Performance anxiety in sport: Revisiting the process goal paradox and measurement development

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R11

Certificate of Research

This is to certify that, except where specific reference is made, the work described in this thesis is the result of the candidate's research. Neither this thesis, nor any part of it, has been presented, or is currently submitted, in candidature for any degree at any other University.

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Summary

This thesis addressed two issues within the performance anxiety literature. The first half of this thesis examined the use of holistic process goals relative to part process goals. The second half of the thesis examined issues associated with the measurement of performance anxiety. The aims of the thesis were to: (a) establish further support for the efficacy of holistic process goals over part process goals, (b) investigate athletes' cognitive anxiety responses to a stressful event, and (c) develop and test a measure of performance anxiety. The thesis comprised of four empirical studies that utilised a range of quantitative and qualitative methodological approaches. Study 1 examined holistic process goals and part process goals in learning, retention and transfer test, whilst study 2 examined both process goals for skilled but anxious athletes. Study 2 also included two psychophysiological measures. The findings of study 1 and 2 provide support for the efficacy of holistic process goals, but provided no evidence that part process goal impaired performance. As such, the measurement of performance anxiety was highlighted as a potentially limiting factor in experimental designs. Therefore, the second half of the thesis focused on addressing this issue. Specifically, study 3 used qualitative interviews to explore the cognitive dimension of the athletes' performance anxiety response. The study revealed that the cognitive dimension contained worry, private self-focus and public self-focus components. Subsequently, study 4 presents a re-examination of Cheng, Hardy, and Markland's (2009) model of performance anxiety using a hierarchical structure of three second order dimensions and six first order subcomponents. The results of partial least squares structural analysis supported a fully differentiated hierarchical model of performance anxiety. Therefore, the results of this thesis provide further support for the efficacy of holistic process goals and a re-conceptualization of performance anxiety.

Chapter 1

Introduction

The demand to perform at optimal levels in competitive situations is a critical factor in elite level sport. However, sporting history is replete with examples of athletes who have performed below their optimal level in pressurized competitive situations. Greg Norman's performance at the 1996 US Masters is often cited as such an example. Norman went in to the last day of the Masters with an almost unbeatable lead, however, he lost the tournament in dramatic fashion and ended the day six over par. Afterwards, Norman said "Never in my career have I experienced anything like what happened...I was totally out of control. And I couldn't understand it" (Jackson & Beilock, 2008). The performance of the England football team in penalty shoot out situations has also been described as an example of poor performance in a critical situation. Specifically, England's spot-kick defeat to Italy in Euro 2012 was their sixth shootout loss from seven in major international tournaments. It is therefore unsurprising that issues related to performing at competitive events contribute to a significant portion of applied sport psychologists' consultancy. In order to meet the demands of these athletes, it is crucial that there is a strong foundation of theory and research in sport psychology literature to inform applied practice.

Researchers have now published a number of literature reviews to contribute to our understanding of performance anxiety (e.g., Jones, 1995; Mellalieu, Hanton, & Fletcher, 2006; Woodman & Hardy, 2001). In addition, research has been keen to explain less than optimal performance in competitive situations, colloquially referred to as "choking" (Hill, Hanton, Matthews, & Fleming, 2010; Masters, 1992). Recent research has also attempted to re-conceptualize the performance anxiety phenomenon with a model that represents the adaptive nature of the anxiety response (Cheng, Hardy, & Markland, 2009). Despite the abundance of literature in this area, mechanisms by which anxiety impairs performance remain poorly understood (Janelle, 2002). In addition, there is no agreed definition of anxiety within the literature and the measurement of performance anxiety has continued to be an area of ongoing development.

Purpose of this Thesis

The purpose of this thesis is to contribute to the established performance anxiety literature. Specifically, the first half of this thesis examines the use of part and holistic process goals in competitive events (Mullen & Hardy, 2010). The second half of the thesis will examine issues associated with the measurement of performance anxiety, with a view to support recent developments proposed by Cheng, Hardy and Markland (2009). Therefore, the aims of this thesis were to: (a) establish further support for the efficacy of holistic process goals over part process goals, (b) investigate athletes' cognitive anxiety responses to a stressful event, and (c) develop and test a measure of performance anxiety. Due to the diverse nature of the investigations, both qualitative and quantitative methods were utilised to achieve the overall aims.

Structure of this Thesis

The thesis comprises of seven main chapters and consists of four empirical studies. This introduction is followed by chapter 2, which provides a review of the performance anxiety research in sport, focusing upon conceptual issues and the anxiety-performance relationship. The chapter concludes with an in-depth review of the conscious processing hypothesis (Masters, 1992) literature and the process goal paradox highlighted by Mullen and Hardy (2010).

Chapter 3 (Study 1 and 2) presents two experimental studies that set out to establish further support for the efficacy of holistic process goals. The studies are presented as a single paper rather than as separate chapters as the work is currently under review in this format.

