment was reported, both as a direct relation with performance and indirectly through challenge and threat evaluations on performance, stress, health, and overall satisfaction (Chemers, Hu, & Garcia, 2001). It was primarily the perception of resources that was associated with self-efficacy and expectations. Challenge and threat evaluations played a mediating role, through which optimism had a positive effect on academic performance. Higher levels of self-efficacy can increase the available coping options, which could help individuals to have a positive perception of the situation.

Other research has suggested that individuals with high levels of self-efficacy put less effort in the task, as they believe that they can succeed anyway

(Vancouver, Thompson, Tischner, & Putka, 2002). The focus of most self-efficacy research has been on "person-level" of analysis, rather than a within-person analysis. At the within-person level, it was found that performance was positively related to subsequent self-efficacy, and self-efficacy was negatively related to subsequent performance (Vancouver et al., 2002). To test the assumption that increased self-efficacy does not necessarily lead to improved performance, participants were asked to play an analytical game, Mastermind. Half of the participant acted as controls, the other half were induced to have high self-efficacy. The results revealed that at a within-person level, for the experimental group, self-efficacy increased and performance decreased. Also, after self-efficacy was initially high, it seemed to decrease once performance diminished, after which performance increased in the next two games after the manipulation, which was attributed to compensation for the previous poor performance (Vancouver et al., 2002).The idea that increased self-efficacy has a negative effect on performance comes from the thought that when self-efficacy is low, the individual will think through the possibilities and feedback more, as well as exerting more effort in the task.

In summary, higher levels of self-efficacy lead to setting higher goals (Phillips, Hollenbeck, & Ilgen, 1996), and higher goals have a higher chance of failure compared to the easier, initial goals set. These higher goals, however, seem to be directly influenced by levels of self-efficacy and should enhance motivation, rather than decreasing it (Bandura & Locke, 2003). It appears that self-efficacy is flexible and continuously adapts to the situation and performance (Wiedenfeld et al., 1990). This is in line with research on self-efficacy in sport; Feltz et al. (2008) outlined that the exact *causal* relation between self-efficacy and performance is unclear, although it is generally a positive relation; high levels of self-efficacy are associated with high levels of performance. Also, sport competition is very different from an analytical game which is partially based on guessing, rather than skill.

Although some of the studies propose that high levels of self-efficacy might negatively affect performance when goals are set too high based on previous performance accomplishments, most of the sport specific studies show that high levels of self-efficacy increase the available resources an individual perceives to have, and in turn it is proposed that self-efficacy is positively related to a challenge state (M. V. Jones et al., 2009).

Perceived control. Control is an important asset of coping and is part of the cognitive component of resource appraisals in challenge and threat states. The TCTSA proposes that high levels of perceived control are related to a challenge state and low levels of perceived control are related to a threat state (M. V. Jones et al., 2009). Differences in perceived controllability have various effects on one's personal state and resulting performance. Individuals can perceive a situation as within (controllable) or outside personal control (uncontrollable). This has an influence on their perception of the situation as a challenge or a threat. When someone believes that a (important) situation is controllable, he/she is motivated to use 'personal efficacy' most, which in turn increases the chances for success. If a situation is approached as uncontrollable, the likelihood of failure increases, as the individual is more likely to use personal efficacy to a lower extent (Bandura & Wood, 1989). The influence of an athlete's perceived control and the association with self-efficacy can be illustrated by an example: imagine a soccer goal keeper who is confident in his ability to keep a clean sheet but he perceives he does not have control over his defensive players to make it difficult for the opponent and this makes him unsure if he has enough resources to cope with the situation and accordingly his effort and persistence may be reduced. This example illustrates that in addition to the belief in having the skills to do well, the athlete also needs to perceive sufficient control. There are always uncontrollable aspects in sport performance, but it is the athlete’s perception of the situation that influences how control affects challenge and threat states (M. V. Jones et al., 2009). The weather, for example, is a factor that is uncontrollable, an athlete might decide to focus on the aspects that are controllable, like the type of shoes that are most favourable in poor weather conditions. On the other hand, if an athlete worries about how the weather conditions might change during the race, this might increase the demands of the situation, as the weather is not controllable. In short, if an athlete only focuses on the factors that are uncontrollable, rather than those that are controllable, this is increasing the demands of the situation and this can lead to a threat state.

A framework explaining the concept of control is suggested by Skinner (1996). Skinner’s framework uses two distinctions to examine control concepts. The first distinction is divided in three aspects of control: objective control, subjective control, and experiences of control. Objective control refers to the actual control an individual has within him/herself and in the social context, whereas subjective control (also referred to as perceived control) refers to the individual’s beliefs about how much control is available. The third aspect of control, experiences of control, refers to an individual’s feelings during interaction with the social environment while he/she is attempting to either attain a desired outcome or avoid a negative outcome. The other set of distinctions are: agents of control, means of control, and ends of control (Skinner, 1996). Agents of control are individuals or groups who apply control, means are the routes through which control is applied (i.e. the response in an individual's variety of skills). Thus agent-means relations are defined by beliefs about the response someone can make (for example self-efficacy beliefs). Ends of control refer to either wanted or unwanted outcomes over which control is exerted. Means-end relations refer to the association between a cause (e.g. behaviour or efforts) and an outcome. Causal attributions are an example of this relation. Agent-end relations outline the degree to which an agent (individuals or groups) can construct or prevent desired or undesired outcomes (Skinner, 1996) and might influence challenge and threat states, with low levels of perceived control relating to a threat states (M. V. Jones et al., 2009).

There are four potential controllability aspects: those that are under one's personal control, those that are in others' control, those in which the control is shared by oneself and others, and those that are not predictable or controllable (Todrank Heth & Somer, 2002). This is based on the idea that in human society people often do not have full personal control over a possible outcome in a situation. Based on the work of Skinner (1996), if a person is aware of the controllability of a situation and the intended outcome, and behave according to this, then that person would be able to manage environmental demands more effectively. This also influences challenge and threat. If an individual perceives a situation as more manageable, due to the awareness of what one is capable of and not, this controllability awareness should decrease the effects of stress responses. Also, being aware of the controllability of possible outcomes will more likely result in challenge appraisals (Todrank Heth & Somer, 2002). In a study examining how wheelchair basketball players' cognitively appraise sources of stress, Campbell and Jones (2002) have found a positive relation between challenge appraisals and controllability, but no relation between threat appraisals and controllability.

Subjective (perceived) control is suggested to have a bigger influence on physiological responses of challenge and threat states than objective control. This relates to perceptions of the situations: individuals who perceived an uncontrollable stressor as controllable showed less physiological changes compared to individuals who appraised the stressor as uncontrollable (Dickerson & Kemeny, 2004; Kemeny, 2003). Similar findings were revealed in a study examining the influence of control and physical effort on cardiovascular reactivity where participants were asked to play a video game which was interrupted by aversive noise (Weinstein, Quigley, & Mordkoff, 2002). The results showed that participants in the low-control condition had increased TPR, related to the vascular pattern characterising a threat state and participants in the high control condition revealed decreased TPR, the vascular reactivity related to a challenge state. No effects were found for cardiac reactivity. It was suggested that perceived control could act as a safeguard for reactivity when aversive conditions occur (Weinstein et al., 2002).

In summary, perceptions of control influence challenge and threat states. High perceptions of control are related to a challenge state and low perceived control is related to a threat state (M. V. Jones et al., 2009).

Achievement goals. The previous sections have outlined that what an athlete is striving for is also important for challenge and threat states. Goals play an important role in one’s well-being, goals give an organisational and motivational sense to life, as having goals is in itself a strong predictor of satisfaction (Brunstein, Schultheiss, & Maier, 1999). On the other hand, when a person remains committed to a goal, goals can change into sources of frustration when they become unattainable or exceed individual resources to reach the goal (Brandtstädter & Rothermund, 2002; Drach-Zahavy & Erez, 2002; Wrosch, Scheier, Carver, & Schulz, 2003). This is further demonstrated by Holt and Dunn (2004); appraisals and coping were closely related to personal goals in female soccer players. The stressors were acknowledged when situational demands seemed to jeopardize the athlete’s goals for the season (Holt & Dunn, 2004). The idea that difficult goals raise the level of motivation and performance accomplishments influences the level of performance an athlete achieves (Bandura, 1997), suggesting that difficult goals will increase the performance.

Achievement goal theory explains athletes’ motives to participate in sport. Achievement goal theory suggests that there are two types of achievement goals: mastery (also known as task) and performance (also known as ego) goals (Ames & Archer, 1988, Dweck, 1986). Over the years, this framework has developed into a 2x2 model including approach and avoidance motivation (Elliot & McGregor, 2001). Approach goals are focused on achieving a positive outcome (success), whereas avoidance goals are focused on avoiding a negative outcome (failure). It is suggested that approach goals are related to challenge appraisals and avoidance goals to threat appraisals (Elliot & Harackiewicz, 1996). The 2x2 model has four types of achievement goals (Elliot & McGregor, 2001). Mastery-Approach goals (MAp) focus on the attainment of task or self-referenced target, for example wanting to improve free throw shooting percentage in basketball. Mastery-Avoidance goals (MAv) reflect a motivation focusing on avoiding task incompetence, for example not wanting to run slower than your personal best. Performance-Approach goals (PAp) reflect a motivation to attain normative competence, for example wanting to score higher than your competitor. Performance-Avoidance goals (PAv) reflect the motivation to avoid normative competence, for example not wanting to be regarded as a worse player than someone else (Elliot & McGregor, 2001).

Achievement goals influence challenge and threat states. In the academic field McGregor and Elliot (2002) found that students adopting mastery and performance approach goals tended to approach the anticipatory time to the exam as a challenge, whereas students adopting performance avoidance goals were more inclined to interpret the upcoming exam as threatening. The 2x2 achievement goal framework has also been examined in relation to challenge and threat appraisals of sport competition (Adie, Duda, & Ntoumanis, 2008). Four hundred and twenty four participants were asked to complete a questionnaire measuring achievement goals, cognitive appraisals of sport competition, self-esteem, and positive and negative affect (Adie et al., 2008). Mastery approach goals were positively associated with challenge appraisals of competition. There was a positive association between mastery avoidance goals and threat appraisals, indicating that taking in mastery avoidance goals relate to negative, instead of positive, processes and outcomes (Adie et al., 2008; Elliot & Conroy, 2005). There was also a positive association between performance approach goals and both challenge and threat appraisals (Adie et al., 2008).

The regulation of mastery-avoidance goals can be complicated by a discrepancy between the intrinsic interest to master a skill and the feelings of worry when not mastering the skill (Sideridis, 2008). He examined the regulation of mastery-avoidance goals on persistence, affect, and arousal in relation to a stressful exam. Mastery-avoidance goals were positively associated with negative affect as well as increased in cognitive and somatic anxiety. Further, only mastery-avoidance goals had harmful effects on emotion regulation. Mastery-avoidance goals were more dysfunctional than performance-avoidance goals.

Recently, performance-approach and performance-avoidance goals have been examined within the biopsychosocial framework of challenge and threat states (Chalabaev, Major, Cury, & Sarrazin, 2009). Participants were placed in a performance-avoidance or performance-approach condition based on an instructional manipulation identifying them as exceptionally strong (performance-approach) or exceptionally weak (performance-avoidance), and they were asked to perform a problem-solving task, while cardiovascular measures were obtained. The results showed that the participants in the performance-approach condition performed better than the performance-avoidance condition, and they also displayed a cardiovascular reactivity pattern characterising a challenge state and reported greater feelings of challenge. The participants in the performance-avoidance condition displayed a cardiovascular pattern characterising a threat state, but they did not report greater feelings of threat (Chalabaev et al., 2009). It appears that avoidance goals are related to threat states and approach goals to challenge states. To summarise, researchers have reported findings in the direction of a positive association between challenge and mastery-approach goals and positive associations between threat and mastery-avoidance goals.

1.5.2 Affective Component

The TCTSA proposes that both the valence of emotions and the interpretation of emotional state as helpful or unhelpful towards performance play a role in challenge and threat states. Skinner and Brewer (2002; 2004) have suggested that in a challenge state athletes experience more positive emotions and negative emotions are associated to a threat state. The TCTSA proposes, however, that the interpretation of emotional state is also important in the affective components of challenge and threat states and emotions of a negative valence can be experienced in a challenge state and emotions. For example, an athlete who experiences anxiety and anger could perceive their emotional state as helpful for their performance. These high intensity negative emotions can provide motivation and are sometimes perceived as helpful towards performance by athletes (M. V. Jones et al., 2009). The cognitive components self-efficacy and perceived control help to determine the interpretation of emotional state as helpful or unhelpful to performance (G. Jones, 1995). In summary, the TCTSA proposes that positive emotions are typically associated with a challenge state and negative emotions are typically associated with a threat states, however, as outlined above this will not always be the case as high intensity negative emotions can also occur in a challenge state. In addition, emotional state will be interpreted as more helpful towards performance in a challenge state and emotional state will be interpreted as unhelpful in a threat state.

1.6 Summary and Aims of Thesis

In summary, the TCTSA outlines how cognitive, affective, and physiological components combine to form challenge and threat states in a unique way and applies it to sport. A challenge state is characterised by a cardiovascular pattern comprising increased cardiac activity and decreased total peripheral resistance, increased self-efficacy and perceived control, approach goals, and the increased experience of positive emotions and a helpful interpretation of emotional state. In addition, the experience of negative emotions in a challenge state is not excluded; rather it is about how these negative emotions are interpreted. Threat states are characterised by a cardiovascular pattern of increased vascular resistance, lower self-efficacy and perceived control, performance-avoidance goals, and more experience of negative emotions. It is not easy to measure challenge and threat states based on cognitive appraisals alone, as appraisals can occur both consciously and sub/unconsciously (Lazarus, 1999) and using self-report measures will not provide the whole story. Therefore, measuring cardiovascular reactivity patterns characterising challenge and threat could provide valuable information about pre-competition states that moves beyond cognitive components only. The aim of this thesis was to examine the associations between the cognitive resources and emotional and cardiovascular responses.

Challenge and threat states have consequences on preparing for competition as well as potential performance consequences. The time in the lead up to competition might have an important influence on an athlete’s appraisal and physiological response. The physiological response in the lead up to competition might get stronger as the competition approaches nearer to the time (anticipatory appraisals; Gaab et al., 2005). Whilst the primary aim of the thesis was to examine the relations between the cognitive, affective, and physiological components of challenge and threat states, understanding how these components relate may provide more insight in peak performance and existing knowledge on peak performance, peak experience, and flow can be expanded (e.g. Harmison, 2006). Cardiovascular responses are indicative of neuroendocrine changes, which can influence performance (Blascovich & Mendes, 2000; Dienstbier, 1989) . Developing awareness of cardiovascular responses characterising challenge and threat states could help applied sport psychologists to develop interventions to help athletes' create an effective pre-performance state.

As research in challenge and threat states in sport is in its infancy, many aspects are still unknown. For instance how the combination of cognitive, affective, and physiological components of challenge and threat states in athletes relate to each other is not yet known. The TCTSA provides a framework for examining challenge and threat states in a sport setting and takes into account current research developments, including the interpretation of emotions as helpful or unhelpful for performance and the use of cardiovascular indices to identify challenge and threat states. This thesis explored the unique combination of variables as outlined by the TCTSA. This thesis extends biopsychosocial model research by specifying the resource components. Measuring the resource components, in addition to the physiological and affective components of challenge and threat states, might increase understanding of challenge and threat states. By understanding the cognitive and affective components of challenge and threat states the knowledge can be applied to enable athletes to approach competition as a challenge rather than a threat. Approaching competition as a challenge rather than a threat might benefit sport performance. Increasing the understanding of practitioners of the components of challenge and threat states could benefit designing effective psychological skills interventions, to help athletes with approaching a competition as a challenge. However, before measuring the influence of challenge and threat states on different types of performance (for example decision making and cognitive functioning), dispositional traits, and implementing interventions, relations between the cognitive resources and physiological and emotional consequences of challenge and threat states need to be understood in a sport setting. A variety of methods was used to pursue this aim of exploring the combination of cognitive, affective, and physiological variables, namely qualitative, psychophysiological and quantitative methods.

1.6.1 Aims

This thesis builds on previous studies examining the role of challenge and threat states in sport settings. Specifically, this thesis examined the relations between the cognitive, affective and physiological components as outlined in the TCTSA (see Figure 1.3 and 1.4). The aims of this thesis were to 1) explore the cognitive elements of challenge and threat states as they occur in a naturalistic setting; 2) examine the relations among the cognitive and affective components of challenge and threat states; 3) examine the cardiovascular reactivity patterns characterising challenge and threat states, cognitive appraisals, self-efficacy, perceived control, and emotions in relation to an upcoming competition; 4) examine athletes’ cognitive, affective, and physiological responses to previous competitions; and 5) explore the efficacy of an intervention designed to develop challenge states in athletes.

CHAPTER 2: A QUALITATIVE EXPLORATION OF THE ANTECEDENTS OF CHALLENGE AND THREAT STATES IN ELITE ATHLETES

2.1 Introduction

The literature review outlined the role of cognitive components in challenge and threat states. The present study aimed to explore the cognitive elements of challenge and threat states as they occur in a naturalistic setting. Challenge and threat states are relevant because they can influence sport performance positively or negatively (M. V. Jones et al., 2009; Skinner & Brewer, 2002; 2004). Challenge states are thought to lead to peak performance and are typically associated with flow, positive cardiovascular patterns, and positive emotions (Blascovich & Mendes, 2000; Blascovich & Tomaka, 1996; Skinner & Brewer, 2002; 2004). Threat states are thought to debilitate performance, and are typically associated with fear of failure, not having sufficient resources to cope with the situation, and with debilitating cardiovascular patterns (Blascovich & Mendes, 2000; Blascovich & Tomaka, 1996; Skinner & Brewer, 2002; 2004). In addition, a threat state can reduce cognitive resources and distract attention (M. V. Jones et al., 2009). Athletes' approaches to competition are dynamic and complex states. They are associated with appraisals and action tendencies which are influenced by situational and personal factors (Cerin, 2003). Exploring the types of things elite athletes talk about when approaching competition may lead to a better insight into challenge and threat states.

Challenge and threat states reflect how an individual engages in personally meaningful situations (Blascovich & Mendes, 2000) and the concepts of demands and resources can be regarded as the basis of challenge and threat states. Challenge and threat states occur when there is something at stake, such as an important competition. Challenge and threat states do not, however, occur when there are extremely high levels of resources compared to the demands of a situation, or when the demands are extremely high compared to available resources (Blascovich & Mendes, 2000). Examples are a top-10 professional tennis player playing a game against a beginner, or an individual just starting to play rugby participating in a rugby clinic and playing against a top-rugby player. During performance episodes there is an interaction between the situation and the individual, which makes it a dynamic process, and each event unique (Blascovich & Mendes, 2000).

The theory of challenge and threat states in athletes (TCTSA; M. V. Jones et al., 2009) comprises cognitive, affective, and physiological components. The TCTSA identified three interrelated constructs of the cognitive component of challenge and threat states: self-efficacy, control, and achievement goals. These constructs are thought to influence challenge and threat states: high levels of self-efficacy, perceived control and an approach goals are expected to related to a challenge, whereas low levels of self-efficacy, low perceived control, and avoidance goals are related to a threat state (M. V. Jones et al., 2009).

The present study built on research examining challenge and threat states, by exploring antecedents of challenge and threat states in a naturally occurring setting. No previous studies have explored challenge and threat states in this manner; however studies have interviewed athletes about their experiences of competition. Gould, Eklund, and Jackson (1992) interviewed 20 members of an Olympic wrestling team where they explored their mental preparation strategies and pre-competitive and competitive cognition and affect. Participants were asked to talk about their best match in the Olympics, their worst match and their most crucial match in the Olympics. Two themes emerged from the best match, these were optimal prematch mental state descriptions such as positive expectations (for example felt confident, going to win), heightened arousal-intensity (for example relaxed and focused, controlled), and heightened effort-commitment, as well as mental preparation strategies such as match preparation routines, tactical strategy focus (for example knew opponent’s weaknesses but focuses on own strengths), and motivational strategies. The two themes emerging from the worst match were pre-match mental state descriptions such as negative feeling states (for example not intense enough, too relaxed), positive feeling states, too many or too few thoughts, task irrelevant thoughts, and negative thoughts and mental preparation deficiencies such as non-adherence to routines and could not visualise. The two themes emerging from the most crucial match were pre-match mental and physical state descriptions such as thoughts, arousal and intensity feeling states, expectancies, and effort and commitment, as well as mental preparation strategies such as mental preparation routines and technical focus strategy (for example concentrating on scoring). In short, there were differences between the three matches. Specifically, before their best match participants recalled more positive expectancies and consistent use of psychological strategies compared to worst Olympic performances where they recalled more negative feeling states and not adhering to pre-performance routines.

Other researchers have looked at sources of stress before a competition (e.g., Campbell & Jones, 2002; Scanlan, Stein, & Ravizza, 1991) using interviews. Scanlan et al. (1991) interviewed former elite figure skaters who performed at national championship level. The participants were informed that stress referred to negative emotions, feelings, and thoughts in relation to their skating experience before being asked to talk about their major causes or sources of stress. Five sources of stress were identified from the data using inductive content analysis. These were negative aspects of the competition, such as experiencing negative thoughts related to competing, negative significant other relationships, such as interpersonal conflict and having others tell them what to do, demands or costs of skating, including financial and personal costs, personal struggles, such as self-doubts about talent and perfectionism, and traumatic experiences, this last theme included family disturbances and death. This study demonstrated that there is a wide range of sources of stress that athletes can experience, these sources of stress are not only related to the competitive experience.

Campbell and Jones (2002) interviewed international male wheelchair basketball players about their sources of stress. The participants were informed that sources of stress could be positive and negative. One of the themes emerging from the inductive content analysis related to pre-event concerns, thus concerns relating to sources of stress experienced before an important basketball event. These concerns related to medical concerns such as a negative influence of injury, individual preparation concerns such as selection concerns, appropriate individual preparation, poor form pre-event, pressure to perform consistently (for example the thought of having to play well throughout the tournament), and team restricting individual potential, and concerns about team preparation, such as poor team preparation, pre-event concern team performance, and concern of other players' preparation. Another theme emerging from the content analysis related to negative match preparations. This related to concerns pre-match, such as pre-match ability worries (for example worrying about the upcoming performance), team ability concerns, equipment concerns, environmental factors, and drugs testing, as well as concerns about inappropriate physical preparation, such as lack of sleep at events and poor match preparation.

In short, Campbell and Jones (2002) and Scanlan et al. (1991) illustrated that there are many sources of stress as athletes approach competition, such as poor form pre-event, the pressure to perform consistently, environmental factors such as the playing arena, personal struggles, and pre-match ability worries such as worrying about the upcoming performance. Gould et al. (1992) showed that there were differences in pre-match mental states when recalling best and worst performances at the Olympics. These studies illustrated that using content analysis is a useful way to explore how athletes approach competition. All of these studies, however, asked athletes to recall previous experiences. The present study will use interviews that were conducted *before* athletes would take part in an important competition.

2.1.2 Aim

The aim of the current research was to explore the types of constructs associated with the cognitive component of challenge and threat states as they occur in sport situations and to identify the prevalence of these constructs amongst elite athletes in a naturalistic setting. Interviews conducted by the media were used to explore if athletes speak in terms related to the cognitive component of challenge and threat states. This way the athletes would talk about how they approach an upcoming competition before taking part in the competition, rather than recalling past performances. Furthermore, using transcripts rather than analysing the reports of interviews is a strength of the present study. A study on attributions of American football players and coaches after competition in the sports pages (Lau & Russell, 1980) acknowledged that sportswriters “serve as gatekeepers in that they decide which statements by players and coaches to print.” (p.36). The use of transcripts of media interviews conducted before a competition enables the use of what athletes have actually said, without depending on the interpretation and opinion of the sportswriter. This study addressed aim one of the thesis; exploring the cognitive elements of challenge and threat states in athletes in a naturalistic setting.

2.2 Method

2.2.1 Participants and Data Collection

The participants in this study were elite tennis players and rugby union players and coaches from whom content from pre-competition interviews were collected. Two different sports were used to enable comparison between individual and team sports. Elite competition was selected due to the importance of the outcome of competition in elite sports, thus it is a goal-relevant setting. This study represents a novel form of data collection in sport psychology; pre-competition interviews conducted by the media were used, this way the researcher could not (unconsciously) influence the participants or control the questions and the direction of the interview. Additionally, this form of data collection provided information on the thoughts people have when they go into a goal-relevant situation where something is at stake. From the tennis players, interviews conducted at the 2008 Australian Open tennis were collected. These were the official interviews conducted on behalf of the Australian Open organisation after each match and included questions about the next match. These interviews were published on the official Australian Open Tennis website (www.australianopen.com) immediately after the interview was conducted. Interviews were collected from 17 male players and 15 female players, totalling 50 interviews. The last two interviews before the player finished the tournament were collected, for most athletes this was one interview followed by a win and one interview followed by a loss, except for the winner of the Australian Open, of which the final two interviews were both followed by a win. For example, a player was interviewed before their first match, which they won, and interviewed again before their second round match, which they lost. In this case there was an interview regarding their expectations of the first round match and one regarding their expectations of their second round match. Unfortunately, not all players were interviewed twice before their game; for these players only one interview could be used. This resulted in data from 18 tennis players who were interviewed twice and 14 tennis players who were interviewed once. Only questions relating to the next match were analysed. In their answers to those questions the players talked about how they felt about the upcoming match.

The data from the rugby union players were collected during the 2008 Six Nations rugby tournament. An internet based search demonstrated that the most consistent pre match interviews for each round were available from the pod casts at the official Six Nations website (www.rbs6nations.com), other websites varied in the number of countries that were interviewed before each round of the competition. Pod casts are media files that are distributed on the internet. During every pre-competition pod cast, data of the four English-speaking nations

(Wales, England, Ireland, and Scotland) was used. The pod casts were transcribed verbatim.

2.2.2 Procedure

Content analysis was used to organise and analyse the data. In content analysis, raw data are organised into interpretable and meaningful categories using deductive and/or inductive procedures (Patton, 1990). Both inductive and deductive reasoning were used. Deductive content analysis organised the raw data in a pre-identified set of categories emerging from the literature review (Blascovich and colleagues; Lazarus, 1999, 2000a; M. V. Jones et al., 2009; Skinner & Brewer, 2004). These themes were demands and resources, the identified constructs for resources were self-efficacy, control, and achievement goal orientation. In conjunction with this, inductive content analysis was performed to allow other themes to emerge from the data which were not pre-identified from the literature.

To summarise, the following five-step procedure was adopted. Similar methods of data-analysis have been used by Gould et al. (1992) and Scanlan, Stein, and Ravizza (1989).

1. Transcribed match interviews from the Australian Open were collected from the official website, and converted into word files comprising 126 single-spaced pages. Pre-competition pod casts were collected and transcribed from the official RBS six nations website. The pod casts were transcribed verbatim, resulting in 60 single-spaced pages of data.

2. Three researchers read and reread the transcripts until they were familiar with the content.

3. Two researchers examined the data in relation to the pre-determined demand and resources themes. The data-analysis was carried out independently by the researchers and included peer debriefing sessions (Biddle, Markland, Gilbourne, Chatzisarantis, & Sparkes, 2001; Côté, Salmela, Baria, & Russell, 1993) to ensure trustworthiness and transparency. The third researcher acted as a 'devil's advocate', who questioned the analyses and interpretation, this is a method recommended by Krane, Andersen, and Strean (1997).
4. For the inductive analysis, the two researchers identified raw themes, characterising challenge and threat themes. The third researcher acted as a 'devil's advocate' again.
5. The three researchers extensively discussed the themes identified from the data and organized the raw data themes in interpretable and meaningful themes. If there was disagreement over a theme, this was discussed until agreement was reached.

2.2.3 Data Analysis

The data were analysed using content analysis as described above. For the deductive content analysis the quotes were identified as demand and resources themes. Further, sub-themes that could be grouped together in a meaningful manner were identified. These were self-efficacy, control, and goal achievement orientation for resources. For the inductive content analysis quotes were clustered together, by comparing and contrasting the quotes and themes, to collate quotes with a similar meaning and to separate quotes with disparate meanings. The clusters then lead to higher order themes, until it becomes impossible to identify further underlying similarities of the themes to create a higher theme level (Scanlan et al., 1989). The results for the Australian Open tennis and Six Nations rugby are reported separately.

2.3 Results

2.3.1 Australian Open Tennis

The inductive content analysis for the Australian Open tennis supported the themes of demands and resources. The three resource themes; self-efficacy, control, and achievement goals, were identified from the data (see Figure 2.1). In addition, perceived support emerged from the content analysis.

Demands. The data demonstrated that most tennis players in the Australian Open who were interviewed acknowledged the demands of the upcoming match. Not all tennis players had specific expectations of the upcoming match and some tennis players did not acknowledge uncertainty of the outcome of the match; this occurred when a tennis player did not have a clear expectation about the upcoming match (for example “I know his game sort of suits my game. I've had some great matches against him where I always play my very best. So we'll see how it goes this time around”), but still recognised the demands of the match. In the Australian Open, in the interviews followed by a loss athletes mentioned that it would be a ‘tough’ match (three times), this was mentioned once in the interviews followed by a win (see Appendix 1).

Resources. Resources refer to what is available to cope with the demands of a situation, and include perceptions or judgments of knowledge and skills relevant to the competition (Blascovich & Mendes, 2000). The three higher order themes self-efficacy, control, and achievement goals comprised resources; in addition the theme “perceived support” was identified.

Self-efficacy. Self-efficacy was reflected by quotes referring to feeling confident and performance accomplishments. An example of feeling confident was exemplified by one player who, when asked what her thoughts were on the possibility of playing a higher ranked player in the next round, mentioned: "For me, yeah, I've got nothing to lose, again, and obviously I'm hitting the ball really well and feel really good." This player showed that she had the belief that she was playing well at that moment. That she was playing a higher ranked player did not appear to influence her, and she demonstrated a belief in her own skills. In addition, performance accomplishments provided the players with knowledge gained from experiences and they can increase the perceived available resources. For example, one player mentioned how she felt after a good performance, "I feel good that not only was it a two-set win, but I feel pretty good coming out of a very tight match like that today".

Control. The theme control was represented by three sub-themes; preparation, concentration, and mindfulness. Preparation refers to tactical, physical, physiological and/or psychological actions expected to prepare the athlete for the upcoming competition. One tennis player referred to preparation as follows: "Something like that I might expect in the finals. But I'll try to recover and get the tactic ready with my coach". This quote exemplifies the importance of preparing tactical play. Another player outlined how previous experience taught her how to prepare for the situation differently: "I had experience playing in the French Open final. That's definitely something I have to look at and just try to deal with differently".

Attentional focus refers to the ability to focus and includes factors such as staying calm, patience, internal focus, and task-focus. One of the main aspects of concentration is the ability to focus on the task at hand, and while executing this task not paying attention to irrelevant internal and external stimuli (J. M. Williams, Nideffer, Wilson, Sagal, & Peper, 2010). The ability to control internal and external factors is essential for concentration (J. M. Williams et al., 2010). Attentional focus included awareness of what you can control and what you cannot control; one player outlined how some things cannot be under his control: "But it's something you can't really control. Depending on the spectators, on your opponent, what shot selection, what's the score line, it always changes, because you don't control it yourself." Mindfulness refers to the idea that for optimal control it is essential to be in the present rather than think about what could have happened or what can happen in the future and could be explained by the term 'here and now'. This was demonstrated by the ability to react during a match to unexpected events. One player referred to this as follows: "I think at the end of the day, when you go out on the court, it's you, the ball and the opponent."

Achievement goals. The theme achievement goals was represented by approach and avoidance goals. The sub-theme approach goals referred to focusing on attaining a positive outcome and an approach goal orientation was related to required effort (Elliot & Church, 1997). One player referred to her next game and opponent as follows: "So I have to be there, be there with her from the first point on and try to get that first shot". Avoidance goals were represented by avoidance behaviour and the thought of going out to play and not to lose, instead of going out to play to win, for example: "I know it's going to be difficult, and I know guys that have had success against him have had big serves and have been able to get some free points or at least put themselves on offense. That's something that's going to be difficult for me to do, because I don't have the overpowering serve".

Perceived support. Perceived support emerged as a theme that was not identified beforehand as part of the TCTSA. Perceived support relates to the awareness and knowledge of the athlete that there is support available (Sarason, Sarason, & Pierce, 1990) and can be classified under resource appraisals (Blascovich & Mendes, 2000). One athlete referred to perceived support as follows: "I have the right surroundings around me, great people, with a lot of knowledge about tennis and about the life." Other athletes referred to perceived support from the supporters, and the positive effects they felt this can have, for example: "But this time I'll be on home soils, so that's going to be nice. You know, I think anything's possible, especially with the crowd behind me."

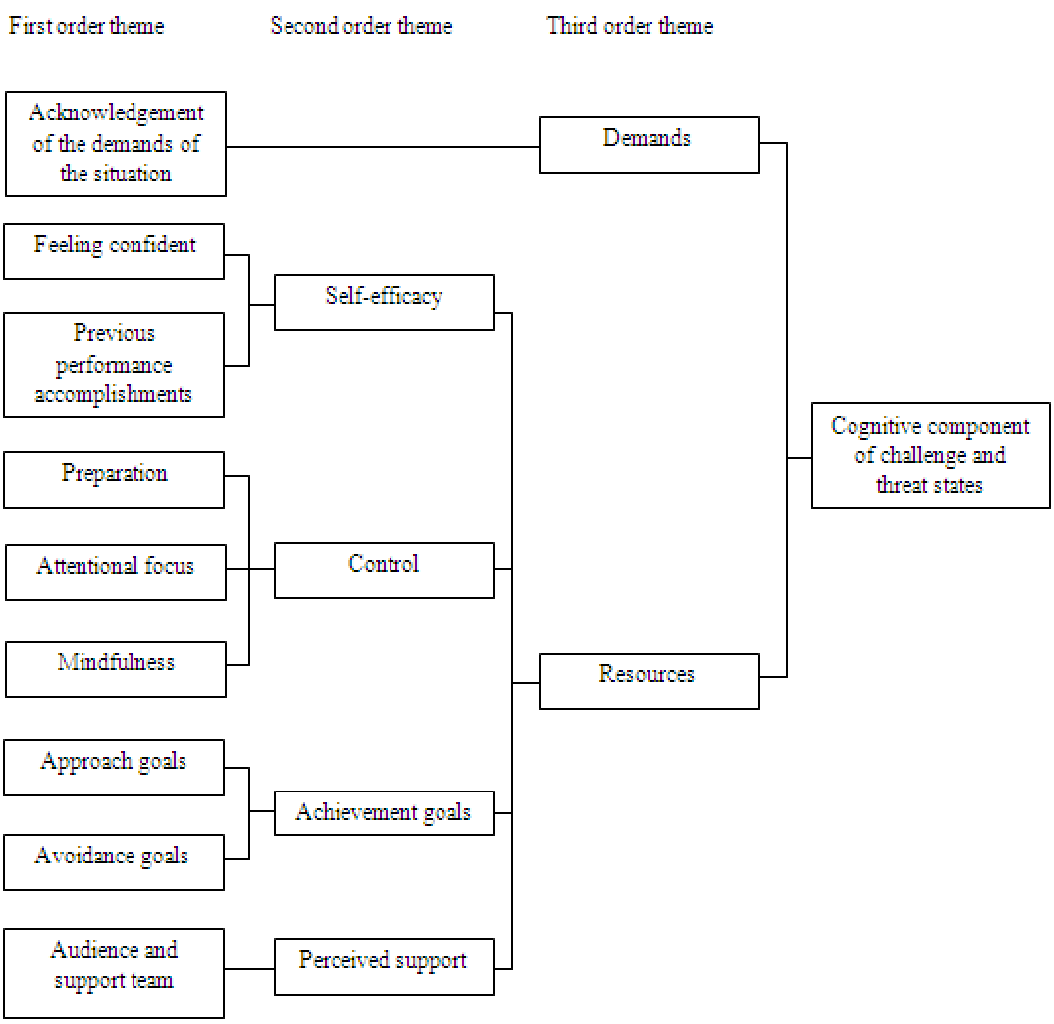

Figure 2.1. Overview of hierarchical content analysis

2.3.2 Six Nations Rugby

Inductive content analysis for the Six Nation rugby demonstrated that rugby players and their coaches spoke about an upcoming competition in terms that support the themes of demands and resources. The sub-themes self-efficacy, control, and achievement goal orientation were identified as part of the theme resources, as well as perceived support (see Figure 2.1). In addition, perceived support was identified as a theme emerging from the raw data.

Demands. The suggestion that demands are inherent to competitive sport situations was acknowledged by the players and coaches in the Six Nations rugby tournament. Players and coaches expected to gain something from the situation, although a win was not always expected (see Appendix 2). The resources to cope with the demands of the situation are discussed next.

Resources. For resources, three themes were identified: self-efficacy, control, and achievement goals.

Self-efficacy. Self-efficacy was comprised of the sub-themes feeling confident and performance accomplishments. The subtheme feeling confident varied from high levels of confidence ("We know that performance is in us and I think that over the last couple of weeks we showed that was there and the confidence is there") to lower levels of confidence ("Obviously their confidence is high having got to a World Cup final, ours is a little bit dented after getting knocked out in the group stages"). One coach acknowledged that whereas his team felt confident, this was not represented by their performance: "We have a lot of confidence in it, but for one reason or the other it has been stuttering a wee bit so far in the championship." Feeling confident as a team was more often referred to when compared to individual feelings of confidence (see Appendix 2). This could be explained by collective efficacy, which is the shared belief of group members to do well on a specific task and is reflected in a group's motivational commitment to the task (or a competition), performance accomplishments and resilience to adversity (Bandura, 2000). The sub-theme performance accomplishments is a component of performance accomplishments as outlined in self-efficacy theory (Bandura, 1997) as well as collective efficacy (Bandura, 2000). The players and coaches identified experience as a source to learn from for the next match, for example: "It is something we need to learn from and not make those mistakes again". Experience is further related to knowledge, providing players and coaches with knowledge about how and how not to play in the next game. Resources are increased by the knowledge and experience of previous games and therefore there are more available resources to cope with the demands of the next game.

Control. The theme control included the sub-themes attentional focus, preparation and mindfulness. Attentional focus refers to the ability to focus and includes factors such as staying calm, patience, internal focus, and task-focus. The ability to focus and refocus is found to be an important factor of peak performance (Orlick, 2000). An example of external focus were the weather conditions and how that did not have to distract performance: “The weather when we played in St. Etienne was horrendous, again we had to adapt to those conditions, we are hoping for a bit less rain and a bit more sun in Rome this weekend”. Preparation refers to actions and behaviour reflecting tactical, physical and/or psychological actions. One team member mentioned adaptation of tactics: “We think now after two games we know exactly what the problems are and we have spend this week making sure that we are rectifying them. The players are very clear about what they need to do this weekend, to ask more questions of the Irish defence”. Mindfulness refers to the idea that for optimal control it is essential to be in the present rather than think about what could have happened or what can happen in the future. This was demonstrated by the ability to react during a match to possibly unexpected events, but also the awareness that results of previous games should not be taken into a future encounter, for example: “I think we are experienced enough now to realise that the next game is the important one rather than one that has happened twelve months ago”.

Achievement goals. The third inductive theme was achievement goals. Both approach and avoidance goals were identified. As the competition progressed an approach focus emerged more compared to an avoidance focus. The eventual winner of the competition stated in their first pre-game interview: “we are massive underdogs but nobody is expecting us to spring a surprise, it is a good situation to be in”. Towards the end of the competition, an approach goal orientation as adopted: “We are just going for the win out in Ireland and everything else is peripheral”. Changing expectations appeared to change the type of goal orientation (avoidance/approach) this team was adopting.