The first study addressed Mullen and Hardy's (2010) suggestion that one way of strengthening their findings would be to use a learning paradigm to examine the effect of different types of process goals on skill acquisition. Study 2 replicated the design of the third experiment reported by Mullen and Hardy, in which novices acquired the skill of golf putting using discovery learning and subsequently performed the acquired skill in low and high anxiety conditions. The second purpose of study 2 was to extend previous process goal research by employing both heart rate variability (HRV) and salivary alpha amylase to explore the autonomic response of participants. The prediction regarding the utility of holistic process goals was supported, as the holistic process group outperformed the part process group in the competition condition in both studies.

Chapter 4 presents a second review that seeks to address the issues associated with measurement of performance anxiety, and how imprecise measurement methods may be hindering the development of experimental research. This chapter discusses the flaws inherent with the Competitive State Anxiety Inventory-2 (Martens, Burton, Vealey, Bump, & Smith, 1990) and critically examines the recent re-conceptualisation of performance anxiety proposed by Cheng, Hardy and Markland (2009).

Chapter 5 (Study 3) reports a qualitative investigation, which explored the cognitive anxiety response of athletes from a range of sports. The study predicted that the cognitive dimension would consist of worry, private self-focus and public self-focus, extending Cheng, Hardy and Markland's (2009) model, which consisted of worry and a unidimensional conceptualization of self-focus. Modified analytic induction supported worry, private self-focus and public self-focus as central features of the cognitive anxiety response. Crucially the results provide evidence that a differentiated approach to the measurement of the cognitive dimension of performance anxiety should be adopted in future research.

Chapter 6 (Study 4) presents a re-examination of Cheng et al.'s (2009) model of performance anxiety using a hierarchical structure. The proposed model consists of five first order subcomponents (worry, public self-focus, private self-focus, somatic tension, autonomic hyperactivity and perceived control) and three second order dimensions (cognitive anxiety, physiological anxiety and a regulatory dimension). The results of partial least squares structural equation modelling revealed support for this fully differentiated hierarchical model.

Chapter 7 summarizes the overall findings of the research programme and discusses the conceptual issues derived from it. The chapter also discusses the major practical implications emanating from the findings and discusses the strengths and limitations of the research programme. Finally, areas of future research are considered, with an emphasis on how the measurement model presented in Chapter 6 can be advanced.

Consideration in the Presentation of this Thesis

The thesis contains two separate reviews. The first outlines performance anxiety theories and provides a foundation for studies 1 and 2, which are presented together in chapter 3. The second review is presented after chapter 3 and examines issues associated with measurement of performance anxiety. Studies 3 and 4 are presented separately in chapters 5 and 6, respectively.

In order to ensure a consistent approach throughout the thesis, the following format was adopted for all seven chapters: (1) American Psychological Association (APA) formatting (6th Edition), (2) Table and Figure numbering re-start with each new chapter, and (3) a single final reference list at the end of the general discussion (chapter 8). Appendices, including copies of the measures used in studies 1, 2 and 4, and the interview guide used in study 3 are provided following the reference list. The decision to use APA formatting was made on the basis of the author's research training, which is within the discipline of sport psychology. The supervisory team recommended that APA be used in preference to the University of Glamorgan Harvard system to ensure that the research training best prepared the author for a career publishing in sport psychology journals.

Chapter 2

Literature Review 1

The aim of this chapter is to provide a review of the performance anxiety literature and offer a foundation for examining the key concepts and theories within the thesis. The review is presented in four sections, beginning with definitions of terms. The second section examines and discusses early performance anxiety theories, while section three focuses on mechanistic theories of the anxiety-performance relationship, with a specific focus on the conscious processing hypothesis (Masters, 1992). Finally, the fourth section examines the process goal literature.

Definition of Terms

The definition of terms has been a longstanding problem in the performance anxiety literature. Terms such as stress, arousal, activation and anxiety have often been used interchangeably (e.g., Gould, Petlichkoff, & Weinberg, 1987) even though they are conceptually distinct. In order to provide clarity for the current thesis, operational definitions are presented here.

Stress

McGrath (1970) defined stress as a "substantial imbalance between demand (physical and/or psychological) and response capability, under conditions where failure to meet that demand has important consequences" (p. 20). McGrath's process model of stress explains how physical or psychological demand can impact on an athlete in a number of ways. For instance, one gymnast may perceive a competitive situation as threatening, whereas another gymnast may look forward to competing against other skilled gymnasts. McGrath suggested that it is the individual's perception of whether they can cope with the demand placed on them that predicts this relationship with performance. The first gymnast may perceive the situation as threatening (i.e., negative) because of the high probability of failing, whereas the second gymnast may perceive the situation as a challenge (i.e., positive). The response of the first gymnast may manifest as self-defeating thoughts, which can lead to an increase in anxiety, and can impact on performance negatively. Although they may be faced with a similarly demanding situation, the second gymnast may instead thrive and produce a positive performance outcome, if they perceive they have the ability to cope with the demand.

In addition to the definition of stress as a process, a clear conceptual distinction between the terms "stressor" and "strain" has been made by Fletcher, Hanton and Mellalieu (2006). Stressors refer to the environmental demands that are associated with competitive performance, whilst strain refers to the individual's negative psychological, physical and behavioural response to a competitive stressor. Depending on the individual's perceived ability to cope with the demand of the stressor, stress may or may not impose a strain on the individual (Jick & Payne, 1980; Lazarus, 1966).

Arousal and activation

Traditionally, the terms arousal and activation have often been used synonymously to describe a single unitary construct which incorporates physiological and psychological aspects of behaviour. However, researchers have questioned this unidimensional approach and suggested that it is necessary to view arousal and activation as multidimensional responses (Lacey, 1967). Moreover, in Pribram and McGuiness's (1975) model of attention, three energetical components were identified to help distinguish between arousal and activation. Firstly, *arousal* was defined as the organism's immediate response to some new input, whereas *activation* was defined as the organism's readiness to respond, and *effort* was viewed as being responsible for the coordination of the arousal and activation resource pools. In view of Pribram and McGuiness's model, Hardy, Jones and Gould (1996) advocated a clearer distinction between arousal and activation and defined them as two separate constructs. Arousal was defined as the psychological and physiological activity that takes place in response to a new input, varying on a continuum from deep sleep to intense excitement. Whilst activation was defined as the cognitive and physiological activity linked to the preparation of a planned response to an anticipated situation. In the context of a sporting example, if a highly skilled basketball player is about to take a crucial free throw, we would assume that he would be in the appropriate activation state in which to shoot successfully. If at the same time of the shot a cheer from the crowd distracts him, the practised activation pattern might be disrupted by an involuntary startle response (arousal), which could potentially lead to an unsuccessful free throw. Crucially, activation refers to the activity geared towards the planned response, whilst arousal refers to the activity in response to some new input, i.e., the cheer from the crowd (Hardy et al., 1996).

Anxiety

Anxiety has traditionally been viewed as a negative emotion (Woodman & Hardy, 2001), with the potential for a debilitating effect on performance (Eysenck, 1996). There has been a considerable debate regarding a favoured definition, particularly as research (Jones, 1991) has challenged the traditional view of anxiety and has suggested that anxiety may not always be a negative or unpleasant emotion. The Oxford Dictionary (2013) defines anxiety as "a feeling of worry, apprehension, nervousness or unease about something with an uncertain outcome"; it also defines it as a "strong desire or concern to do something, or for something to happen". These two contrasting definitions reflect the complexity of anxiety, and, defining anxiety as a negative concept may risk an over-simplification of this complex response. Moreover, representing anxiety as a purely negative concept appears to be in conflict with an evolutionary perspective, which depicts anxiety as a functional defense mechanism that serves to protect and prepare the individual to a perceived threat (Ohman, 2000). A negative definition also neglects the potential positive effect anxiety can have on performance by mobilizing resources (Eysenck, 1992), or the energizing and focusing effects of anxiety (Carver & Scheier, 1986). Hence, Cheng, Hardy, and Markland (2009, p.271) defined anxiety as "an unpleasant psychological state in reaction to perceived threat concerning the performance of a task under pressure". For the purpose of this research, Cheng et al.'s definition will be adopted; in addition, a more balanced viewpoint is applied to account for the maladaptive and adaptive potential of the anxiety response.

The literature has also differentiated between state and trait properties of the anxiety response (Speilberger, 1966). State anxiety represents the moment to moment fluctuations and the "right now" tension or apprehension associated with being in a specific situation. Trait anxiety refers to the predisposition to view and interpret situations to be threatening in a more general way (Hardy et al., 1996). Researchers also identified anxiety as a multidimensional concept (Fazey & Hardy, 1988; Martens, Vealey, & Burton, 1990), made up of two subcomponents. The two specific components proposed to represent the anxiety response include; cognitive anxiety, to represent the mental component and, somatic anxiety to represent the physiological component. Morris, Davis, and Hutchings (1981) defined cognitive anxiety as "negative expectations and cognitive concerns about oneself, the situation at hand, and potential consequences" (p. 541). Whilst somatic anxiety was defined as "one's perception of the physiological-affective elements of the anxiety experience, that is, indications of autonomic arousal and unpleasant feeling states such as nervousness and tension" (Morris et al., p. 541). The performance anxiety literature also uses the term physiological arousal. Specifically, physiological arousal is regarded as part of the organism's natural physiological response to anxiety-inducing situations and physiological arousal is believed to have the potential to influence upon performance via two different mechanisms (Hardy, Parfitt, & Pates, 1994). Physiological arousal can have a direct effect by changing the performer's activation state and as such available resources. In an indirect form, physiological arousal can influence performance via the individual's positive or negative interpretation of their physiological symptoms such as increased heart rate and sweaty palms.