Perceived support. Perceived support was both referred to in relation to support from the audience and support from the players in the team. The support from players in the team was rated as important from the perspective of being a newcomer in the team (“I know… and they have been talking to me through the whole week and hopefully they will be able to pull me through”). External support from the audience was regarded as helpful towards performance: “Certainly playing at home for us, getting the Irish supporters behind us always have been, will be great and we need to give them something to cheer about. We always have been trying to do that and if we do, it will certainly be in our favour at home in Croke Park”. High levels of perceived support could increase perceived available resources and in turn benefit a challenge state.

2.4 Discussion

The content analysis demonstrated that the athletes acknowledged the demands of an upcoming competition. The resource themes, self-efficacy, control, and achievement goals were identified in the content analysis. In addition, perceived support emerged as a theme for both the Australian Open tennis and Six Nations rugby. Simply demonstrating that these constructs appear when athletes talk about an upcoming competition is a worthy finding in itself and provides face validity to the TCTSA.

The TCTSA suggests that the cognitive component of challenge and threat states include the constructs of self-efficacy, control, and achievement goals (M. V. Jones et al., 2009). In the present study, self-efficacy was further represented by performance accomplishments. The six sources of efficacy information are performance accomplishments, vicarious experiences, verbal persuasion, physiological states, emotional states and imaginal experiences (Maddux, 1995). Studies on the relation between self-efficacy and performance have mainly focused on the influence of positive performance on self-efficacy (Moritz, Feltz, Fahrbach, & Mack, 2000). For the Six Nations rugby, collective efficacy emerged from the data. Additionally, the content analysis demonstrated that performance accomplishments do not necessarily have to be positive, a negative performance experience can be interpreted as a learning experience, and used to enhance future performance and self-efficacy. For self-efficacy to occur, it is essential that an athlete perceives control over their actions to cope with the demands of the competitive situation (Bandura, 1997). High levels of self-efficacy are thought to relate to challenge states, whereas lower levels of self-efficacy relate to threat states (M. V. Jones et al., 2009).

The findings of the content analysis demonstrated that athletes talk in terms of control. Control was represented by the sub-themes preparation, attentional focus and mindfulness. The sub-theme of preparation was closely linked to the sub-theme of experiences in self-efficacy. Athletes can use previous experiences to prepare for subsequent competition. In addition to the sub-themes preparation and attentional focus or concentration, the sub-theme of mindfulness was identified. Mindfulness is linked to the flow literature and being in the “here and now” (Kee & Wang, 2008). More mindful athletes are more likely to experience flow states (Kee & Wang, 2008). High levels of mindfulness may have a positive influence on performance (Kee & Wang, 2008). The constructs of novelty seeking and flexibility (Bodner, 2000; Kee & Wang, 2008) appeared as the main theme of mindfulness. Novelty seeking refers to “approach each environment as an opportunity to learn something new and look specifically and actively for such opportunities” (Bodner, 2000, p. 15). Flexibility refers to an individual’s tendency to view situations from multiple perspectives and includes the ability to easily change perspectives (Bodner, 2000). Athletes in a challenge state are thought to experience higher levels of perceived control compared to athletes in a threat state (Jones et al., 2009).

The theme of achievement goals was defined by approach and avoidance goals. It is suggested that an individual’s belief to attain competence in an achievement situation will direct him/her towards the opportunity for success and the adopting of approach achievement goals (Adie et al., 2008; Elliot & Church, 1997). On the other hand, an individual with low expectancies is expected to align toward the possibility of failure, and in turn adopt an avoidance goal (Elliot & Church, 1997; McGregor & Elliot, 2002). Approach goals are related to challenge states and avoidance goals are related to threat states (M. V. Jones et al., 2009; McGregor & Elliot, 2002). Approach and avoidance goals have an influence on the self-regulatory behaviour of athletes (Elliot & Church, 1997). Athletes adopting approach goals are focused on their task, whereas athletes adopting avoidance goals are trying to avoid doing worse than they did before and as a result they are less likely to focus on the task at hand (Elliot & Church, 1997. Changing expectations could change the type of goal a team is adopting. The winner of the Six Nations moved towards approach goals, where they mentioned that they have the outcome in their own hands ("it is nice to being able to put yourself in this position where destiny is in your own hands and the fact that you are at home in the last game of the championship"), whereas one of the teams finishing as one of the bottom teams talked more in terms of an avoidance goal orientation towards the end of the competition, and mentioned that they should not perform worse than they did in earlier games ("our message is constant, we have got to go forward, what we don't want to be doing is going backwards and playing the sort of rugby we were playing two or three weeks ago").

A theme that emerged from the content analysis was perceived support. External support is included as a construct of resources in the BPS model (Blascovich & Mendes, 2000). High levels of perceived support are expected to result in less perceived stress compared to individuals with low levels of perceived support (Rees & Freeman, 2007). The perception of support that is available can lead the athlete to change perceptions of available coping resources or feelings of control, this can results in re-appraising of the threat posed by a stressor (Cohen & Willis, 1985).

2.4.1 Differences between Australian Open Tennis and Six Nations Rugby

There did not appear to be a difference between how athletes in the Australian Open tennis and Six Nations rugby approached an upcoming competition in terms of the cognitive component of challenge and threat states. Similar themes were identified from the data. The players and coaches in the Six

Nations rugby spoke more in we-terms than I-terms, compared to the Australian Open tennis. In terms of self-efficacy, the Six Nations teams referred to the team rather than to their individual performance when talking about efficacious feelings, providing support for the concept of collective efficacy, where team members have a shared belief to successfully perform a task (Bandura, 2000).

2.4.2 Limitations

Demand appraisals can be problematic to define, as it is unclear how the demand elements of uncertainty, perception or assessment of danger, and required effort combine exactly (Wright & Kirby, 2003). The three elements are potential, but not exhaustive, components of demand and may share some variance (Blascovich et al., 2003). In addition there is a reciprocal relation between demand and resource appraisals.

A limitation of the present study was the public display the athletes were under when they were interviewed. Revealing tactics or talking about weaknesses of the athlete or the team could have benefited their competitor. The interviews and pod casts were published online and a wide audience could access the information. Public statements pose a limitation in that they may differ from the personal explanations provided by the athletes. This is underlined by Lau and Russell (1980) who questioned whether the causal attributions that were made in the media reflected the attributions really made by the players, coaches, and sportswriters.

The use of pod casts and interviews presented both strengths and weaknesses. Pod casts are a novel way of sharing information and provided an opportunity to explore the views of a relatively large number of elite athletes. A limitation of using pod casts and the interviews taken from the Australian Open website is that there was no control over the questions that were asked. Not having control over the questions enhanced the difficulty of interpreting the questions and the answers of the participants. Although this was a weakness it also posed as a strength, because the researcher could not influence the participants with the type of questions that were asked and the interviews identified those elements athletes considered important when approaching the next match, whether it reflects their true feelings or not. Further, the demand and resource appraisals identified in the study emerged from questions unrelated to specific challenge and threat states, and this emphasised the naturalistic character of the study.

2.4.3 Implications

The present study showed that the types of things athletes speak about before competition are in line with the cognitive component of challenge and threat states, namely self-efficacy, control, and achievement goals. In addition, perceived support emerged as an element athletes talk about when they approach competition. The dynamic and reciprocal relation between demand and resource appraisals can result in re-appraisal of demands and in turn the available resources to cope with the demands of a situation. The type of goals an athlete adopts affects his/her behaviour and possibly influences an athlete’s self-efficacy and perceived control. Mindfulness was identified as a factor of control. Mindful individuals are thought to have a higher likelihood of adopting mental skills and further tend to experience elements of a flow state more regularly (Kee & Wang, 2008).

Future research directions include how the physiological changes of challenge and threat states relate to the themes self-efficacy, control, and goals, which will be addressed in chapter four and five. The effect of perceived support on challenge and threat states is another area worthy of further exploration as high levels of perceived control can increase the perceived available resources and influence the balance between demands and resources. The present study emphasised the important role goals and expectations have in sport performance. The demands of a situation change when goals are adapted; this is an interactive process, where the available resources are interpreted in relation to the adapted goal. Easy goals can decrease the demands, whereas difficult goals can increase the situational demands. This has an influence on challenge and threat states; when demands are increased and perceived coping resources remain the same, this could lead to a threat state. Examining physiological changes in addition to psychological changes could increase the influence of future studies. If the physiological reactions of athletes to competition and the relation with various psychological correlates of challenge and threat states can be identified, this will aid understanding of athletes' approaches to competition and provide opportunities for interventions focused at promoting challenge states.

In summary, findings from the content analysis in the present study provide a rationale for the next two studies as the present study provided some support for the components of the TCTSA, which will be tested in more detail in the next studies. Although perceived support emerged as a theme from the present study, this was not further explored in this thesis, the aim of this thesis is to examine some of the predictions made by the TCTSA first before extending the TCTSA. Aims of the next studies were to examine the correlations between self-efficacy, control, and achievement goals whilst testing the cognitive and affective components of the theory of challenge and threat states in athletes, as well as examining the cardiovascular responses of athletes in relation to an upcoming competition in combination with the cognitive and affective component of challenge and threat states.

CHAPTER 3: AN EXPLORATION OF THE COGNITIVE AND AFFECTIVE COMPONENTS OF THE THEORY OF CHALLENGE AND THREAT STATES IN SPORT

3.1 Introduction

Chapter two showed that athletes acknowledged an upcoming competition as a demand, and the resource themes self-efficacy, control, and achievement goals, as well as perceived support, were identified in the content analysis as factors athletes talk about in the lead up to competition. The present study builds on chapter two by examining relations between the cognitive (self-efficacy, control, approach and avoidance goals) and affective components of challenge and threat states.

Achievement goals have been found to be related to challenge and threat states. Adie et al. (2008) examined relations between approach and avoidance goals, challenge and threat appraisals of sport competition, and positive and negative indices of well-being. They also explored the influence of cognitive appraisals on approach and avoidance goals in a sample of 422 participants competing in a team sport (cricket, hockey, basketball, netball, football, and rugby). They found that mastery approach goals were positively associated with challenge appraisals, but not associated with threat appraisals of sport competition. Mastery avoidance goals positively predicted threat appraisals, but did not predict challenge appraisals. Performance approach goals were positively related to both challenge and threat appraisals and performance avoidance goals were negatively associated with challenge appraisals.

Weinstein and Quigley (2006) provided evidence for the relation between challenge and threat appraisals and control. They reported that internal locus of control predicted challenge and threat appraisals and cardiovascular reactivity to a novel coping task. Participants completed a locus of control questionnaire and their maximum voluntary force on response buttons was determined. Before participating in a video game task, the participants completed an appraisal questionnaire. Participants with higher locus of control had higher pre-task coping ability and lower post-task stressfulness than those with lower internal locus of control. The results indicated that even though participants with higher locus of control approached an upcoming unknown task with a larger belief in their coping abilities, when asked to report their appraisals after the task, the participants with higher locus of control were no more likely to think they coped well. High levels of control contribute to good performance as high levels of perceived control have been found to be related to higher expectancies of success, more persistence, increased effort, and higher levels of aspiration (Brown & Marshall, 2001; Burger, 1985).

Research has also examined the role of self-efficacy and challenge and threat states. Chemers et al. (2001) examined academic self-efficacy, performance, and challenge and threat appraisals among first year students before they received their evaluations towards the end of the first term. The participants completed the questionnaire, except for the self-efficacy scale, again towards the end of the academic year. The results demonstrated that academic self-efficacy was directly related to performance, and indirectly related through expectations and evaluations of challenge and threat (Chemers et al., 2001). High levels of self-efficacy, perceived control, and approach goals are hypothesised to be related to a challenge state and are associated with increased performance levels (M. V. Jones et al., 2009).

A central tenet of the TCTSA is the role of emotions. Specifically, research has demonstrated that there is a relation between emotions and challenge and threat appraisals (Cerin, 2003; Skinner & Brewer, 2002, 2004); generally positive emotions are thought to be related to a challenge state and negative emotions are thought to be related to a threat state. Cerin measured the contribution of anxiety and fundamental emotions (including interest/excitement, enjoyment, anger, guilt, shame) regarding athletes' perceived functionality of pre-competitive emotional states. Participants were asked to complete pre-competitive emotional state questionnaires recalling their best and worst competition ever, as well as a questionnaire measuring emotions experienced an hour before an actual competition. The results showed that most participants approached the upcoming competition with a mixed pattern of challenge and threat appraisals, indicating that the competition could be regarded as both a challenge and a threat. Those who were challenged reported more interest-excitement, while those who appraised the competition as a threat reported more anxiety and fear. Schneider (2004) examined the role of neuroticism on psychological and physiological responses and found that threatened participants experienced more negative affect than challenged participants. Challenged participants reported more positive affect than threatened participants. Skinner and Brewer (2002) also examined relations among emotions and challenge and threat appraisals. Skinner and Brewer (2002) found that challenge appraisals were related to more confident coping expectancies, lower perceptions of threat, increased positive emotion and a more helpful perception of the influence of appraisals and emotions on performance compared to threat appraisals. Skinner and Brewer (2004) focused on positive emotions and beneficial interpretations of emotion and reviewed how they influence preparation prior to sport competition and sport performance.

In addition to the direct relation between challenge and threat appraisals and emotions as reported above, the cognitive components of challenge and threat states are thought to predict emotional state. For example, Sideridis (2008) examined relations among negative affect, anxiety and stressful arousal and mastery-avoidance goals and found that mastery avoidance goals predicted negative affect. Lewthwaite (1990) reported that young soccer players with higher competitive anxiety reported more perceived threat to effort and mastery goals. The perception of emotional state is also influenced by the cognitive components, self-efficacy and perceived control. G. Jones (1995) suggested that self-efficacy and perceived control determine the interpretation of emotional state as helpful or unhelpful, an internal locus of control is related to a more helpful interpretation of competitive anxiety for performance.

In short, these studies demonstrated that achievement goals, control, and self-efficacy can predict emotions. No previous research, however, has explored the unique combination of cognitive and affective variables as outlined by the TCTSA in one study and the present study will test this.

3.1.1 Aim

The present study contributes to existing literature by exploring relations among self-efficacy, control, achievement goals, emotions, interpretation of emotions, and challenge and threat appraisals in relation to approaches before competing in an important competition in one single study. The present study addressed aim two of the thesis, by examining relations between the cognitive and affective components as outlined by the TCTSA. Specifically, it was hypothesised that 1) a challenge state is characterised by increased self-efficacy, perceived control, approach goals, positive emotions and a more facilitative interpretation of emotions just before an important competition, 2) a threat state is characterised by decreased levels of self-efficacy, lower perceived control, avoidance goals and more negative emotions and a more debilitative interpretation of emotions just before an important competition, and 3) self-efficacy, control, approach/avoidance goals influence emotional state, specifically lower levels of self-efficacy, control, approach and avoidance goal orientation are predicted to increase anxiety. No predictions were made for dejection, excitement, anger, and happiness as there was not enough supporting research.

3.2 Method

3.2.1 Participants

Based on 15 variables (challenge appraisal, threat appraisal, self-efficacy, control, approach goals, avoidance goals, anxiety, dejection, excitement, anger, happiness, interpretation emotion, age, sport, gender) the present study required 170 participants (Green, 1991), for detecting a medium effect size with power =.80 when using a $p < .05$ criterion for statistical significance in a multiple regression analysis. The formula used to calculate the number of participants was $N > 50 + 8p$, with p being the number of predictor variables (Green, 1991). One hundred and seventy seven collegiate athletes participating took part in the study, competing in a variety of sports. These sports were equestrian (n = 2); martial arts (n = 7); triathlon (n = 2); cricket (n = 14); handball (n = 3); American football (n = 2); rugby (n = 9); football (n =73); cycling (n = 3), basketball (n = 16), tennis (n = 4), swimming (n = 4), netball (n = 9), hockey (n = 7), trampolining (n = 2), athletics (n = 1), volleyball (n = 4), squash (n = 1), dragon boat racing (n = 1), gymnastics (n = 1), dance (n = 3), motorcycle trials (n = 2), golf (n = 3), table tennis (n = 1), Olympic weight lifting (n = 1), Gaelic football (n = 1), and rowing (n =1). The mean age of the participants was 22.50 years (*SD* = 6.32), ranging from 18 to 52 years old. Participants' competitive level varied from international to recreational level with an average of 10.13 (*SD* = 6.04) years sports experience, and the participants played their main sport 6.18 (*SD* = 4.86) hours per week.

3.2.2 Measures

Participants completed demographic information about their gender, age, main sport, years of experience in their main sport, current level of competition, and their highest level of competition.

Self-efficacy. To measure self-efficacy a sport specific self-efficacy questionnaire (Coffee & Rees, 2008) was used (see Appendix 3). Participants competed in different sports, therefore a specific football, swimming, or rowing self-efficacy measure as recommended by Bandura (2006) could not be used. The self-efficacy questionnaire used in the present study asked participants to rate a number of statements in relation to how they typically feel before an important competition. The self-efficacy measure has internal consistency reliability values of α =.88 to .90 in previous studies (Coffee & Rees, 2008; Coffee, Rees, & Haslam, 2009). The participants were instructed to relate the statement to *how they feel just before an important competition, and to indicate to what extent they feel confident that they can …,* followed by six statements rated on a five-point scale (1 = *not at all* to 5 = *completely*). The internal consistency reliability of the sport-specific self-efficacy measure in the present study was $\alpha = .75$.

Perceived control. Perceived control was measured using three items. The items were based on Bonetti and Johnston's (2008) perceived control over walking measure and followed Ajzen's (1991) perceived behavioural control protocol and Conner and Sparks' (1996) locus of control protocol. Locus of control was measured using a single item, *Do you think it is entirely up to you whether you perform to the best of your abilities*? rated on a five point scale (1 = *strongly disagree* to 5 = *strongly agree*). Perceived behavioural control was measured with two items, *How much control do you feel you have over whether you perform to the best of your abilities*? rated on a five point scale (1 = *no control at all* to 5 = *complete control*) and *How difficult will it be for you to perform to the best of your abilities?* (1 = *extremely difficult* to 5 = *not at all difficult*). The perceived behavioural control items were in line with the theoretical framework of control (Skinner, 1996) where perceived control relates to the individual's belief about how much control is available. In addition, the locus of control item measures the means-end relation which refers to the association between a cause and an outcome. The internal consistency reliability coefficient of the perceived control measure in the present study is $\alpha = .55$. Deleting any of the three items did not improve the internal consistency of the scale. To further explore the scale, a principal component factor analysis was conducted. All three items were significantly correlated, with correlation coefficients between $r = .22$ to .40. The Kaiser-Meyer-Olkin measure was .59, which is acceptable (Kaiser, 1974). Bartlett's test of sphericity was significant, χ^2 (3) = 42.64, $p < .001$. The communalities of the three items were all above .3, indicating that each item shared some common variance with the other two items. The principal component factor analysis extracted one component. Therefore it was decided to retain the scale for further analysis, given the importance attributed to control in the TCTSA.

Achievement goals. Achievement goals were measured using the 12-item Achievement Goal Questionnaire for Sport (AGQ-S; Conroy, Elliot, & Hofer, 2003; see Appendix 3) to measure the four achievement goals in the 2x2 achievement goal model, MAp (*It is important for me to master all aspects of my performance*), MAv (*I am often concerned that I may not perform as well as I can perform*), PAp (*My goal is to do better than most other performers*), and PAv (*It is important to avoid being one of the worst performers in the group*). The participants indicated the extent to which items was true of them in relation to how they feel just before an important competition, on a 7-point scale ranging from 1 (*not at all true*) to 7 (*very true*). Previous studies have provided evidence of the validity of the AGQ-S (Adie et al., 2008; Van Yperen, 2006). In the present study the internal consistency reliability coefficient values were α = .58 for MAp, α = .88 for MAv, α = .84 for PAp, and α = .86 for PAv. The low reliability value for MAp could have been caused by the high mean scores and a non-normal distribution of the data with kurtosis values of more than 2 for item 1 (*It is important for me to perform as well as I possibly can*) and item 5 (*I want to perform as well as it is possible for me to perform*). Deleting any of the items did not result in an improved internal consistency for the MAP scale and it was decided to use all three items for further analysis. A low internal consistency score for MAp (α = .50) has also been reported by Conroy, Cassidy, and Elliot (2008). MAp is an important variable in relation to the other three goals (Conroy et al., 2008) and thus it was decided to retain the MAp scores for further analyses notwithstanding the low internal consistency reliability scores. In addition, the internal consistency reliability coefficient for the combined avoidance (MAp and PAp) and approach (MAv and PAv) were calculated in line with the TCTSA. The internal consistency reliability coefficient for approach was α = .70 and for avoidance α = .84.

Emotions. Emotions were measured using the Sport Emotion Questionnaire (SEQ, M. V. Jones, Lane, Bray, Uphill, & Catlin, 2005, see Appendix 3), a 22-item questionnaire. The SEQ identifies five emotions, anger, anxiety, dejection, happiness and excitement. The participants were asked to indicate on a five point Likert-scale ranging from 0 (*not at all*) to 4 (*extremely*), how they feel just before an important competition in their main sport, to words including *uneasy*, *exhilarated*, and *dejected*. The questionnaire has been validated by M. V. Jones et al. (2005), providing evidence of reliability values for each subscale above α =.80, and further support from confirmatory factor analyses (M. V. Jones et al., 2005). The internal consistency reliability coefficients in the present study were α = .84 for anxiety, α = .92 for dejection, α = .66 for excitement, α = .82 for anger, and α = .86 for happiness. Interpretation of emotional state was measured using a single item, "*how helpful do you feel your emotional state is for your performance?* ", rated on a five point scale (0 = *not at all helpful* to 4 = *extremely helpful*).

Challenge and threat appraisals. Participants were asked to imagine that they are about to take part in the most important competition of the season and to indicate on a 5-point scale ranging from 0 (*not at all*) to 4 (*extremely*), on two items; *how threatened do you feel by this* and *how challenged do you feel by this*.

Manipulation check. To verify if participants were able to imagine if they were just about to compete in an important competition, they were asked to indicate how able they were to complete the task that was asked of them by ticking one out of three options (M. V. Jones & Uphill, 2004), option one *I was able to complete the questionnaire as if I was just about to compete in an important competition accurately*, option two *I was able to complete the questionnaire as if I was just about to compete in an important competition with some degree of accuracy*, or option three *I was unable to complete the questionnaire as if I was just about to compete in an important competition with any degree of accuracy*. Participants who ticked option three were removed from data analysis.

3.2.3 Procedure

Ethical approval was granted by the University's ethics committee. The participants provided informed consent before completing the questionnaire booklet. Participants were recruited from three university sites, using convenience sampling (non-probability). The participants, who agreed to take part, completed the questionnaire at the start of a lecture or took the questionnaire with them and returned it at the next session. The questionnaire booklet took approximately 10 minutes to complete.

3.2.4 Analysis

The aim of the first part of the data analysis was to examine if the cognitive elements predicted challenge and threat appraisals. Before doing this, differences in gender and type of sport were explored as previous research has outlined that there are differences in anxiety and type of sport and anxiety (see Martens et al., 1990). Next the predictive value of the cognitive components and challenge and threat appraisals on emotions was tested. Finally, the predictive value of the cognitive components and challenge and threat appraisals on interpretation of emotional state was tested in the first part of the data analysis. Initially, the demographic variables (level of competition, type of sport, gender, age) were controlled for in the first step of the hierarchical regression analysis and removed when not significant. The final analysis, without non-significant demographic variables, was reported.

In the first set of hierarchical regression analyses self-efficacy, control, approach goals, and avoidance goals were entered as predictor variables with either challenge appraisal or threat appraisal as the outcome variable. The second set of regression analyses entailed five analyses with anxiety, dejection, excitement, anger, or happiness as the outcome variable. Self-efficacy, control, approach goals, and avoidance goals were entered in the first step and challenge appraisal and threat appraisal were entered in the second step. In the final analysis of the first part of the data analysis a hierarchical regression analysis was performed to examine the predictors of interpretation of emotional state. Anxiety, dejection, excitement, anger, and happiness were entered in the first step to control for emotional state, self-efficacy, control, approach goals, and avoidance goals were entered in the second step, and challenge appraisal and threat appraisal were entered in the third step.

The second part of the data analysis focused on exploring the relation among the four types of challenge and threat appraisal patterns (high challenge/high threat, high challenge/low threat, low challenge/high threat, and low challenge/low threat) and the cognitive and affective components of challenge and threat states. Differences between the four types of challenge/threat responders were examined using a multivariate analysis of variance. A 2x2 multivariate analysis of variance (MANOVA) was performed with challenge appraisal and threat appraisal as the independent variable and self-efficacy, control, approach goals, avoidance goals, anxiety, dejection, excitement, anger, happiness, and interpretation of emotional state as the dependent variables.

3.3 Results

The data were screened for outliers and normal distribution. All variables were normally distributed with skewness and kurtosis values between the recommended values of -2 and 2 (Field, 2009), except for the variable dejection. Inspection of the mean of dejection showed that most participants scored 0 on the 5-point scale, hence there was low variability in the scores for dejection. Three participants were removed from further data analysis as they indicated they were unable to complete the questionnaire as if they were just about to compete in an important competition with any degree of accuracy, another two participants failed to indicate how able they were to recall the competition and were also removed from further data analysis. There were 172 participants remaining for the further analyses.

3.3.1 Descriptive Statistics and Pearson's Correlations

The descriptive statistics and Pearson's correlations are presented in Table 3.1. The results showed that participants had scores above the midpoint (representing high scores) for self-efficacy, control, approach goals, interpretation of emotional state, and challenge appraisal, scores below the mean point (representing low scores) for dejection and anger, and scores close to the midpoint for anxiety, excitement, happiness, avoidance, and threat appraisal.

The Pearson's correlation analysis showed that challenge appraisals were positively correlated with threat appraisals and anxiety. Threat appraisals were positively correlated with challenge appraisals, anxiety, dejection, anger, and avoidance goal orientation and negatively correlated with self-efficacy. Interpretation of emotional state was positively correlated with self-efficacy and negatively correlated with avoidance goal orientation.

3.3.2 Gender and Type of Sport

Differences in gender and type of sport (individual versus team) were explored. A one-way ANOVA showed that there were significant differences between males and females on avoidance and anxiety. Females (M = 4.88, SD = 1.23) scored higher on avoidance goals than males (M = 3.95, SD = 1.30), F (1, 168) = 19.30, p < .001 and females scored higher on anxiety (M = 2.22, SD = 0.89) than males (M = 1.79, SD = 0.84), F (1, 158) = 8.72, p < .01. Females scored higher on both challenge, and threat appraisals, this result was not significant. Another one-way ANOVA was performed to analyse differences in type of sport, the results demonstrated that individual sport participants scored higher (M = 3.87, SD = 0.70) than participants playing in a team sport (M = 3.64, SD = 0.58) on control, F (1, 170) = 4.19, p < .05, individual sport participants also reported using more avoidance goal orientation (M = 4.80, SD = 1.28) compared to team sport participants (M = 4.08, SD = 1.32), F (1, 169) = 9.46, p < .01. Participants competing in an individual sport reported more anxiety before an important competition (M = 2.21, SD = 0.91) compared to participants in a team sport (M = 1.84, SD = 0.85), F (1, 159) = 5.32, p < .05. Individual sport athletes scored higher on challenge and threat appraisals, this result was not significant.

3.3.3 Cognitive Components and Challenge and Threat Appraisals

To test the predictive value of self-efficacy, control, approach and avoidance goals on challenge or threat appraisals, two regression analyses were performed with either challenge appraisal or threat appraisal as the outcome variable. The TCTSA states that approach goals and avoidance goals are key elements and hence the scores for MAp and PAp were summed up for an overall score for approach goals and MAv and PAv were summed up for an overall avoidance score.

Table 3.1

Summary of Means, Standard Deviation, and Correlations for Scores on Self-efficacy, Control, Approach Goals, Avoidance Goals, Emotions, Interpretation of Emotions and Challenge and Threat Appraisals

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Self efficacy	3.70	0.59	--														
2 Control	3.69	0.62	.31***	--													
3 Approach	5.36	0.89	.21**	.13	--												
4 Avoidance	4.25	1.34	-.09	-.09	.42***	--											
5 MAP	6.22	0.71	.29***	.22**	.57***	-.04	--										
6 MAV	4.74	1.48	-.24**	-.12	.25**	.82***	.04	--									
7 PAP	4.50	1.50	.12	.06	.92***	.52***	.20*	.28***	--								
8 PAV	3.75	1.71	.06	-.04	.44***	.86***	-.10	.41***	.57***	--							
9 Anxiety	1.93	0.87	-.27**	-.11	.13	.47***	-.02	.53***	.16*	.27**	--						
10 Anger	0.48	0.77	-.09	.03	.00	.22	-.19*	.14	.09	.23**	.23**	--					
11 Excitement	2.85	0.67	.26**	.12	.19*	-.14	.27*	-.15	.09	-.08	.03	.04	--				
12 Dejection	0.27	0.61	-.18*	.08	-.02	-.25**	-.18*	.24**	.06	.19*	.32***	.74***	-.04	--			
13 Happiness	2.26	0.98	-.20*	.19*	.03	-.13	.14	-.15	-.03	-.07	-.12	.16*	.55***	.21**	--		
14 Interpretation emotional state	3.05	0.86	.25**	.12	.07	-.20*	.26**	-.11	-.04	-.21*	-.09	-.01	.15	-.09	.18	--	
15 Challenge appraisal	3.05	0.93	-.01	-.06	.10	.02	.15	.09	.05	-.04	.29***	-.11	.05	-.04	-.05	.16	--
16 Threat appraisal	1.72	1.14	-.23**	-.15	-.02	.34***	-.19*	.42***	.06	.17*	.47***	.17*	-.07	.17*	-.07	.12	.33***

Note * $p < .05$, ** $p < .01$, *** $p < .001$

The results for the hierarchical regression analysis with challenge appraisal as the outcome variable are presented in Table 3.2. The cognitive elements self-efficacy, control, approach goals and avoidance goals did not significantly predict challenge appraisal, $R^2 = .02$, $p = .54$. The results for the regression analysis with threat appraisal as the outcome variable are presented in Table 3.2. There was a significant effect for the addition of the cognitive variables, $R^2 = .16$, $p < .001$, the addition of the cognitive elements accounted for 16.2% of the variation in threat appraisal. Avoidance goals was the only significant predictor variable and positively related to threat appraisal. Self-efficacy ($\beta = -.15$, $p = .06$) and approach goals ($\beta = -.16$, $p = .06$) were nearing significance. The results for threat appraisal were in the expected direction. Approach orientation appeared to be a suppressor variable. A suppressor effect occurs in a regression model when including two correlated predictor variables in the same regression model increases one or both validities, for example the bivariate (zero-order) coefficient is less than the beta coefficient for one or both of the predictor variables with the outcome variable, or the partialed coefficients has the opposite sign of the zero-order coefficient, for example the beta coefficient is negative and the zero-order coefficient is negative (Cohen, Cohen, West, & Aiken, 2003). For example, a suppressor effect can occur when the initial predictor is not significantly related to the outcome variable and when a second predictor variable is entered the relation changes.

In the present analysis with threat appraisal as an outcome variable, the beta-coefficient between threat appraisal and approach orientation was larger ($\beta = -.16$) than the zero order correlation between threat appraisal and approach orientation ($r = -.02$). In addition, there was a moderate to high correlation between approach and avoidance orientation ($r = .42$, $p < .001$), both predictor variables. To examine the effects of approach orientation as a suppressor variable, the hierarchical regression analysis was run again without approach orientation. The results showed that the cognitive resources without approach orientation significantly predicted threat appraisal, $\Delta R^2 = .14$, $p < .001$. Avoidance orientation ($\beta = .29$, $p < .001$) and self-efficacy ($\beta = -.18$, $p < .05$) significantly predicted threat appraisal. It appeared that approach orientation suppressed the effect of self-efficacy, without approach orientation in the hierarchical regression analysis self-efficacy appeared as one of the significant predictors of threat appraisal.

Research has outlined differences in mastery and performance goal orientation (Adie et al., 2008). To explore the predictive value of the four goal orientations in more detail another hierarchical regression analysis was performed with self-efficacy, control, MAp, MAv, PAp, and PAv as the predictor variables. The results showed that adding the cognitive components with the four goal orientations did not significantly predict challenge appraisals, $R^2 = .04$, $p = .31$. The cognitive components did significantly predict threat appraisals, $R^2 = .22$, $p < .001$, with mastery avoidance ($\beta = .40$, $p < .001$), positively predicting threat appraisal and mastery approach negatively predicting threat appraisal ($\beta = -.19$, $p < .05$).

Table 3.2

Regression Analyses for Self-efficacy, Control, Approach Goals and Avoidance Goals Predicting Challenge and Threat Appraisal

	Challenge			Threat		
	B	*SE b*	*Β*	*b*	*SE b*	*Β*
Self-efficacy	-0.04	0.13	-.02	-0.35	0.14	-.18*
Control	-0.13	0.13	-.08	-0.13	0.14	-.07
Approach	0.14	0.09	.14			

Avoidance	-0.05	0.06	-.07	0.24	0.06	.29**

Challenge R^2 = .02, p = .54, Threat R^2 = .14, p < .001 ** p <.001,,* p < .05

3.3.4 Emotions

To test the predictive value of the cognitive components self-efficacy, control, approach goals, avoidance goals, challenge appraisal, and threat appraisal on emotions, five hierarchical regression analyses were run with the five emotions anxiety, dejection, excitement, anger, and happiness as the outcome variables. The results are presented in Table 3.3. The results for anxiety showed a significant effect for step 1, R^2 = .25, p < .001, with self-efficacy (β = -.22, p < .01) and avoidance (β = .41, p < .001) as the significant predictor variables.

Challenge and threat appraisals accounted for 11.2% of the variance in anxiety, the addition of challenge and threat appraisals in step 2 was significant, ΔR^2 = .11, p < .001, for challenge appraisal, β = .18, p < .05, and threat appraisals, β = .25, p < .01. Both challenge and threat appraisals had a positive association with anxiety. The results for dejection showed that the cognitive components accounted for 13.3% of the variance in dejection. The variables control and avoidance were positively associated with dejection and self-efficacy was negatively associated with dejection. The addition of challenge and threat appraisals in step 2 was not significant. Excitement was positively predicted by the variables self-efficacy, approach goals, and negatively predicted by the variable avoidance. The cognitive components accounted for 11.7% of the variance in excitement. The addition of challenge and threat appraisals was not significant. The results for anger showed a significant effect for step 1, R^2 = .08, p < .05, avoidance was the only significant predictor variable and was positively associated with anger. The cognitive components accounted for 6.2% of the variance in happiness. Adding challenge and threat appraisals in step 2 did not result in a significant effect.

Table 3.3
Summary of Hierarchical Regression Analysis for Variables Predicting Anxiety, Dejection, Excitement, Anger, and Happiness

	Anxiety			Dejection			Excitement			Anger			Happiness		
	b	*SE b*	*B*	*b*	*SE b*	*β*	*b*	*SE b*	*β*	*B*	*SE b*	*B*	*b*	*SE b*	*β*
Step 1															
Self-efficacy	-.31	.11	-.22**	-.18	.08	-.18*	.19	.09	.17*	-.10	.11	-.07	.22	.14	.14
Control	-.04	.11	-.03	.19	.08	.19*	.03	.09	.03	.12	.10	.10	.19	.13	.12
Approach	.01	.08	.01	-.09	.06	-.13	.17	.07	.23*	-.09	.08	-.11	.06	.10	.05
Avoidance	.27	.05	.41***	.15	.04	.31***	-.09	.04	-.18*	.17	.05	.28**	-.08	.07	-.10
Step 2															
Self-efficacy	-.25	.10	-.18*	-.17	.09	-.16	.21	.10	.19*	-.07	.11	-.05	.24	.14	.15
Control	.00	.10	.00	.18	.08	.19*	.04	.09	.04	.11	.10	.09	.18	.13	.12
Approach	.02	.08	.02	-.08	.06	-.11	.18	.07	.23*	-.05	.08	-.06	.09	.10	.08
Avoidance	.22	.05	.28***	.13	.04	.28**	-.10	.05	-.20*	.13	.06	.22*	-.10	.07	-.14
Challenge	.17	.07	.18*	-.03	.06	-.05	.02	.06	.03	-.13	.07	-.14	-.07	.09	-.07
Threat	.19	.06	.25**	.05	.05	.10	.04	.05	.06	.11	.06	.16	.07	.08	.08

Anxiety R^2 = .25, p < .001 for step 1: ΔR^2 = .11, p < .001 for step 2, Dejection R^2 = .13, p < .001 for step 1: ΔR^2 = .01, p > .05 for step 2, Excitement R^2 = .12, p < .01 for step 1: ΔR^2 = .01, p > .05 for step 2, Anger R^2 = .08, p < .05 for step 1: ΔR^2 = .03, p > .05 for step 2, Happiness R^2 = .06, p < .05 for step 1: ΔR^2 = .01, p > .05 for step 2.
* p < .05, ** p < .01, *** p < .001

Examining the data for anxiety and challenge and threat appraisal suggested a mediation effect for threat appraisal (see Figure 3.1).

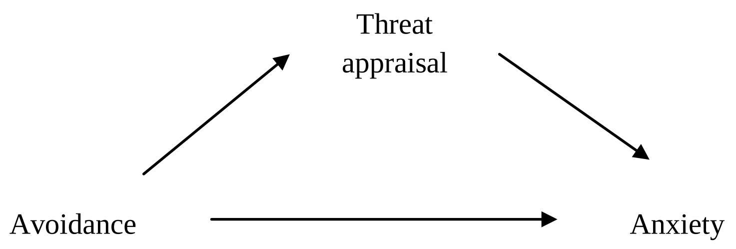

Figure 3.1. Threat appraisal as a mediator variable

Further analysis of the data for mediation effects using the protocol by (Baron & Kenny, 1986; Kenny, Kashy, & Bolger, 1998) suggested partial mediation (see Table 3.4). This protocol identifies three steps, in the first step the outcome variable (anxiety) was regressed on the predictor variable (avoidance) to test Path c and in the second step the mediator variable (threat appraisal) was regressed on the predictor variable (avoidance) to test Path a. Both of these steps needed to be significant for a mediation effect to occur. In the third step, the outcome variable (anxiety) is regressed on both the predictor (avoidance, Path c') and mediator (threat appraisal, Path b) variables. When there is a full mediation effect, the association between avoidance and anxiety (Path c') would be zero (Baron & Kenny, 1986). Although this relation was not zero, the relation between the predictor and outcome was still smaller with the mediator (threat appraisal) in the equation (B = .22) than without the mediator (B = .30). Kenny et al.'s method to test the significance of this effect was used, namely to calculate the square root of $b^2sa^2 + a^2sb^2 + sa^2sb^2$. This revealed a z score of 163.13, which is larger than 1.96 and indicative of a significant partial mediation (Baron & Kenny, 1986; Kenny et al., 1998), with threat appraisal as a partial mediator.

Table 3.4

Testing Mediator Effects Using Multiple Regression

Testing steps in mediation model	*B*	*SE B*	95% CI	*β*
Testing Step 1 (path c)				
Outcome: Anxiety				
Predictor: Avoidance	0.30	0.05	0.21, 0.39	.47***
Testing Step 2 (path a)				
Outcome: Threat appraisal				
Predictor: Avoidance	0.29	0.06	0.17, 0.41	.34***
Testing Step 3 (path b and c')				
Outcome: Anxiety				
Mediator: Threat appraisal	0.27	0.05	0.16, 0.37	.34***
Predictor: Avoidance	0.22	0.05	0.13, 0.31	.34***

Note. CI = Confidence Interval

*** $p < .001$

The regression analysis was also performed with the four separate goal orientations. The results showed that adding the cognitive components with the four goal orientations did significantly predict anxiety, $R^2 = .29$, $p < .001$, with self-efficacy ($\beta = -.17$, $p < .05$) negatively and mastery avoidance goal orientation ($\beta = .43$, $p < .001$), positively predicting anxiety. Dejection ($R^2 = .14$, $p < .01$) was predicted by control ($\beta = .20$, $p < .05$) and mastery avoidance ($\beta = .20$, $p < .05$). Excitement was predicted by the cognitive components, $R^2 = .13$, $p < .01$, with mastery approach ($\beta = .18$, $p < .05$) as the significant predictor variable. The cognitive components with the four goal orientations significantly predicted anger,

$R^2 = .11$, $p < .05$, mastery approach goal orientation negatively ($\beta = -.17$, $p < .05$) and performance avoidance positively ($\beta = .22$, $p < .05$) predicted anger. The cognitive components with four goal orientations did not significantly predict happiness, $R^2 = .07$, $p = .08$.

The interpretation of emotional state was measured by a three step hierarchical regression. In the first step the five emotions were added, so that the emotional state was controlled for, the second step included the cognitive components of challenge and threat states and in the third step challenge and threat appraisals were entered. The results are presented in Table 3.4. Only half of the participants completed the interpretation of emotional state question, because there was an error with this scale in the other half of the questionnaire booklets. Therefore this analysis had a lower number of participants (n = 88). The results show that the cognitive components did not significantly predict the interpretation of emotional state, $R^2 = .09$, $p < .10$. The addition of challenge appraisal and threat appraisal in step 3 revealed a significant effect, $R^2 = .11$, $p < .05$, threat appraisal positively predicted the interpretation of emotional state. The participants who reported to feel more threatened by an important competition indicated that their emotional state was more helpful towards their performance.

Table 3.5

Summary of Hierarchical Regression Analysis for Variables Predicting Interpretation of Emotional State

	Interpretation of emotional state		
	b	*SE b*	*B*
Step 1			
Anxiety	-0.08	0.12	-.08
Dejection	-0.44	0.26	-.27
Excitement	0.07	0.16	.05
Anger	0.19	0.18	.16
Happiness	0.15	0.12	.15
Step 2			
Anxiety	0.07	0.13	.07
Dejection	-0.36	0.26	-.22
Excitement	-0.09	0.17	-.07
Anger	0.23	0.17	.20
Happiness	0.11	0.12	.11
Self-efficacy	0.35	0.17	.26
Control	-0.12	0.15	-.09
Approach	0.07	0.14	.07
Avoidance	-0.18	0.10	-.27
Step 3			
Anxiety	-0.11	0.13	-.10
Dejection	-0.44	0.25	-.27
Excitement	-0.06	0.16	-.04
Anger	0.28	0.17	.24
Happiness	0.03	0.12	.03
Self-efficacy	0.35	0.16	.26*
Control	-0.14	0.14	-.11
Approach	0.09	0.13	.08
Avoidance	-0.22	0.10	-.32*
Challenge	0.16	0.10	.17
Threat	0.25	0.10	.32*

$R^2 = .08$, $p = .23$ for step 1: $\Delta R^2 = .09$, $p = .10$ for step 2: $\Delta R^2 = .11$, $p < .01$ for step 3.

* $p < .05$.

3.3.5 Challenge and Threat Appraisal Patterns

The results showed that challenge and threat appraisals are positively correlated. Further analysis of participants' challenge and threat patterns showed that participants had mixed patterns. Based on a median split for challenge (*Mdn* =3) and threat (*Mdn* =2), participants were assigned to one of four groups, high on challenge and threat, low challenge/high threat, high challenge/low threat, and low challenge/low threat. Forty six participants (27 %) scored high on both challenge and threat appraisal in relation to how they felt about an upcoming important competition, 88 participants (52 %) scored high on challenge and low on threat, 4 participants (2%) scored low on challenge and high on threat, and 33 participants (19%) scored low on both challenge and threat appraisal.

A MANOVA was carried out to identify if there were differences between the challenge and threat patterns and self-efficacy, control, approach and avoidance goals, anxiety, dejection, excitement, anger, and happiness. As only 2% had a low challenge/high threat pattern, this group was not included in the MANOVA. In addition, because there were fewer participants who completed the item measuring interpretation of emotional state, to calculate the difference between the patterns and interpretation of emotional state a one-way ANOVA was performed, instead of including the interpretation of emotional state in the MANOVA.

The results for the MANOVA showed that there is a main effect for group (challenge/threat pattern), Wilks $\lambda = .764$, $F\ (18, 262) = 2.09$, $p < .01$. Univariate tests using Bonferroni correction showed that there was a significant difference between the challenge and threat patterns in terms of self-efficacy ($F\ (2, 139) = 3.37$, $p < .05$), avoidance ($F\ (2, 139) = 4.79$, $p < .05$), anxiety ($F\ (2, 139) = 13.32$, $p < .01$), and interpretation of emotional state and interpretation of emotional state, $F\ (2, 98) =$

3.48, $p < .05$). The high challenge/low threat group scored higher on self-efficacy ($M = 3.80$, $SD = .55$) than the high challenge/high threat group ($M = 3.49$, $SD = .69$). For avoidance goals, the high challenge/low threat group scored lower ($M = 3.88$, $SD = 1.29$) than the high challenge/high threat group ($M = 4.67$, $SD = 1.19$). For anxiety, the high challenge/high threat group reported higher scores ($M = 2.44$, $SD = .87$) than the low challenge/low threat group ($M = 1.52$, $SD = .78$) and the high challenge/low threat group ($M = 1.74$, $SD = .78$). For interpretation of emotional state, the high challenge/high threat group reported higher scores ($M = 3.22$, $SD = .87$) than the low challenge/low threat group ($M = 2.59$, $SD = .94$). There were no significant differences between the challenge and threat patterns and control, $F\ (2, 139) = 1.91$, $p = .15$, approach goals, $F\ (2, 139) = 0.05$, $p = .99$, dejection, $F\ (2, 139) = 1.74$, $p = .18$, excitement, $F\ (2, 139) = 0.32$, $p = .73$, anger, $F\ (2, 139) = 2.59$, $p = .08$, happiness, $F\ (2, 139) = 0.01$, $p = .99$.

3.4 Discussion

The aim of this study was to examine relations among self-efficacy, control, approach and avoidance goals, emotions, interpretation of emotions, and challenge and threat appraisals before competing in an important competition. It was hypothesised that a challenge state would be characterised by increased self-efficacy, perceived control, approach goals, positive emotions and a more facilitative interpretation of emotions just before an important competition, a threat state would be characterised by decreased levels of self-efficacy, lower perceived control, avoidance goals, more negative emotions, and a more unhelpful interpretation of emotions just before an important competition. The results support some of the predictions made by the TCTSA and the hypotheses of this study. Specifically, challenge appraisal was not predicted by any of the cognitive components. Threat appraisal was predicted by avoidance goals. Approach orientation appeared to suppress the effect of self-efficacy. Emotions were predicted by the cognitive resource components. Specifically, anxiety was negatively predicted by self-efficacy and positively predicted by avoidance goals, and positively predicted by challenge and threat appraisals. Dejection was negatively predicted by self-efficacy and positively predicted by avoidance goals and perceived control. Participants who reported having more control in relation to an upcoming competition felt more dejected.

This study showed that, in line with Cerin (2003), participants can have a mixed challenge and threat appraisal profile and cognitively appraise an upcoming important competition as both a challenge and a threat. Most participants (52%) displayed a pattern where they scored high in challenge and low in threat. Participants with this pattern tended to have higher self-efficacy and less avoidance goals than the other patterns and were less anxious before an upcoming important competition.

The results showed that the cognitive components of challenge and threat states were associated with emotions. Consistent with Sideridis (2008) and Elliot and McGregor (2001) who found that mastery avoidance goals predicted negative affect, the results showed that mastery avoidance goal orientation positively predicted anxiety. Thus, the people who were anxious before competition reported more of an avoidance goal orientation compared to those who had lower levels of anxiety before competition. Anxious individuals might not actively engage in the competition. This effect appeared to be mediated by threat appraisal. In addition, the results showed that there was a positive association between approach goals and interpretation of emotional state and a negative association between avoidance goals and interpretation of emotional state. Those who perceived their emotional state as beneficial to performance had more approach goals and less avoidance goals, this is in line with the predictions made by the TCTSA.

The perception of the upcoming sport competition and available resources (such as self-efficacy and achievement goals) play an important role in determining anxiety responses (Hall, Kerr, & Matthews, 1998; Martens et al., 1990), the present study shows that they also predict other emotional states such as excitement, dejection, and happiness. For happiness, the combination of self-efficacy, goal orientations, and control contributed more than the constructs separately, which provides support for the combination of cognitive variables as outlined by the TCTSA. Athletes' interpretation of their emotional state was predicted by threat appraisals: the higher a participant scored on threat appraisal, the more helpful they interpreted their emotional state to be. Interpretation of emotional state is found to be a powerful predictor of performance (Swain & Jones, 1996) and therefore relevant. This finding, however, is inconsistent with the hypothesis and with previous work (cf. Skinner and Brewer, 2004). Skinner and Brewer (2004) proposed that a beneficial interpretation of emotional state is related to a challenge, however mild or weak levels of emotions, specifically anxiety (Carver, 1996), do not appear to be associated with a strong interpretation of emotional state as beneficial or harmful for performance. To explain this in relation to the findings in the present study, it is useful to look at the challenge and threat patterns. The results for the challenge and threat patterns showed that the high challenge/high threat group interpreted their emotional state as most beneficial for their performance compared to the high challenge/low threat group and the low challenge/low threat group. The high challenge/low threat group also interpreted their performance more positively than the low challenge/low threat group. Thus, for the challenge/threat patterns where participants scored low on both challenge and threat appraisals, they also scored lower on the interpretation of emotional state for performance item. This did not mean, however, that they interpreted their emotional state as not at all helpful towards performance as the mean score on interpretation of emotional state was high, with most of the participants rating their emotional state as relatively helpful towards performance.

In summary, these findings provided partial support for the TCTSA. The findings showed that the combination of cognitive variables predicted happiness more than each cognitive variable individually. There was, however, a positive association between threat appraisal and interpretation of emotional state, which was contrary to expectations. This could be influenced by the challenge and threat patterns, people can score high on challenge appraisal and high on threat appraisal, as well as the high mean score on the interpretation of emotional state for performance item, most of the participants rated their emotional state as helpful for their performance. Thus, participants who were threatened might have been challenged too and interpreted their emotional state to be helpful for their performance.

The present study showed that females display more avoidance goals and they were more anxious than males regarding an upcoming important competition. This result is consistent with previous research; Morris and Kavussanu (2008) found that females scored higher on mastery-avoidance goals and lower on performance-approach goals than males. The finding that females scored higher on anxiety compared to males is consistent with previous work (see G. Jones, Swain, & Cale, 1991; Martens et al., 1990). In addition, females scored higher than males on both challenge and threat appraisals in the present study. Cerin et al. (2000) suggested that the differences in gender could be attributed to the differences in interpretation between males and females, with males possibly less willing to report unpleasant feelings.

Only limited research has looked at differences in individual and team sport on challenge and threat appraisals. White (2008) examined how cognitive appraisal moderated the effect of solo status on performance. She found that when resources exceed demands (high appraisal levels) solo status benefits performance, whereas solo status impairs performance at low appraisal levels (when demands exceed resources, a threat appraisal). Participants who felt challenged rather than threatened by their work might benefit from working solo. This study did measure challenge and threat appraisals as opposite ends of the spectrum and most participants tended more towards a challenge appraisal. This study outlined that solo status can influence performance through challenge and threat appraisals. Although this study does not relate to sport, it does provide some support for the findings in the present study regarding team versus individual sports. The results in the present study showed that athletes competing in an individual sport scored higher on both threat appraisal and challenge appraisal compared to athletes competing on a team sport. In addition there were differences on emotions and cognitive components of challenge and threat states on the type of sport, individual sport athletes reported to have more control, felt more anxious, and employed more avoidance goal orientation than those competing in a team sport. Previous research partially supports the anxiety findings that athletes competing in individual sports reported more cognitive and somatic anxiety than those competing in team sports (Hanton, Jones, & Mullen, 2000; Martens et al., 1990), but Kleine (1990) only found weak effects and Mellalieu, Hanton, and O’Brien (2004) found that golfers reported lower levels of symptoms related to cognitive anxiety and higher levels of self-confidence compared to rugby players. The type of sports used in previous research to compare different sports might have influenced these effects. For example, Hanton et al. examined differences between rugby players and pistol shooting and Mellalieu et al. used rugby and golf players rather than using a wider range of sports. A strong point of the present study is that it includes a wide range of sports, rather than comparing only two sports, and this makes the findings more generalisable.

Practical implications of the present study are that an avoidance orientation appeared to be related to potentially negative constructs such as anxiety, threat appraisal, and dejection. In addition, the findings of the present study provide some insight into the associations between cognitive resources and affective responses of challenge and threat states in relation to how athletes *typically* respond to an upcoming competition. However, practitioners should be cautious with using the findings of the present study for applied practice as it is not clear how the combination of constructs exactly influence sport performance.

3.4.1 Limitations

The present study has at least five limitations. First, the questionnaire-based design which only provided support for the resource and affective components of the TCTSA, and this study did not address the physiological component of the TCTSA. An advantage of physiological measures compared to self-report measures is that it is more difficult to consciously control physiological responses (Blascovich et al., 2004). Measuring the physiological component in addition to the cognitive and affective component of challenge and threat states will allow for more accurate measures of challenge and threat states.

Second, the present study included a wide range of different sports, each with their unique characteristics and thus it was not a homogenous sample. On the other hand, as outlined above, this posed as a strength, as using a wide range of sports make the results more generalisable.

Third, the non-specificity of an upcoming competition could have played a factor in the results, participant will probably have drawn on previous experience to be able to imagine how they would feel just before an important competition. Alternatively, participants could have been asked to recall and describe a specific important competition or describe an upcoming competition.

Fourth, the measure of control had a low internal consistency reliability coefficient. Control appeared as the poorest predictor of challenge/threat appraisal and emotional states. The inability of control to predict these states might be due to the measure of control, which has not been previously validated in a sport setting. On the other hand, running a factor analysis extracted one component and the limited number of control items might also have attributed to the low internal consistency reliability coefficient. The notion that participants could have drawn on previous experiences when imagining how they typically feel before an important competition, attribution theory might have influenced the control findings. For successful performance, self-efficacy and controllability were not associated, whereas for less successful performance self-efficacy and controllability were positively related (Coffee & Rees, 2008). When recalling a successful performance, controllable or uncontrollable causes of this successful performance showed to have little influence on subsequent self-efficacy beliefs (Coffee & Rees, 2008). Finally, as the present study presented correlation data no predictions could have been made about the causal relation between the various variables.

3.4.2 Conclusion

The present study provided partial support for the TCTSA. Specifically, emotions were predicted by the cognitive resource components, there was a positive association between anxiety and avoidance goals. Threat appraisal was predicted by avoidance goals. Also, this study showed that different challenge and threat appraisals patterns can occur, with a high challenge/low threat pattern mostly occurring in this sample. The next chapter will build on the present study by including cardiovascular reactivity to measure the influence of the physiological component of challenge and threat states in relation to the cognitive and affective components.

CHAPTER 4: CHALLENGE AND THREAT STATES IN ATHLETES: ARE YOUR HEAD AND HEART TELLING YOU A DIFFERENT STORY?

4.1 Introduction

The previous chapters addressed the first two aims of the thesis; exploring the cognitive elements of challenge and threat states in a naturalistic setting and examining the relations amongst self-efficacy, control, achievement goals, emotions, interpretation of emotional state, and challenge and threat appraisals. Both studies provided partial support for the association between the cognitive elements of challenge and threat states as predicted by the TCTSA. The present study seeked to build on these findings by addressing aim three of the thesis; exploring the cardiovascular reactivity characterising challenge and threat states, self-efficacy, perceived control, and emotions before an important competition.

Specifically, the present study explored if self-efficacy, perceived control, and emotions relate to cardiovascular reactivity in line with that predicted by the TCTSA (M. V. Jones et al., 2009). This extends Blascovich et al's (2004) earlier work which demonstrated that athletes experienced both challenge and threat states when talking about a fictional competitive scenario and those athletes who reported cardiovascular responses consistent with a challenge state performed better in the subsequent season. Blascovich et al. (2004) did, however, not explore the cognitive elements of the challenge and threat states, although they did suggest that self-confidence may influence challenge and threat states. Determining the cognitive and affective elements of challenge and threat states, together with an individual's cardiovascular responses, will contribute towards the development of psychological interventions to facilitate challenge states in sport settings and enhance performance and help to understand athletes' approaches to competition.

Cognitive and affective elements of challenge and threat states have been examined in previous research. High levels of self-efficacy have been shown to associate with challenge states (e.g., Chemers et al., 2001). Furthermore, control has been associated with challenge appraisals (e.g., Todrank Heth & Somer, 2002) and cardiovascular reactivity patterns indicative of a challenge (Weinstein et al., 2002). Both high levels of self-efficacy and control are proposed to be part of a challenge state and low levels of self-efficacy and control are proposed are indicative of a threat state in the TCTSA (M. V. Jones et al., 2009).

This study further builds on existing challenge and threat research by including emotions. It has been proposed that a tough physiological pattern, or a challenge state, facilitates the experience of positive emotions (Dienstbier, 1989). Threat appraisals, which are associated with PAC system activation and insecurities about one’s ability to cope with the demands of the situation, are associated with the experience of negative emotions, such as anxiety (Dienstbier & Pytlik Zillig, 2005). Schneider (2008) demonstrated that individuals displaying a cardiovascular pattern representing a threat experienced increased negative affect and participants displaying a challenge pattern reported less negative affect and had a tendency towards positive affect.

The TCTSA proposes that positive emotions will *generally* be associated with a challenge state and a threat state will generally be associated with negative emotions. In addition, a helpful interpretation of an individual’s emotional state is associated with a challenge state, whereas an unhelpful interpretation of emotional state is associated with a threat state (M. V. Jones et al., 2009).

The final aim of this study was to explore the use of psychological strategies in relation to physiological challenge and threat states. The use of psychological strategies relates to available coping resources and may influence how athletes perceive competition. The use of psychological strategies to cope with the pressure of athletic competition has been reported extensively in the literature (e.g. Fletcher & Hanton, 2001; Pensgaard & Duda, 2002). The present study considered how the use of psychological skills relates to challenge and threat states in athletes.

4.1.2 Aims

The present study extends the literature by testing two major predictions of the TCTSA. Specifically, that high levels of self-efficacy are associated with cardiovascular responses indicative of a challenge state and that high levels of control are associated with cardiovascular responses indicative of a challenge state. The present study also explored relations between emotional states and interpretation of emotional state and cardiovascular responses indicative of challenge and threat states. Also, the association between the use of psychological skills and cardiovascular responses indicative of challenge and threat states was explored. In addition, performance ratings of the actual competition were taken to examine if challenge and threat states predicted performance. The present study builds on Blascovich's work by asking the participants about their thoughts, feelings, and expectations of an upcoming competition they will compete in, instead of giving the participants a hypothetical scenario.

To summarise, the aim of the present study was to examine challenge and threat states in athletes by examining cardiovascular patterns, emotions, self-efficacy, and psychological skills usage of collegiate athletes. This study tested three hypotheses, these are 1) participants displaying a cardiovascular pattern characterising a challenge state experience more positive emotions and higher levels of control and self-efficacy; 2) participants displaying a cardiovascular pattern characterising a threat state experience lower levels of self-efficacy and perceived control, and more negative emotions; and 3) challenge states positively predict performance. No specific hypotheses were set for the use of psychological strategies.

4.2 Method

4.2.1 Participants

The sample for this study was based on detecting a medium to large effect size, with statistical power of .80, for which a sample between 38 and 84 is recommended (Cohen, 1992a), in order to achieve a statistical power of .80, a). The present study is the first to explore the combination of variables as outlined by the TCTSA and therefore this recommendation by Cohen is adopted. The sample size of 48 is consistent with other studies using a similar design (Blascovich et al., 2001; Blascovich et al., 2001, Mendes et al., 2003). Forty-eight healthy student athletes (31 men, 17 women, M_{age} = 20.56, SD = 2.02, age range 18-28 years) agreed to take part in the study on a voluntary basis. All participants had competed in a sport over the last two years and/or were competing at the time of testing. The competitive standard of participants ranged from international level to regional level, with the majority of the participants competing for the university. The sports the participants reported to be their main sport were football (n = 16), basketball (n = 5), kickboxing (n = 1), lacrosse (n = 1), rowing (n = 1), hockey (n = 5), rugby (n = 2), badminton (n = 4), volleyball (n = 1), cricket (n = 4), motorcycle trials (n = 1), road cycling (n = 1), running (n = 1), swimming (n = 2), karate (n = 2), and American football (n = 1).

4.2.2 Measures

Demographic information. Demographic information was obtained by collecting participants' date of birth, gender, height, weight, occupation, main sport, how long they had competed in their main sport, the level of competition in their main sport, other sport experience, and the total amount in hours of sport participation in a week.

Self-efficacy. The main sport varied across the participants; therefore a sport-specific self-efficacy measure as recommended by Bandura (2006) could not be used. Accordingly a generic measure of self-efficacy was used that catered for a variety of sports (Coffee & Rees, 2008). The participants were instructed to indicate with reference to the imagined critical situation, to what extent they felt confident that they could cope with a range of statements on a five-point scale, 1 represented *not at all* and 5 *completely*, followed by six statements (see Appendix 4). The internal consistency reliability coefficient of the sport-specific self-efficacy measure in the present study was α = .77.

Emotions. Emotions were measured using the Sport Emotion Questionnaire (SEQ, M. V. Jones et al., 2005). The SEQ (see Appendix 4) comprised three four-item and two five-item scales. The SEQ measured three negative emotions; anger, anxiety, and dejection, and two positive emotions, happiness and excitement. The participants were asked to indicate on a five point Likert-scale ranging from 0 (*not at all*) to 4 (*extremely*), *how they feel right now, at this moment, in relation to the critical situation they have just imagined and talked about* in relation to the items such as *pleased* or *irritated*. The questionnaire has been validated by M. V. Jones et al. (2005), providing evidence of internal consistency reliability values for each subscale above α =.80, and further support from confirmatory factor analyses (M. V. Jones et al., 2005). The internal consistency reliability coefficients for each subscale in the present study were α = .86 for anxiety, α = .71 for dejection, α = .88 for excitement, α = .54 for anger, and α = .91 for happiness.

Interpretation of emotions was measured by adding an extra rating scale for each item to the SEQ, where participants were asked to indicate whether they regarded this feeling as negative (debilitative) or positive (facilitative) in relation to their performance in the important competition they just talked about. The participant were asked to rate this on a 7-point scale, ranging from -3 (*very debilitative*) to 3 (*very facilitative*), in line with the directional scale of the CSAI-2d (G. Jones & Swain, 1992).

Psychological skills. Psychological skills were measured using the 64-item Test of Performance Strategies (TOPS; P. R. Thomas, Murphy, & Hardy, 1999). The TOPS (see Appendix 4) measured a range of psychological skills and strategies used by athletes during both practice and competition. Eight subscales measured the psychological strategies employed during competition, these were activation, relaxation, imagery, goal-setting, self-talk, automaticity, emotional control, and negative thinking for use during competition. An example item of the subscale self-talk for competition was: *I have specific cuewords or phrases that I say to myself to help my performance during competition*. The eight subscales measuring psychological strategies employed during training were the same strategies employed during competition, with negative thinking replaced by attentional control. An example-item for the subscale imagery during training was: *during practice I visualize successful past performances*. The participants were instructed to rate how frequently the items applied to them on a 5-point Likert scale, ranging from 1 (*never*) to 5 (*always*). The questionnaire has been validated by P. R. Thomas et al. (1999), who demonstrated internal consistency values of the subscales ranging from Cronbach's alpha coefficient .66 to .81. The internal consistency values for the subscales in the present study ranged from $\alpha = .52$ (practice automaticity) to $\alpha = .89$ (competition goal-setting).

Appraisals and control. Challenge and threat appraisals, perceived stress, coping, and control were measured with five single items (see Appendix 4). The participants were asked how they felt during the imagined critical competition by giving an indication on a five point Likert-scale ranging from 0 (*not at all*) to 4 (*extremely*) in relation to their experiences of threat, challenge, feelings of stress, coping, and perceived control of the situation. Finally the participants were asked to outline how they would imagine coping with the critical situation. The challenge and threat questions were similar to those used in previous studies using cardiovascular measures and challenge and threat self-report measures (Schneider, 2004; Tomaka et al., 1997).

Follow-up questionnaire. A follow-up questionnaire was developed to measure the outcome of the competition (win/loss/draw where relevant), performance rating of the important competition on a ten-point scale, and measures of self-efficacy, challenge and threat appraisals, and perceived control. A short version of the Marlowe-Crowne social desirability scale was included (M-C 2 (10); Strahan & Gerbasi, 1972).

Physiological measures. An impedance cardiograph, model HIC-3000, with an external electrocardiographic lead was used to record ZKG and ECG signals following a protocol in line with Sherwood et al. (1991). A Critikon Dinamap Pro 100 blood pressure monitor was used to obtain systolic (SBP), diastolic (DBP) blood pressure, and mean arterial pressure (MAP) readings. Four additional cardiovascular (CV) measures were obtained; namely heart rate (HR), systolic time intervals preejection period (PEP), cardiac output (CO), and total peripheral resistance (TPR).

CO was calculated by heart rate multiplied by the stroke volume. Total peripheral resistance was calculated with the formula (MAP/CO) X 80, in line with guidelines provided by Sherwood et al. (1991). Four self-adhesive band electrodes (Instrumentation for Medicine Inc., Greenwich, CT) were placed on the participant's body. Two electrode bands were placed around the base of the neck and at the level of the xiphisternal junction around the chest. One electrode was attached at least three cm above the electrode placed around the neck, and the other electrode at least three cm under the electrode placed around the chest (see Figure 1.1, Sherwood et al., 1991). Three self-adhesive gel spot ECG electrodes (Vermed Inc.) were used to record ECG signals. The electrodes were placed on the left and right wrist and the left lower inside leg (Berntson, Quigley, & Lozano, 2007).

4.2.3 Design

A mixed-method design was used to explore the differences between the control and experimental conditions over time. The cardiovascular reactivity scores were calculated by deducting the first minute of the task by the last minute of the baseline for each cardiovascular measure. This is in line with other challenge and threat research. In addition, the first minute of the task is said to resemble the most change as adaptation to cardiac habituation happens quickly (e.g. Mendes et al., 2008).

4.2.4 Procedure

After gaining approval from the ethics committee of Staffordshire University, student athletes were recruited from the university's individual and team sports. An overview of the procedure is outlined in Figure 4.1.

Informed consent was obtained and the study explained to the participants. Demographic information was collected and the TOPS administered to identify the use of psychological skills. After completing these questionnaires, the researcher placed the band electrodes and spot electrodes on the participant's body and connected the participant to the impedance cardiograph and the blood pressure monitor. The testing took place in a temperature controlled room, with a divider between the participants and the researcher.

Once connected to the impedance cardiograph and blood pressure monitor, the participants were asked to sit still on a comfortable chair, and five minutes of baseline data were collected. Next, the participant was introduced to one of two tasks. The control task was identical to that used by Blascovich et al., (2004) in that the participants were asked to talk about the topic of friendship for three minutes, and to talk about their strengths and weaknesses as a friend, what they look for in a friend, the qualities that make a good friend, things they like to do with their friends, and how their friends would describe them as a friend. The control task was followed by a short questionnaire asking the participants how they felt during this task. For the sport task the participants were asked to talk for three minutes about their thoughts, feelings, and expectations immediately before an important competition they could face in their main sport. After collecting three minutes of CV data, the participants were given a set of questionnaires measuring self-efficacy, emotions, perceived control, and challenge and threat appraisals. The participants completed these questionnaires in relation to the competition they just talked about. Lastly, the electrodes were removed and the participants debriefed. The two tasks were counterbalanced, such that half of the participants talked about the topic of friendship first before talking about the upcoming sport competition; the other half of the participants spoke first about the upcoming sport competition, followed by the control task where they talked about the topic of friendship.

After finishing the data collection, the participants were contacted by e-mail two weeks after the competition and asked to complete a follow-up questionnaire measuring their performance rating, self-efficacy, perceived control, challenge and threat appraisals, and emotions in relation to the important competition. A prize draw was organised to encourage the participants to complete this questionnaire. Two prizes of £25 were awarded to participants who completed the follow-up questionnaire.

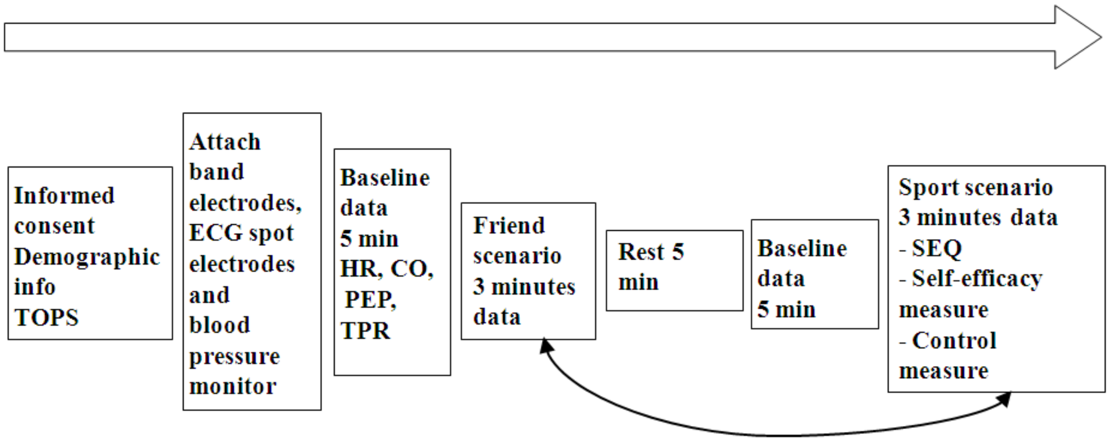

Figure 4.1. Overview of the procedure

4.2.5 Data Analysis

The hypotheses were tested using separate hierarchical regressions with cardiovascular reactivity as the outcome variable. A challenge and threat index was created to be able to measure the cardiovascular pattern indicative of a challenge or threat response (see Blascovich et al., 2004). To do this, the last minute of each baseline and the first minute of the tasks for TPR and CO were converted into z-scores and summed. TPR was assigned a weight of -1 and CO a weight of 1, so that higher scores correspond with a challenge pattern and lower scores with a threat pattern. The TCTSA and BPS model state that both challenge and threat states are characterised by increases in CO, more so in a challenge state than a threat state. Therefore the hierarchical regression analyses were also run for the reactivity scores for TPR and CO separately as the outcome variable. Finally, the performance rating of the follow-up competition was analysed using hierarchical multiple regression, with the challenge and threat index as a predictor variable.

4.3 Results

4.3.1 Data Screening

Four participants were deleted from the data, as cardiovascular data were missing for both baseline and tasks. Due to loss of signal or noisy signals occasionally cardiovascular data for a particular minute were lost, and therefore the analyses of the physiological data have variable degrees of freedom. Preliminary screening of the data revealed a normal distribution for the cognitive and affective variables used in the regression analyses, with skewness and kurtosis values between the recommended values of -2 and 2 (Field, 2009), except for the variable dejection. The mean score for dejection was 0.09 on a 5-point scale, with no participant scoring higher than 1. Participants who reported on the self-report measures they were threatened ($n = 1$), stressed ($n = 2$) and/or could not cope ($n = 2$) with the friend (control) task were removed from the analysis as the control task should have been a neutral task for the participants. For the reactivity of cardiovascular variables, one outlier (more than 3 standard deviations away from the mean) was found for cardiac output and deleted from further analyses. There were 40 remaining participants for further analyses.

Next, the cardiovascular data were screened for gender differences, differences between type of sport (individual and team), and years of playing experience in the sport. Comparing gender resulted in one outlier on heart rate. The tests were run with and without this outlier, it was decided to keep the participant in the sample as it did not influence the results. There were no further differences in cardiovascular reactivity between males and females. Finally, no differences were found for cardiovascular scores between the type of sport (individual or team).

4.3.2 Exploration Cardiovascular Data

The descriptive statistics for the various cardiovascular measures are presented in Table 4.1 and Table 4.2.

Table 4.1

Means and Standard Deviations for Total Peripheral Resistance and Cardiac Output for the Friend and Sport Task

	Minute 1		Minute 2		Minute 3	
	Mean	SD	Mean	SD	Mean	SD
Friend TPR	1539.64	432.94	1545.21	427.78	1561.41	441.20
Sport TPR	1548.54	439.70	1602.67	462.15	1629.50	442.09
Friend CO	5.15	1.36	5.02	1.23	5.00	1.38
Sport CO	5.26	1.31	5.04	1.30	4.95	1.19

Differences between the minutes of the tasks. Repeated measures analysis showed that there was a significant difference in cardiac output between the three minutes of the sport task, F (2, 74) = 11.19, $p < .01$, $\eta_p^2 = .35$ and the friend task, F (2, 76) = 3.90, $p < .05$, $\eta_p^2 = .09$. Individual paired t-tests showed that CO in the first minute of the sport task was significantly higher compared to the second minute, t (38) = 3.77, $p < .01$, $r = .30$ and the third minute, t (37) = 4.15, $p < .01$, $r = .32$. CO in the first minute of the friend task was marginally higher compared to the third minute, t (38) = 2.44, $p < .05$, $r = .25$.

Repeated measures analysis showed that there was a significant difference in total peripheral resistance between the three minutes of the sport task, F (2, 74) = 5.76, $p < .01$, $\eta_p^2 = .14$, no differences were found for TPR between the three minutes of the friend task, *F* (2, 76) = 0.50, *p* > .01, η_p^2 = .01. Individual paired t-tests showed that TPR in the first minute of the sport task was marginally lower compared to the second minute, *t* (38) = 2.26, *p* < .05, *r* = .24, and the third minute, *t* (37) = 3.27, *p* < .01, *r* = .29. No significant effects were found for the friend task.

Task engagement. The data indicate participants engaged with both tasks. There was a significant increase in HR between baseline and condition, for both the friend condition, *t* (37) = 9.12, *p* < .01, *r* = .44 (mean increase 11.45, SD = 7.74) and the sport competition condition, *t* (37) = 9.70, *p* <.01, *r* = .46 (mean increase 13.08, SD = 8.31). No differences were found for PEP in the friend task *t* (37) = 1.38, *p* > .05, *r* = .19 (mean decrease 2.11, SD = 9.44) or the sport task, *t* (37) = 1.48, *p* > .05, *r* = .19 (mean decrease 2.58, SD = 10.75), but the results were in the direction expected.

Table 4.2

Means and Standard Deviations for Heart Rate, Cardiac Output, Preejection Period, and Total Peripheral Resistance in the Friend and Sport Task

		Friend		Sport	
		Mean	SD	Mean	SD
HR	Baseline	70.33	11.50	70.82	11.22
	Task	81.87	13.31	84.21	13.25
	Reactivity	11.54	7.66	13.38	8.42
CO	Baseline	5.07	1.26	5.10	1.26
	Task	5.16	1.36	5.26	1.31
	Reactivity	0.08	0.64	0.16	0.52
PEP	Baseline	135.64	27.43	135.79	24.37
	Task	133.03	25.34	132.56	22.12

	Reactivity	-2.62	9.84	-3.23	11.37
TPR	Baseline	1340.18	416.17	1332.05	371.75
	Task	1539.64	432.94	1548.54	439.70
	Reactivity	199.46	215.01	216.49	171.75

* Note. Baseline scores are based on the last minute of the baseline; task scores are based on the first minute of the task; reactivity is the difference between the first minute of the task and the last minute of the baseline. HR measured in BPM, CO in L/m, PEP in msec, and TPR in dyne seconds times cm^{-5}.

Presentation order of the tasks. A repeated-measures 2 x 2 mixed ANOVA was performed to analyse carry-over effects relating to the presentation order of the tasks. The descriptive statistics are presented in Table 4.3.

Table 4.3

Descriptive Statistics for Presentation Order

		TPR		CO	
	Condition	Mean	SD	Mean	SD
Baseline friend	Friend first	1299.25	342.61	5.09	1.15
	Sport first	1383.26	487.77	5.06	1.39
Baseline sport	Friend first	1374.45	346.33	4.89	1.11
	Sport first	1287.42	401.30	5.32	1.40
Friend	Friend first	1543.90	446.24	5.28	1.54
	Sport first	1535.16	430.66	5.04	1.19
Sport	Friend first	1598.55	430.85	5.01	1.24
	Sport first	1495.89	454.43	5.52	1.37

For both the baseline and the task there was a decrease for CO and an increase in TPR. The effect of condition was not significant for TPR, F (1, 37) = .05, p = .83, η_p^2 = .001 and CO, F (1, 37) = .18, p = .67, η_p^2 = .01. This indicated that there were no carry-over effects and that the order of presenting the sport task or the control task first did not need to be controlled for in further analyses.

4.3.3 Cognitive Components

A challenge and threat index was created to analyse uniformity between CO and TPR (cf. Blascovich et al., 2004). The last minute of each baseline and the first minute of the tasks for TPR and CO were converted into z-scores and summed. TPR was assigned a weight of -1 and CO a weight of 1, so that higher scores correspond with a challenge pattern and lower scores with a threat pattern. Such an index was calculated for both the friend and the sport task. Hierarchical regression analyses were run with the index for the sport task (referred to as sport index) as an outcome predicted by the addition of the cognitive elements self-efficacy, perceived control, and challenge and threat appraisals and the addition of emotions. The index for the friend task (referred to as friend index) was used to enter in the first step of the hierarchical regression analysis to control for the individual's cardiovascular responses. The descriptive statistics for self-efficacy, perceived control, appraisals, and emotions are presented in Table 4.4.

Self-efficacy, control, appraisals and challenge and threat index. A hierarchical regression analysis was performed to analyse the association between the cognitive component of challenge and threat states and cardiovascular reactivity. In the first level of the regression analysis, the index for the friend task, level of competition, and hours of sport participation in the main sport per week were entered. Level of competition and hours of sport participation were initially controlled for as there were differences between athletes in these variables and deleted when these variables were not significant. People differ in level of competition and hours of sport participants and therefore these factors were initially controlled for in the regression analysis as this can reflect engagement and involvement with the sports task. In the second level self-efficacy, controls, and appraisals were entered. The results are presented in Table 4.5. The results showed that in the first step the friend index significantly predicted the index for the sport task. In addition, there was a marginal negative effect for hours of sport participation. The second step revealed a significant effect for the cognitive components of challenge and threat states ($\Delta R^2 = .20$, $p < .05$), with self-efficacy as the only significant predictor ($\beta = -.35$, $p < .05$). This negative association indicates that participants with higher levels of self-efficacy displayed a cardiovascular pattern indicative of a threat state.