Although this approach attempts to take into account the indirect and direct response associated with physiological arousal, the definition remains inherently unidimensional. Researchers should be sensitive to the multidimensional approach described earlier when explaining the physiological arousal response (Hardy et al., 1996 Lacey, 1967). Moreover, researchers have suggested adopting a "fine-grained" view of arousal, with all the different subsystems that support performance identified (Hockey & Hamilton, 1983). Neiss (1988) suggest that arousal should not be considered as a unitary construct, but as a patterning of different physiological patterns. If this multidimensional view was adopted, performance effectiveness would be affected by the appropriateness of this pattern with respect to the performance on the task at hand (Hardy et al., 1996).

Performance Anxiety Theories

The sport psychology literature has also generated a large amount of empirical research exploring the nature of the relationship between anxiety and performance. Traditionally, research had proposed that anxiety would negatively affect performance; however, researchers have been eager to explain the potential facilitative and positive effects that can be linked with performance anxiety (Jones, 1995). Early and more recent performance anxiety theories such as drive theory (Hull, 1943), the inverted-U theory theories (Yerkes & Dodson, 1908), multidimensional anxiety theory (Martens, Vealey, & Burton, 1990) and the catastrophe model (Hardy & Fazey, 1987) have attempted to describe when athletes will suffer from the effects of performance anxiety. In the following section, these theories will be reviewed to provide the reader with a foundation for understanding how performance anxiety theories have developed.

Unidimensional theories

Early theories attempted to explain the anxiety-performance relationship through arousal-based descriptions. Traditionally, these theories adopted a simplistic approach and suggested that performance levels could be predicted by arousal. Drive theory (Hull, 1943) suggested that there is a proportional linear relationship between arousal and performance. Increasing levels of drive (arousal) energise the performance of habitual (well learned) dominant response in a linear manner. However, if the task is complex or the dominant response is not correct, arousal will inhibit performance. Similarly, the Inverted-U theory (Yerkes & Dodson, 1908) also attempted to describe the performance-arousal relationship. Yerkes and Dodson suggested that heightened arousal enhanced performance to a certain point, after which continued increases in arousal would hinder performance. Despite the potential applications to sport, researchers became dissatisfied with the simplistic nature of these unidimensional approaches (Hardy, 1990). Specifically, these theories fail to take in to account the physical and mental responses associated with being in an anxious situation.

Due to the confusion that exists between the concepts of anxiety, arousal and activation, it is not surprising that that these descriptions have received extensive criticism. Central to this criticism is the suggestion that arousal is a unitary construct, which has a positive linear or curvilinear relationship with anxiety. Some researchers have attempted to address this by developing alternative anxiety theories, such as Hanin's (1980) individualised zones of optimal functioning (IZOF). The theory itself suggests that each performer has his or her own optimal pre-performance anxiety zone within which performance will be optimal. Despite the apparent practical significance, the IZOF remains theoretically barren (Gould & Tuffey, 1996) and it also fails to account for the mental and physiological responses associated with anxiety. Furthermore, researchers argued that these undimensional approaches under represent both the arousal and the anxiety response (Burton, 1988). Hence researchers suggested the need to adopt a multidimensional approach when describing the relationship between anxiety and performance.

Multidimensional anxiety theory

Anxiety was recognised as a multidimensional concept by early clinical, psychophysiological, and test anxiety research (Davison & Schwartz, 1976; Lacey, 1967; Morris et al., 1981) and further multidimensional properties were revealed through the development of the Worry-Emotionality Inventory (WEI; Liebert & Morris, 1967). Specifically, Liebert and Morris proposed that the worry dimension represented the cognitive element associated with anxiety, whilst the emotionality dimension accounted for the physiological element. This approach was later adopted in the development of a sport specific theory of performance anxiety; multidimensional anxiety theory (MAT; Martens et al., 1990). The MAT is based on the assumptions proposed by Liebert and Morris, and suggests that anxiety is comprised of a cognitive and somatic component (see earlier definitions), which are predicted to have different relationships with performance. Firstly, somatic anxiety has an inverted-U relationship with performance, that is, individuals have an optimal somatic anxiety level, which will enable best performance (Gould, Petchlikoff, Simons, & Vevera, 1987). Secondly, cognitive anxiety has a negative linear relationship with performance, that is, higher levels of cognitive anxiety result in poorer performance (Burton, 1988).