Further exploration of the data revealed that challenge appraisal could be a suppressor variable. The suppressor effect for challenge appraisal was visible in the hierarchical regression where challenge appraisal had a larger beta-weight ($\beta = .16$) than the zero-order correlation with the challenge and threat index ($r = -.02$). The zero-order correlation for challenge appraisal and the cardiovascular index was very close to zero and the sign of the beta coefficient changed in comparison with the zero-order coefficient, from negative to positive. Also, challenge appraisal was moderately correlated with threat appraisal ($r = .33$) and there was a small correlation with self-efficacy ($r = .22$). To further explore the suppressor effects, the multiple regression analysis was run again without challenge appraisal. The findings for the multiple regression analysis without challenge appraisal showed that the addition of the self-efficacy, perceived control and threat appraisal significantly predicted cardiovascular reactivity for the sport speech, $\Delta R^2 = .18$, $p < .05$. Self-efficacy was the only marginally significant predictor, ($\beta = -.30$, $p = .05$).This indicates that although challenge appraisal appeared to be a suppressor variable, the pattern of results of the multiple regression analysis without challenge appraisal were similar.

Table 4.4

Summary of Means, Standard Deviations, and Correlations for Scores on Self-efficacy, Control, Challenge Appraisal, Threat Appraisal, Anxiety, Dejection, Excitement, Anger, Happiness, Positive Emotions, and Negative Emotions

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1 Self-efficacy	3.92	0.55	--										
2 Perceived control	2.90	0.97	.55**	--									
3 Challenge appraisal	2.64	1.20	.22	-.06	--								
4 Threat appraisal	0.64	0.87	-.05	-.26	.33*	--							
5 Anxiety	1.50	0.91	-.17	-.13	.23	.31	--						
6 Dejection	0.09	0.20	-.22	-.11	.22	.03	.24	--					
7 Excitement	2.34	1.05	.39*	.33*	.27	-.06	.46**	-.13	--				
8 Anger	0.23	0.36	-.04	-.01	.46**	.15	.41**	.21	.39*	--			
9 Happiness	2.12	1.04	.28	.35*	.31	.11	.17	-.20	.62**	.15	--		
10 Positive emotions	2.23	0.94	.37*	.37*	.32*	.03	.35*	-.18	.90**	.30	.90**	--	
11 Negative emotions	0.61	0.39	-.18	-.12	.36*	.29	.94**	.42**	.45**	.66**	.14	.33*	--

Note * p < .05, **p < .01

Table 4.5

Summary Regression Analysis for Self-efficacy, Control, Challenge Appraisal and Threat Appraisal Predicting the Challenge and Threat Index in Relation to an Upcoming Important Competition

	b	*SE b*	*B*
Step 1			
Index friend	0.56	0.14	.56**
Step 2			
Index friend	0.64	0.13	.64**
Self-efficacy	-1.15	0.51	-.35*
Control	-0.31	0.30	-.17
Challenge appraisal	0.24	0.20	.16
Threat appraisal	-0.08	0.28	-.04

R^2 = .32, $p < .001$ for step 1: ΔR^2 = .20, $p < .05$ for step 2.

* $p < .05$, ** $p < .001$.

Self-efficacy, control, appraisals and regression for total peripheral resistance and cardiac output. Two hierarchical regressions analyses were run to break down the index and explore how self-efficacy, control, and appraisals predict reactivity for TPR and CO. One analysis was run for TPR reactivity, and one analysis was run for CO reactivity. In the first step of the regression analysis the difference in TPR between the first minute of the friend task and the last minute of the friend baseline (referred to as TPR reactivity) was entered, as well as the competition level of the athlete and their hours of sport participation for their main sport. These demographic variables were initially controlled for and removed when not significant. In step 2 the scores on self-efficacy, perceived control, challenge and threat appraisals were entered. The difference in TPR between the first minute of the sport task and the last minute of the baseline preceding the sport task was used as the outcome variable.

The results for the regression analysis for self-efficacy, control, and TPR reactivity are presented in Table 4.6. There was a significant effect for the cognitive components of challenge and threat states ($\Delta R^2 = .19$, $p < .05$), with only a marginal positive effect for self-efficacy ($\beta = .33$, $p = .06$). An increase in self-efficacy was associated with an increase in TPR reactivity, characterising a threat pattern. The results for the regression analysis for self-efficacy, control, and CO reactivity are presented in Table 4.6. There was a significant effect for the addition of the cognitive components of challenge and threat states in step 2 ($\Delta R^2 = .17$, $p < .05$). In line with the previous findings, there was a significant negative effect for self-efficacy ($\beta = -.30$, $p < .05$); an increase in self-efficacy was related to a decrease in CO reactivity, indicative of a threat pattern.

Table 4.6

Summary Regression Analysis for Self-efficacy, Control, Challenge Appraisals and Threat Appraisals Predicting Total Peripheral Resistance and Cardiac Output Reactivity in Relation to an Upcoming Important Competition

	TPR			CO		
	b	*SE b*	*β*	*b*	*SE b*	*B*
Step 1						
Reactivity friend task	0.39	0.12	.49**	0.50	0.11	.61**
Step 2						

Reactivity friend task	0.41	0.11	.52**	0.56	0.10	.68**
Self-efficacy	102.88	52.23	.33	-0.30	.14	-.32*
Control	30.88	30.42	.17	-0.06	0.08	-.11
Challenge appraisal	-8.87	20.67	-.06	0.10	0.06	.22
Threat appraisal	23.88	28.60	.12	0.02	0.08	0.03

TPR $R^2 = .24$, $p < .01$ for step 1: $\Delta R^2 = .19$, $p < .05$ for step 2, CO $R^2 = .37$, $p < .001$ for step 1: $\Delta R^2 = .17$, $p < .05$ for step 2.

* $p < .05$, ** $p < .01$.

4.3.4 Emotions

A hierarchical regression analysis was run for the challenge and threat index and emotions (see Table 4.7). The addition of the five emotions in the second step did not significantly predict the challenge and threat index ($\Delta R^2 = .13$, $p > .05$). In addition, two hierarchical regressions analyses were run to break down the index and explore how emotions predict reactivity for TPR and CO. One analysis was run for TPR, and one analysis was run for CO. The results are reported in Table 4.8, there were no significant effects for the addition of anxiety, dejection, excitement, anger, and happiness.

Table 4.7

Summary Regression Analysis for Emotions Predicting the Challenge and Threat Index in Relation to an Upcoming Important Competition

	b	*SE b*	*B*
Step 1			
Index friend	0.56	0.14	.56*
Step 2			
Index friend	0.60	0.14	.60*

Anxiety	-0.14	0.32	-.06
Dejection	0.04	1.32	.00
Excitement	-0.63	0.35	-.36
Anger	0.43	0.81	.09
Happiness	0.02	0.30	.01

R^2 = .31, p < .001 for step 1: ΔR^2 = .13, p = .22 for step 2.

* p < .001.

Table 4.8

Summary Regression Analysis for Emotions Predicting Total Peripheral Resistance and Cardiac Output Reactivity in Relation to an Upcoming Important Competition

	TPR			CO		
	b	*SE b*	*β*	*b*	*SE b*	*β*
Step 1						
Reactivity friend task	0.39	0.12	.49*	.44	0.10	.53**
Hours of sport per week				-.06	0.02	-.32*
Step 2						
Reactivity friend task	0.39	0.12	.49	0.50	0.11	.61**
Hours of sport per week				-0.05	0.02	-.25
Anxiety	25.47	32.78	.14	0.02	0.09	.03
Dejection	-92.84	133.15	-.11	-0.20	0.35	-.08
Excitement	34.33	35.28	.21	-0.19	0.09	-.39*
Anger	-1.07	80.63	-.00	0.21	0.22	.14
Happiness	10.26	30.49	.06	0.04	0.08	.07

TPR R^2 = .24, p = .002 for step 1: ΔR^2 = .13, p = .31 for step 2, CO R^2 = .47, p < .001 for step 1: ΔR^2 = .08, p = .36 for step 2.

* p < .05, ** p < .001.

Interpretation of emotions. In addition, similar analyses were run for the interpretation of the five emotions, see Table 4.9 and 4.10. The results for the challenge and threat index showed that there is no effect for any of the emotions. The hierarchical regression analysis for CO showed that there was a significant effect for the addition of the directional scales of the five emotions in step 2 ($\Delta R^2 = .16$, $p < .05$). The significant variables was excitement ($\beta = -.29$, $p < .01$), anxiety was marginally significant ($\beta = .28$, $p = .05$). Participants who rated their feelings of excitement as more debilitative (unhelpful) and anxiety as more facilitative (helpful) for their performance displayed a cardiovascular pattern indicative of a challenge state.

Table 4.9

Summary Regression Analysis for Interpretation of Emotions Predicting the Challenge and Threat Index in Relation to an Upcoming Important Competition

	B	*SE b*	*Β*
Step 1			
Index friend	0.56	0.14	.49*
Step 2			
Index friend	0.64	0.14	.64
Anxiety	0.49	0.29	.29
Dejection	0.18	0.23	.14
Excitement	-0.61	0.44	-.20
Anger	-0.28	0.20	-.27
Happiness	-0.11	0.12	-.13

$R^2 = .32$, $p < .001$ for step 1: $\Delta R^2 = .13$, $p = .26$ for step 2.

* $p < .001$.

Table 4.10

Summary Regression Analysis for Interpretation of Emotions Predicting Total Peripheral Resistance and Cardiac Output Reactivity in Relation to an Upcoming Important Competition

	TPR			CO		
	b	*SE b*	*B*	*b*	*SE b*	*B*
Step 1						
Reactivity friend task	0.38	0.12	.48*	0.43	0.10	.53*
Hours of sport per week				-0.06	0.03	-.32*
Step 2						
Reactivity friend task	0.44	0.13	.55*	0.47	0.10	.58*
Hours of sport per week				-0.07	0.02	-.36*
Anxiety	-30.77	30.23	-.19	0.14	0.07	.28
Dejection	-19.81	23.39	-.17	0.00	0.06	.01
Excitement	20.99	46.36	.07	-0.29	0.10	-.34*
Anger	23.72	20.59	.25	-0.04	0.05	-.15
Happiness	11.89	12.14	.16	-0.02	0.03	-.09

TPR R^2 = .23, p = .002 for step 1: ΔR^2 = .07, p = .66 for step 2, CO R^2 = .47, p < .001 for step 1: ΔR^2 = .16, p < .05 for step 2.

Strength of emotional response. The strength of the emotional response to an upcoming competition was also explored as this strength could influence the cardiovascular response. The scores for the five emotions were summed and entered in step 2 of the regression analysis. Cardiovascular responses of the control task, level of competition, and hours of sport participation were initially controlled for in step 1 and removed when not significant. The results show that the addition of the strength of the emotional response significantly predicted the challenge and threat index, $\Delta R^2 = .10$, $p < .05$; $\beta = -.31$, $p < .05$. To further examine the strength of the emotional responses, another regression analysis was performed with positive and negative emotions as the predictor variables in step 2. The results showed there was a marginal effect for the addition of positive and negative emotions in step 2, $\Delta R^2 = .10$, $p = .06$, positive emotions were the significant predictor ($\beta = -.29$, $p < .05$). This negative association indicates that participants who experienced more positive emotions when talking about an upcoming important competition displayed a cardiovascular pattern indicative of a threat.

4.3.5 Psychological Strategies

The relation between the use of psychological strategies and cardiovascular patterns of challenge and threat states was explored using a similar method as for self-efficacy, control, and appraisals and emotions. As the participants' cardiovascular responses related to an upcoming important competition they talked about, only the psychological skills athletes used before competition were included in analysis.

In the first step the friend task index, level of competition, and hours of sport participation in their main sport per week were initially entered and removed when not significant. In the second step, the eight psychological skills athletes could use before competition were entered. These were activation, relaxation, imagery, goal setting, self talk, automaticity, emotional control, and attention control. The addition of step 2 (see Table 4.11) to predict the challenge and threat index was significant ($\Delta R^2 = .30$, $p < .05$), the significant variables was imagery ($\beta = -.55$, $p < .01$). These results indicate a negative association between imagery and the index; participants displaying a challenge pattern reported using less imagery in competition.

Table 4.11

Summary Regression Analysis for Psychological Strategies Predicting the Challenge and Threat Index in Relation to an Upcoming Important Competition

	b	*SE b*	*B*
Step 1			
Index friend	0.55	0.14	.46*
Step 2			
Index friend	0.83	0.15	.81*
Activation	-0.07	0.52	-.02
Relaxation	-0.53	0.60	-.08
Imagery	-1.16	0.37	-.55*
Goal setting	0.60	0.31	.32
Self-talk	0.51	0.29	.26
Automaticity	-0.71	0.37	-.26
Control	0.21	0.30	.09
Attention control	0.88	0.49	.24

$R^2 = .30$, $p < .001$ for step 1: $\Delta R^2 = .30$, $p < .05$ for step 2.

* $p < .05$.

4.3.6 Performance

Performance scores were obtained from 17 participants (35% of the total sample), as well as follow-up data on self-efficacy and emotions which were collected after the participant competed in the competition they talked about. Two participants were excluded from this analysis, as they reported a different event than the important competition they talked about when the cardiovascular reactivity was measured. Next, the influence of social desirability (M = 6.00, SD = 1.91) was analysed. Participants with scores higher than seven were taken out of the analysis (n = 2) and the analyses were run for both the sample without the high social desirable scores and with the high social desirability scores. This did not provide different results, and therefore the participants with high social desirability scores were included in the analyses as this would increase the power of the hierarchical regression analysis.

A simple regression analysis was performed using the challenge and threat index, with subjective performance rating of the competition (M = 7.08, SD = 1.04) as the dependent variable. There was a marginal significant effect for the sport index to predict performance rating, $R^2 = .26$, $p = .08$. The sport index negatively predicted performance rating, $\beta = -.51$, $p = .07$. This result was marginally significant and indicated that participants who displayed cardiovascular reactivity patterns indicative of a challenge rated their performance lower.

In addition, pre-competition and post-competition challenge and threat appraisals, perceived control, and emotions were analysed using multiple paired-samples t-tests. The results showed that participants scored higher (M = 2.92, SD = 0.95) on perceived control pre-competition than after the competition (M = 2.38, SD = 0.65), t (12) = 2.21, $p < .05$.

4.4 Discussion

Athletes can respond to competition in two ways, as a challenge or as a threat (M. V. Jones et al., 2009), or a combination of challenge and threat. The present study builds on previous challenge and threat research by examining self-efficacy, perceived control, emotions, and the use of psychological strategies in relation to an upcoming important competition in which the participants were planning to participate. Follow-up data were collected from a small number of participants (35%

of the total sample) after they had competed in the competition they spoke about during the sport task.

The results of the present study showed that participants who demonstrated cardiovascular patterns characterising a challenge state experienced lower levels of self-efficacy compared to participants displaying a CV pattern characterising a threat state. People with higher self-efficacy appeared to be more physiologically threatened by an upcoming important sport competition. The self-report measures of challenge and threat appraisals did not predict cardiovascular responses, however challenge appraisal appeared to be a suppressor variable; running the analyses without challenge appraisal did not change the results. The results further revealed that none of the measured emotions predicted cardiovascular reactivity. However, the results did show that participants who rated their feelings of excitement as more unhelpful for their performance had higher cardiac output. Also, the strength of the emotional response influenced cardiovascular responses; specifically, individuals who reported more positive emotions displayed a cardiovascular pattern indicative of a threat. In relation to the use of psychological strategies in competition, athletes who displayed a cardiovascular pattern characterising a challenge used less imagery in competition.

The follow-up performance data did not reveal a clear pattern for the association between cardiovascular reactivity and performance rating. Athletes displaying a cardiovascular reactivity pattern characterising a threat had a tendency to rate their performance better compared to athletes displaying a challenge state. Only a small number of participants took part in the follow-up study.

In summary, the results in the present study reveal findings that do not provide support for the TCTSA (M. V. Jones et al., 2009) or the work of Blascovich et al. (2004). Specifically, participants who displayed a cardiovascular pattern indicative of a threat reported higher levels of self-efficacy. No clear association between cardiovascular reactivity and performance was observed in the follow-up sample, but there was a tendency for those with a cardiovascular reactivity pattern indicative of threat to have lower performance ratings.

There are two potential explanations for the findings that were inconsistent with the predictions made by the TCTSA. First other psychological variables may mediate the relation between cardiovascular responses and self-efficacy. Studies on the consequences of attributional ambiguity and the implications on self-esteem have demonstrated that individuals who attributed negative feedback to discrimination or prejudice reported higher self-esteem (Crocker, Voelkl, Testa, & Major, 1991; Major, Quinton, & Schmader, 2003). This buffer is thought to be used as protection for the self, but could also act as a defensive responsive masking underlying distress (Mendes et al., 2008). Participants might have reported higher levels of self-efficacy when they approached the competition as a threat to use as a buffer. However, these studies on attributional ambiguity have not measured self-esteem in relation to cardiovascular markers of challenge and threat states.

Other research supports the finding that high levels of self-efficacy are related to a cardiovascular pattern characterising a threat. Hoyt and Blascovich (2010) found that women who had high perceptions of their leadership self-efficacy displayed a cardiovascular pattern characterising a threat compared to women with low perceptions of their leadership self-efficacy when taking part in a leadership task under stereotype activation. This notion that higher levels of self-efficacy elicit a cardiovascular threat pattern could be explained by the positive relation between self-efficacy and self-relevance of the task. High self-relevance of a task might make an individual more disposed to feelings of threat by negative stereotype-based expectation (Hoyt & Blascovich, 2010; Marx & Stapel, 2006). Thus an athlete, who feels that they have the skills to perform well in the upcoming competition, might feel that there is more at stake for them than those with low levels of self-efficacy, and in turn the demands of the competition are higher for those with high levels of self-efficacy than those with low levels of self-efficacy. The athlete with high self-efficacy might feel more threatened by their desire to do well in the competition as poor performance might interfere with the view they have of their own capabilities and self-belief.

Unrealistic optimism and positive illusions about the self are not uncommon and suggested to relate to areas such as academic exaggeration (Gramzow, Willard, & Mendes, 2008) and this might also have influenced the results. Findings from the academic domain could explain findings in the domain of sport, and the relation between the academic and sport domain has been applied before (e.g. Skinner & Brewer, 2002; 2004). “Academic exaggeration is a psychologically meaningful self-positivity bias that reflects important emotional, motivational, and self-regulatory processes (p. 142, Gramzow et al., 2008).” Research on academic exaggeration has taken cardiovascular reactivity into account, albeit not in terms of challenge and threat. Gramzow et al. (2008) found that cardiovascular reactivity (measured by respiratory sinus arrhythmia, an index of cardiac vagal control, and preejection period) supported previous self-report findings; when thinking about academic performance exaggerators reported and experienced more positive than negative emotions.

Second, the role of temporal patterning might explain some of the findings in the present study. The participants talked about an *upcoming* important competition and they displayed anticipatory responses. There were differences between participants in the time leading up to competition. Some participants spoke about a competition that was taking place in the same week, whereas other participants talked about a competition in one month's time. Research has found that individuals experience anticipatory physiological responses to a potentially stressful event which could change in the lead up to the event (Fenz & Epstein, 1967; Fenz & Jones, 1972). Fenz and colleagues found that individuals, specifically experienced parachutists, displayed an initial increase in parachute-relevant reactivity in the lead up to the jump followed by a decline in physiological reactivity as the time of the jump got closer. The parachutists were doing the worrying early in the lead up to the jump (Fenz, 1988) and this effect of temporal patterning might have influenced the reactivity of the participants in the present study in the lead up to the upcoming important competition they were talking about. Regarding the temporal patterning of cognitive responses in the lead up to competition Mellalieu, Hanton, and Shearer (2008) found that competition related cognition and role specific cognitions increased as the competition approached. Hanton, Thomas, and Maynard (2004b) reported that the intensity and frequency of anxiety increased in the lead up to competition.

In summary, both psychological variables and temporal patterning might have played a role in the inconsistent findings. Participants might have created a buffer to protect their self-identity. It appears to be more likely, however, that temporal patterning was the main confounding factor. The time leading up to the competition the participants spoke about varied across participants, some participants spoke about a competition that would take place within a week, whereas others spoke about a competition that would take place in three weeks time. As the studies by Fenz and colleagues outlined, the physiological patterns of individuals change in the lead up to a demanding event. In addition, the cognitive and affective components of challenge and threat states are also likely to change in the lead up to competition (Hanton et al., 2004b; Mellalieu et al., 2008). Specifically, emotional, cognitive and physiological responses may change in the lead up to competition, but not necessarily at the same time, and this might have influenced the results as there were differences between participants in the time leading up to the important competition they were asked to talk about.

Practical implications of the present study are that there might not always be consistency between what athletes think and their physiological responses. In the present study, those who were physiologically threatened reported higher levels of self-efficacy which is counterintuitive. This highlights that using multiple methods of assessing athletes' responses to stressful situations may help elucidate the complex responses of athletes. For example, athletes who have high levels of self-efficacy might want to make sure that they do well (Hoyt & Blascovich, 2010) and this could influence their physiological responses, whereas those who do not have high expectations might withdraw from the situation and consequently not demonstrate clear changes in physiological responses (Ennis et al., 2001). Therefore, it is recommended to not change the demands of the situation as this does not solve the withdrawal symptoms but to increase the available resources. In addition, awareness of the physiological and psychological responses to an upcoming competition could help an athlete to prepare more effectively for competition.

4.4.1 Limitations

The TCTSA hypothesises that high levels of self-efficacy and control were related to a cardiovascular pattern characterising a challenge (M. V. Jones et al., 2009). The results in the present study did not support these expectations. There are limitations of using self-report measures of challenge and threat appraisals, as well as self-report measures in general. Some appraisals are made unconsciously (Lazarus & Folkman, 1984) and thus difficult to measure using a self-report tool. In addition, the use of the Trier Social Stress Test (Kirschbaum, Pirke, & Hellhammer, 1993) has resulted in inconsistent findings when measuring cortisol and comparing the measures of cortisol with self-report measures of stress (Schlotz et al, 2008).

The sport task in the study might have been unclear for some of the participants. The participants were asked to think and talk about an upcoming important competition in their main sport. Unpredictability was reflected by the unknown components surrounding an upcoming competition, for example a week beforehand, a swimmer would not know when they have to swim the series and who they will compete against in the series. This unpredictability in itself might have influenced the cardiovascular response of (some of) the participants. In addition, events such as an important sport competition can be anticipated a long time in advance (Skinner & Brewer, 2004), but differences might appear in the time leading up to competition; the closer an event approaches the stronger the cognitive appraisals generally are (Lazarus & Folkman, 1984).

In addition, the validity of the TOPS to measure the use of psychological strategies can be questioned, studies have demonstrated poor fits for the competition and practice subscales (Hardy, Roberts, Thomas, & Murphy, 2010). In addition, some items were ambiguous and could be placed under more than one scale. A different and more compact measure for the use of psychological strategies would have provided a better insight into the psychological strategies used and the relation with challenge and threat states.

Also, the act of talking might have influenced the results. Using speech tasks to measure stress has been used in previous studies (Blascovich et al., 2004; Mendes et al., 2008; Smith, Bladwin, & Christensen, 1990) and comparisons with other stress tasks in the same study has resulted in similar results (Feldman et al., 1999) suggest that the sport speech was an appropriate task. Research has found that changes in cardiovascular and neuroendocrine responses in tasks including speech were not solely caused by the physical act of speaking (McCann et al., 1993). Also, when speaking about a topic that has greater relevance for the self than a neutral task the increases in blood pressure were greater (Lynch, Long, Thomas, Malinow, & Katcher, 1981). Although the friend task could have been perceived as a relevant, rather than neutral, topic for the participants, this was controlled for by asking the participants how they felt during the task. Participants who rated the task as stressful were taken out of further data analysis. In addition, the control speech task ensured that the tasks controlled for the act of talking.

Finally, the difference in time leading up to competition across participants appeared to be the main limitation of this study. Some participants spoke about a competition within the same week, whereas other participants spoke about a competition that would take place in three weeks time. As discussed earlier, the differences in physiological, cognitive, and affective responses in the time leading up to competition might have influenced the results and this should be better controlled in further research.

4.4.2 Further Research

Despite these limitations, this study had several strengths and provides opportunities for follow-up research. One of the strengths of this study is that it took place *pre*-competition and the sport speech was related to a real-life upcoming competition rather than a hypothetical situation as in Blascovich et al's (2004) study and measured self-efficacy, control, and emotions in relation to this competition. No other research has done this so far. Psychological skills were measured in relation to the general use of these strategies before competition, rather than recalled after competition. In addition, the research looked at change within the individual and took a variety of sports into account, making the results more generalisable.

The next study will include achievement goal orientation, a multiple item control measure, and include two past sport competitions. In this study athletes will speak about a previous important competition where they did well and about a previous competition where they did not perform up to their expected standards, rather than an upcoming competition, to account for the influences of temporal patterning. Furthermore, participants will interpret the helpfulness of their overall emotional state, rather than for each emotion separately.

4.4.3 Conclusion

Athletes respond to an upcoming competition with different cardiovascular patterns. This study aimed to examine the relation between the cognitive and affective components of challenge and threat states with the physiological component in relation to a sport competition that the participants will face in the near feature. Findings of the present study are inconsistent, and in places contrary, to the predictions made by the theory of challenge and threat states in athletes (TCTSA; M. V. Jones et al., 2009).

Even though there are some explanations for the findings, temporal patterning appeared to be the main explanation as to why the findings were inconsistent. Follow-up studies will build on the findings of this study by exploring the influence of the result of a competition on cardiovascular reactivity, self-efficacy, goal achievement motivation, and perceived control.

CHAPTER 5: CHALLENGE AND THREAT STATES IN ATHLETES: THE INFLUENCE OF OUTCOME OF COMPETITION

5.1 Introduction

The data in chapter four demonstrated that athletes respond to an upcoming competition with different cardiovascular patterns. However, these cardiovascular responses did not correlate with self-efficacy, control, and emotions in the direction predicted by the TCTSA and in most cases no relation was found. Specifically, individuals who had higher levels of self-efficacy appeared to be more physiologically threatened than individuals who had lower levels of self-efficacy. No relation was observed between control, emotional state and physiological measures of challenge and threat states. A possible reason for these findings may have been the temporal patterning of emotional, cognitive and physiological responses in the lead up to competition (cf. Fenz & Epstein, 1967; Hanton et al., 2004b; Mellalieu et al., 2008). Specifically, emotional, cognitive and physiological responses may change in the lead up to competition and this might have influenced the results of the previous chapter as there were differences between participants in the time leading up to the important competition they were asked to talk about.

The perception of the intensity of cognitive and somatic anxiety responses have been found to increase as competition approached (Hanton et al., 2004b; O. Thomas, Maynard, & Hanton, 2004). Specifically, O. Thomas et al. collected data on competitive anxiety and self-confidence from 60 athletes at four precompetition stages, namely seven days before competition, 48 hours before competition, 24 hours before competition, and 1 hour before competition. They found that participants who interpreted their anxiety as facilitative for their performance had higher intensities of self-confidence and interpreted their cognitive and somatic symptoms as more positive compared to the participants who interpreted their anxiety as debilitative in approaching competition. Hanton et al. collected data from 82 athletes at five precompetition (seven days, two days, one day, two hours, and 30 minutes before the competition) stages. They reported that there were differences in the amount of times athletes reported feeling anxious and self-confident in the lead up to competition; for cognitive anxiety this was an increase from seven to two days, one day to two hours, and 30 minutes before the competition; for somatic anxiety this was an increase in frequency from seven to two days and from two hours to 30 minutes before the competition, for self-confidence this was from seven to two days before the competition. The intensities of cognitive and somatic anxiety and self-confidence appeared to increase only close to the actual event, namely from two hours to 30 minutes before the competition.

To eliminate the confounding effects of an upcoming competition the present study aimed to examine athletes' cognitive, physiological and emotional responses to previous competitions. Specifically, data were collected from two competitions; one in which the athlete performed above their expected standard and a competition where the athlete performed below their expected standard. This study further builds on chapter four by examining relations between cardiovascular responses characterising challenge and threat states and approach and avoidance goals. The inclusion of approach and avoidance goals is relevant because the achievement goal orientation of an individual influences their expectations about how they perform (Elliot & Church, 1997) and approach and avoidance goals can influence challenge and threat states (Elliot & Harackiewicz, 1996). Only one study has examined relations between cardiovascular patterns of challenge and threat states and approach and avoidance goals. Chalabaev et al. (2009) examined the mediating effects of cardiovascular patterns of challenge and threat on performance-based goals on performance. Participants in the performance-approach goal condition displayed a cardiovascular pattern characterising a challenge and the participant in the performance-avoidance condition displayed a cardiovascular pattern characterising a threat state. To date, no study has explored relations between the cognitive, affective and physiological responses as outlined by the TCTSA after participating in competition.

In addition, the control task in the present study was different from the control task in chapter four. Talking about the topic of friendship might not be as neutral as anticipated. This was shown by the number of participants who rated the control task as stressful or could not cope with the task, four participants indicated that they could not cope with the control, found the control task stressful and/or threatening. This might be because friendship is a value-laden concept. People may worry about saying the right, or wrong things when talking about what makes them a good friend. Therefore, in the present study the participants were asked to talk about a different topic that was suggested to be less stressful to the participants. Specifically, the participants were asked to talk about their normal route to university, to describe the university building after they entered the building and to describe what their house looks like.

5.1.2 Aim

The present study builds on the previous chapter by focusing on past competition, rather than an upcoming important competition to prevent confounding factors of the temporal patterning of an upcoming competition. The present study addressed aim four of the thesis, to examine how athletes respond in terms of the cognitive, affective, and physiological components of challenge and threat states when talking about a past competition. Participants were asked to talk about two past competitions, one where they performed to, or above, their expected standard and one where they performed below their expected standard to elicit positive and negative experiences. This provided an opportunity to explore differences between success and failure on cognitive, affective and cardiovascular responses. It was hypothesised that when participants talk about a competition they performed above, or up to, their expected standards, they will demonstrate a challenge response. In line with the TCTSA the hypothesis of this study was that athletes displaying a cardiovascular response indicative of a challenge report higher levels of self-efficacy, control, more approach goals, positive emotions and a more helpful interpretation of their emotional state. Also, the present study explored how people respond physiologically to competition regardless of the outcome of the competition or if the outcome of competition is reflected in different cardiovascular responses.

5.2 Method

5.2.1 Participants

Based on an effect size of $r = 0.50$ and an alpha of .05, in order to achieve a statistical power of 0.80, a sample size of 19 is recommended (Barcikowski & Randall, 1985) for an exploratory repeated measures analysis. A statistical power of 0.80 was chosen because there are no similar studies (Cohen, 1992b). Thirty participants (22 male, 8 female) participated in this study, from 13 different sports. These sports were netball (n = 3), badminton (n = 1), martial arts (n = 3), cricket (n = 3), swimming (n = 1), football (n = 6), basketball (n = 4), bowls (n = 1), hockey (n = 2), skiing (n = 1), rowing (n = 1), volleyball (n = 3), and cycling (n = 1) varying from national to amateur level. The participants' mean age was 23.17 (SD = 6.23) years and they competed in their main sport for an average of 9.96 (SD = 5.18) years and at the time of testing participated for an average of 5.00 (SD = 3.81) hours per week in their main sport.

5.2.2 Measures

Demographic information. Information was collected on participants' dates of birth, gender, height, weight, ethnicity, occupation, main sport, years of competing in main sport (referred to as duration), current level of competition, highest level of competition, other sport experience, and hours of sport participation in their main sport per week.

Self-efficacy. Self-efficacy was measured using the self-efficacy questionnaire (Coffee & Rees, 2008; see Appendix 5). The questions were the same as the previous chapter and participants were asked to rate them on a five-point Likert scale, ranging from 1 = *not at all* to 5 = *completely*. The internal reliability coefficient scores for the self-efficacy questionnaire are presented in Table 5.1.

Control. Control was measured using three items, as outlined in chapter 3 (see Appendix 5). Participants were asked to rate these questions on a five-point Likert scale. The items were based on a perceived behavioural control protocol (Azjen, 1991) and locus of control protocol (Connor & Sparks, 1996) and taken from Bonetti and Johnston (2008). The internal reliability coefficient scores for control presented in Table 5.1.

Achievement goals. Achievement goals were measured using the Achievement Goal Questionnaire for Sport (AGQ-S; Conroy et al., 2003). The AGQ-S (see Appendix 5) measures mastery-approach, mastery-avoidance, performance approach, and performance-avoidance goals. Each scale comprises of 3 items. The participants indicated *the extent to which each item is true of them in relation to how they felt thinking back to the start of the important competition they* *just talked about* on a seven-point scale, ranging from 1 = *not at all true* to 7 = *very true*. The internal reliability coefficient values for each scale are presented in Table 5.1.

Emotions. Emotions were measured using the Sport Emotion Questionnaire (SEQ, M. V. Jones et al., 2005; see Appendix 5). Participants were instructed *to indicate on the scale how they felt before competing in the important competition they just talked about*. After completing the SEQ, the participants were asked to rate how helpful they feel their emotional state was for their performance on a five-point scale, ranging from 0 *not at all helpful* to 4 *extremely helpful*. The internal reliability coefficient scores for the SEQ are presented in Table 5.1.

Appraisals. Appraisals were measured with a single item for challenge ("I experienced the competition as a challenge) and a single item for threat ("I experienced the competition as a threat"), see Appendix 5. Participants were also asked to rate how stressful they felt about the competition and if they felt they could cope with the competition on a five-point scale ranging from 0 *not at all* to 4 *extremely*.

Cardiovascular responses. An HIC-3000 impedance cardiograph, with an external electrocardiographic lead was used to record ZKG and ECG signals. A Sun-Tech Medical Tango blood pressure monitor was used to obtain systolic and diastolic blood pressure readings. The self-adhesive electrode bands and spot ECG electrodes were placed in the same manner as the previous chapter.

5.2.3 Design

A within-subjects design was used to explore the associations between the cognitive, affective, and physiological components of challenge and threat states for a competition where participants performed above their expected standard and a competition where the participants performed below their expected standard. Participants were recruited using convenience sampling.

5.2.4 Procedure

This study followed a similar protocol as chapter four. Approval was gained from the ethics committee of Staffordshire University. Upon arrival in the laboratory the procedure was explained to the participants and informed consent obtained, followed by demographic information. After placing the four self-adhesive electrode bands and three spot electrodes the participants were connected to the impedance cardiograph and blood pressure monitor.

Once the participant sat comfortably in a chair, five minutes of baseline data (heart rate, cardiac output, preejection period, total peripheral resistance) were obtained. Following the baseline, the participants were introduced to the first of three tasks, a control task and two experimental tasks. The three tasks were counterbalanced across participants and each task was preceded by a five minute rest, followed by collecting five minutes of resting baseline data (HR, CO, PEP, and TPR).

For the control task, the participants were asked to talk for two minutes about their journey to university, what the university building looks like, and what they saw when they entered the building and to describe what their house looks like. This task differed from chapter four to make the task more neutral. The control task was followed by a short questionnaire asking the participants how they approached this task. The two experimental tasks required the participants to talk about an important competition they performed to, or above, their expected standard (hereafter referred to as above task), and to talk about an important competition where they performed below their expected standard (hereafter referred to as below task). They were asked to recall the thoughts and feelings they experienced just before the start of each competition and to try to relive these thoughts, feelings and expectations as they described them.

Self-report measures of self-efficacy, control, achievement motivation, emotions and interpretation of emotional state, and challenge and threat appraisals were collected immediately following the above and below task. Participants were asked to complete the questionnaires in relation to the important competition they just talked about.

Table 5.1

Internal Consistency Reliability Values for the Cognitive and Affective Components of Challenge and Threat States

	Cognitive components			Affective components	
	Below	Above		Below	Above
Variable	α	α	Variable	α	α
Self-efficacy	.80	58	Anxiety	.87	.89
Control	.66	.71	Dejection	.90	.85
Map	.82	.56	Excitement	.78	.77
MAv	.84	.89	Anger	.87	.88
Pap	.91	.91	Happiness	.88	.92
PAv	.92	.90			

5.2.5 Data Analysis

Similar to the previous chapter, cardiovascular reactivity was calculated by deducting the last minute of the baseline from the first minute of the task (as there is shown to be a peak in the first minute of the task, Blascovich & Tomaka, 1996). The data were analysed in three stages. First correlation analysis was performed to explore associations between the cognitive, affective, and physiological components of challenge and threat states for both competitions. Next, a series of hierarchical regression analysis was performed to examine the predictor variables for the challenge and threat index for each task. Finally, another series of hierarchical regression analyses were performed to analyse the participants' overall responses to competition.

5.3 Results

5.3.1 Data Screening

One participant mentioned difficulties recalling the two competitions and was deleted from further analyses. One participant rated the control task as 'quite a bit stressful' and indicated they could only cope with the task 'a little bit' and was therefore removed from further analyses. Cardiovascular data were missing from four participants' baseline and tasks; this resulted in 24 participants remaining for further analyses. There were no differences in gender or type of sport for the cognitive, affective and physiological components of challenge and threat states. Preliminary screening of the data revealed a normal distribution for the variables used in the main analyses, with skewness and kurtosis values between the recommended values of -2 and 2 (Field, 2009).

5.3.2 Exploration of Physiological Components

The means and standard deviations for HR, CO, PEP, and TPR are presented in Table 5.2. Repeated measures analysis showed that there was a significant difference in HR reactivity between the three tasks, F (2, 46) = 4.97, p = .01, η_p^2 = .18. Paired-samples t-tests demonstrated that reactivity in HR was significantly higher for the above task than the control task, t (23) = 3.80, p < .01, r = .38. The cardiovascular reactivity (CVR) responses were in the expected direction, participants displayed increases in CO and decreases in TPR (indicative of a challenge pattern) in the above task and no changes in CO and increases in TPR (indicative of a threat pattern) in the below task. Repeated measures analysis demonstrated that there was no significant difference in CO reactivity between tasks, F (2, 46) = 0.92, p > .05, η_p^2 = .04 and TPR reactivity between the three tasks, F (2, 46) = 2.22, p > .05, η_p^2 = .09.

Table 5.2

Means and Standard Deviations for Heart Rate, Cardiac Output, Preejection Period, and Total Peripheral Resistance in the Three Tasks

		Control		Below		Above	
		Mean	SD	Mean	SD	Mean	SD
HR	Baseline	67.75	10.35	68.00	10.33	66.96	11.58
	Task	76.83	11.25	78.92	11.41	80.88	12.63
	Reactivity	9.08	7.30	10.92	8.74	13.92	8.17
CO	Baseline	6.04	1.28	6.06	1.44	6.00	1.24
	Task	6.09	1.26	6.07	1.50	6.15	1.39
	Reactivity	0.05	0.41	0.00	0.54	0.15	0.60
PEP	Baseline	134.17	16.98	136.33	17.03	139.75	30.06
	Task	133.42	16.53	135.25	15.69	135.83	27.36
	Reactivity	-0.75	8.08	-1.08	10.15	-3.92	12.34
TPR	Baseline	1226.08	320.06	1216.46	328.77	1216.46	304.52
	Task	1367.58	356.82	1414.58	354.48	1408.38	335.47
	Reactivity	141.50	115.60	198.13	151.62	191.92	146.96

Note. Baseline scores are based on the last minute of the baseline; task scores are based on the first minute of the task; reactivity is the difference between the first minute of the task and the last minute of the baseline. HR measured in BPM, CO in L/m, PEP in msec, and TPR in dyne seconds times cm^{-5}.