Despite some initial support for MAT, a number of researchers have criticized the model and its predictions. Burton's (1998) review revealed that out of the 16 papers examining the MAT predictions, only two provided strong support, and the remaining 14 only provided moderate and/or weak support. In addition, a meta-analysis revealed a weak to moderate relationship between the subcomponents of multidimensional anxiety and performance (Woodman & Hardy, 2003). These equivocal findings may be attributed to MAT's prediction that elevated levels of cognitive anxiety will invariably lead to negative and detrimental effects on performance. In addition, MAT only explains the additive effects and not the interactive effects of the proposed dimensions (Hardy et al., 1996). The dissatisfaction with both unidimensional theories and MAT led researchers to develop more sophisticated models that explained the interactive effects of cognitive and somatic anxiety on performance (Hardy & Fazey, 1987).

Catastrophe models

The cusp catastrophe model (Hardy & Fazey, 1987) describes the interactive effects of cognitive anxiety, and physiological arousal on performance. In contrast to MAT, the cusp catastrophe model recognises that high levels of cognitive anxiety can have positive performance consequences, depending on physiological arousal levels. The main predictions of the catastrophe model are: a) with low cognitive anxiety, variations in physiological arousal cause small performance effects characterized by a mild inverted-U effect; b) with high cognitive anxiety and increasing levels of physiological arousal (up to a certain point) there will be positive performance effects; c) high cognitive anxiety and high levels of physiological arousal will eventually result in a dramatic performance decrement, which is characterized by a "catastrophic" drop in performance levels.

There has been some empirical support for the catastrophe model (Edwards & Hardy, 1996; Hardy & Parfitt, 1991); however; the interactions revealed in these studies have generally not been in precisely in the form predicted by the cusp catastrophe model originally proposed by Hardy and colleagues. Researchers have suggested more sophisticated catastrophe models that incorporate factors such as self-confidence and task difficulty, which may mediate the anxiety-performance relationship (Cohen, Pargman, & Tenenbaum, 2003). Consequently, a five-dimensional butterfly model (Hardy, 1990, 1996a) was developed that included a bias feature to account for the potential mediation effects of additional factors. This butterfly model allowed for the inclusion of self-confidence as a factor in the anxiety-performance relationship. Thus, the model predicts that under high levels of cognitive anxiety, highly self-confident performers might be able to withstand higher levels of physiological arousal before experiencing the sudden drop in performance predicted by the model, in comparison to a less self-confident athlete. In summary, the cusp and butterfly catastrophe models provide a more sophisticated approach to understanding the interactive dynamics of the anxiety-performance relationship, which can serve to examine potential interactions underlying performance disruption (Beattie & Davies, 2010). Despite this greater explanatory power, the catastrophe approach fails to provide a specific mechanistic explanation through which anxiety may affect performance.

Despite the appeal of the above theories, they are only limited in describing the relationship between performance and anxiety. Specifically, the unidimensional approaches discussed above failed to take in to account the different subsystems that affect this relationship. Whilst the multidimensional theory and the catastrophe model identified cognitive and somatic components, and described the separate and interactive effects on performance, they lack detail concerning the underlying mechanisms that predict this relationship. Therefore, the following section discusses theories and models that attempt to explain the mechanisms that underpin the performance impairment that plays a major part in the anxiety-performance relationship.

Mechanistic Theories

Mechanistic theories attempt to explain the underlying mechanisms associated with poor performance. These mechanistic theories have traditionally been associated with attentional explanations of the anxiety-performance relationship (Easterbrook, 1959; Wine, 1980), and include the cognitive interference theory (Sarason, 1984; 1988), processing efficiency theory (PET; Eysenck & Calvo, 1992), attentional control theory (ACT; Eysenck, Derakshan, Santos, & Calvo, 2007), which will be reviewed first. Following this, an alternative mechanistic explanations grounded in self-focus mechanisms (Baumeister, 1984) will be presented, including, Wegner's theory of ironic processes of mental control (1989; 1994), and a more detailed review of the conscious processing hypothesis (CPH; Masters, 1992).

Cognitive interference theory

Cognitive interference theory (CIT; Sarason, 1984) suggests that the performance of highly anxious individuals is impaired due to the load placed on the information processing capacity by worry. This theory predicts that highly anxious individuals will experience "self pre-occupying worry, insecurity and self doubt" (p.936). These intrusive thoughts are task-irrelevant and divert attention from the execution of the task that is being performed. As such, the task-irrelevant thoughts consume resources ordinarily allocated for performance, resulting in poor performance.

Although CIT provides a plausible explanation of performance impairment, research has highlighted that high levels of anxiety are not always associated with such impairment; specifically, Eysenck (1992) suggested that other factors such as task difficulty and individual differences should be considered when predicting if anxious individuals will perform poorly or not. Research has also demonstrated the potentially facilitative nature of anxiety (Hardy et al., 1994; Jones, Hanton, & Swain, 1994), therefore, the suggestion that these intrusive thoughts only have a negative impact on performance seems questionable. In summary, this theory predicts that anxiety directs focus away from performance by focusing on task-irrelevant thoughts, but only provides a partial account for the effect of anxiety on performance.