Task engagement. The participants showed that they were engaged with the task. This was indicated by an increase in HR between the last minute of the baseline and the first minute of task (referred to as reactivity in Table 5.2), for the control condition t (23) = 6.10, $p < .001$, $r = .46$, when they spoke about a competition they performed above their expected standard t (19) = 5.12, $p < .001$, $r = .46$ and below their expected standard, t (19) = 7.70, $p < .05$, $r = .54$. In addition, there was a decrease in PEP between the last minute of the baseline and the first minute of the task for the control condition t (23) = 0.46, $p = .65$, $r = .14$, the above task, t (23) = 0.52, $p = .60$, $r = 15$, and the below task, t (23) = 1.56, $p = .13$, $r = .25$. These results indicate that the participants were engaged with the task.

Carry over effects. Repeated-measures mixed ANOVAs were performed to explore carry-over effects for the last minute of the baseline of CO and TPR to examine if there was an order effect of condition. There was no main effect for the last minute of TPR in the baseline, indicating that the last minute of the baseline was similar across all three tasks, F (2, 36) = .04, $p > .05$, $\eta_p^2 = .002$. There was no main effect for the last minute of CO in the baseline, F (2, 36) = .22, $p > .05$, $\eta_p^2 = .01$.

In addition, the order effect of presenting the below task first compared to presenting the above task first was examined. The results show that for the last minute of the baseline CO decreases from the first competition the participants talked about to the second competition, regardless if they first spoke about a competition that went well ($M = 5.81$ to $M = 5.64$) or first spoke about a competition that did not go well ($M = 6.42$ to $M = 6.16$). For the last minute of the baseline TPR increased from the first talk about competition to the second talk about competition for both the competition that went well (*M* = 1226.09 to *M* = 1305.36) and the competition that did not go well (*M* = 1141.23 to *M* = 1208.31). There were no significant differences between the last minute of the baseline of the conditions. In summary, for the CVR there were no order effects of the presentation of conditions.

5.3.3 Exploration of Cognitive and Affective Components

The means and standard deviations for the cognitive and affective components of challenge and threat states are presented in Table 5.3. To correct for the number of analyses (14) and to protect against a type I error, the significance level was adjusted to .05/14 = .004. Independent t-tests showed that scores on self-efficacy, control, excitement, happiness, and interpretation of emotional state were significantly higher for the competition the participants did well at compared to the one they performed below their expected standard. Participants scored significantly lower on dejection for the competition they did well at compared to the competition they performed below their expected standard.

Table 5.3

Means and Standard Deviations for the Cognitive and Affective components of TCTSA for Below and Above Task

	Below		Above		
	Mean	SD	Mean	SD	*p*
Self-efficacy	2.76*	0.93	4.21*	0.55	.000
Control	3.08*	0.76	4.04*	0.59	.000
Mastery Approach	6.19**	0.79	6.61**	0.41	.03
Mastery Avoidance	5.35	1.23	5.22	1.35	.74
Performance Approach	4.86	1.67	5.07	1.61	.36
Performance Avoidance	4.54	1.80	4.26	1.79	.40

Anxiety	2.48**	1.04	1.61**	1.01	.01
Dejection	1.35*	1.08	0.24*	0.47	.000
Excitement	1.65*	1.00	2.97*	0.70	.000
Anger	1.15**	1.12	0.41**	0.69	.01
Happiness	1.02*	0.94	2.46*	1.02	.000
Interpretation emotions	1.05*	1.28	3.14*	1.13	.000
Challenge appraisal	2.33**	1.27	3.33**	0.82	.01
Threat appraisal	1.63	1.41	1.13	1.30	.26

* Significant at $p < .001$, ** Significant at $p < .05$

5.3.4 Above Task

A correlation analysis was performed to explore the association between participants' CV responses to the above and below competition and the cognitive and affective components of challenge and threat states. Similar to chapter four, a challenge and threat index was calculated for both the above and below task to analyse uniformity between CO and TPR. The results for the correlation analysis (see Table 5.4) for the above task demonstrated that there are no significant associations between the challenge and threat index and the cognitive and affective components.

To control for the act of speaking, two hierarchical regression analyses were performed to measure the predictive value of the cognitive components and the affective components of challenge and threat states on the challenge and threat index. One hierarchical regression analysis was performed for the cognitive components and one for the affective component of challenge and threat states. The cardiovascular index for the control task was entered in step one to control for the cardiovascular responses generated by the act of speaking. Hours of sport participation per week and level were initially controlled for in step 1 and removed when not significant. **Cognitive components**. The results for the hierarchical regression analysis to analyse the association between the cognitive component of challenge and threat states and the challenge and threat index for the above task are presented in Table 5.6. The addition of the cognitive components in step two was not significant, $\Delta R^2 = .23$, $p = .29$. Further exploration of the data revealed two possible suppressor variables, perceived control and avoidance orientation. The suppressor effect for perceived control was visible in the hierarchical regression where the sign of the beta weight ($\beta = .01$) changed in comparison to the zero-order correlation with the challenge and threat index ($r = -.17$). Also, perceived control was largely correlated with self-efficacy ($r = .70$) and there was a moderate negative correlation with avoidance orientation ($r = -.40$). The suppressor effect for avoidance orientation was visible when comparing the beta weight ($\beta = -.02$) to the zero-order correlation with the challenge and threat index ($r = .22$), the sign changed from positive (*r)* to negative (beta weight). Also, avoidance orientation was moderately correlated with approach orientation ($r = .36$). The hierarchical regression analysis was run again without perceived control and avoidance orientation, the results revealed a marginal significant effect for the addition of self-efficacy, approach orientation, challenge appraisal and threat appraisal in step 2, $\Delta R^2 = .22$, $p = .10$, with self-efficacy as the only significant predictor variable ($\beta = -.46$, $p < .05$). Those participants who displayed a cardiovascular pattern indicative of a challenge when talking about a competition where they did well reported lower levels of self-efficacy.

Table 5.4

Summary of Correlations for Scores on Challenge and Threat Index and Cognitive and Affective Elements of Challenge and Threat States for the Above Task

	1	2	3	4	5	6	7	8	9	10	11	12	13
1 Challenge and threat index	--												
2 Self-efficacy	-.30	--											
3 Control	.17	.70**	--										
4 Approach	.10	.32	.14	--									
5 Avoidance	.22	-.19	-.40	.36	--								
6 Challenge appraisal	.10	.19	.06	.10	.12	--							
7 Threat appraisal	-.13	-.30	-.57**	-.02	.29	.33	--						
8 Anxiety	.25	-.23	-.20	-.07	.32	.39	.27	--					
9 Dejection	-.04	-.45*	-.39	-.10	-.11	-.15	.26	.13	--				
10 Excitement	.16	.41	.48*	.08	-.17	.50*	.04	.31	-.20	--			
11 Anger	-.08	-.15	-.08	.27	-.19	-.03	.23	.15	.68**	.06	--		
12 Happiness	-.14	.33	.59**	.02	-.28	.18	-.27	.02	-.15	.68**	.12	--	
13 Interpretation Emotional state	-.35	.32	.29	-.02	-.36	.27	.16	-.33	-.10	.44*	.01	.25	--

Note * $p < .05$, ** $p < .01$

Table 5.5

Summary of Correlations for Scores on Challenge and Threat Index and Cognitive and Affective Elements of Challenge and Threat States for the Below Task

	1	2	3	4	5	6	7	8	9	10	11	12	13
1 Challenge and threat index	--												
2 Self-efficacy	.09	--											
3 Control	.05	.47*	--										
4 Approach	.08	.22	.08	--									
5 Avoidance	-.05	-.19	-.16	.35	--								
6 Challenge appraisal	-.14	.25	.09	.04	-.20	--							
7 Threat appraisal	.30	-.39	-.38	.33	.34	-.10	--						
8 Anxiety	.16	-.53**	-.68**	-.02	.23	-.15	.54**	--					
9 Dejection	.15	-.38	-.26	-.11	.05	-.38	.32	.50*	--				
10 Excitement	.04	.38	.10	-.26	-.30	.23	-.14	-.23	-.44	--			
11 Anger	-.07	-.35	-.26	-.30	.19	-.61**	.03	.28	.75**	-.18	--		
12 Happiness	-.07	.33	.09	-.41	-.29	.27	-.05	-.29	-.45*	.75**	-.32	--	
13 Interpretation Emotional state	.06	.36	.39	-.13	-.02	.32	.01	-.22	-.45	.34	-.49*	.40	--

Note * $p < .05$, ** $p < .01$

Table 5.6

Regression Analysis for Self-efficacy, Control, Challenge Appraisal, Threat Appraisal, Approach Goals, and Avoidance Goals for Above Task and Below Task

	Above			Below		
	b	*SE b*	*B*	*b*	*SE b*	*β*
Step 1						
Index control	-0.67	0.20	-.58*	-0.60	0.20	-.55*
Step 2						
Index control	-0.70	0.20	-.60*	-0.99	0.27	-.91*
Self-efficacy	-1.77	0.72	-.46	-0.29	0.53	-.13
Control				0.91	0.56	.34
Approach goals	-0.10	0.46	-.04	-0.41	0.48	-.18
Avoidance goals				-0.82	0.35	-.51
Challenge Appraisal	0.90	0.46	.34	0.18	0.31	.11
Threat Appraisal	-0.61	0.30	-.37	0.38	0.33	.27

Above R^2 = .33, p < .01 for step 1: ΔR^2 = .22, p = .10 for step 2, Below R^2 = .31, p < .01 for step 1: ΔR^2 = .27, p = .22 for step 2.

* p < .05

Emotions. A hierarchical regression analysis was run for the challenge and threat index and emotions and interpretation of emotional state (see Table 5.7). The results show that the addition of emotions in step 2 did not significantly predict the challenge and threat index, ΔR^2 = .10, p = .76; the addition of interpretation of emotions in step 3 was not significant, ΔR^2 = .10, p = .11.

Table 5.7

Regression Analysis for Emotions and Interpretation of Emotional State for Above Task and Below Task

	Above			Below		
	b	*SE b*	*Β*	*b*	*SE b*	*β*
Step 1						
Index control	-.67	.21	-.58*	-0.69	0.23	-.61*
Step 2						
Index control	-0.71	0.24	-.62*	-0.65	0.24	-.57*
Anxiety	0.37	0.45	.18	-0.47	0.48	-.25
Dejection	0.53	1.26	.12	1.45	0.75	.77
Excitement	0.51	0.97	.17	1.22	0.68	.58
Anger	-0.69	0.85	-.22	-0.73	0.53	-.41
Happiness	0.09	0.68	.04	-0.23	0.66	-.11
Step 3						
Index control	-0.55	0.25	-.47*	-0.79	0.26	-.70*
Anxiety	-0.25	0.57	-.12	-0.52	0.48	-.28
Dejection	0.59	1.19	.13	1.37	0.75	.72
Excitement	1.99	1.27	.66	1.16	0.68	.55
Anger	-0.55	0.81	-.18	-0.93	0.55	-.53
Happiness	-0.51	0.73	-.24	-0.06	0.67	-.03
Interpretation	-0.91	0.54	-.48	-0.54	0.47	-.30

Above R^2 = .34, p <.01 for step 1: ΔR^2 = .10 p =.76 for step 2; ΔR^2 = .10, p =.11 for step 3.

Below R^2 = .37, p <.01 for step 1: ΔR^2 = .21 p =.40 for step 2; ΔR^2 = .05, p =.28 for step 3.

* p <.05

5.3.5 Below Task

The results for the correlation analysis (see Table 5.5) for the below task showed that there are no significant associations between the challenge and threat index and the cognitive and affective components of challenge and threat states.

Cognitive components. The results for the hierarchical regression analysis to analyse the association between the cognitive component of challenge and threat states and the challenge and threat index for the below task (see Table 5.6) demonstrated that the addition of the cognitive components of challenge and threat states in step 2 was not significant, $\Delta R^2 = .27$, $p = .22$. Self-efficacy ($\beta = -13$, $r = .08$), approach orientation ($\beta = -.18$, $r = .08$) and challenge appraisal ($\beta = .11$, $r = -.16$) appeared to be suppressor variables, only self-efficacy had moderate to high correlations with other predictor variables, namely a positive correlation with control, $r = .45$ and a negative correlation with threat appraisal, $r = -.41$. Running the hierarchical regression analysis without self-efficacy did not result in a significant effect for the addition of the cognitive components, $\Delta R^2 = .26$, $p = .15$.

Emotions. A three-step hierarchical regression analysis was performed to analyse the predictive value of emotions and the interpretation of emotional state on the challenge and threat index for the below task. The results (see Table 5.8) show that the addition of emotions in step 2 was not significant, $\Delta R^2 = .21$, $p = .40$, the addition of interpretation of emotional state in step 3 was also not significant, $\Delta R^2 = .05$, $p = .28$.

5.3.6 General Response

A series of hierarchical regression analyses were run to predict the effects of the general response of the participants to competition. Research has suggested that CVR is relatively stable (Cohen et al., 2000). The correlations between the CVR for the two tasks support this; there was a positive correlation for CO reactivity in the above and below task, $r = .58$, $p < .005$, and for TPR reactivity in the above and above task, $r = .63$, $p < .005$. In addition, it might be worthwhile to explore how the cognitive, affective, and physiological components relate averaged over both tasks. CVR, self-efficacy, control, achievement goals and emotion scores were averaged over the two tasks, such that there was one overall score for the challenge and threat index and the cognitive and affective components of challenge and threat states. In the first step of the hierarchical regression analyses the challenge and threat index for the control task was entered.

Cognitive components. A hierarchical regression analysis was run for the challenge and threat index and self-efficacy, control, challenge appraisal, threat appraisal, approach goals, and avoidance goals (see Table 5.8). The regression analysis revealed no significant effect for the addition of the cognitive components in step 2, $\Delta R^2 = .20$, $p = .61$.

Table 5.8

Regression Analysis for Self-efficacy, Control, Challenge Appraisal, Threat Appraisal, Approach Goals, and Avoidance Goals Overall Response

	b	*SE b*	*B*
Step 1			
Index control	0.36	0.18	0.41
Step 2			
Index control	0.06	.25	.07
Self-efficacy	-.63	1.04	-.16
Control	1.39	.99	.35
Approach	-.30	.57	-.14

Avoidance	-.45	.44	-.28
Challenge appraisal	-.04	.58	-.02
Threat appraisal	-.04	.48	-.02

R^2 = .16, p =.06 for step 1: ΔR^2 = .20, p =.61 for step 2.

Emotions and interpretation of emotional state. The results for the association between emotions and interpretation of emotional state are presented in Table 5.9. There was a marginal effect for the addition of emotions in step 2; excitement was the only significant predictor variable, β = 1.13, p < .05. Participants who displayed an overall cardiovascular response indicative of a challenge reported to be more excited about competition. Emotions accounted for 50% of the variance for the overall challenge and threat index. There was no effect for the interpretation of emotional state as an addition in step 3 of the regression analysis ΔR^2 = .05, p = .25.

Table 5.9

Regression Analysis for Emotions and Interpretation of Emotional State Overall Response

	b	*SE b*	*B*
Step 1			
Index control	0.30	0.22	.33
Step 2			
Index control	0.33	0.22	.36
Anxiety	-0.10	0.53	-.04
Dejection	0.88	0.85	.33
Excitement	3.09	1.02	1.13
Anger	-0.54	0.65	-.25

Happiness	-1.33	0.98	-.53
Step 3			
Index control	0.28	0.22	.31
Anxiety	-0.36	0.56	-.16
Dejection	1.42	0.94	.53
Excitement	3.18	1.00	1.16
Anger	-1.13	0.80	-.51
Happiness	-1.14	0.97	-.45
Interpretation of emotion	-0.65	0.53	-.31

R^2 = .11, p =.18 for step 1: ΔR^2 = .50 p =.07 for step 2; ΔR^2 = .05, p =.25 for step 3.

5.4 Discussion

The aim of the present study was to examine how athletes respond in terms of the cognitive, affective, and physiological components of challenge and threat states when recalling a competition where they performed to, or above, their expected standard and when recalling a competition where they performed below their expected standard. The cardiovascular reactivity responses were in the expected direction specifically when talking about a competition where they performed to, or above, their expected standard, participants displayed an increase in cardiac output and a decrease in total peripheral resistance compared to baseline. The participants scored higher on self-efficacy, control, excitement, happiness, and interpretation of emotional state and lower on dejection in relation to the competition they performed to, or above, their expected standard compared to the competition they performed below their expected standard. There were no clear effects for the association between cardiovascular reactivity patterns characterising challenge and threat responses and self-efficacy, approach/avoidance goals, emotional states, or the interpretation of the emotional states for the two separate competitions. However, there was a tendency for the participants who rated their self-efficacy higher when talking about the competition that went well to display a cardiovascular pattern indicative of a threat. The findings for participants' general response to competition demonstrated that participants who were more physiologically challenged by competition indicated to be more excited about competition.

5.4.1 Implications

An individual's expectation of a situation can influence affective components of challenge and threat states. In addition, it might not only be about the favourableness of the expectations (Carver & Scheier, 1988), but also relate to the intensity (high or low) of these expectations. Athletes have expectations approaching a competition and there are individual differences regarding the intensity of these expectations regardless of their performance (above or below their expected standard). When talking about a competition where they performed above their expected standard, some athletes talked about a situation where they had low expectations of the competitions, such as the first time they played in the team or when coming back from an injury, whereas others had high expectations of the competition such as a cup game where they were the captain of the team or the county semi-final where they had 'a point to prove'.

Furthermore, the outcome of a competition might have influenced CVR patterns and the cognitive and affective components of challenge and threat states. Athletes might respond differently physiologically after winning or losing. In a study examining cortisol changes after winning or losing, Wirth, Welsh, and Shultheiss (2006) found that increased cortisol levels after a reaction time-based cognitive task were associated with high levels of power motivation among losers but with low levels of power motivation among winners of the task. They suggested that the individuals who did not strive for dominance might perceive winning more stressful than losing, indicating that athletes might not display similar physiological patterns after winning or losing. Ricarte, Salvador, Costa, Torres, and Subirats (2001) examined heart rate and blood pressure responses to a competitive role-playing game. Winners showed a more active strategy, characterised by their increased HR and their subjective response of the outcome (higher internal attribution of the outcome) compared to losers, who showed a more passive strategy (Ricarte et al., 2001). None of these studies, however, specifically examined how cardiovascular reactivity patterns are influenced by the outcome of a competition or the expectations when approaching a competition.

The findings of the present study are mostly inconsistent with the findings of chapter three and four. This might be because of the different nature of the competition. In the present study the participants were asked to talk about two past competitions, whereas in the previous chapter the participants were asked to talk about an upcoming competition. The uncertainty surrounding this upcoming competition and the consideration of the demands of this upcoming situation is different from the present study where there was not much at stake for the participants anymore, as they had already participated in the competition. Because of the difference in demands of the situation (before and after the competition), the participants' physiological and psychological responses might not have been as strong in the present study compared to the previous study. For example, the reactivity scores for TPR were higher in chapter four than the present study. From an applied perspective, when talking about thoughts and feelings from previous competitions as opposed to an upcoming competition, practitioners should be aware that the physiological responses might not be as strong when talking about a past competition.

5.4.2 Cardiovascular Response

In the present study, the participants' general cardiovascular patterns when talking about competition were explored in addition to examining the task-specific responses. Psychophysiological reactivity is suggested to appear as a trait response, much reactivity research, however, included only single observations (Manuck, Kamarck, Kasprowicz, & Waldstein, 1993), whereas others have highlighted the state like nature of psychophysiological reactivity (Carroll & Sheffield, 1998). Kelsey, Ornduff, and Alpert (2007) examined the internal consistency of cardiovascular reactivity to stress and found that even in experiments taking place in a single session, CVR was not less reliable across tasks. Gerin et al. (1998) suggested that even small changes in the procedure can influence the generalisability of the cardiovascular response. On the other hand, some research has found that there was consistency in the CVR response across tasks (Kamarck, Debski, & Manuck, 2000). Therefore, in the present study the CVR responses for each task as well as the overall CVR responses were explored. Response patterns were taken into account by also looking at the differences between cardiac output and total peripheral resistance (in addition to the challenge and threat index), the present study not only examined the overall response but also differences across tasks.

In summary, the present study showed that it was useful to explore both the task specific responses to competition as well as the overall response; the results showed that for the overall response there was a positive association with excitement. Specifically, those participants who were physiologically challenged by competition in general reported to be more excited about competition in general.

5.4.3 Limitations

Limitations of the present study are the low power and the act of talking; the latter also applies to chapter four. Previous studies examining challenge and threat states or stress response have used the act of talking (Blascovich et al., 2004; Seery, Weisbuch, Hetenyi, & Blascovich, 2010), some participants, however, might feel uncomfortable talking out loud. The control task partially accounted for this by asking the participants how stressful they rated this task. It was decided to ask the participants to talk about their approach to competition rather than imagining it, as it was difficult to control for individual differences in imagery ability, and this would have added another mediating effect to the study.

In addition, the control measure in the current study is not a previously validated measure. The participants scored lowest on the question how difficult it was to perform up to the best of their abilities, both in the above and the below task, with lower scores in the below task. However, the control measure was able to distinguish between the two competitions, with higher scores for the competition they did well. In addition, a principal component factor analysis in chapter 3 showed that the measure extracted one scale, all three items shared some common variance. Obtaining measures of control in relation to an upcoming competition could have provided more insight into how much the outcome of the competition influenced the responses on the control measures in the present study.

Finally, there was a low range for the self-report measures in relation to the competition where the participants performed to, or above, their expected standard. The participants scored high on self-efficacy, control, and approach goals.

5.4.4 Conclusion

The present study extends previous research by including two sport-related tasks, examining approach and avoidance goals and by including multiple measures using a biopsychosocial approach. This study followed on from the previous study by eliminating the confounding effects of an upcoming competition and the temporal patterning in the approach to competition. The idea of temporal patterning does not just apply to CVR patterns, but also emotions (Cerin et al., 2000; Wiggins, 1998) and possibly self-efficacy and control, providing an avenue for further research. The present study did, however, not show a consistent pattern between the cognitive, affective, and physiological components of challenge and threat states.

Expectations may have an influence on perceived control and CVR patterns. This has implications for applied sport psychology practice. In line with the TCTSA, the expectancies an athlete has of the competition, pre-competition, might have a significant influence on their CVR pattern, which in turn can influence performance. To summarise, the findings did not provide clear support for the TCTSA. The present study outlines suggestions for future studies, such as further exploration of temporal patterning in the lead up to competition; how do the cognitive, affective, and physiological components of challenge and threat outlined in the TCTSA change when the competition approaches.

CHAPTER 6: THE EFFICACY OF A PSYCHOLOGICAL SKILLS INTERVENTION: A CASE STUDY

6.1 Introduction

The previous chapters have outlined that people respond to competition with different cardiovascular patterns. In addition, individuals differed in their cognitive responses to competition although it was not clear what determined the cardiovascular reactivity in those studies, in the previous chapter cognitive responses appeared to be unrelated to cardiovascular responses. The present study extends the previous chapters by exploring the effects of a psychological skills intervention on the cognitive, affective, and physiological components of challenge and threat states. This study implements challenge and threat states in an applied setting and aims to explore the effectiveness of a psychological skills intervention designed to develop challenge states.

The TCTSA outlines that challenge and threat states can influence performance in a variety of ways. This includes decision making, cognitive functioning, and task engagement. It is hypothesised that these are improved or enhanced when in a challenge state. Enhancing self-efficacy, perceived control and a focus on approach goals can be used to create a challenge state, for example by implementing a sport psychology consultancy model. The use of a typical sport consultancy model has been outlined by Thelwell, Greenlees, and Weston (2006), based on Taylor’s (1995) conceptual framework. This conceptual framework outlines the use of a psychological skills intervention with the needs of the individual in mind. A similar approach was used in the current chapter, where the needs of the athlete in relation to her sport were assessed and a psychological skills intervention was constructed accordingly. This psychological skills intervention included goal setting, self-talk, self-awareness, adaptability, relaxation, imagery, and attention control. The effectiveness of psychological skills on performance in sport is further outlined by a number of researchers (Patrick & Hrycaiko, 1998; Rogerson & Hrycaiko, 2002; Thelwell et al., 2006).

Only limited research has examined the influence of psychological skills on challenge and threat states. A recent study examined the influence of an imagery intervention on manipulating antecedents of challenge and threat states (S. E. Williams, Cumming, & Balanos, 2010). S. E. Williams et al. (2010) used neutral, challenge, and threat imagery scripts to identify changes in psychological and cardiovascular responses in 20 athletes. Even though the challenge and threat scripts elicited an increase in cardiac output, the results for the cardiovascular responses did not significantly differentiate between challenge and threat scripts. The challenge imagery script was related to higher levels of self-confidence compared to the threat script, providing support for the cognitive component of the TCTSA.

In determining the effectiveness of psychological skills interventions, researchers have been encouraged to use a single case study approach, as an addition to nomothetic group designs (Mace, 1990). The question ‘why are there so few case studies in sport psychology’ has been raised a number of times (Hrycaiko & Martin, 1996; Martin, Vause, & Schwartzman, 2005). However, in the last decade more single case studies on the effectiveness of psychological skills interventions in sport have been conducted (Barker & Jones, 2006, 2008; Callow, Hardy, & Hall, 2001; Uphill & Jones, 2007; Von Guenthner, Hammermeister, Burton, & Keller, 2010). The use of psychophysiological single case studies, however, is still underreported in the sport psychology literature. Prapavessis, Grove, McNair, and Cable (1992) examined the effectiveness of a cognitive-behavioural intervention in decreasing state anxiety and enhancing sport performance. In this single-case study, a small-bore rifle shooter took part in a six-week intervention program comprising twelve sessions including training relaxation, thought stoppage, refocusing, coping statements, and biofeedback, using a multidimensional and multi-method design. Changes in cognitive anxiety, somatic anxiety, self-confidence, performance, gun vibration, and urinary catecholamines were measured. The results showed that the participant had improved shooting performance, reduced state anxiety, lower levels of cognitive and somatic anxiety, less gun vibration, lower urinary adrenaline and noradrenaline levels, and increased self-confidence post-intervention compared to the baseline. Psychological skills interventions can benefit an effective physiological pattern, for example Perna, Antoni, Kumar, Cruess, and Schneidermann (1998) have found that a cognitive behavioural intervention reduced cortisol levels of rowers during a heavy training period compared to a control group.

The present study was set up as a case study, where the athlete's cardiovascular response patterns are measured on three occasions. Case studies are especially useful when evaluating the effectiveness of an intervention (M. V. Jones, 1999). In addition, self-report measures of challenge and threat states were taken to ensure triangulation of the data. In summary, the present study explores how cardiovascular patterns develop over the course of a psychological skills training.

6.1.1 Aims

The aim of this study was to explore the efficacy of an intervention designed to develop challenge states in athletes. This study addressed aim five of the thesis. It is expected that the psychological skills intervention will have a positive influence on the cognitive, affective, and physiological components of challenge and threat states. Specifically, the intervention is expected to increase self-efficacy, control, approach goal orientation, decrease avoidance goal orientation and anxiety, as well as promoting a facilitative interpretation of the participant's emotional state. In line with the TCTSA, it was expected that the participant would display a cardiovascular pattern indicative of a challenge state towards the end of the intervention. To summarise, the aim of the intervention was to work towards a challenge state and to be more able to meet the demands of the situation by increasing perceived available resources. In addition, the temporal patterning of cardiovascular reactivity responses over time was explored as the previous chapters suggested that the components of challenge and threat states may change in the lead up to competition.

6.2 Method

6.2.1 Participant and Experimental Design

The study was conducted with a 16 year old county racket sport player with eight years of playing experience, who at the time of the intervention was training five hours a week. The participant was ranked second in her county for junior female players. During the intake the client mentioned having difficulties juggling training and school commitments. In addition, it emerged from the intake interview that self-talk and unfair playing styles of competitors bothered the participant and dwelling on mistakes during matches limited her playing style and shot selection. During the intake session the participant further mentioned that she was a bit shy and introverted in interactions with others and that this was something she wanted to address. The participant did not have any specific sport psychology consultancy experience.

6.2.2 Measures

Cognitive components of challenge and threat states. Self-efficacy, perceived control, achievement goals, emotions and interpretation of emotional state were measured using the self-report measures from chapter three (see Appendix 7).

Anxiety. State anxiety was measured using the Competitive State Anxiety Inventory-2C (CSAI-2C; Stadulis, MacCracken, Eidson, & Severance, 2002) with the instructions adapted to the age of the participant (see Appendix 7). The CSAI-2C comprises fifteen items measuring three components, cognitive anxiety, somatic anxiety, and confidence, with scores on each item ranging from 1 (“not at all”) to 4 (“very much so”). Each subscale consists of five items with total scores for each scale ranging from 5 to 20, high scores are indicative of high levels of state anxiety and confidence.

Sport specific trait anxiety was measured using the Sport Anxiety Scale (SAS-2; Smith, Smoll, Cumming, & Grossboard, 2006, see Appendix 7). The SAS-2 consists of fifteen items measuring somatic anxiety, worry, and concentration disruption. The participant was asked to indicate how she usually feels before or while competing in sport on a four-point scale ranging from 1 (“not at all”) to 4 (“very much”).

Cardiovascular reactivity. An HIC-3000 impedance cardiograph, with an external electrocardiographic lead was used to record ZKG and ECG signals and obtain reading of heart rate (HR), preejection period (PEP), cardiac output (CO), and total peripheral resistance (TPR). A Sun-Tech Medical Tango blood pressure monitor was used to obtain systolic and diastolic blood pressure readings. The self-adhesive electrode bands were placed in a similar manner as the previous studies, in line with guidelines provided by Sherwood et al. (1990), the three spot electrodes for measuring ECG were placed on the two clavicles and on the fifth left rib as recommended by the HIC-3000 manual. This placement would allow movement with the hands when taking part in the tasks without increasing noise of the signal.

6.2.3 Procedure

Approval was gained from Staffordshire University ethics committee. After the participant was recruited to participate in the study, informed consent and parental consent were obtained (see Appendix 6). It was explained to the participant that she would take part in a psychological skills intervention that would be tailored towards her needs and that cardiovascular measures would be obtained during a maximum of six sessions. During the first meetings the participant's needs were identified using an intake interview and performance profiling. The sessions included self-talk, goal-setting, breathing, imagery, relaxation, attention control, and self-awareness and usually took between 45 and 60 minutes at the same time of the day. The participant completed self-report measures of anxiety (CSAI-2C and SAS-2) after the first session and during the last session. Self-report measures of the cognitive components of challenge and threat states (self-efficacy, control, approach and avoidance goal orientation, emotions, and interpretation of emotional state) were obtained after the third session and during the last session.

The cardiovascular measures (HR, PEP, CO, and TPR) related to a sports-specific task were taken on three occasions (session seven, eleven, and twelve). During these three sessions, the cardiovascular measures were taken before the psychological skills session. To obtain the cardiovascular reactivity measures, four self-adhesive band electrodes and three spot electrodes were placed on the participant's body, after which she was connected to the impedance cardiograph and blood pressure monitor. After the participant sat comfortably in a chair, five minutes of baseline data (HR, PEP, CO, and TPR) were obtained before each task, the participant was asked to take part in two tasks, a Stroop task and a concentration grid task. After each task, the participant was asked to rate on a ten-point scale how stressful she perceived the task to be. These tasks were used to familiarise the participant with the equipment, before engaging in the sports-specific task. This sport-specific task will be described after explaining the Stroop task and the concentration grid task.

The Stroop task is frequently used as a mental stress task and previous studies have reported increases in HR compared to the baseline (Freyschuss et al., 1990; Hjemdahl et al., 1989; Hoshikawa & Yamamoto, 1997; Waldstein, Bachen, & Manuck, 1997), indicating that the Stroop task reflects a motivational performance setting. The Stroop task is found to elicit a stable pattern of responses from the cardiovascular system (Hoshikawa & Yamamoto, 1997). The Stroop task in the current study used six words representing a colour. The words red, blue, green, yellow, orange, and purple would randomly flash up on the screen and the words could be written in a different colour than the word itself, which elicits a response conflict between naming the words and colour. The participant was asked to press the button on the response box that represents the name of colour of the word that was spelt. For example, if the word red was written in blue, the participant was asked to press the red button on the response box. A concentration grid task (Harris & Harris, 1984) was used as another mental stress task. In the concentration grid task, the numbers 00 to 99 were randomly placed in a 100 cell (ten by ten) grid. The participant was asked to check off as many numbers in numerical order (ascending or descending) in 60 seconds as possible.

The participant required two sessions to feel secure with the equipment and procedure. During these sessions, the participant completed the Stroop and concentration grid task as described above. After the participant felt comfortable with the equipment, she talked about an important competition on three occasions (session seven, eleven, and twelve). In the sport task, the participant was asked to talk about her thoughts, feelings, and expectations in relation to an important competition (county championships). In session seven and eleven, the participant spoke about the upcoming county junior championships (similar to the scenario in chapter four), where she aimed to win the ladies singles. The first time was approximately six weeks before the championships, whereas the second time the championships were only a few days ahead of her. In session twelve she, again, spoke about the county junior championships, but this time she talked about her actual performance in the championships (similar to the scenario in chapter five).

6.2.4 Intervention

The intervention followed a sport psychology consultancy protocol as outlined by Thelwell et al. (2006) and was delivered by the main researcher, a chartered sport psychologist. The first two sessions focused on education and self-awareness, followed by teaching, rehearsal and implementation of skills such as imagery, relaxation and self-talk.

Session one and two. During the first session, the needs of the participant were discussed by an intake interview and the CSAI-2C and SAS-2 (see Table 6.2) were administered, after which it was decided to start the intervention. The participant was also given a hand-out with questions aimed to help her understand her motivations for playing badminton (see Appendix 8). During the first session she mentioned that she struggled with some of the questions, for example “what do you do before competition” and “how would you describe you as a person”. This was underlined by her coach and mother, who both were present during the intake session to gain a better understanding of the issues the participant might face. The second session mainly focused on performance profiling (Butler, 1989, 1991) to further explore the needs of the participant. Performance profiling is based on Personal

Construct Theory (Kelly, 1955) and is a powerful tool as the participant plays an active role in the process and it helps to enhance self-awareness (Gucciardi & Gordon, 2009). In this session, the participant was asked to list qualities and skills that are needed to be a successful racket sport player, identify the importance of each skill, rate the ideal ability, and rate her current ability on each quality on a ten-point scale (see Appendix 9). The results provide an indication of the skills the participant can work on and helps with goal setting. The data from the performance profile (see Appendix 9) identified the following areas: self-confidence (discrepancy score of 68), adaptability and game plan (40), motivation and will to win (40), keeping head up (40), nutrition (40), and self control (40). The second session also educated the participant about self-talk and how negative thinking can impact on performance. She was encouraged to keep a diary and write down thoughts and feelings before and after playing her sport. She was given a hand out with example questions she could include in the diary.

Session three. This session started with familiarisation with the impedance cardiogram and the Stroop and concentration grid task. The third session was dedicated towards goal setting. The results from the performance profile were used as a guidance point and the top five results were used to set goals for, these were self-confidence, the will to win, adaptability and game plan, cardiovascular fitness, and self-control. The participant was encouraged to set goals using the SMART guidelines, SMART goals are used as an acronym for setting specific, measurable, adjustable, realistic, and time-based goals (Bull, Albinson, & Shambrook, 1996; see Appendix 10). In addition, the participant was encouraged to set positive goals and the differences between performance and mastery goals were discussed, the aim of this was that the participant would focus on her own performance and goals.

Initially, the participant struggled with specifying the goals. After a few examples, she understood how to set goals and was able to set goals independently. In addition, the importance of short and long term goals and the adaptability of goals were discussed. The participant was asked to write down three short term goal and identify what she would do this week to get a step closer to achieving these short term goals.

Session four. In the fourth session, self-task was addressed. Based on the diary entries and discussion, the rationale of some of the negative thoughts was discussed by asking the question "what is the logic, evidence, and usefulness of this statement?" In addition, the diary entries showed that the participant phrased her self-talk in an avoidance goal orientation way, for example "I don't want to…." Therefore, in addition to discussing the rationale of the negative thoughts we also focused on rephrasing her thoughts in an approach goal orientation, for example "I will do…." Approach goals are related to a challenge state (M. V. Jones et al., 2009). In addition, the participant was introduced to breathing techniques, to help her with relaxation and concentration. The main focus was on diaphragm breathing, deep diaphragm breathing activates the parasympathetic nervous system, which helps the body to relax (Gilbert, 1999) and could reduce stress (Peddicord, 1991). Diaphragm breathing could also have a positive effect on cardiovascular activity, as it increases blood flow towards the heart (Bell & Saltikov, 2000). Finally, in this session it was discussed how self talk and breathing could be implemented in her preperformance routine. Preperformance routines can focus an athlete's attention and have been found to aid performance (Mesagno, Marchant, & Morris, 2008).

Session five. This session started with familiarisation with the impedance cardiogram and Stroop and concentration grid tasks. The participant was introduced to imagery in the fifth session. Imagery is a tool that enables an individual to create or re-create an experience in the mind (Vealey & Greenleef, 2010). The participant was taken through basic imagery scenarios, such as imagining an apple and taking a bite out of it (Mace, 1994), such that she would feel comfortable with imagery (Vealey & Greenleaf, 2010), after this the imagery progressed to racket sport specific scenarios, which was followed up in the next sessions. A benefit of imagery for the participant was the opportunity to mentally rehearse a variety of shots and practice adaptability and changes to her game plan (Simons, 2000), as well as enhancing her self-efficacy (M. V. Jones, Mace, Bray, MacRae, & Stockbridge, 2002). Increased levels of self-efficacy are related to a challenge state (M. V. Jones et al., 2009).

Session six. In the sixth session the participant was taken through a progressive muscular relaxation session, using an adapted version based on Jacobson's principles (1930), as outlined by J. M. Williams (2010; see Appendix 11). The participant was asked to lie on her back in a comfortable position, followed by taking a few long and deep breaths using diaphragm breathing. When she indicated she was comfortable, she was asked to tense a muscle group for five to seven seconds and then relax for 30 seconds, going through every muscle group. Afterwards, the participant was given a CD with the relaxation guidance (adapted from J. M. Williams, 2010) on it, so that she could practice the progressive muscular relaxation exercises at home.

Session seven. This session started with taking measures of cardiovascular reactivity in relation to an upcoming important competition. The seventh session aimed to evaluate the participant's experiences with relaxation, imagery, and self-talk. The participant discussed her experiences with relaxation, imagery, and self-talk and indicated that she used an acronym (BRASS; breathing, relaxation, adapt, stop, slow down) to remind herself of these techniques during training and competition. The participant was encouraged to practice the skills during training and reflect on it afterward by writing down her experiences. The participant mentioned difficulties implementing positive self-talk, during this session the participant was taken through a guided imagery scenario to implement positive self-talk when trying to adapt her game plan. In this scenario the participant was asked to imagine how she felt in the last competition when she used negative self-talk. Next, she was asked to rewind this scenario and replace the negative self-talk by positive or more neutral self-talk.

Sessions eight and nine. In the eighth and ninth session, managing expectations and dealing with distractions were discussed. The aim of this session was to outline the importance of focusing on “the moment” when playing in a competition and play one point at the time, rather than focusing on the outcome. Focusing on the outcome rather than the task at hand can interfere with focus and consequently, performance (Orlick, 2000). Focusing on the moment is thought to benefit a challenge state as it is reduces the participants’ focus on the outcome and expectations.

Session ten. This session comprised of attention control based on the principles outlined by J. M. Williams et al. (2010). The four dimensions of attention (external-broad, external-narrow, internal-broad, and internal-narrow) were explained to the participants and examples were used to illustrate each dimension. The aim of this session was to demonstrate that concentration can be accomplished by controlling the width and direction of her attentional focus (J. M. Williams et al, 2010; see Appendix 12). The session aimed to create awareness that different situations require different attentional dimensions, sometimes the athlete requires an internal-wide focus, for example when reviewing shot selection, whereas at other times she requires an external-narrow or broad focus where she is focused on the opponent or shuttle. In addition, this session aimed to increase her ability to switch between attentional styles. Also, attention control is expected to increase the participants' perceived control over the competition and benefit a challenge state. The skills from earlier sessions, such as self-talk and imagery were used to aid shifting attentional style to adapt to situational demands.

Sessions eleven and twelve. Session eleven started with taking measures of cardiovascular reactivity in relation to an upcoming important competition. Session eleven consisted of discussing the upcoming county championship and how some of the techniques could be used as part of her pre-performance routine and during competition. Finally, session twelve started with taking measures of cardiovascular reactivity in relation to the important competition she participated in. Session twelve entailed a recap of the psychological skills intervention and a debrief.

6.2.5 Analysis

Visual comparison of the pre and post intervention scores was conducted, as well as comparing the scores of the sport speech six weeks before competition, just before competition, and post competition. The dependent variables are cardiovascular reactivity (CVR) and the scores on the self-report measures.

6.3 Results

6.3.1 Performance

Towards the end of the intervention the participant won the county age group ladies and mixed doubles and she was the runner-up for the ladies singles. She played all these finals after each other, on the same day. The first match was the mixed double, which was an intense three set final. This match was immediately followed by the ladies singles final, the participant lost in a close match. The ladies doubles final was won easily after the singles final. Even though it was her aim to win the singles final, which she has never won before, she felt she performed well given the circumstances on the day.

6.3.2 Cardiovascular Data

The cardiovascular responses for the three tasks and the mean and standard deviations for each task are presented in Table 6.1.

Table 6.1

Means and Standard Deviations for Heart Rate, Cardiac Output, and Total Peripheral Resistance for the Stroop Task, Concentration Grid Task, and Sport Speech

		Stroop		Grid		Sport	
		Mean	SD	Mean	SD	Mean	SD
HR	Baseline	62.00	4.94	62.00	5.14	60.00	4.58
	Task	66.50	4.09	63.00	4.38	71.67	4.51
	Reactivity	4.50	3.56	1.00	2.10	11.67	5.03
CO	Baseline	7.17	0.88	6.95	0.72	7.47	0.40
	Task	7.42	1.05	7.08	4.38	7.87	0.25
	Reactivity	0.25	0.40	0.13	0.27	0.40	0.17
PEP	Baseline	126.33	9.07	129.33	7.97	126.00	5.29
	Task	128.67	8.26	129.00	8.83	126.00	6.00
	Reactivity	2.33	6.61	-0.33	2.34	0.00	4.00
TPR	Baseline	736.17	121.10	769.50	104.77	740.33	49.60
	Task	732.50	102.15	759.50	125.83	693.00	31.76
	Reactivity	55.45	0.47	-10.00	68.48	-47.33	67.84

Note. Baseline scores are based on the last minute of the baseline; task scores are based on the first minute of the task; reactivity is the difference between the first minute of the task and the last minute of the baseline. HR measured in BPM, CO in L/m, and TPR in dyne seconds times cm^{-5}.

Sport speech. The results for the cardiovascular reactivity responses for the sport speech (Figure 6.1) showed that CO reactivity increased just before and after competition compared to six weeks before competition. TPR reactivity increased just before competition, after which it returned to the same level as six weeks before competition. These results illustrate that the participant displayed more of a challenge pattern at the end of the intervention, when she spoke about the competition after she performed in the competition. In addition, the increase in TPR reactivity just before the competition might indicate that her body anticipates the stress of a competition as it approaches closer.

PEP and HR reactivity scores (indicative of engagement with the task) showed that HR reactivity gradually increased, from 6 weeks before the task to post competition. The scores for PEP showed an increase (indicative of less engagement) just before the competition.

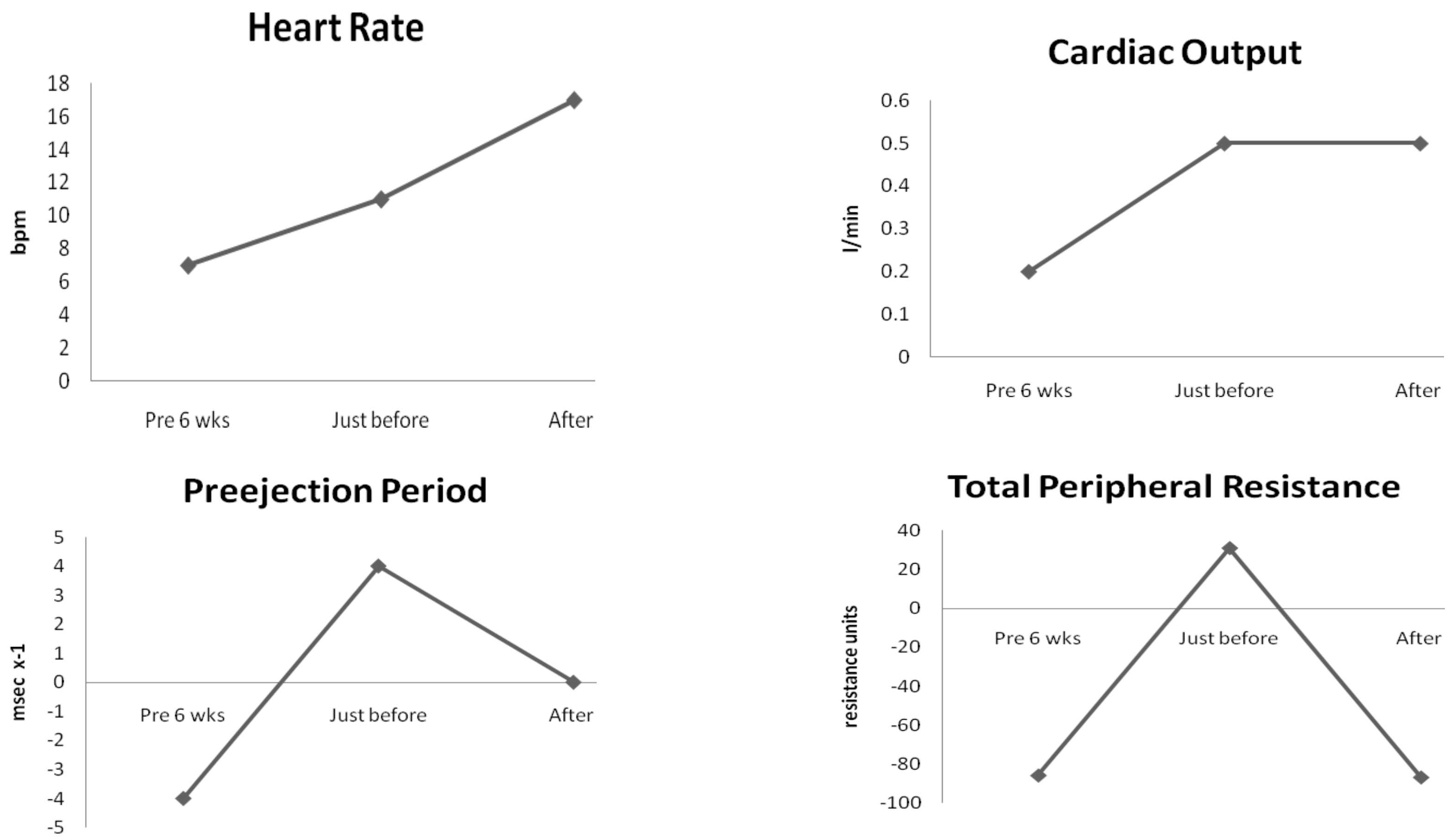

Figure 6.1. Cardiovascular reactivity scores for the sport speech before and after the junior county championships

6.3.3 Self Report Data

The self-report data are presented in Table 6.2 and Figure 6.2. Visual comparison of the data showed that there was an upwards trend for most cognitive and affective components in the direction of a challenge state, except for performance approach goals. Specifically, self-efficacy slightly improved compared to the first administration of the questionnaire, there were no changes in perceived control, there was an increase in mastery approach goal orientation and a decrease in mastery avoidance, performance approach, and performance avoidance goal orientation, anxiety slightly decreased and excitement and happiness increased. The participant rated the helpfulness of her emotional state for performance as very helpful on both occasions. Visual comparison of the results of the SAS-2 showed that the participant was less worried and her concentration was less disrupted at the end of the intervention. In addition, the results of the CSAI-2C showed that the participant reported to be more confident post intervention. There were no differences for somatic anxiety, the participant reported to have low levels of somatic anxiety. These results indicate that there was a slight positive increase to support that the intervention helped to enhance the cognitive and affective components of challenge and threat states.

Table 6.2

Scores for the Self-report Measures at the Start and End of the Intervention

	Pre	Post	Moving Towards a Challenge State
Self-efficacy	2.33	2.83	✓
Control	3.67	3.67	_
Map	6.33	6.67	✓
MAv	5.00	4.33	✓
Pap	4.33	3.67	×
PAv	3.67	2.67	✓
Anxiety (SEQ)	1.00	0.60	✓
Dejection (SEQ)	0.00	0.00	_
Excitement (SEQ)	3.00	3.25	✓
Anger (SEQ)	0.25	0.25	_
Happiness (SEQ)	3.00	3.75	✓
Interpretation emotional state	4.00	4.00	_
Cognitive anxiety (CSAI-2C)	1.80	1.80	_
Confidence (CSAI-2C)	2.60	3.00	✓
Worry (SAS-2)	2.80	2.00	✓
Concentration disruption (SAS-2)	1.60	1.40	✓

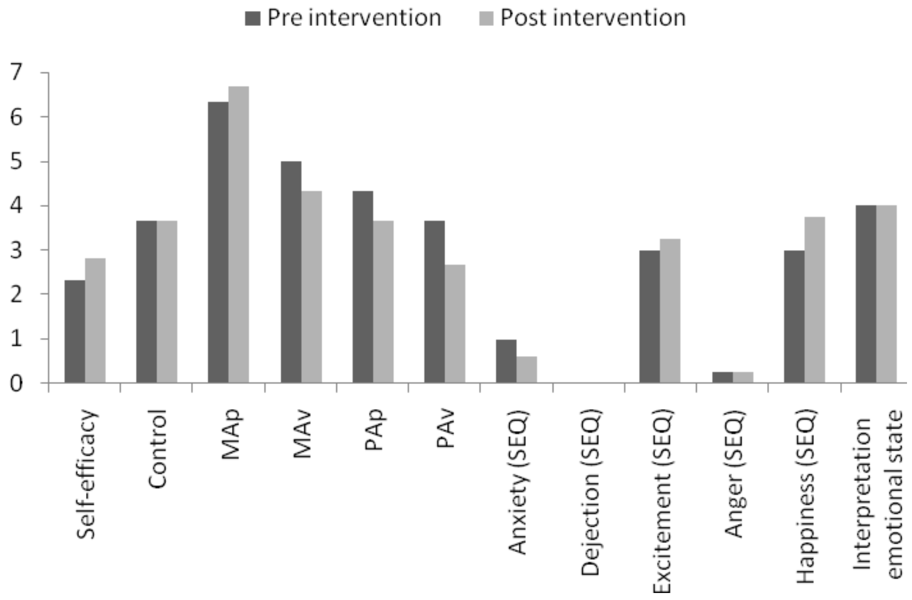

Figure 6.2 Scores on the cognitive component of challenge and threat states at the start and end of the intervention

6.3.4 Observations

At the start of the intervention, the participant mentioned she had problems with anticipation and adaptation of her shot selection, especially when she made the same mistake a couple of times in a row. In addition, she mentioned that her performance was influenced negatively if her opponent had a tendency to cheat; cheating was one of the aspects she did not like about her sport. Throughout the intervention it appeared that the client had some difficulties with writing down her thought and feelings, and changing negative self-talk to more effective self-talk. During the evaluation session the participant reported that she felt her confidence had increased, that the audience did not bother her that much anymore, and that she was more prepared to play different shots and take more risks when playing her sport. Also, she felt she did not want to give up and she was more vocal on the court.

6.4 Discussion

The present study aimed to explore the efficacy of a psychological skills intervention on the cognitive, affective, and physiological components of challenge and threat states. The self-report measures showed increases in self-efficacy, confidence, and mastery approach orientation and a decrease in mastery avoidance, performance approach and performance avoidance goal orientation. In addition, the participant reported to feel less worried towards the end of the intervention and levels of cognitive anxiety (both state and trait) decreased compared to the start of the intervention, as well as concentration disruption. There were no changes in somatic anxiety, the participant mentioned in the intake interview that she did not feel any physical symptoms (such as increased heart rate, butterflies) before competition.

The cardiovascular data did not follow the predictions made by the TCTSA in relation to the physiological component, namely increases in CO and decreased TPR. There was little indication of moving towards a challenge state over time. For the sport speech, TPR reactivity appeared to decrease towards the end of the intervention, after a slight increase in the middle of the intervention and CO reactivity increased throughout the intervention for the sport speech task. These findings, however, could have been influenced by the anticipation of the county championship during the second time of testing and do not represent a consistent pattern across the three times. In addition, these patterns demonstrate the importance of examining the temporal patterning of challenge and threat states regarding competition. Previous research has suggested that there are changes in anxiety in the lead up to competition. Specifically, both somatic and cognitive anxiety have been found to increase as competition approaches (Hanton et al., 2004b). A psychological skills intervention can be used to reduce state anxiety before competition; cognitive and somatic anxiety were lower after an intervention compared to baseline measures of somatic and cognitive state anxiety in a shooter (Prapavessis et al., 1992). Also, elite performers have indicated that they use psychological skills such as positive self-talk to cope with high levels of anxiety and an unhelpful interpretation of anxiety for performance (Hanton, Mellalieu, & Hall, 2004a).

No previous research has examined the influence of a psychological skills training on the cognitive, affective, and physiological components of challenge and threat states in athletes. Some studies have looked at individual components of a psychological skills intervention in relation to challenge and threat states, such as imagery or manipulating performance-avoidance and performance-approach orientations. In a study examining perceptions of situations as performance-approach or performance-avoidance, Chalabaev et al. (2009) found that an approach orientation was related to a challenge cardiovascular response pattern and an avoidance orientation to a threat cardiovascular response pattern. Previous research has outlined that challenge and threat imagery scripts influenced some of the cognitive component of challenge and threat states (S. E. Williams et al., 2010). Specifically, self-confidence increased in the challenge script compared to the threat script and increased anxiety was perceived as facilitative in the challenge script, whereas increased anxiety was perceived as debilitative in the threat script. No clear effects were reported in relation to the physiological component (S. E. Williams et al., 2010). S. E. Williams et al. (2010) did not take measures of TPR. The present study adds to these studies by exploring the influence of a psychological skills intervention on challenge and threat states, as well as providing some interesting data on temporal patterning, despite its limitations which are discussed next.

6.4.1 Limitations

The cardiovascular reactivity patterns in the present study showed that there was no specific stable pattern across tasks and time. Even short-term stressful experiences could change the intensity of cardiovascular reactivity patterns (Blascovich & Katkin, 1993) and therefore interpreting the cardiovascular patterns in the current study should be done with caution. The present study posed a number of other limitations. First, no sports related cardiovascular data were collected before the intervention started. It took two sessions before the participant was comfortable with the equipment and the procedure before collecting sport specific data, time constraints made it impossible to do the familiarisation before the intervention commenced.

Second, no long-term performance data were collected to analyse longer term treatment effects or to assess the influence on performance, specifically adaptability of shot selection during competition. Performance could have been assessed by having an experienced racket sport coach observe matches and identify the adaptability of the player, as this was outlined to be one of the weaknesses and aspects she wanted to work on.

Third, this study could not control for external influences, such as the exams that the participant was revising for and taking throughout the intervention. As mentioned above, this might have had an impact on stress levels of the participant.

Fourth, a limitation of any multimodal intervention is that it is not clear which aspect of the psychological skills intervention has the biggest impact on the participant (Collins, Morriss, & Trower, 1999). For example self-talk and imagery could have benefited both self-efficacy and perceived control, performance profiling and goal setting might have benefited mastery approach goals, and diaphragm breathing could have helped activating the parasympathetic nervous system (Gilbert, 1999) which benefits a challenge cardiovascular pattern. The intervention does reflect a typical sport psychology consultancy model and catered for the needs of the participant (Barker & Jones, 2006). Within applied sport psychology settings, focusing on just one aspect (such as imagery or self-talk) might not be feasible at all times.

Finally, this case study did not resemble a ‘true single-case design’. A case study is represented by uncontrolled conditions (Brossart, Meythaler, Parker, McNamara, & Elliot, 2008), whereas single-case designs are represented by more rigour where the researcher “can control the independent variable(s) or introduce an intervention and examine the influence on the dependent variable(s)” (Barker, McCarthy, Jones, & Moran, 2011, p. 5). There was no opportunity to implement a baseline phase, which is essential in single-case designs (Kazdin, 1982). Therefore the findings of this study should be treated with caution when making recommendations for applied practice, as it is not clear if the changes are the result of the intervention or from being a participant in a study. Taken this into account, implications for applied practice could be to measure physiological responses in addition to using self-report measures and observation to achieve triangulation and a more holistic understanding of athletes’ approaches to competition, as there might be discrepancies between the physiological responses and self-report measures.

6.4.2 Suggestions for Further Research

There are a number of suggestions for further research. In the present study the participant wanted to work on shot adaptability. A future study could measure the performance of shot adaptability using observation and self-report measures alongside measuring the cognitive, affective, and physiological components of challenge and threat states. This would also enable measuring the influence of challenge and threat states on performance and decision making.

Second, the influence of biofeedback on the cognitive, affective, and physiological components of challenge and threat states could be examined. This could include heart rate control and learning to consciously control psychophysiological responses.

Third, a longer term multiple- or single-case study design could be implemented to examine if a psychological skills intervention, for example an imagery intervention (Williams et al., 2010), affects cardiovascular reactivity patterns. This could exclude external stressors such as exams and ensure that the treatment had an effect on the dependent variable of interest, namely cardiovascular reactivity. This would include a baseline phase (first phase A) followed by the implementation of a psychological skills intervention (B) and a second baseline (second phase A), this is referred to as a withdrawal design (Kazdin, 1982). For example, for the first phase A, cardiovascular responses could be measured immediately before competition and before training sessions over a period of time to establish a stable baseline. This also provides a more comprehensive insight into the variability of the cardiovascular pattern in relation to different types of competition and training sessions. This will also enable exploration of how cardiovascular reactivity changes in the time leading up to competition, as well as measuring temporal patterning of challenge and threat states. After the first phase A, the intervention will be introduced, for example an imagery intervention, followed by second phase A where the intervention is withdrawn.

A benefit of single-case study designs is that they can be used for unique populations, such as elite athletes, and in addition to identifying the effectiveness of a specific intervention; single-case study designs can also provide insight into how effective the intervention is with what type of participants (Barker et al., 2011). A limitation of an ABA design is that after introducing a psychological skills intervention complete withdrawal is not always feasible as the athlete might feel that some of the skills are beneficial for them and they keep on using them (Barker et al., 2011). However, athletes taking part in a single-case study design could still be monitored after the intervention has finished, and data of all three stages could be compared, but caution should be taken in interpreting the second phase A if the participant is not explicitly instructed not to use the skills from the intervention in phase B.

The present study supported the effectiveness of a psychological skills intervention on the cognitive components of challenge and threat states. The results do need to be treated with caution as it only consisted of one case. The findings, however, did indicate that a psychological skills intervention could be effective when moving towards a challenge state. In addition, the cardiovascular data provided interesting information on temporal patterning, the participants showed a sharp increase in TPR just before the competition. The present study underlines the limited knowledge that is available in sport regarding cardiovascular reactivity in the time leading up to competition and emphasises the need for more studies to explore the role of cardiovascular reactivity in the lead up to competition, as well as the influence of a psychological skills intervention on challenge and threat states and performance.

CHAPTER 7: DISCUSSION

7.1 Summary of Findings

The main aim of this thesis was to examine the cognitive, affective, and physiological components of challenge and threat states in a sport setting. This thesis tested the unique combination of these components as outlined by the theory of challenge and threat states in athletes (TCTSA; M. V. Jones et al., 2009).

Chapter two explored the cognitive elements of challenge and threat states as they occur in a naturalistic setting. The results demonstrated that athletes acknowledge the demands of a competitive situation. The resource components self-efficacy, perceived control and achievement goals were identified from the content analysis. The results showed that there was an interaction between demands and resources and the important role of goals and expectations emerged from this study. In addition, perceived support was identified as a resource athletes refer to as they approach competition and perceived support could extend the TCTSA. This study showed that the content of athletes' conversations before competition is in line with the cognitive component of the TCTSA.

Chapter three examined the relation between the cognitive and affective components of challenge and threat states. These were self-efficacy, perceived control, achievement goals, emotions, and interpretation of emotional states. In addition, the relation between challenge and threat appraisals and the cognitive and affective components was explored. This study built on chapter two by quantitatively examining the relation between the cognitive and affective components of challenge and threat states. In general, the results provided mixed support for the TCTSA. There was a positive association between self-efficacy, perceived control, excitement, and interpretation of emotional state. Avoidance goals predicted threat appraisal and anxiety. Those who reported to use more avoidance goals also reported more threat appraisals and the participants indicated that they approached an upcoming competition with more anxiety.

Chapter four examined the relation between cardiovascular responses indicative of challenge and threat states, cognitive appraisals of challenge and threat, self-efficacy, perceived control and emotions before an upcoming competition. The participants talked about a competition they expected to take part in the near future. A cardiovascular pattern indicative of a threat was positively associated with self-efficacy. Thus, those participants who had a physiological threat response reported to have higher levels of self-efficacy. None of the emotions or the cognitive appraisals of challenge and threat predicted cardiovascular patterns indicative of a challenge or threat state; no consistent pattern was found. Further analyses showed that the strength of the emotional response influenced the cardiovascular response. Specifically, positive emotions predicted a threat cardiovascular pattern. In summary, the results of chapter four were mostly inconsistent with the predictions made by the TCTSA and in the case of self-efficacy, contrary to the expectations of the TCTSA.

Chapter five examined athletes' responses in terms of the cognitive, affective, and physiological components of challenge and threat states in relation to a competition where they performed to, or above, their expected standard and one competition where they performed below their expected standard. This study built on chapter four by aiming to eliminate the confounding effects of an upcoming competition by asking participants to talk about previous competitions, and by measuring achievement goals. The participants displayed more of a cardiovascular pattern indicative of a challenge when talking about a competition that went well, this finding was, however, not statistically significant, and they scored higher on self-efficacy, perceived control, excitement, happiness, and interpretation of emotional state. When talking about a competition where the participants performed below their expected standard, participants displayed a cardiovascular pattern more indicative of a threat, this finding was not statistically significant, and they scored higher on, dejection. The results did not show a consistent relation between cardiovascular reactivity patterns and the cognitive and affective components of challenge and threat states for the competition that went well or the competition that did not go well. Those who were more physiologically challenged by competition in general reported to be more excited about competition.

Finally, chapter six explored the efficacy of an intervention designed to develop challenge states in athletes. It extended the previous studies by providing an illustration of how challenge and threat states may change during a psychological skills intervention. The results showed that cardiovascular patterns changed in the lead up to an important competition; TPR and CO increased just before the important competition. In addition, the participant reported to have higher self-efficacy, confidence, and mastery approach goal orientation after the intervention. Also, she reported a decrease in mastery avoidance, performance approach and performance avoidance goal orientation. This study suggested that the use of a psychological skills intervention may be effective in promoting a challenge state when approaching competition.

In summary, the findings of this thesis demonstrate that the cognitive and affective components of challenge and threat states are somewhat in the expected direction as outlined by the TCTSA. Specifically, there appeared to be a positive relation among self-efficacy, perceived control, and approach goals in athletes. In addition, avoidance goals played an important role in challenge and threat states; threat appraisals and anxiety were positively predicted by avoidance goals and self-efficacy was negatively predicted by avoidance goals. The results did not support the relation between cardiovascular reactivity patterns and cognitive components as outlined by the TCTSA; self-efficacy was positively related to a cardiovascular pattern indicative of a threat state. Thus those participants who were physiologically threatened by an upcoming competition had a higher belief in their skills to do well in this upcoming competition, this finding was inconsistent with the predictions made by the TCTSA. The findings can be explained in a number of ways.

7.2 Explanation of Findings

The unique combination of variables as outlined by the TCTSA states that a challenge state occurs when an athlete experiences high levels of self-efficacy, perceived control and an approach orientation, as well as a positive emotional state, a helpful interpretation of their emotional state and a physiological reactivity pattern of increased cardiac output and less total peripheral resistance. The findings of studies three and four did not provide consistent support for this. On the contrary, the results showed that self-efficacy was related to a cardiovascular pattern indicative of a threat state in chapter four and no clear relation was observed in chapter five. There are a number of possible explanations which are described below. These include the confounding effects of temporal patterning, in addition the relation between self-efficacy and cardiovascular reactivity might be opposite to that outlined by the TCTSA.

High levels of self-efficacy might not always be beneficial, for example Vancouver et al. (2002) reported that individuals reduced their effort when they believe they had the skills to do well in the required task. In addition, others have found that a little self-doubt might be effective for performance (Woodman, Akehurst, Hardy, & Beattie, 2010). In this study, participants took part in a skipping task where self-confidence was manipulated by competitive demands and task demands. They found that in the experimental condition, where self-confidence was reduced by competition and task demands, participants showed a decrease in self-confidence and an increase in performance, suggesting that a little self-doubt might aid performance (Woodman et al., 2010). Self-efficacy is a dynamic construct and can fluctuate depending on the situation and previous experiences (Feltz et al., 2008), relating to the demands of the situation. In addition, similar to the findings reported in chapter four, others have found that high levels of self-efficacy are not related to a cardiovascular pattern indicative of a challenge. Hoyt and Blascovich (2010) reported that females higher in self-efficacy had a cardiovascular pattern indicative of a threat. They outlined that high levels of self-efficacy can result in a cardiovascular threat pattern because participants with high levels of self-efficacy might put more pressure on themselves to perform well; these participants want to ensure they are performing in line with the view they have of their own capabilities and self-belief. Finally, athletes could have created a buffer as a protection for the self or to use it as a defensive response masking underlying distress (Mendes et al., 2008) and used this to rate their scores on the cognitive components higher than might be the case.

There were no clear findings for the relation between perceived control and achievement goals and the cardiovascular patterns indicative of challenge and threat. Low perceived control has been found to increase TPR (Weinstein et al., 2002) and individuals who perceived uncontrollable stressors as within their control displayed less physiological changes than those who perceived the stressor as uncontrollable, those who perceived the stressor as uncontrollable showed more increases in cortisol (Dickerson & Kemeny, 2004). Chapter three has outlined that perceived control is positively associated with approach goals and self-efficacy, as predicted by the TCTSA, and elite athletes spoke about perceived control in their pre-competition interviews, which underlines the relevance of perceived control to challenge and threat states.

Achievement goals are relevant because they can influence an athlete's approach to competition. Chapter three showed that avoidance goals predicted anxiety, mediated by threat appraisal. Performance approach or performance avoidance instructions could influence participants' cardiovascular responses (Chalabaev et al., 2009). Specifically, participants who were given performance approach instructions displayed a cardiovascular pattern indicative of a challenge and performed better on a problem solving task than those who were given performance avoidance instructions. Again, the findings of this thesis provided some support for the relation between the cognitive and affective components as outlined by the TCTSA, but not for the relation with the physiological component.

Challenge and threat states can influence performance. Blascovich et al. (2004) reported that those athletes who displayed a cardiovascular challenge pattern when talking about a hypothetical situation in baseball or softball performed better in the subsequent season than athletes who displayed a cardiovascular threat pattern. The cardiovascular measures, however, were not taken in relation to a real competition. Similar findings have been reported in relation to academic performance (Seery et al., 2010). Chapter four measured if a challenge and threat index based on cardiovascular responses when participants talked about an upcoming competition could predict performance. The results showed that there was no relation between the challenge and threat index and performance, but there was a tendency for those with a cardiovascular reactivity pattern indicative of threat to have lower performance ratings, which is contrary to the findings of Blascovich et al. Only a small amount of participants took part in this follow-up measure and future research could explore the relation between challenge and threat states and performance in more depth, especially as this might have implications for promoting a challenge state as athletes approach performance. This could include measuring performance over a longer period of time and including more participants before discarding the suggestion that cardiovascular patterns indicative of a challenge are positively related to performance. The results of chapter five showed that the participants responded to the questionnaires measuring the cognitive and affective components of challenge and threat states in line with the expectations, specifically participants scored higher on self-efficacy, perceived control, approach goals, positive emotions and interpretation of emotional state on performance for the competition they performed to, or above, their expected standard compared to the competition they performed below their expected standard. This provides some support for the notion that it is beneficial for performance that athletes have high levels of self-efficacy, perceived control, an approach orientation, experience positive emotions and perceive the overall emotional state to be helpful for performance.

This thesis is an example of how sport psychology can implement social psychology and psychophysiology approaches. An experimental approach might have been able to provide clearer results for the relation between the self-report measures and the cardiovascular responses, as talking about a competition is different from engaging in a competitive task. However, many factors play a role in athletes' approaches to competition and an experimental setting where only one or two factors are measured might not transfer to an applied setting. For example, there might be occasions when an athlete perceives high levels of self-efficacy, yet perceives to have low levels of perceived control and an avoidance orientation. For example, a basketball player believes that he has the ability to successfully score points, but is not sure if he will receive the ball from his team mates, in addition his focus is on *not* missing his shots rather than making the shots. Therefore, high levels of self-efficacy will only be related to a challenge state when athletes' perceived control is high and athletes have an approach orientation. According to the TCTSA, a challenge state is not likely to occur when athletes have high levels of self-efficacy, but low perceived control and an avoidance orientation.

On the other hand it might be possible that the mind and body are telling a different story; perhaps the mind is looking forward to something but the body is dreading it, or the other way around. For example, athletes might tell themselves that they look forward to the upcoming competition and believe that they will do well, but their body feels weak and sick the morning before the competition. The body and mind might interact, an athlete who feels their heart is racing could tell himself to feel more confident. Not many studies have examined the psychophysiology of approaches to competition incorporating cognitive, affective, and physiological responses; this thesis is the first to explore the unique combinations of components as outlined by the TCTSA and the results of this thesis point out that more research is required to better understand the relation between the cognitive, affective, and physiological components better in relation to athletes' approaches to competition and to examine if some of the predictions made by the TCTSA need to be revised. In summary, the cardiovascular reactivity patterns displayed by athletes as they approach competition might not be in line with the suggestions made by the TCTSA and the biopsychosocial model; the mind and body could be telling us a different story.

In summary, the studies in this thesis obtaining cardiovascular measures of challenge and threat states showed that there was no consistent pattern between the physiological component of challenge and threat states and the cognitive and affective components with the predictions made by the TCTSA and the findings were contrary for the relation between self-efficacy and cardiovascular reactivity. Chapter four showed that participants with high levels of self-efficacy displayed a cardiovascular threat pattern. This indicated that some of the predictions made by the TCTSA were not supported and might need to be revisited. The explanations of the findings above illustrate the interactive relation between the demands and resources in a competitive sport setting. This research extends traditional stress research, such as the transactional model of stress (Cox & Mackay, 1976), by specifying the resource components self-efficacy, perceived control, and approach goals in sport specific situations and exploring how these resource components and physiological and emotional components combine in challenge and threat states.

The TCTSA could be extended with other variables. Chapter two suggested that perceived support might be related to challenge and threat states and perceived support might play a role in increasing resources in relation to an upcoming competition. Specifically, high levels of perceived support may increase the resources an individual has as they approach a competition. In a study measuring perceptions of support availability, challenge and threat appraisals, perceived importance and performance of golf, Freeman and Rees (2009) found that there was a positive association between perceived support and challenge appraisals. Perceived support is expected to result in less perceived stress (Rees & Freeman, 2007) and this might explain the positive association between perceived support and challenge appraisals. Perceived support could extend the TCTSA, by adding a component focusing on the support network perceived to be available to the athlete. It was beyond the scope of the thesis to include this as this thesis aimed to test some of the predictions made by the TCTSA before testing other variables that might extend the TCTSA, moreover more support for the TCTSA is needed before extending the TCTSA with other variables.

Temporal patterning appeared to confound the findings in chapter four. Research has demonstrated the influence of temporal patterning on cognitive appraisals, emotions, and the physiological response (cf. Fenz & Epstein, 1967; Hanton et al., 2004b; Mellalieu et al., 2008), none of this research, however, has addressed the combination of these components. Most research on temporal patterning and emotional responses has examined changes in anxiety in the time leading up to competition. Most research has reported that anxiety increases as the competition approaches (Hanton et al., 2004a; Mellalieu et al., 2006). Cerin and Barnett (2006) found that negative emotions were reported less post-competition than pre-competition, whereas other studies suggested that this was dependent on the outcome of the competition and on the time of measuring the pre-competitive response (recall or before; Cerin et al., 2000). To illustrate, after a negative outcome participants reported higher levels of pre-competitive anxiety than after a positive outcome (Raglin, 1992). Mellalieu et al. (2008) reported that cognitive appraisals related to thoughts about a forthcoming match and coping options such as imagery increased in the lead up to competition. In summary, there have been inconsistencies in how changes in anxiety in the lead up to competition have been measured and there is a gap in the research on examining other emotional responses such as excitement in the time leading up to competition.

Physiological responses also change in the time leading up to competition. Fenz and colleagues (Fenz & Epstein, 1967; Fenz & Jones, 1972) reported that there was a temporal pattern of physiological responses in the lead up to a parachute jump. Specifically, there was an initial increase in physiological activity in the lead up to a parachute jump after which the physiological reactivity decreased just before the jump. They also found that psychological fear and physiological fear followed the same pattern for inexperienced jumpers, but not for experienced jumpers. Experienced jumpers reported an inverted-U pattern for the self-reported fear, their peak of subjective fear occurred before their physiological peak (Fenz & Epstein, 1967). Thus, the psychological and physiological responses of anxiety do not necessarily occur simultaneously. Fenz (1988) suggested that the parachute jumpers did the worrying at an early stage and referred to this as an anxiety inhibition process. Replication of these studies, however, did not always yield the same results. For example, Schedlowski and Tewes (1992) found that the peak of physiological arousal (using measures of heart rate and respiratory rate) was observed just before the parachute jump. They suggested that the measures in Fenz' studies, even when taken in the plane, were not taken up until the point of greatest (objective) danger, namely the actual jump. What Schedlowski and Tewes demonstrated is that there is variety in the physiological responses in the lead up and during the actual parachute jump. Recently, research has examined psychological and neuroendocrine changes in the week leading up to a competition (Strahler, Ehrlenspiel, Heene, & Brand, 2010). Consistent with previous research, it was found that self-report anxiety increased as the competition approached. There was, however, no anticipatory response in the cortisol awakening response, this might be the result of a habitual response as noted earlier by Fenz and colleagues (Strahler et al., 2010).

In summary, the variability in the time leading up to competition in chapter four and the time after the actual competition in chapter five might have resulted in inconsistent findings of the relations between the cognitive, affective, and physiological responses. Cognitive, affective and physiological responses might not occur simultaneously or at the same intensity in the lead up to competition or when talking about a past competition. Implications of these findings are that the studies in this thesis did not measure the point of greatest danger, namely just before an actual competition, where the physiological responses are the strongest. The implications of these findings for research are that the temporal patterning aspect of, especially the physiological component of, challenge and threat states need to be explored in more detail and closer to the start of competition.

7.3 Implications for Applied Practice

This thesis might have some potential implications for applied work. For example, managing expectations and increasing the available resources, such as self-efficacy, perceived control, an approach orientation, and positive emotions, might positively influence an athlete's perceptions of the demands of an upcoming competition. Interventions can be tailored towards increasing the resources (such as self-efficacy, perceived control, and approach goals) to effectively approach an upcoming situation as a challenge.

Practitioners are recommended to focus on increasing resources rather than decreasing the demands of a situation. Research has found that adjusting the demands of a situation downwards does not necessarily have positive implications.

For example, Marshall and Brown (2006) found that when participants had low expectancies of success they did not report feeling happier, calmer, or better when they did well, those participants did also not feel less sad, less tense, or less bad about themselves when they failed. They reported feeling worse about themselves after a good or bad performance compared to participants with high expectancies of success. In addition to feeling worse about themselves, lowering demands could be indicative of an avoidance approach. If practitioners want to promote a challenge state it is recommended that they work with athletes towards an approach goal orientation.

Promoting a challenge state in athletes before an upcoming competition may be beneficial from a physiological perspective. The cardiovascular response indicative of a threat state is linked to the increase of cortisol. Cortisol has a long half-life of approximately 60-90 minutes in the body (Dickerson & Kemeny, 2004; Dienstbier, 1989; M. V. Jones et al., 2009) and this results in immune system suppression (Dienstbier & Pytlik Zillig, 2005). In addition, because of this 60 to 90 minute half-life, the body still releases energy (Dienstbier & Pytlik Zillig, 2005) even when it might not be appropriate, for example in a shooting competition, and as a consequence this may affect performance negatively. Physiological responses in a challenge state might be beneficial for performance (M. V. Jones et al., 2009) and practitioners are encouraged to work with athletes towards creating a challenge state before competition.

Research has already suggested that the use of imagery instructions can increase heart rate, stroke volume and cardiac output (S. E. Williams et al., 2010). More research is required to examine if imagery (and other psychological skills) can increase an athlete's available resources, including self-efficacy, control and an approach orientation, as well as a helpful interpretation of emotional state and its effect on TPR. More knowledge on this topic could help practitioners to establish specific imagery instructions which lead to a cardiovascular pattern characterising a challenge state and an overall challenge state.

Finally, applied practitioners should be aware of differences in cognitive, affective and physiological components in the time leading up to competition. Challenge and threat responses appear to become stronger as the competition approaches and this might influence measures that applied practitioners might take to identify progress of the athlete. Finally, perceived support might play a role in challenge and threat states and this should also be taken into account when developing an intervention or evaluating challenge and threat states. For example, the practitioner could help the athlete to enhance awareness of the perceived support that is available to the athlete.

7.4 Limitations

The results of the various studies in this thesis provide partial support for the predictions made by the TCTSA for the cognitive and affective components of challenge and threat states; the results did, however, not provide clear support for the relation between the physiological component of challenge and threat states and the cognitive and affective components. This thesis has five main limitations that may have prevented the results to provide more consistent support for challenge and threat states in athletes. Alternatively, the TCTSA might not have made the right predictions regarding athletes' approaches to competition.

The first limitation relates to the use of self-report measures to examine the cognitive and affective components of challenge and threat states. Social desirability can be a negative side effect of using self-report measures and this can influence the results (Wiechman, Smith, Smoll, & Ptacek, 2000). Chapter four did include a social desirability scale as part of the follow up questionnaires; the results suggested that social desirability did not influence the results. Awareness of social desirability is relevant because athletes might not want to perceive themselves as being “weak” and will respond to the questionnaires in a manner that reflect a social desirable response. In this thesis this could be reflected by high scores in self-efficacy in chapter three. Wiechman et al. (2000) reported that social desirability influenced the response set regarding psychosocial factors and injury and that including participants with high social desirability scores could result in a type II error.

The second limitation relates to the cardiovascular measures and the sensitive ECG signal. Cardiovascular data could not be taken of every participant and there were missing cardiovascular data in approximately 20% of the participants because of noise in the ECG signal. Thus, data could only be collected of those participants where there was no noise in the data and therefore the successfully collected data might not have provided an accurate sample of the population. Percentages between 10% and 20% of missing cardiovascular data have been reported by others in studies using impedance cardiography (Blascovich et al., 2004; Mendes, Blascovich, Major, & Seery, 2001; Seery et al., 2010).