Processing efficiency theory

Processing efficiency theory (PET; Eysenck & Calvo, 1992) explains how highly anxious individuals may sometimes perform better than low anxious individuals. Eysenck

(1992) suggested that cognitive anxiety serves two purposes. Firstly, cognitive anxiety consumes some of the attentional capacity ordinarily allocated for the execution of the task; thereby reducing available working memory capacity due to the task irrelevant thoughts associated with cognitive anxiety, which consequently reduces processing efficiency (Baddeley, 2001). Secondly, cognitive anxiety acts to highlight the importance of the task to the individual, which promotes increased motivation to minimise the potentially negative consequences associated with anxiety. This is achieved by promoting an increase in on-task effort. Therefore, potential performance impairment can be avoided by increasing effort, which typically involves the use of further working memory resources. Crucially, PET makes a distinction between performance efficiency and performance effectiveness. Performance efficiency relates to the relationship between effectiveness of performance and the effort or processing resource invested (Eysenck & Calvo, 1992), whilst performance effectiveness relates to the quality of the task performance. Performance effectiveness is dependent on individual's perception of their personal performance expectations, and will dictate whether additional resources will be allocated to the task. For example, if the individual perceives that they are performing under par, the individual will invest further resources to compensate for poor performance. If the individual perceives that they are incapable of success in the task, then they are unlikely to invest further resources and will withdraw effort (Eysenck, 1982). Therefore, PET suggests that anxiety can have a negative cognitive effect via reduced attentional capacity, but can also serve a positive motivational function via increased effort.

There have been a number of studies that have supported the predictions of PET. Eysenck (1985) tested the predictions by using a letter transformation task to tax working memory. Crucially, the results demonstrated a significant interaction in performance between the two groups as a function of task difficulty, i.e., low and high working memory. The performance of the highly anxious individuals was increasingly worse than their low anxious counterparts as task difficulty increased. In line with PET, the results suggest that tasks that do not tax working memory will not be affected because individuals can maintain performance by increasing effort. When the cognitive demand reaches a certain threshold, performance will suffer due to the lack of confidence in achieving success and therefore the withdrawal of effort.

In sport, a number of studies have lent support to the predictions of PET (Hardy & Jackson, 1996; Hatzigeorgiadis & Biddle, 1998). Wilson, Smith, Chattington, Ford, and Marple-Horvat (2006) revealed support for the predictions of PET in a simulated race driving experiment. Specifically, high anxious individuals reported higher levels of worry more than the low anxious individuals, and this negatively impacted on performance. However, Wilson et al. suggested that further research should attempt to fully support the predictions of PET by employing more sophisticated measures of performance, effort and performance efficiency. Subsequently, Wilson, Smith and Holmes (2007b) investigated the role of effort and the influence of anxiety on golf putting performance. The sample included eighteen golfers who were required to putt in low and high pressure conditions. The results revealed both groups reported significantly higher mental effort scores in the high anxiety condition. In addition, all golfers took longer in a measure of "time to putt", and "glances to the target" were increased in the high anxiety condition. This would support a processing efficiency explanation as it suggests a reduction in visual search efficiency, through the increased glances at target and the reduction in time to putt. This lengthened processing time suggests that processing efficiency was impaired due to increased anxiety. In summary it would seem that the high trait anxious golfers were unable to maintain performance, reported higher levels of effort and less efficient pre-putt behaviour. Here, Wilson et al. suggested that the findings could be explained by either PET or the conscious processing hypothesis (CPH; Masters, 1992). The CPH explanation would propose that the increased effort exerted by these golfers focused inwards in an attempt to control their putting performance (Masters, Polman, & Hammond, 1993). It would therefore seem that the results of this investigation can be explained by both PET and CPH.

In summary, despite the equivocal findings presented by Wilson, Smith and Holmes (2007a), there is some evidence to support the predictions of PET and, more importantly, Eysenck and Calvo (1992) suggest that PET reveals a control system involved in the performance-anxiety relationship. This system responds to performance that does not meet the individual's expectations by allocating extra resources to the task. This theoretical argument again suggests that the anxiety-performance relationship is adaptive and may not always be detrimental to performance. Thus, the strength of PET is that it has the ability to account for occasions when performance is not significantly impaired despite increased levels of anxiety. Processing efficiency theory provided a platform for the development of a more advanced theory (Attentional control theory [ACT]; Eysenck, Derakshan, Santos, & Calvo, 2007), which has attempted to build on the strengths, and address some of the limitations inherent in PET.