Third, the act of speaking could also have influenced the physiological results. This includes both the mechanical act of speech and having to talk out loud or to talk about a sensitive topic, which some participants might have found stressful. Changes in cardiovascular and neuroendocrine responses in tasks including speech have been found not to be solely caused by the mechanical act of speaking (McCann et al., 1993), these changes could also have been the result of the content of the task. In addition, speech has been used in studies measuring challenge and threat

(Blascovich et al., 2004; Chalabaev et al., 2009; Mendes et al., 2008). Moreover, the studies in this thesis included a control speech task to account for the effect of the mechanical act of speech and participants who indicated on a self-report measure that they found the act of speaking stressful were removed from data analysis.

Fourth, the time leading up to competition varied between athletes and it appears that temporal patterning *might* play a key role in challenge and threat states; not only for the cognitive and affective components, but also for the physiological component. The thesis did not control for the differences in the time leading up to competition sufficiently, some athletes spoke about a competition three weeks before and other just a few days before the competition would take place. Unfortunately there is no record of this time leading up to competition to analyse differences in time to competition and this is something that needs to be explored further.

The fifth limitation relates to the sample used in chapter three, four, and five. These samples were not homogeneous; there was variability in the level of athletes and the type of sport the athletes competed in. On the other hand, this made the results generalisable and showed that there was a pattern across athletes. Other studies (Cerin, 2003; Coffee & Rees, 2008; S. E. Williams et al., 2010) have used a similar variety in their samples.

Finally, the measure used for self-efficacy was not sport specific and the control measure was not previously validated in a competitive sport setting. The self-efficacy measure, however, has been successfully used in previous studies and revealed high internal reliability coefficient values. This was not the case for the perceived control measure and perhaps this has influenced the results for control in chapter five and six. Sport specific measures for control are not extensively reported in the sport psychology literature, whereas the role of perceived control in sport is widely acknowledged (e.g. Biddle, 1999). Control has been measured using self-regulation questionnaires, coping measures, or attentional focus questionnaires. This does, however, not specifically measure the concept of control as outlined by the TCTSA such as subjective control. Principal factor analysis did extract one component and the control measure did reveal a difference between the two competitions, when talking about a competition that went well athletes scored higher on perceived control than when talking about a competition where they performed under their expected standard. This provided some support for the use of the control measure. Also, potential problems with the AGQ-S have been recently outlined (Elliot & Murayama, 2008; Stoeber & Crombie, 2010). Some of the items appear to suggest a value instead of a goal as such, and other items measure affective content instead of goals. In addition, some items include extreme ends of the scale, such as “It is important for me to avoid being one of the *worst* performers”, which might not be representative for all athletes (Stoeber & Crombie, 2010). A revised and published version of the AGQ-S was not ready the time of data collection.

This thesis is one of the first exploring the unique combination of variables as outlined by the TCTSA and more research is needed to explore the role of temporal patterning in all three components of challenge and threat states. Taking into account the limitations described above, this thesis begins to provide an insight into how the cognitive and affective components of challenge and threat states relate to each other as proposed by the TCTSA. This is the beginning of this line of research and there are a number of suggestions for further research which are outlined in the next section.

7.5 Suggestions for Further Research

Over the last five years or so, an increasing amount of work has been published on the biopsychosocial model (for example Blascovich et al., 2004; Chalabaev et al., 2009; Mendes, Seery; S. E. Williams et al., 2010; Seery, West, Weisbuch, & Blascovich, 2008). The domain of sport, however, has not been given much attention. This TCTSA provides a framework within which future research in the domain of challenge and threat states can be conducted.

This thesis is one of the first to apply the biopsychosocial model to a sport setting by examining the relation between the cognitive, affective, and physiological components as outlined by the TCTSA using a holistic approach. The findings were mainly inconsistent with the predictions made by the TCTSA. A particular strength of this thesis is the actual rather than hypothetical setting; participants were asked to recall past competitions they actually participated in or to talk about a competition they would participate in the near future. Despite this naturalistic approach, further research could take this a step further and measure cognitive, affective and physiological responses just before competition rather than having participants talk about it. The largest physiological changes might only happen close to the start of a competition. Therefore, it might be difficult to measure physiological changes any longer than a week before an important competition takes place. The area of temporal patterning of the combination of variables of challenge and threat states is therefore worthy of further research. For example, how do the physiological, cognitive, and affective components of challenge and threat states develop as the competition approaches; one month, one week, three days, one day and one hour before competition?

An extension of the previous suggestion is to explore the influence of a challenge state or a threat state on the next task. Individuals have indicated to appraise a situation as both a challenge and a threat (Cerin, 2003), this mixed pattern of challenge and threat appraisals is not likely to occur for the physiological component of challenge and threat states as challenge and threat states are suggested to have distinct cardiovascular response patterns (Blascovich & Mendes, 2000). It is unknown how quickly individuals can change from a challenge to a threat physiological state; further research can explore the impact of a threat state on future challenge states and vice versa. Specifically, further research can examine what the influence of a threat response first or a challenge response first is on the next task or sport performance and how long it takes to change from one state to another.

In addition to this point, further research can examine the relation between cortisol and cardiovascular reactivity in a sport setting. Although it is suggested that cardiovascular reactivity patterns are indicative of neuroendocrine changes (Blascovich & Mendes, 2000), there is no research in the domain of sport that underlines this statement. Alternatively, increased energy levels as a result of the release of cortisol could give individuals the feeling that they are ready for competition (Filaire et al., 2009; Kivlighan et al., 2005). However, large increases in cortisol could negatively affect performance (Bateup et al., 2002; Filaire et al., 2009), but it is unclear how much is too much in a sport setting. Therefore it might be possible that the cardiovascular reactivity patterns indicative of challenge and threat states do not translate well to a sport setting. Future research could examine which levels of cardiovascular reactivity and neuroendocrine changes are beneficial for performance and when this becomes detrimental for performance.

Another suggestion for further research is to examine the influence of challenge and threat states on performance. Chapter four already made an attempt to examine the influence of challenge and threat states on sport performance, but this study lacked statistical power. It is suggested that a challenge state benefits performance (Blascovich et al., 2004; Skinner & Brewer, 2002; 2004), for example challenge states have been found to enhance cognitive performance such as decision making (Kassam, Koslov, & Mendes, 2009), but this has not been examined systematically in a sport context while taking into account the cognitive, affective, and physiologically in one study. Further research could examine the relation between challenge and threat states over the course of a season. In addition, different types of sports can be examined. For example, the consequences of a physiological challenge state before competition might be different in the 100m sprint compared to a shooting competition or a field hockey match. In relation to this point, the influence of challenge and threat states on reaction time can be examined. It has been suggested that increases in cortisol, indicative of a threat state, negatively influences cognitive processes such as attention and perceptual processing (Erickson et al., 2003).

If research can establish that a challenge state may benefit performance, applied interventions can be implemented to increase the resource components, including self-efficacy, perceived control, approach goals, positive emotions, and a helpful interpretation of emotional state for performance. For example, a multiple case study approach would allow researchers to observe a difference in challenge and threat states between an intervention and control group. To do this, an ABA design could be implemented, where there would be a first baseline phase (A) to establish a stable baseline, followed by the intervention or no intervention for the control group (B) and a second baseline (A). Alternatively, the implementation of psychological skills can be measured in a more controlled manner by focusing on one aspect of an intervention; for example how does self-talk influence perceived control, self-efficacy, approach goals, positive emotions, and a helpful interpretation of emotional state for performance, and in turn challenge and threat states.

The TCTSA has outlined that, in line with the BPS model, for challenge and threat states to occur the situation needs to be identified as a motivational performance setting (M. V. Jones et al., 2009). In addition, there might also be differences in psychological engagement and challenge and threat states; for example chapter four showed that the strength of the emotional response might influence cardiovascular patterns of challenge and threat states. The relevance of an upcoming important competition could be further explored by examining the effects of the relevance on perceived effort, identity, and the cognitive, affective, and physiological components of challenge and threat states.

Chapter two outlined that perceived support might be playing a role in challenge and threat states. Increased perceived support can enhance the perceived available resources and is found to be positively related to challenge appraisals (Freeman & Rees, 2009). The role of perceived support was not specifically examined in any of the further studies of this thesis as this thesis aimed to explore the unique combination of variables as outlined by the TCTSA first before extending this theory. The role of perceived support in the TCTSA could be explored in further research, for example by examining if perceived support could increase the available resources.

Based on the points raised above, the following six recommendations are made for further research, these are to:

1) Examine the temporal patterning of the cognitive, affective and physiological components of challenge and threat states in athletes

2) Examine the impact of a threat state on future challenge states and vice versa and measure levels of cardiovascular reactivity and neuroendocrine changes in relation to sport performance.
3) Examine the relation between challenge and threat states and performance
4) Implement a psychological skills intervention using a multiple case study approach
5) Examine the relation between perceived effort and challenge and threat states
6) Examine the role of perceived social support in relation to challenge and threat states

7.6 Conclusion

Athletes approach competition differently; some might approach a competition positively, as a challenge, whereas others approach a competition negatively, as a threat, and some athletes might approach competition as a mixture of challenge and threat. This thesis has made a unique contribution to research, by making a first attempt to examine the combination of variables as outlined by the TCTSA using a holistic approach. Even though this thesis only takes the first steps in testing some of predictions made by the TCTSA, the results provide rationale to continue research in this field even if this might mean revising the TCTSA. This is demonstrated in the findings that those participants who reported to have higher levels of self-efficacy displayed a cardiovascular pattern indicative of a threat. The role of physiology is not always taken into account in sport psychology research and this is something that needs to be considered for further research as it might be more difficult to consciously control the body than the mind. In addition, this thesis has specified the resource components of challenge and threat states, which makes challenge and threat states measurable. The take home message of this thesis is that in addition to self-report measures, physiological measures should be obtained to identify relations between cognitive, affective, and physiological responses to an upcoming competition to endorse a holistic understanding of how athletes approach competition. Identifying this association is a *challenge.* In summary, this thesis has made an original contribution to existing stress research by testing the combination of cognitive, affective, and physiological components as outlined by the TCTSA and applying this to sport.

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APPENDIX 1: HIERARCHICAL CONTENT ANALYSIS OF AUSTRALIAN OPEN TENNIS

Hierarchical content analysis of Australian Open tennis with a win in the next round

Raw Data Theme	Higher Order Themes	General Dimension
- Obviously, we will not have anything to lose. We will have, you know, motivation more, even though looking at the rankings I would be the favorite - Well, pressure is something which is natural. I mean, if you don't have pressure then something is wrong with you - 'cause it's very dangerous to play against somebody who is first time in a Grand Slam final who has nothing to lose - But again, as a third player of the world, I have a lot of expectations and pressure, and sometimes it's difficult to stay calm on the court - So it's going to be a very tough match - Previous matches don't count. This is a new encounter, a new match. This is a great opportunity for both of us. I'm very excited about the matchup - Plays incredibly aggressive tennis. Improved his serve a lot, his backhand. So have to be very careful - I know his game sort of suits my game. I've had some great matches against him where I always play my very best. So we'll see how it goes this time around. - We'll see what happens, but I'm excited to play against him - You've got a dream and you've got to have goals - Obviously, I will have to change something and make sure I play my best tennis	Acknowledgment of the situation	Demand
Feeling confident - I feel confident about the final, though - But, you know, I'm feeling really, really good at the moment, physically and mentally - And I'm feeling really well now. I'm playing with a lot of confidence - Well, I don't know if it suits him or not. But it suits me, that's for sure. I've been playing great, great tennis - In a Grand Slam, you know, where I've had good success but	Self-efficacy	Resources

some tough endings as well, I still believe at the end of the day I'll always have more opportunities - But I play better than last year, and I'm very confident in my game - yeah, I've got nothing to lose, again, and obviously I'm hitting the ball really well and I feel really good - The way my confidence is right now I think I have the ability - I know that I can lift up my game. - I feel confident - I'm ready. I'm ready, but I need some confidence in my game. I need to win some matches to find the momentum. That's why I'm happy I won today - Well, I don't know if it suits him or not. But it suits me, that's for sure - I feel confident with my game, whether I've played my best or not my best in previous matches	Self-efficacy	
Previous performance accomplishments - I mean, experience is a huge - I mean, when you have experience behind your back it's a huge advantage - You know, I've beaten her a few times. I know how I have to play		
Preparation - But I'll try to recover and get the tactic ready with my coach - that I'm more experienced and I can handle the pressure better than last year		Resources
Attentional focus - It's always important to focus on your side of the net and do what you have to do in order to win that match and not concentrate on her shot making or her movement or whatever she's doing - Yeah, for me, I've got to worry about my game, though, and executing what I want to do, staying aggressive - I feel like doesn't matter like	Control	

what day I have, I go on the court and I feel more consistent that I can change things. Even if I'm not playing well, like I have always Plan B or I always can control myself, you know. Like I'm always there	Control	
Mindfulness - I try to stay on this world and that's it		
Approach goals - I have to make sure I go out there and play my best tennis, no matter who is on the other side	Achievement goal orientation	
Avoidance goals - This year I'm not the favorite. So who knows what can happen. We will see. I mean, it will be a tough match, for sure		Resources
Perceived support - I have the right surroundings around me, great people, with a lot of knowledge about tennis and about the life - The crowd's always extremely into it. Yeah, it is a big buzz; that's for sure	Perceived support	

Hierarchical content analysis of Australian Open tennis with a loss in the next round

Raw Data Theme	Higher Order Themes	General Dimension
- Maybe I will lose; maybe I will win - It's going to be definitely a very, very tough match - There's a few things I'm going to focus on tomorrow - Well, it's going to be, again, a new experience for me, which	Acknowledgment of the situation	Demand

I'm really excited about. Either way, whoever I play, it's going to be a tough match - Yeah, I'll get my opportunities - So I guess I'm ready for another battle against Lleyton. - It's going to be a tough match. He's a great player, great ball striker. You know, he reads the play so well	Acknowledgment of the situation	Demand
Feeling confident - And, also, when I'm out on the court, you know, I just believe I can beat anyone - I look forward to playing my best tennis about Novak Djokovic. I look forward to playing to win - Every time I go out on the court I like to think I have a chance and I'm gonna win - It's going to work out well - I'm pretty happy with the way I'm playing at the moment. I'm playing very good. I'm moving good on court. I'm fit. So I guess I'm ready for any opponent - I'm feeling good. I just can't wait to play - I've just got to go out there and believe I can win, try to do the right things I've been working on. Previous performance accomplishments - I think experience can be a benefit, you know - I feel good that not only was it a two-set win, but I feel pretty good coming out of a very tight match like that today against Kanepi - I know my game, so I think experience always helps - But, you know, you get to play those players more and more times. I think that goes also at the age. You them more, you have more experience with them, so you do respect them. But the intimidation I think goes to the side - But right now I have to go inside because I am touching very good	Self-efficacy	Resources

the ball with the forehand, and I have to do for this in the semifinals if I want to win - I like the dry heat, although sometimes it can be humid here. I feel comfortable playing here.	Self-efficacy	
Preparation - I had experience in the French Open playing final. That's definitely something I have to look at and just try to deal with differently - Especially for my next match, is try and keep the emotions intact and trying to really make sure that mentally and physically I'm prepared for that next match against - I want to make sure I'm prepared as well as I can.		
Attentional focus - So, you know, it's just important to focus on your own thing and what's your ritual before returning or serving - I concentrate on what I have to do - I usually concentrate on my own game. That's what's happened over the last few years. And I go a lot with my feeling throughout the match. If I need to adjust something, I'll do that during the match, to play more aggressive or more defensive, playing counter-punching. You can always decide during the match - Sometimes you feel a bit more nervous on some days and some days you don't for some reason. But it's something you can't really control. Depending on the spectators, on your opponent, what shot selection, what's the score line, it always changes, because you don't control it yourself - Mentally I just try to stay focused all the time. I can be powerful when I want. I'm not scared of the long rallies or of the girls hitting the ball hard because I know I can do it	Control	Resources

myself. But I can change the rhythms, can use different things - I just, you know, focus on what I have to do - I think I'm going to try and stick with what works well for me and concentrate a lot on what I've been doing and keep working on the things that have been working well - I think I just have to go and play my thing and not think who's on the other side of the net. Just play my game, focus on that	Control	
Mindfulness - I think at the end of the day, when you go out on the court, it's you, the ball and the opponent - I'm just trying to play my game and just going for the win		
Approach goals - So I have to be there, be there with her from the first point on and try to get that first shot. - There are things I'll have to improve and really raise my level in the next matches - But what I can say is that I believe that I have the game to, again, put up a great fight against Nicole Vaidisova - Lefties are always difficult. He's going to make a lot of balls, like today, and, you know, I'm going to have to stay on top of him for sure - You know, I have to into court and try to show hundred percent what I can do from my game. And after we'll see if it will be enough to beat Tsonga, as well - I'll definitely have to have my A game on - I have to play aggressive if I want to win the semifinals, aggressive and good - And I'll have to play very well if I want to beat him, to serve big and just rip every ball as hard as I can - I'm just going to go for it. I have nothing to lose	Achievement goal orientation	Resources

Avoidance goals - But I've got nothing to lose. I'm in a great position. I'm feeling like I'm playing well. I'm just really looking forward to be out on the court again and give my best and see what happens - I know it's going to be difficult, and I know guys that have had success against him have had big serves and have been able to get some free points or at least put themselves on offense. That's something that's going to be difficult for me to do, because I don't have the overpowering serve - I hope so. I'll give myself a chance at least, so that's the main thing - I think he's at home. He's playing good at the moment. He's confident. So I guess I just go on court and I think I'll just try to find the solution on court - You know, we'll see what happens	Achievement goal orientation	Resources
Perceived support - Like before the match he's saying me some things, like getting more confidence, you know, and I know he's right. Maybe he can say me just simple things, and I'm, like thinking, and of course it's true - But this time I'll be on home soil, so that's going to be nice. You know, I think anything's possible, especially with the crowd behind me	Perceived support	

APPENDIX 2: HIERARCHICAL CONTENT ANALYSIS OF SIX NATIONS RUGBY

Hierarchical content analysis for the Six Nations rugby

Raw Data Theme	Higher Order Themes	General Dimension
- From an England point of view we have got a massive challenge this weekend with a new team, we are looking to get a level of intensity and aggression. - I mean obviously there is a fierce for us to win this competition there is no doubt about that but obviously - there is nobody out there that we are really afraid of - There is a lot more responsibility on you in the centre, but hopefully that is something that will bring out the best of me - it is a really important game for us - We have got to make sure that we do not underestimate Scotland - Performance wise you have to be on top of your game - They are a team that are really gonna fight to the death against us this weekend and it is up to us really to try and play our own game and really move on from where we did in the last 20 minutes against France - It is going to be a huge challenge for us as well - but against Wales we probably have to own a lot more ball and work harder for tries. We certainly have to up it another gear - We have to look forward to England and realise it is a massive physical challenge for us at a huge, huge game - Yeah Italy would definitely, they are known for their forward power, definitely takes us up on front and it is a challenge we are looking forward to - If we do things right we can beat England, they know that as well. That won't get the job done, you cannot hang your head on that alone, it is something to put in your pocket and bring it with you to Twickenham - It is huge, this weekend is a pivotal game and we have underperformed in some games, but if we get a win this weekend I think it will be very important to the coaching staff and the bunch of players that is here - You probably couldn't have asked for a better situation to be in, so it is important that we try and capitalize on that -	Acknowledgment of the situation	Demands

- we have one more to go and probably our toughest one Feeling confident - All through the season I had , we know that performance is in us and I think that over the last couple of weeks we showed that that was there and the confidence is there - We know that we have to be right on top on our game and with confidence is you have seen in coaching regime the biggest thing they brought on boards for us and still is the self-belief that you know we are capable of playing these sides - So with each game there is an opportunity for us to get a win - But we certainly feel that it is that big performance is there, the full 80 minutes is there for us just to take control of. Hopefully it will happen this Saturday - I don’t know, there is certainly a belief there. That so many have played in that game, and there would be no fear going into there in terms of thinking that we could win the game - Yeah a little bit of confidence and the players are building up some self-belief - I think our defense needs to step up big time. We have a lot of confidence in it, but for one reason or the other it has been stuttering a wee bit so far in the championship - Through our forward pack we are going to have the confidence of playing France away, and beating them up. And that is what we are going to do this weekend. - Hopefully we can throw the ball around and play with some real confidence Previous performance accomplishments - But if the pressure does come on that familiarity of playing together should help in that area - You know it is obviously, winning helps, you certainly feel better after winning and it seems	Self-efficacy	Resources

to lift the country. It certainly feels as a player as a well sport to yourself. It is, seems to bring the sunshine back to us at the moment literally - And I am sure he uses that as a sort of platform to build on in Paris - There is going to be a massive crowd, but I am lucky with the way things have been going with Wasps, I have played in a lot of games where there has been big crowds, pressure situations - I am just going to make sure training goes well and if it does then that is what I going to draw confidence from - We just have got to build on last week, and get some confidence	Self-efficacy	
Preparation - So you know I am probably as ready as ever to score these tries - We think now after two games we know exactly what the problems are and we have spend this week making sure that we are rectify them. The players are very clear about what they need to do this weekend, to ask more questions of the Irish defense - you go in the game with a game plan and a mindset to win the game, which is what we have done in the tournament so far and it has gone well that way		Resources
Attentional focus - I can only worry about what I can do and that is working hard and playing well for England - I am just concentrating on the game and there - I can only control what I do - `Whether you have won the previous week or lost the previous week, you almost have got to block it out, you start again from zero - we just have got to concentrate on what we are trying to do - but otherwise I am just going to	Control	

concentrate on what I do best - We have a good squad of players, we have got some great players, and it is just a matter of getting it all right on the day - Obviously all we can really concentrate on is our performance to give us a win - it is a really it is I think it is more just a mental thing than anything else and we have really got sort of concentrate a lot harder in the second half performance in terms of making sure that our process is works from, if things go wrong, not panicking and going back to square one again, so right we are going to rebuild from here - There will be a little bit of work going in that Wales are such a challenge and that is all we can focus on at the moment - We just have to try and concentrate on our game - that what is important is that you keep your focus and you keep that to added edge up your sleeve, but you have to be clear in your mind about what you are doing - You know we have to put that out of our minds and just focus on the next game and it is the same amount of pressure this week as it was last weekend - It is really concentrating on the grand slam and trying to achieve that and win - We are playing a great side with great players, we need just concentrate on our job, which is the game. And enjoy things after that, if all go well Mindfulness - Just sort of keep my feet on the ground really and focus on our training and take it on Saturday - I know it is the old cliché, but every game one game at the time and reassess where we are at the end of the match - Over the last four years, the results went our way, but that won't make much of a difference come at kick off time	Control	Resources

Approach goals - So we are going out to win Saturday that will be a big bonus, but as I say I think this is the start of an exciting period for everyone - There is a real focus amongst the players and a real ambition to get in there - we need to be confident and to perform we know where we are at and not make the same mistakes we did on Saturday against the Welsh, we have to get back on the bike and win the next four internationals - so we just got to work hard and do our basics right - There is a huge hunger to do well, you know obviously, we hopefully get really firing it in the weekend and if we play as good as we can it should really be great - I think in the context of this sort of evolution of this side as well, it is getting more important that we put in a really good performance, which very often leads to a victory - So the curve is upward and hopefully Saturday is another step in the right direction, which it will have to be, no question about it against a form Welsh team that is the challenge - A challenge for us at heart is to deprive that opportunity and play that game and that is going to be a big part of our game on Saturday - We are just going for the win out in Ireland and everything else is peripheral - We just need to make sure we win - A victory would come in handy obviously, but in addition to that I want a performance that truly reflects the ability and potential we have got in the England team - I want to get a team win and every single player wants his team to win this weekend - we pulled together today and we are going to make sure things are	Achievement goal orientation	Resources

moving forward - I make sure that we deliver a performance and that is the key to this weekend - In the end of the day we want to win, a win for us is most important thing and like I say there is no doubt, in defense it is going to be our biggest ask so far, and hopefully we can come up with answers again - It is nice to being able to put yourself in this position where destiny is in your own hands and the fact that you are at home in the last game of the championship Avoidance goals - We are massive underdogs but nobody is expecting us to spring a surprise, it is a good situation to be in - We don't want to be on the receiving end of that, we have to go out, and really go hard at them and just impose our game on them and really hopefully not let them get into their way - Hopefully, if God forbid we are not going to be in that situation again, then we are confident that the players know exactly what to do, to make sure it doesn't prolong itself - And we would be very disappointed if we didn't make some progress this week - I don't know how I fare against them, whether I will get that little gap to go in or will I not. I just have to go as hard as I can - But also, what is absolutely critical for us, is that when we get close to 22 we make a mistake, we have been doing that on a regular basis. As we got to make that score board tick over - there is no reason why we can't do it again - our message is constant, we have got to go forward, what we don't want to be doing is going backwards and playing the sort of rugby we were playing two or three weeks ago - Yeah definitely, if you don't get your set piece right, you are	Achievement goal orientation	Resources

going to be struggling, no matter who you are playing against. So we got to make sure that it is spot on, and hopefully we will be

- I don't think it is going to be easy as far for marks it is going to be a very tough game

Achievement goal orientation

- we just need to make sure that as a team, we put up a good performance, because we need to perform well this week to have any sort of have any future with England

Resources

Perceived support

- Yeah I think there are be no doubt that the crowd will get behind us.
- we have been through a lot together and we know everybody makes each other tick as well.
- I know Heskey, Rees, and a few others from age group rugby and they have been talking to me through the whole week and hopefully they will be able to pull me through
- crucial for us that we are at home and getting the crowd behind us, to support us and hopefully getting a result as well

Perceived support

- Certainly playing at home for us, getting the Irish supporters behind us always have been, will be great and we need to give them something to cheer about. We always have been trying to do that and if we do, it will certainly be in our favour at home in Croke Park
- And we were always chasing the game after them and really the longer we can stay in the game on Saturday, the more of an impact the crowd will have

APPENDIX 3: QUESTIONNAIRE BOOKLET CHAPTER 3

Information Sheet

We would like you to complete the attached questionnaires to gain more understanding on how athletes approach competition. Completing the questionnaires takes approximately 10 minutes. There are no right or wrong answers for the questionnaires and we would ask you to answer the questions as honestly as possible. In addition, you are under no obligation to complete the questionnaires and you can withdraw from the research at any time.

If you are happy to complete the questionnaires please indicate your consent by signing on the front page of the questionnaire.
Please note, all data are treated in the strictest of confidence, and only the researchers have access to them. **When we examine the information from the questionnaires we will make them anonymous, and your data will remain anonymous if we discuss or publish any information from this study**.

Should you have any questions and/or want to know more about the outcome of the study please feel free to contact Carla Meijen on carla.meijen@staffs.ac.uk or 01782 294024.

Thank you for agreeing to participate in this study.

STAFFORDSHIRE UNIVERSITY

THOUGHTS AND FEELINGS ABOUT SPORT COMPETITION

I have read the information sheet. The nature, demands, risk and benefits of the project have been explained to me. I understand that I may withdraw my consent and discontinue participation at any time.

Participant's signature ………………..…………………

Date……………………..

Please provide us with some brief details about yourself:

Date of birth (dd/mm/yy): __________

Sex: Male/Female (please circle)

Ethnicity: -
____

Main sport:
____

How long have you been competing in this sport: _____________ (years/months)

How many hours a week do you play this sport: __________________________

Please state what level you are *currently* competing at (please circle one option)

International National County Club University Other (please specify)

Please state the highest level at which you have competed at (please circle one option)

International National County Club University Other (please specify)

On the next pages you will find a number of questions. Please answer all the questions in reference to how you typically feel just before an important competition in your main sport.

Below you will find a number of statements reflecting aspects of sport performance. Please read each one carefully, relate the statement to how you feel *just before an important competition*, and indicate to what extent you feel confident that you can:

	Not at all	**Some what**	**Moderately so**	**Quite a bit**	**Completely**
1. Stay calm despite the pressure	1	2	3	4	5
2. Stay focused on the most important parts of your performance	1	2	3	4	5
3. Mobilise all your resources for this performance	1	2	3	4	5
4. Perform well even if things get tough	1	2	3	4	5
5. Raise the level of your performance if you have to	1	2	3	4	5
6. Stay motivated throughout your performance	1	2	3	4	5

Below you will find three questions, please rate each question to how you feel *just before an important competition* in your main sport.

	Strongly Disagree				**Strongly Agree**
Do you think it is entirely up to you whether you perform to the best of your abilities?	1	2	3	4	5

	No control at all				**Complete control**
How much control do you feel you have over whether you perform to the best of your abilities?	1	2	3	4	5

	Extremely difficult				**Not at all difficult**
How difficult will it be for you to perform to the best of your abilities?	1	2	3	4	5

Below you will find a number of statements reflecting aspects of sport performance. Please read each one carefully and relate them to how you feel *just before an important competition in your main sport*. Indicate the extent to which each item is true of you. If you think the statement is very true of you, circle 7. If a statement is not at all true of you, circle 1. If the statement is more or less true of you, circle the number between 1 and 7 that best describes you.

	Not at all true						**Very true**
It is important to me to perform as well as I possibly can	1	2	3	4	5	6	7
I worry that I may not perform as well as I possibly can	1	2	3	4	5	6	7
It is important to me to do well compared to others	1	2	3	4	5	6	7
I just want to avoid performing worse than others	1	2	3	4	5	6	7
I want to perform as well as it is possible for me to perform	1	2	3	4	5	6	7
Sometimes I’m afraid that I may not perform as well as I’d like	1	2	3	4	5	6	7
It is important for me to perform better than others	1	2	3	4	5	6	7
My goal is to avoid performing worse than everyone else	1	2	3	4	5	6	7
It is important for me to master all aspects of my performance	1	2	3	4	5	6	7
I’m often concerned that I may not perform as well as I can perform	1	2	3	4	5	6	7
My goal is to do better than most other performers	1	2	3	4	5	6	7
It is important for me to avoid being one of the worst performers in the group	1	2	3	4	5	6	7

SPORT EMOTION QUESTIONNAIRE

Below you will find a list of words that describe a range of feelings that sport performers may experience. Please focus on how you feel immediately before an important competition. Read each word carefully and indicate on the scale next to each item how you typically feel *just before an important competition in your main sport*. There are no right or wrong answers. Do not spend too much time on any one item, but choose the answer which best describes your feelings right now in relation to the important situation.

	Not at all	A little	Moderately	Quite a bit	Extremely
Uneasy	0	1	2	3	4
Upset	0	1	2	3	4
Exhilarated	0	1	2	3	4
Irritated	0	1	2	3	4
Pleased	0	1	2	3	4
Tense	0	1	2	3	4
Sad	0	1	2	3	4
Excited	0	1	2	3	4
Furious	0	1	2	3	4
Joyful	0	1	2	3	4
Nervous	0	1	2	3	4
Unhappy	0	1	2	3	4
Enthusiastic	0	1	2	3	4
Annoyed	0	1	2	3	4
Cheerful	0	1	2	3	4
Apprehensive	0	1	2	3	4
Disappointed	0	1	2	3	4
Angry	0	1	2	3	4
Energetic	0	1	2	3	4
Happy	0	1	2	3	4
Anxious	0	1	2	3	4
Dejected	0	1	2	3	4

How helpful do you feel your emotional state is for your performance?

Not at all helpful	A little bit	Moderately	Quite a bit	Extremely helpful
0	1	2	3	4

Imagine that you are about to take part in the most important competition of the season. Please indicate on the items below how you feel about this upcoming important competition.

	Not at all	A little bit	Moderatel y	Quite a bit	Extremely
How threatened do you feel by this?	0	1	2	3	4
How challenged do you feel by this?	0	1	2	3	4

AND FINALLY ……………………………

Could you please tick the box below that best describes your ability to complete the task that was asked of you

1) I was able to complete the questionnaire as if I was just about to compete in an important competition <u>accurately.</u> ☐

2) I was able to complete the questionnaire as if I was just about to compete in an important competition <u>with some degree of accuracy.</u> ☐

3) I was unable to complete the questionnaire as if I was just about to compete in an important competition <u>with any degree of accuracy</u>. ☐

THANK YOU FOR YOUR TIME

APPENDIX 4: QUESTIONNAIRES CHAPTER 4

Information Sheet

Approaches to competition

We would like you to take part in a study where we measure your psychological and physiological responses to a sport situation. Participation in this study will take approximately 80 minutes and will consist of a number of stages; these stages are briefly outlined below.

We will first collect information on your age, date of birth, height and weight. Next, you will be asked to complete a questionnaire measuring your psychological approach to competition and training. After this, we will place electrode tape bands on four places around your body and connect you to a blood pressure monitor. We will collect physiological data during two separate conditions, a condition where you are talking about a sport related setting (3 minutes) and a condition where you are talking about the concepts of friendship (3 minutes). We will audio record your speech during these conditions. Before each condition, five minutes of baseline data will be obtained. During this data collection you are required to *sit as still as possible*. At various stages during the process you will be asked to complete questionnaires measuring the thoughts and feelings about the task you have just done. There are no right or wrong answers for the questionnaires and we would ask you to answer the questions as honestly as possible, the information will be kept confidential. In addition, you are under no obligation to complete the questionnaires and you can withdraw from the research at any time.

The testing procedures are completely safe. However, please be aware that the electrode bands may cause skin irritation and may leave temporary red marks on the skin. Although blood pressure readings will be taken, I am not qualified to give medical advice about the readings.

If you are happy to take part in this study please indicate your consent by signing the consent form. Please note, all data are treated in the strictest of confidence, and only the researchers have access to them. **When we examine the information from the physiological measures, the audio recording and questionnaires we will make them anonymous, and your data will remain anonymous if we discuss or publish any information from this study**.

Should you have any questions and want to know more about the outcome of the study please feel free to contact Carla Meijen on carla.meijen@staffs.ac.uk or 01782 294024.

STAFFORDSHIRE UNIVERSITY

Consent form

Approaches to competition

Researchers: Carla Meijen and Dr. Marc Jones

	Yes	No	Don't know
Do you bruise easily?	☐	☐	☐
Are you a haemophiliac?	☐	☐	☐
Are you allergic to gel?	☐	☐	☐
Do you have high blood pressure?	☐	☐	☐

Please tick the following boxes:

1. I confirm that I have read and that I understand the information sheet for the study "approaches to competition" and have had the opportunity to ask questions ☐
2. I understand that my participation is voluntary and I understand that I may withdraw my consent and discontinue participation at any time, without further consequences ☐
3. I agree that audio recordings will be taken and used for this research only. The audio recordings will be stored safely on a password protected computer ☐
4. I agree to take part in the above study ☐

....	....	....
Name of Subject	Signature	Date
....	....	....
Name of Researcher	Signature	Date

Participant number: ☐

Please provide us with some brief details about yourself:

Date of birth (dd/mm/yy): ___________

Sex (M/F): ______

Height: _________ (cm)

Weight: _________ (kilograms)

Ethnicity:

____

Occupation: ____

Main sport:

____

How long have you been competing in this sport: ______________ (years/months)

Please state what level you are currently competing at (e.g. club/county/university):

____

Other sport experience

____

____

____

How many hours a week do you play sport? Please specify for every sport separately.

____

____

____

Participant number

TEST OF PERFORMANCE STRATEGIES

Each of the following items describes a specific situation that you may encounter in your training and competition. Please rate how frequently these situations apply to you on the following scale:	Never	Rarely	Sometimes	Often	Always
1. I set realistic but challenging goals for practice	1	2	3	4	5
2. I say things to myself to help my practice performance	1	2	3	4	5
3. During practice I visualize successful past performances	1	2	3	4	5
4. My attention wanders while I am training	1	2	3	4	5
5. I practise using relaxation techniques at workouts	1	2	3	4	5
6. I practise a way to relax	1	2	3	4	5
7. During competition I set specific result goals for myself	1	2	3	4	5
8. When pressure is on at competitions, I know how to relax	1	2	3	4	5
9. My self-talk during competition is negative	1	2	3	4	5
10. During practice, I don't think about performing much - I just let it happen	1	2	3	4	5
11. I perform at competitions without consciously thinking about it	1	2	3	4	5
12. I rehearse my performance in my mind before practice	1	2	3	4	5
13. I can raise my energy level at competitions when necessary	1	2	3	4	5
14. During competition I have thoughts of failure	1	2	3	4	5
15. I use practice time to work on my relaxation technique	1	2	3	4	5
16. I manage my self-talk effectively during practice	1	2	3	4	5
17. I am able to relax if I get too nervous at a competition	1	2	3	4	5
18. I visualize my competition going exactly the way I want	1	2	3	4	5
19. I am able to control distracting thoughts when I am training	1	2	3	4	5
20. I get frustrated and emotionally upset when practice does not go well	1	2	3	4	5
21. I have specific cuewords or phrases that I say to myself to help my performance during competition	1	2	3	4	5
22. I evaluate whether I achieve my competition goals	1	2	3	4	5
23. During practice, my movements and skills just seem to flow naturally from one to another	1	2	3	4	5
24. When I make a mistake in competition, I have trouble getting my concentration back on track	1	2	3	4	5
25. When I need to, I can relax myself at competitions to get ready to perform	1	2	3	4	5
26. I set very specific goals for competition	1	2	3	4	5
27. I relax myself at practice to get ready	1	2	3	4	5
28. I psych myself up at competitions to get ready to perform	1	2	3	4	5
29. At practice, I can allow the whole skill or movement to happen naturally without concentrating on each part of the skill	1	2	3	4	5
30. During competition I perform on 'automatic pilot'	1	2	3	4	5

TEST OF PERFORMANCE STRATEGIES CONTINUED

	Never	Rarely	Sometimes	Often	Always
31. When something upsets me during a competition, my performance suffers	1	2	3	4	5
32. I keep my thoughts positive during competitions	1	2	3	4	5
33. I say things to myself to help my competitive performance	1	2	3	4	5
34. At competitions, I rehearse the feel of my performance in my imagination	1	2	3	4	5
35. I practise a way to energize myself	1	2	3	4	5
36. I manage my self-talk effectively during competition	1	2	3	4	5
37. I set goals to help me use practice time effectively	1	2	3	4	5
38. I have trouble energizing myself if I feel sluggish during practice	1	2	3	4	5
39. When things are going poorly in practice, I stay in control of myself emotionally	1	2	3	4	5
40. I do what needs to be done to get psyched up for competitions	1	2	3	4	5
41. During competition, I don’t think about performing much - I just let it happen	1	2	3	4	5
42. At practice, when I visualize my performance, I imagine what it will feel like	1	2	3	4	5
43. I find it difficult to relax when I am too tense at competitions	1	2	3	4	5
44. I have difficulty increasing my energy level during workouts	1	2	3	4	5
45. During practice I focus my attention effectively	1	2	3	4	5
46. I set personal performance goals for a competition	1	2	3	4	5
47. I motivate myself to train through positive self-talk	1	2	3	4	5
48. During practice sessions I just seem to be in a flow	1	2	3	4	5
49. I practise energizing myself during training sessions	1	2	3	4	5
50. I have trouble maintaining my concentration during long practices	1	2	3	4	5
51. I talk positively to myself to get the most out of practice	1	2	3	4	5
52. I can increase my energy to just the right level for competitions	1	2	3	4	5
53. I have very specific goals for practice	1	2	3	4	5
54. During competition, I play/perform instinctively with little conscious effort	1	2	3	4	5
55. I imagine my competitive routine before I do it at a competition	1	2	3	4	5
56. I imagine screwing up during a competition	1	2	3	4	5
57. I talk positively to myself to get the most out of competitions	1	2	3	4	5
58. I don’t set goals for practices, I just go out and do it	1	2	3	4	5
59. I rehearse my performance in my mind at competitions	1	2	3	4	5
60. I have trouble controlling my emotions when things are not going well at practice	1	2	3	4	5
61. When I perform poorly in practice I lose my focus	1	2	3	4	5
62. My emotions keep me from performing my best at competitions	1	2	3	4	5
63. My emotions get out of control under the pressure of competition	1	2	3	4	5
64. At practice, when I visualize my performance, I imagine watching myself as if on a video replay	1	2	3	4	5

Scenario

Please read the following instructions carefully

What we would like you to do is to talk about the topic "friendship" for a few minutes.