Attentional control theory

Attentional control theory (Eysenck, Derakshan, Santos, & Calvo, 2007) suggests that the effects of anxiety on attentional processes are central to understanding how anxiety affects performance. Specifically, ACT contains the same main predictions as PET, but also attempts to explain which functions of the central executive are affected by anxiety. The ACT is based on the assumption that anxiety impairs efficient functioning via two systems; the goal-directed attentional system and stimulus-driven attentional system (Corbetta & Shulman, 2002). Increases in anxiety are suggested to influence the stimulus-driven attentional system at the cost of the goal-directed attentional system. Specifically, it is lower level functions of the central executive that are linked to the impairment of the goal-directed attentional system (Baddeley, 1986). Specifically, the goal directed system has two functions: *Inhibition*, which makes use of attentional control to resist disruption or interferences from task irrelevant stimuli (depicted as a negative control), and *Shifting*, which uses attentional control to shift individuals allocation of attention to remain focused on task relevant stimuli (positive control). Increases in anxiety cause impairment of these two functions and disrupts balance between the goal-directed and the stimulus-driven attentional systems (Eysenck et al., 2007).

Wilson, Vine, and Wood (2009) have attempted to test the predictions of ACT. They utilised the quiet eye period (Vickers, 1996) as an objective measure of attentional control in a sample of basketball players under conditions designed to manipulate anxiety. The quiet eye period was adopted as it was suggested to be sensitive to increases in anxiety and may be a useful index of attentional control. Specifically, free throws rely heavily on the goal-directed attentional system; therefore, impairment of inhibitory control should result in reductions in quiet eye periods of anxious athletes. The increase in stimulus-driven attentional system is reflected in anxious performers making more gazes of shorter duration at the basketball hoop. The results demonstrated that performance was worse when quiet eye period was significantly reduced in the high anxiety condition, thus, providing support for the ACT prediction that anxiety can negatively influence performance due to disruptions in attentional control.

Research conducted by Wilson, Wood and Vine (2009) also attempted to test the predictions of ACT, this time in penalty kicks. Wilson et al. hypothesized that high trait anxious footballers would fixate earlier and for longer on a goalkeeper before shooting, than low trait anxious players. Fourteen male football players executed penalty kicks under low and high threat counterbalanced conditions in a repeated measures design. The results supported Wilson et al.'s predictions and the authors concluded that the earlier and longer fixations on the goalkeeper reflect the increase in the stimulus-driven attention system. Similar support for ACT predictions has been reported in individuals with high levels of trait anxiety (Coombes, Higgins, Gamble, Cauragh, & Janelle, 2009) in pre-planned motor tasks. In view of the research examining the predictions of ACT, Eysenck and Derakshan (2011) set out to review these developments and highlighted how the research area could be strengthened. Specifically, Eysenck and Derakshan suggested that the behavioural evidence reported concerning performance effectiveness, only provides indirect evidence of the internal processes associated with ACT. Thus, Eysenck and Derakshan outline how research using neuroscience methods might be one way to further explore the predictions of ACT. The research reported above provides some support for ACT and its predictions. However this literature is in its infancy, especially in the sporting environment. The strength of ACT is that it highlights the specific functions of the central executive that are affected by anxiety, whilst also retaining the central prediction of PET concerning performance efficiency and effectiveness.

The aforementioned theories are predominantly based on the assumption that attentional processes mediate the anxiety-performance relationship; these are often referred to as distraction or attentional theories (Beilock & Carr, 2001). However, performance anxiety decrements can also be explained by self-focus theories. Self-focus theories are based on the assumption that pressure raises self-consciousness and anxiety about performing correctly, which increases the attention paid to skill processes and their step-by-step control (Baumeister, 1984; Lewis & Linder, 1997). Most prominent in the sport psychology literature have been the theory of ironic processes (Wegner, 1989) and the conscious processing hypothesis (Masters, 1992), which will be reviewed in detail below.

Theory of ironic processes of mental control

The theory of ironic processes of mental control (Wegner, 1989) was developed from the observation that the mind wanders because we try to control it. Wegner suggests that it is this control process that causes individuals to suffer performance impairment. Developed by Baudouin (1921) this theory suggests that individuals have two mental processes that work together in order to maintain task control; the intentional operating and the ironic monitoring processes. The operating process searches for mental contents that are aimed at creating the desired state or goal. This process is effortful, conscious, effective, and interruptible. Conversely, the monitoring process searches for mental contents that depict failure to achieve the desired state, or goal. The monitoring process is usually unconscious, autonomous, and therefore less demanding of effort; in addition, it attempts to identify lapses in control to ensure an individual enjoys mental control (Wegner, 1994). Both processes occur at the same time and are competing for mental capacity available to host them (Navon & Gopher, 1979). Crucially, under mental load, such as anxiety (Janelle, 1999), the operating process enjoys less cognitive space. The interference at the cognitive level by anxiety, consumes attentional space ordinarily used by the operating process. The result is the monitoring process becomes more dominant and supersedes the operating process, and consequently the focus shifts to the undesired state. In essence, by ensuring that we are aware of potential failure the monitoring system is actually ironically responsible for this failure. If we take the example of a golf putt, the operating process will be searching for factors that will enable the successful execution, such as, a focus on the distance to the hole. At the same time, the monitoring process is searching for factors that are counter-intuitive to the successful putt, such as, the incline of the green or wind strength. Under cognitive load the monitoring process supersedes the operating process, which results in the unintended performance outcome, such as missing the putt.