We would like you to talk about:

- *Your strengths and weaknesses as a friend*
- *What do you look for in a friend*
- *What are the qualities that would make a good friend*
- *You can also talk about things you like to do with friends and how your friends would describe you as a friend.*

While you are talking about this topic, please <u>keep your body as still as possible</u>

Please indicate on the scales below how you felt during the task

	Not at all	**A little bit**	**Moderately**	**Quite a bit**	**Extremely**
I experienced the task as a threat	0	1	2	3	4
I experienced the task as a challenge	0	1	2	3	4
I felt stressed during the task	0	1	2	3	4
I felt that I could cope with the task	0	1	2	3	4

Scenario

Please read the following instructions carefully

and relate it to your main sport.

We would like you to talk for a few minutes about an important game/competition you will face when playing your sport. You will be talking about the thoughts, feelings, and expectations immediately before this competition.

When thinking and talking about this important competition, try to provide as much information as possible. For example, in addition to describing the context and importance of the game/competition we would also like you to describe how you expect to perform and how you feel immediately before the important competition. Try also to relive the thoughts, feelings and expectations as you describe them.

While you are talking about this topic, please keep your body as still as possible

Please describe the important competition you were just talking about

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Below you will find a number of statements reflecting aspects of sport performance. Please read each one carefully and indicate with reference to the **important competition**, to what extent you feel confident that you can:

	Not at all	**Somewhat**	**Moderately so**	**Quite a bit**	**Completely**
1. Stay calm despite the pressure	1	2	3	4	5
2. Stay focused on the most important parts of your performance	1	2	3	4	5
3. Mobilise all your resources for this performance	1	2	3	4	5
4. Perform well even if things get tough	1	2	3	4	5
5. Raise the level of your performance if you have to	1	2	3	4	5
6. Stay motivated throughout your performance	1	2	3	4	5

SPORT EMOTION QUESTIONNAIRE

Below you will find a list of words that describe a range of feelings that sport performers may experience. In section 1 please read each word carefully and indicate on the scale next to each item how you feel **right now, at this moment, in relation to the important competition you have just talked about**. There are no right or wrong answers. Do not spend too much time on any one item, but choose the answer which best describes your feelings right now in relation to the important situation.

In addition, for section 2 please indicate whether you regard this word as negative (debilitative) or positive (facilitative) in relation to your performance in the important competition you have just talked about.

Section 1: Please read each word and circle the appropriate number to the right of the word to indicate how you feel *right now, at this moment, in relation to the important competition you have just talked about*

Section 2: Please indicate whether you regard this feeling as negative (debilitative) or positive (facilitative) in relation to your performance in the important competition you have just talked about

	Not at all	A little	Moderately	Quite a bit	Extremely	Very debilitative			Neutral			Very Facilitative
Uneasy	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Upset	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Exhilarated	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Irritated	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Pleased	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Tense	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Sad	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Excited	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Furious	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Joyful	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Nervous	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Unhappy	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Enthusiastic	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Annoyed	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Cheerful	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Apprehensive	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Disappointed	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Angry	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Energetic	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Happy	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Anxious	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3
Dejected	0	1	2	3	4	-3	-2	-1	0	+1	+2	+3

Please indicate on the scales below how you felt thinking of the important competition

	Not at all	A little bit	Moderatel y	Quite a bit	Extremely
I experienced the situation as a threat	0	1	2	3	4
I experienced the situation as a challenge	0	1	2	3	4
I felt stressful about the important competition	0	1	2	3	4
I felt that I could cope with the important competition	0	1	2	3	4
I felt that I had control over the situation to demonstrate my skills to the best of my ability	0	1	2	3	4

How would you imagine coping with the important competition?

____

____

____

____

____

____

APPENDIX 5: QUESTIONNAIRES CHAPTER 5

Information Sheet

<u>Approaches to competition</u>

We would like you to take part in a study where we measure your psychological and physiological responses to a sport situation. Participation in this study will take approximately 80 minutes and will consist of a number of stages; these stages are briefly outlined below.

We will first collect information on your age, date of birth, height and weight. After this, we will place electrode tape bands on four places around your body and connect you to a blood pressure monitor. We will collect physiological data during three separate conditions, two conditions where you are talking about a sport related setting (2 minutes) and a condition where you are talking about a general topic (2 minutes). We will audio record your speech during these conditions. Before each condition, five minutes of baseline data will be obtained. During this data collection you are required to <u>*sit as still as possible*</u>. At various stages during the process you will be asked to complete questionnaires measuring the thoughts and feelings about the task you have just done. There are no right or wrong answers for the questionnaires and we would ask you to answer the questions as honestly as possible, the information will be kept confidential. In addition, you are under no obligation to complete the questionnaires and you can withdraw from the research at any time.

The testing procedures are completely safe. However, please be aware that the electrode bands may cause skin irritation and may leave temporary red marks on the skin. Although blood pressure readings will be taken, I am not qualified to give medical advice about the readings.

If you are happy to take part in this study please indicate your consent by signing the consent form. Please note, all data are treated in the strictest of confidence, and only the researchers have access to them. **When we examine the information from the physiological measures, the audio recording and questionnaires we will make them anonymous, and your data will remain anonymous if we discuss or publish any information from this study**.

Should you have any questions and want to know more about the outcome of the study please feel free to contact Carla Meijen on carla.meijen@staffs.ac.uk.

STAFFORDSHIRE UNIVERSITY

Consent form

Approaches to competition

Researchers: Carla Meijen and Dr. Marc Jones

	Yes	No	Don't know
Do you bruise easily?	☐	☐	☐
Are you a haemophiliac?	☐	☐	☐
Are you allergic to gel?	☐	☐	☐
Do you have high blood pressure?	☐	☐	☐

Please tick the following boxes:

1. I confirm that I have read and that I understand the information sheet for the study "approaches to competition" and have had the opportunity to ask questions ☐

2. I understand that my participation is voluntary and I understand that I may withdraw my consent and discontinue participation at any time, without further consequences ☐

3. I agree that audio recordings will be taken and used for this research only. The audio recordings will be stored safely on a password protected computer ☐

4. I agree to take part in the above study ☐

....	....	....
Name of Subject	Signature	Date
....	....	....
Name of Researcher	Signature	Date

Participant number: ☐

Participant number

Please provide us with some brief details about yourself:

Date of birth (dd/mm/yy): ___________

Sex (M/F): _______

Height: _________ (cm)

Weight: _________ (kilograms)

Ethnicity: ____

Occupation: ____

Main sport: ____

How long have you been competing in this sport: ______________ (years/months)

Please state what level you are *currently* competing at (please circle one option)

International National County Club University Other (please specify)

Please state the highest level at which you have competed at (please circle one option)

International National County Club University Other (please specify)

Other sport experience

____

____

____

How many hours a week do you play sport? Please specify for every sport separately

____

____

Scenario

Please read the following instructions carefully

We would like you to describe and talk about:

- *What you saw on your way to the Brindley building from leaving your house. That is, describe coming here.*
- *What the Brindley building looks like and what you saw when you got here today*

While you are talking about this topic, please keep your body as still as possible

Please indicate on the scales below how you felt during the task

	Not at all	**A little bit**	**Moderately**	**Quite a bit**	**Extremely**
I experienced the task as a threat	0	1	2	3	4
I experienced the task as a challenge	0	1	2	3	4
I felt stressed during the task	0	1	2	3	4
I felt that I could cope with the task	0	1	2	3	4

Scenario

Please read the following instructions carefully

and relate it to your main sport.

We would like you to talk for a few minutes about an important game/competition where you performed to, or above, the standard you expected. You will be talking about the thoughts and feelings you experienced just before the start of this competition.

When thinking and talking about this important competition, try to provide as much information as possible. For example, in addition to describing the context and importance of the game/competition we would also like you to recall how you felt and what your expectations were immediately before the important competition. Try also to relive the thoughts, feelings and expectations as you describe them.

While you are talking about this topic, please keep your body as still as possible

Please describe the important competition you were just talking about

____

____

Below you will find a number of statements reflecting aspects of sport performance. Please read each one carefully and indicate with reference to the **important competition where you performed to or above the standard you expected**, to what extent you felt confident before the start of the competition that you could:

	Not at all	**Somewhat**	**Moderately so**	**Quite a bit**	**Completely**
1. Stay calm despite the pressure	1	2	3	4	5
2. Stay focused on the most important parts of your performance	1	2	3	4	5
3. Mobilise all your resources for this performance	1	2	3	4	5
4. Perform well even if things got tough	1	2	3	4	5
5. Raise the level of your performance if you had to	1	2	3	4	5
6. Stay motivated throughout your performance	1	2	3	4	5

Below you will find three questions, please rate each question to how you felt before the start of the **important competition where you performed to, or above, the standard you expected**.

	Strongly Disagree				**Strongly Agree**
Do you think it was entirely up to you whether you performed to the best of your abilities?	1	2	3	4	5
	No control at all				**Complete control**
How much control did you feel you had over whether you performed to the best of your abilities?	1	2	3	4	5
	Extremely difficult				**Not at all difficult**
How difficult was it for you to perform to the best of your abilities?	1	2	3	4	5

Below you will find a number of statements reflecting aspects of sport performance. Please read each one carefully and relate them to how you felt**, thinking back to the start of the important competition where you performed to, or above, the standard you expected.** Indicate the extent to which each item is true of you. If you think the statement is very true of you, circle 7. If a statement is not at all true of you, circle 1. If the statement is more or less true of you, circle the number between 1 and 7 that best describes you.

	Not at all true						**Very true**
It is important to me to perform as well as I possibly can	1	2	3	4	5	6	7
I worry that I may not perform as well as I possibly can	1	2	3	4	5	6	7
It is important to me to do well compared to others	1	2	3	4	5	6	7
I just want to avoid performing worse than others	1	2	3	4	5	6	7
I want to perform as well as it is possible for me to perform	1	2	3	4	5	6	7
Sometimes I’m afraid that I may not perform as well as I’d like	1	2	3	4	5	6	7
It is important for me to perform better than others	1	2	3	4	5	6	7
My goal is to avoid performing worse than everyone else	1	2	3	4	5	6	7
It is important for me to master all aspects of my performance	1	2	3	4	5	6	7
I’m often concerned that I may not perform as well as I can perform	1	2	3	4	5	6	7
My goal is to do better than most other performers	1	2	3	4	5	6	7
It is important for me to avoid being one of the worst performers in the group	1	2	3	4	5	6	7

SPORT EMOTION QUESTIONNAIRE

Below you will find a list of words that describe a range of feelings that sport performers may experience. Please read each one carefully and indicate on the scale next to each item how you felt before competing in **the important competition you have just talked about where you performed to, or above, the standard you expected**. There are no right or wrong answers. Do not spend too much time on any one item, but choose the answer which best describes your feelings right now in relation to the important situation.

	Not at all	A little	Moderately	Quite a bit	Extremely
Uneasy	0	1	2	3	4
Upset	0	1	2	3	4
Exhilarated	0	1	2	3	4
Irritated	0	1	2	3	4
Pleased	0	1	2	3	4
Tense	0	1	2	3	4
Sad	0	1	2	3	4
Excited	0	1	2	3	4
Furious	0	1	2	3	4
Joyful	0	1	2	3	4
Nervous	0	1	2	3	4
Unhappy	0	1	2	3	4
Enthusiastic	0	1	2	3	4
Annoyed	0	1	2	3	4
Cheerful	0	1	2	3	4
Apprehensive	0	1	2	3	4
Disappointed	0	1	2	3	4
Angry	0	1	2	3	4
Energetic	0	1	2	3	4
Happy	0	1	2	3	4
Anxious	0	1	2	3	4
Dejected	0	1	2	3	4

How helpful did you feel your emotional state was for your performance?

Not at all helpful	**A little bit**	**Moderately**	**Quite a bit**	**Extremely helpful**
0	1	2	3	4

Please indicate on the scales below how you felt about the important competition where you **performed to, or above, the standard you expected**

	Not at all	**A little bit**	**Moderately**	**Quite a bit**	**Extremely**
I experienced the competition as a threat	0	1	2	3	4
I experienced the competition as a challenge	0	1	2	3	4
I felt stressful about the important competition	0	1	2	3	4
I felt that I could cope with the important competition	0	1	2	3	4

How did you cope with the important competition where you performed to, or above, the standard you expected?

____

____

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Scenario

Please read the following instructions carefully and relate it to your main sport.

We would like you to talk for a few minutes about an important game/competition where you performed below the standard you expected. You will be talking about the thoughts and feelings you experienced just before the start of this competition.

When thinking and talking about this important competition, try to provide as much information as possible. For example, in addition to describing the context and importance of the game/competition we would also like you to recall how you felt and what your expectations were immediately before the important competition. Try also to relive the thoughts, feelings and expectations as you describe them.

While you are talking about this topic, please keep your body as still as possible

Please describe the important competition you were just talking about

____

____

Below you will find a number of statements reflecting aspects of sport performance. Please read each one carefully and indicate with reference to the **important competition where you performed below the standard you expected**, to what extent you felt confident before the start of the competition that you could:

	Not at all	**Somewhat**	**Moderately so**	**Quite a bit**	**Completely**
1. Stay calm despite the pressure	1	2	3	4	5
2. Stay focused on the most important parts of your performance	1	2	3	4	5
3. Mobilise all your resources for this performance	1	2	3	4	5
4. Perform well even if things got tough	1	2	3	4	5
5. Raise the level of your performance if you had to	1	2	3	4	5
6. Stay motivated throughout your performance	1	2	3	4	5

Below you will find three questions, please rate each question to how you felt before the start of the **important competition where you performed below the standard you expected**.

	Strongly Disagree				**Strongly Agree**
Do you think it was entirely up to you whether you performed to the best of your abilities?	1	2	3	4	5
	No control at all				**Complete control**
How much control did you feel you had over whether you performed to the best of your abilities?	1	2	3	4	5
	Extremely difficult				**Not at all difficult**
How difficult was it for you to perform to the best of your abilities?	1	2	3	4	5

Below you will find a number of statements reflecting aspects of sport performance. Please read each one carefully and relate them to how you felt, **thinking back to the start of the important competition where you performed below the standard you expected.** Indicate the extent to which each item is true of you. If you think the statement is very true of you, circle 7. If a statement is not at all true of you, circle 1. If the statement is more or less true of you, circle the number between 1 and 7 that best describes you.

	Not at all true						**Very true**
It is important to me to perform as well as I possibly can	1	2	3	4	5	6	7
I worry that I may not perform as well as I possibly can	1	2	3	4	5	6	7
It is important to me to do well compared to others	1	2	3	4	5	6	7
I just want to avoid performing worse than others	1	2	3	4	5	6	7
I want to perform as well as it is possible for me to perform	1	2	3	4	5	6	7
Sometimes I’m afraid that I may not perform as well as I’d like	1	2	3	4	5	6	7
It is important for me to perform better than others	1	2	3	4	5	6	7
My goal is to avoid performing worse than everyone else	1	2	3	4	5	6	7
It is important for me to master all aspects of my performance	1	2	3	4	5	6	7
I’m often concerned that I may not perform as well as I can perform	1	2	3	4	5	6	7
My goal is to do better than most other performers	1	2	3	4	5	6	7
It is important for me to avoid being one of the worst performers in the group	1	2	3	4	5	6	7

SPORT EMOTION QUESTIONNAIRE

Below you will find a list of words that describe a range of feelings that sport performers may experience. Please read each one carefully and indicate on the scale next to each item how you felt before competing in **the important competition you have just talked about where you performed below the standard you expected**. There are no right or wrong answers. Do not spend too much time on any one item, but choose the answer which best describes your feelings right now in relation to the important situation.

	Not at all	A little	Moderately	Quite a bit	Extremely
Uneasy	0	1	2	3	4
Upset	0	1	2	3	4
Exhilarated	0	1	2	3	4
Irritated	0	1	2	3	4
Pleased	0	1	2	3	4
Tense	0	1	2	3	4
Sad	0	1	2	3	4
Excited	0	1	2	3	4
Furious	0	1	2	3	4
Joyful	0	1	2	3	4
Nervous	0	1	2	3	4
Unhappy	0	1	2	3	4
Enthusiastic	0	1	2	3	4
Annoyed	0	1	2	3	4
Cheerful	0	1	2	3	4
Apprehensive	0	1	2	3	4
Disappointed	0	1	2	3	4
Angry	0	1	2	3	4
Energetic	0	1	2	3	4
Happy	0	1	2	3	4
Anxious	0	1	2	3	4
Dejected	0	1	2	3	4

How helpful did you feel your emotional state was for your performance?

Not at all helpful	**A little bit**	**Moderately**	**Quite a bit**	**Extremely helpful**
0	1	2	3	4

Please indicate on the scales below how you felt about the important competition where you **performed below the standard you expected**

	Not at all	**A little bit**	**Moderatel y**	**Quite a bit**	**Extremely**
I experienced the competition as a threat	0	1	2	3	4
I experienced the competition as a challenge	0	1	2	3	4
I felt stressful about the important competition	0	1	2	3	4
I felt that I could cope with the important competition	0	1	2	3	4

How did you cope with the important competition where you performed below the standard you expected?

____

APPENDIX 6: INFORMATION SHEET AND INFORMED CONSENT FORM

CHAPTER 6

Information Sheet

You have signed up for a programme, which will involve learning a number of psychological skills. During this programme we will also take measures of your cardiovascular responses. The programme will take no more than 10 sessions of approximately one hour per session.

The programme will involve practice in some, or all, of the following areas; goal setting, relaxation and arousal control, imagery, concentration training and techniques to help maintain self confidence when you compete. I am required to ask you to sign an informed consent form in order for you to take part in this programme.

It is important that you understand that these skills will require regular practice and will normally involve some form of self-evaluation of your progress. It is also important for you to realise that many of the techniques involve relaxation and imagery skills which can be powerful influence on the way you think and perform.

To measure cardiovascular responses, I will place band electrode tape on four places around your upper body and connect you to a blood pressure monitor. The testing procedures are completely safe. However, please be aware that the electrode bands may cause light skin irritation and may leave temporary red marks on the skin. Although blood pressure readings will be taken, I am not qualified to give medical advice about these readings.

Some of the sessions may be audio-recorded. No one but the lead researcher will have access to this information, and the recordings will be stored safely.

As a sport psychologist I am concerned that you have the opportunity to discuss with me any matters relating to the mental skills programme. Your involvement with this work is, of course, voluntary and you are free to withdraw from the programme at any time. Obviously I hope that you will stay with the programme and that you will find the work interesting and rewarding.

As a sport psychologist I work with talented performers from a variety of sports. During this work you can be assured that I hold the welfare of those in receipt of my services to be paramount at all times and ensure that the interests of the performers are safeguarded.

If you are happy to take part in this intervention please indicate your consent by signing the consent form. Please note, all data are treated in the strictest of confidence, and only the researchers have access to them. **Your data will remain anonymous if I discuss or publish any information from this study**.

If you have any questions you can contact Carla Meijen on carla.meijen@staffs.ac.uk or 01782 294024 at any stage of the programme.

STAFFORDSHIRE UNIVERSITY

Consent form

Researchers: Carla Meijen and Dr. Marc Jones

	Yes	No	Don't know
Do you bruise easily?	☐	☐	☐
Are you a haemophiliac?	☐	☐	☐
Are you allergic to gel?	☐	☐	☐
Do you have high blood pressure?	☐	☐	☐

Please tick the following boxes:

1. I confirm that I have read and understand the information given to me. I have been given the opportunity to seek clarification of any aspect of the mental training programme and the cardiovascular measures taken during this programme which is not clear to me ☐

2. I understand that my participation is voluntary and I understand that I may withdraw my consent and discontinue participation at any time, without further consequences ☐

3. I agree that audio recordings will be taken and used for research purpose only. The audio recordings will be stored safely on a password protected computer ☐

…………………………	…………………………	…………………………
Name of Athlete	Signature	Date

…………………………	…………………………	…………………………
Name of Researcher BPS Chartered Psychologist	Signature	Date

APPENDIX 7: QUESTIONNAIRE BOOKLET CHAPTER 6

Please provide us with some brief details about yourself:

Date of birth (dd/mm/yy): __________

Sex: Male/Female (please circle)

Main sport: ____

How long have you been competing in this sport: _____________ (years/months)

How many hours a week do you play this sport: __________________________

Please state what level you are *currently* competing at (please circle one option)

International National County Club University Other (please specify)

Please state the highest level at which you have competed at (please circle one option)

International National County Club University Other (please specify)

On the next pages you will find a number of questions. Please answer all the questions in reference to how you typically feel just before an important competition in your main sport.

Below you will find a number of statements reflecting aspects of sport performance. Please read each one carefully, relate the statement to how you feel *just before a stressful event when playing your sport*, and indicate to what extent you feel confident that you can:

	Not at all	**Some what**	**Moderately so**	**Quite a bit**	**Completely**
1. Stay calm despite the pressure	1	2	3	4	5
2. Stay focused on the most important parts of your performance	1	2	3	4	5
3. Mobilise all your resources for this performance	1	2	3	4	5
4. Perform well even if things get tough	1	2	3	4	5
5. Raise the level of your performance if you have to	1	2	3	4	5
6. Stay motivated throughout your performance	1	2	3	4	5

Below you will find three questions, please rate each question to how you feel *just before a stressful event when playing your sport*.

	Strongly Disagree				**Strongly Agree**
Do you think it is entirely up to you whether you perform to the best of your abilities?	1	2	3	4	5
	No control at all				**Complete control**
How much control do you feel you have over whether you perform to the best of your abilities?	1	2	3	4	5
	Extremely difficult				**Not at all difficult**
How difficult will it be for you to perform to the best of your abilities?	1	2	3	4	5

Below you will find a number of statements reflecting aspects of sport performance. Please read each one carefully and relate them to how you feel *just before a stressful event when playing your sport*. Indicate the extent to which each item is true of you. If you think the statement is very true of you, circle 7. If a statement is not at all true of you, circle 1. If the statement is more or less true of you, circle the number between 1 and 7 that best describes you.

	Not at all true						**Very true**
It is important to me to perform as well as I possibly can	1	2	3	4	5	6	7
I worry that I may not perform as well as I possibly can	1	2	3	4	5	6	7
It is important to me to do well compared to others	1	2	3	4	5	6	7
I just want to avoid performing worse than others	1	2	3	4	5	6	7
I want to perform as well as it is possible for me to perform	1	2	3	4	5	6	7
Sometimes I’m afraid that I may not perform as well as I’d like	1	2	3	4	5	6	7
It is important for me to perform better than others	1	2	3	4	5	6	7
My goal is to avoid performing worse than everyone else	1	2	3	4	5	6	7
It is important for me to master all aspects of my performance	1	2	3	4	5	6	7
I’m often concerned that I may not perform as well as I can perform	1	2	3	4	5	6	7
My goal is to do better than most other performers	1	2	3	4	5	6	7
It is important for me to avoid being one of the worst performers in the group	1	2	3	4	5	6	7

SPORT EMOTION QUESTIONNAIRE

Below you will find a list of words that describe a range of feelings that sport performers may experience. Please focus on how you feel immediately before an important competition. Please read each word carefully and indicate on the scale next to each item how you typically feel *just before a stressful event when playing your sport*. There are no right or wrong answers. Do not spend too much time on any one item, but choose the answer which best describes your feelings right now in relation to the important situation.

	Not at all	A little	Moderately	Quite a bit	Extremely
Uneasy	0	1	2	3	4
Upset	0	1	2	3	4
Exhilarated	0	1	2	3	4
Irritated	0	1	2	3	4
Pleased	0	1	2	3	4
Tense	0	1	2	3	4
Sad	0	1	2	3	4
Excited	0	1	2	3	4
Furious	0	1	2	3	4
Joyful	0	1	2	3	4
Nervous	0	1	2	3	4
Unhappy	0	1	2	3	4
Enthusiastic	0	1	2	3	4
Annoyed	0	1	2	3	4
Cheerful	0	1	2	3	4
Apprehensive	0	1	2	3	4
Disappointed	0	1	2	3	4
Angry	0	1	2	3	4
Energetic	0	1	2	3	4
Happy	0	1	2	3	4
Anxious	0	1	2	3	4
Dejected	0	1	2	3	4

How helpful did you feel your emotional state was for your performance?

Not at all helpful	**A little bit**	**Moderately**	**Quite a bit**	**Extremely helpful**
0	1	2	3	4

Imagine that you are about to take part in the most important competition of the season. Please indicate on the items below how you feel about this *stressful event when playing your sport*.

	Not at all	**A little bit**	**Moderatel y**	**Quite a bit**	**Extremely**
How threatened do you feel by this?	0	1	2	3	4
How challenged do you feel by this?	0	1	2	3	4

Below are some statements about how people feel when they play games or participate in sports and physical activities. Please read each statement, then circle the appropriate number to the right of the statement to indicate how you feel before you take part in a badminton competition. There are no right or wrong answers. Do not spend too much time on any one statement, but choose the answer which describes how you feel before taking part in a badminton competition. If you do not understand any statement or word, circle that statement or word, then ask the tester for an explanation.

	Not At All	Somewhat	Moderately so	Very Much so
I am concerned that I may not play as well as I can today	1	2	3	4
My body feels tense	1	2	3	4
I feel self-confident	1	2	3	4
I feel tense in my stomach	1	2	3	4
I feel secure	1	2	3	4
I'm confident I can meet the challenge of playing well today	1	2	3	4
I am concerned that I will play poorly today	1	2	3	4
My heart is racing	1	2	3	4
I'm confident that I will play well today	1	2	3	4
I'm worried about reaching my goal	1	2	3	4
I feel my stomach sinking	1	2	3	4
I'm concerned that others will be disappointed with my badminton performance	1	2	3	4
I'm confident because, in my mind, I picture myself reaching my goal	1	2	3	4
I'm concerned about not being able to concentrate today	1	2	3	4
My body feels tight	1	2	3	4

REACTIONS TO PLAYING SPORTS

Many athletes get tense or nervous before or during games, meets or matches. This happens even to pro athletes. Please read each question. Then, circle the number that says how you USUALLY feel before or while you compete in sports. There are no right or wrong answers. Please be as truthful as you can.

Before or while I compete in sports:	Not At All	A Little Bit	Pretty Much	Very Much
1. It is hard to concentrate on the game	1	2	3	4
2. My body feels tense.	1	2	3	4
3. I worry that I will not play well.	1	2	3	4
4. It is hard for me to focus on what I am supposed to do.	1	2	3	4
5. I worry that I will let others down.	1	2	3	4

Before or while I compete in sports:	Not At All	A Little Bit	Pretty Much	Very Much
6. I feel tense in my stomach.	1	2	3	4
7. I lose focus on the game.	1	2	3	4
8. I worry that I will not play my best.	1	2	3	4
9. I worry that I will play badly.	1	2	3	4
10. My muscles feel shaky.	1	2	3	4

Before or while I compete in sports:	Not At All	A Little Bit	Pretty Much	Very Much
11. I worry that I will mess up during the game.	1	2	3	4
12. My stomach feels upset.	1	2	3	4
13. I cannot think clearly during the game.	1	2	3	4
14. My muscles feel tight because I am nervous.	1	2	3	4
15. I have a hard time focusing on what my coach tells me to do.	1	2	3	4

APPENDIX 8: TAKE HOME BOOKLET AFTER INTAKE SESSION

What is it like to be a badminton player?

What do you like most about badminton?

What do you like less about badminton?

Do you think you are a good badminton player?

How would you describe *you* as a person?

What are the best things about you as a badminton player?

What are the best things about you as a person?

What would you change about your sport?

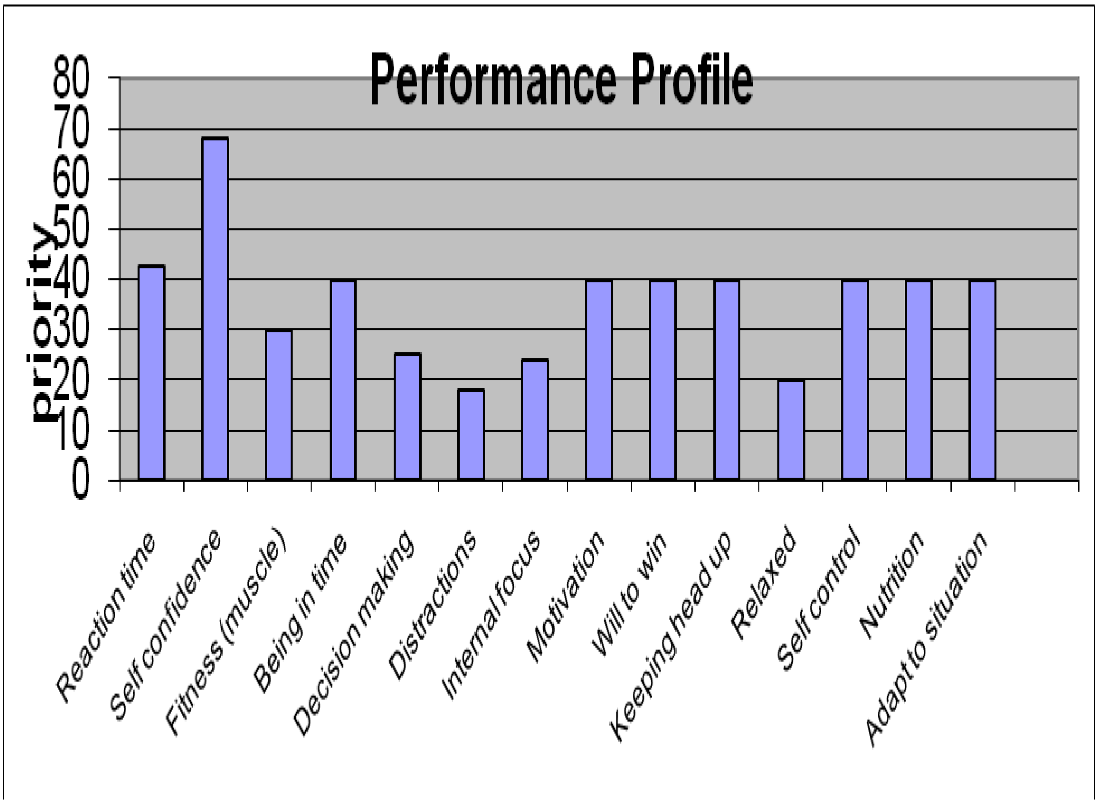
What do you do before a competition?

How do you feel before a competition?

APPENDIX 9: PERFORMANCE PROFILE

What are qualities that you feel are important to do well in your sport? These can be physical skills, technical skills, psychological skills, or skills specific to badminton.

Characteristics identified by the athlete	Athlete’s perceived level of importance on a 10 point scale (API)	Athlete’s self-assessment (ASA)	Discrepancy (10-ASA) X API


Performance Profile
priority
80
70
60
50
40
30
20
10
0
Reaction time
Self confidence
Fitness (muscle)
Being in time
Decision making
Distractions
Internal focus
Motivation
Will to win
Keeping head up
Relaxed
Self control
Nutrition
Adapt to situation

APPENDIX 10: SMART GOAL SETTING HAND OUT

SMART goals

Specific
Be clear, explicit and precise. What will you do to reach your goals?

Measurable
How will you keep track and measure your goals?

Attainable
Realistic is not too high or too low, yet still a challenge

Relevant
Goals will change as you progress. Base your goal on the present - where you are now

Timely
Set a deadline for your goals, short term as well as long term

<u>A few other things to keep in mind:</u>

Set positive goals (do's instead of don'ts) and be positive about your goals!

Make sure your goals are something you WANT to achieve. If you are passionate about your goal, it'll be easier to reach that goal. Think about why do you want it? What are the consequences of not reaching your goal?

Make sure the goal is something YOU want achieve rather than going after a goal someone else has set for you.

Only set controllable goals, rather than uncontrollable goals such as winning a race. Base your goals on personal performance, not the performance of those around you.

Write your goals down using the SMART guidelines.
How you will keep track of your progress in the goals? Set a deadline and do what is needed to reach your goal by that time.
Your goals can change. Revise your goals when necessary! If it is too easy, make it more challenging. If your goal is too difficult, change it to a more realistic goal.

When you achieve a goal, remember to reward yourself!

a. **Write down three *short* term goals you want to reach, using the SMART guidelines**

1.

2.

3.

b. **What will you do today/this week to get a step closer to reaching these short term goals?**

APPENDIX 11: RELAXATION SCRIPT

Relaxation script

The following is a relaxation script for 16 muscles groups. After you feel comfortable with the relaxation script and have practiced it thoroughly, you can learn to do a quick body scan, where you feel which muscle group you want to relax.

Sit or lie down in a comfortable position. Feel free to change your position at any stage throughout the session if you are uncomfortable. Close your eyes. Take a few long and slow deep breaths. Inhale as much air as you can. Exhale slowly and completely, feeling the tension leave your body as you exhale.

Relax as much as possible and listen to the script. Remember not to strain to relax, just let it happen. Try not to move more than necessary to stay comfortable. If possible, try to keep the muscles that have been relaxed still.

As we go through the muscle groups, you will first tense the muscle group for approximately 5 to 7 seconds and then relax for approximately 30 seconds. Do not start the tensing until I say “NOW”. Continue to tense until I say “OK”, and then immediately let go of all the tension.

Begin with tensing the muscles in your right hand and lower arm by making a tight fist NOW. Feel the tension in the hand, over the knuckles, and up into the lower arm… OK, relax by simply letting go of the tension. Notice the difference between tension and relaxation (pause for 20 to 30 seconds). Make another fist with the right hand NOW (pause 5 to 7 seconds). OK, relax. Just let the relaxation happen, don’t put out any effort (pause 20 to 30 seconds).

Next tense the muscles of the right biceps by pushing your elbow down against the floor or back of the chair. Tense NOW. Feel the tension in the biceps without involving the muscles in the lower arm and hand…. OK, release the tension all at once, not gradually. Just let it happen (pause for 20 to 30 seconds). Tense the right biceps NOW (pause 5 to 7 seconds). OK, release it. Notice the difference between tension and letting go into relaxation (pause 20 to 30 seconds).

With your left hand, make a tight fist NOW. Feel the tension in your hand and lower arm, but keep the upper arm relaxed. OK, relax by simply draining all of the tension out (pause 20 to 30 seconds). NOW tense again… OK relax and feel the difference between the tension and relaxation… Also notice the different feeling for each new muscle group… (pause for 20 seconds).

NOW push the elbow down to tighten the left biceps…OK relax (pause for 20-30 seconds). NOW tense the biceps again… OK, notice the decrease in tension, drain it all out, and enjoy the feeling of relaxation (pause for 20 seconds). Notice the sensations you have in the muscles of both arms and hands… Perhaps there is a feeling of warmth and even heaviness in these muscles. Notice and enjoy this feeling of relaxation.

Turn your attention to the muscles in your face. We will tense and relax the face by progressing through three muscle groups. Tense the muscles in your forehead by raising your eyebrows NOW. Feel the tension in your forehead and scalp (pause for 3-5 seconds). OK, relax. Release the tension. Enjoy the spreading sensation of relaxation (pause for 20-30 seconds). Next squint your eyes very tightly and at the same time wrinkle your nose. Tense NOW. Can you feel the tension in the upper part of the cheeks and through the eyes? OK, relax (pause for 20-30 seconds). Next pull the corners of your mouth back and clinch your teeth, but not so hard that your teeth hurt. Tense NOW. You should feel tension all through the lower part of your face and jaw. OK, relax (pause for 20-30 seconds).

Next tense the muscles of the neck by trying to pull your chin downward and upward simultaneously, thus contracting the muscles in the front and back part of the next simultaneously. NOW tense (pause for 5 seconds). OK, relax. Drain all the tension from the muscles in the neck… See if you can get your neck and face to feel completely relaxed (pause for 20-30 seconds).

Remember, relaxation is simply the absence of tension.

Take a deep breath and hold it while raising your shoulders upward and pulling your shoulder blades back. Tense NOW. Feel clear tension in the chest, the shoulders and the upper back… OK, relax. Drain all the tension out…. (pause for 20 seconds). NOW hold your breath and raise your shoulders up and back. OK, exhale and drain all the tension out. Let your shoulders drop completely. Enjoy the spreading sensation of relaxation (pause for 20 seconds).

Next tighten your abdomen as though you are expecting a punch while simultaneously squeezing the buttocks together. Tense NOW. You should feel a good deal of tightness and tension in the stomach and buttocks. … OK release the tension, gradually letting it all drain out. Just let it happen (pause for 20-30 seconds).

Turn your attention to your right leg. Tighten the muscles in your right thigh by simultaneously contracting all the muscles of your thigh. Tense NOW. Try to localise the tension only to your thigh… Note the sensation. OK relax. Contrast the tension and relaxation sensations. Remember relaxation is just the absence of tension, it takes no effort except merely releasing the tension (pause for 20 seconds).

Next flex your right ankle as though you are trying to touch your toes to your shin. Tense NOW. You should be feeling tension all through your calf, ankle, and foot. Contrast this tension with when you tensed the thigh. OK, relax. Simply release the tension, let go of any remaining tension (pause for 20-30 seconds).

Tense the muscles in your right foot by either pointing the toes or curling your toes inside your shoes, but don't tense very hard or you might cramp the muscles. Tense NOW. Particularly note the sensation of tension in your arch and the ball of your foot. OK, relax. As all the tension drains out, feel the spreading sensation of relaxation… and perhaps warmth, heaviness, or even tingling. All of these sensations are normal (pause for 20 seconds).

We will go through the same sequence with the left leg. Begin by tensing all the muscles of your left thigh, contracting all the muscles of your thigh. Tense NOW. Try to localise the *tension only to your thigh. OK relax now, feel the difference between tension and relaxation (pause for 20 seconds).*

NOW flex your left ankle as though you are trying to touch your toes to your shin…. OK release the tension, just let it happen (pause for 20 seconds).

NOW point your toes downward and curl your toes, don't tense very hard or you might cramp the muscles… OK relax. As all the tension drains out, enjoy the spreading sensation of relaxation (pause for 20-30 seconds).

Relax all of the muscles of your body… let them all go limp. You should be breathing slowly and deeply. Let all last traces of tension drain out of your body. Scan your body for any places that might still feel tension. Wherever you feel tension, do an additional tense and relax. You may notice a sensation of warmth and heaviness throughout your body, as though you are sinking deeper and deeper into the chair or floor. Or you may feel as though you are as light as air. Whatever feelings you have, go with them. Enjoy the sensation of relaxation.

Before opening your eyes, take several deep breaths and feel the energy and alertness flowing back into your body. Stretch your arms and legs if you want. Open your eyes when you are ready.

APPENDIX 12: ATTENTIONAL STYLES HAND OUT

Focus?
Attentional styles

Broad

Internal **External**

Narrow

Four styles:
Internal-Narrow
Internal- Broad/ Wide
External- Narrow
External- Broad/Wide