In the context of the demands of sport, the theory of ironic effects would seem to fit the experiences that athletes report. In addition, Wegner, Ansfield, and Pilloff (1998) revealed strong support for the theory in a golf putting experiment. Novice golfers were asked "not to hit the ball past the glow spot (target)" in two conditions; under mental load and without mental load. The results revealed that participants overshot the ball significantly more when under mental load. In line with ironic process theory, it would seem that under increased cognitive load, the monitoring process of avoiding hitting the ball past the target, ironically caused the counter-intentional performance. Dugdale and Eklund (2002) also reported ironic process effects when they asked participants not to focus on umpires. Participants were asked to watch clips of Australian Rules football under a low and a high cognitive load condition. The results revealed that the when participants were told to suppress thoughts of the umpire, they were in fact more aware of the umpire. However, the results were not significantly greater in the anxiety condition, and therefore did not support the prediction that ironic processes occur in high cognitive load.

More recently, de la Pena, Murray, and Janelle (2008) challenged the lack of support for Wegner's theory and suggest an alternative explanation, which they termed the *implicit overcompensation theory*. Whilst Wegner's model suggest that self-instructions not to perform in a certain manner will lead to the behaviour the individual seeks to avoid if the person is anxious, the implicit overcompensation theory predicts that avoidant instructions will produce the opposite outcome to that intended by the performer regardless of anxiety. de la Pena et al. report findings that support their alternative explanation and suggest that the instruction "not to leave a putt short" creates an implicit message that it is better to putt firmly than leave it short. Tonar, Moran, and Jackson (2013) examined predictions of the implicit overcompensation theory in highly skilled golfers and low skilled golfers. Tonar et al. reported over compensatory behaviour was more apparent in low skilled than high skilled golfers. Although no predictions were made in terms of performance anxiety, this theory might prove a useful extension of Wegner's original theory. In summary, Wegner's theory of ironic processes (1989) includes an operational and a monitoring process to achieve mental control. When individuals are under conditions of high cognitive load, the operating process is superseded by the monitoring process, which causes individuals to focus on behaviours and actions they are ironically trying to avoid. Whilst the theory of ironic processes has received some attention in the sport psychology literature, the conscious processing hypothesis (Masters, 1992) has been extensively researched. The following section will discuss this research and outline why this theoretical approach was chosen as the conceptual basis for this thesis.

The conscious processing hypothesis

Masters' (1992) conscious processing hypothesis (CPH) suggests that under pressure experts attempt to ensure task success by using task relevant knowledge to guide their performance. The combination of high levels of state anxiety and a focus on task specific explicit knowledge can lead to conscious control over skill execution, and result in performance impairment. Masters' hypothesis is based upon the stages of learning proposed by Fitts and Posner (1967), who described learning in three stages. Firstly, the early cognitive stage relies on explicit or declarative knowledge and is characterized by a large number of errors, a high level of variability and slow effortful movements. Individuals then progress to the associative stage, in which they are able to associate certain environmental cues with the correct pattern of movement for performance success. Finally, individuals progress to the autonomous stage, where performance is smooth, unconscious and covertly controlled (i.e., procedural). Masters suggested that under stress, athletes attempt to control performance, by focusing on task relevant, explicit knowledge. Explicit knowledge is laden with facts and rules regarding skill execution (Reber, 1993), thus is characteristic of the declarative knowledge that supports performance in the early cognitive stage of learning. By attending to this information individuals begin to control movement in a step-by step manner and interfere with the normal automatic processing associated with the autonomous stage of learning. Thus, the increase in levels of state anxiety that athletes might experience in competitive events causes "deautomatization" and task control reverts to that associated with the early stages of learning and consequently performance is impaired.

To test the predictions of the CPH, Masters (1992) used a sample of forty novice golfers. The experiment consisted of two phases; an acquisition stage consisting of 400 putts conducted over four days, and a test phase of 100 putts conducted on the fifth day. Participants were assigned to one of five experimental conditions; implicit learning, explicit learning, implicit learning control, stressed control and non-stressed control. Both the implicit learning and implicit learning control groups performed a random letter generation task (RLG; Baddley, 1966) during the acquisition phase. The RLG was used to prevent the use of explicit knowledge and to encourage athletes to learn using implicit knowledge. The explicit learning group were given instructions on technical knowledge related to putting. Following 400 putts in the acquisition phase, participants performed the 100 putts under stress. The results revealed that those who learnt using explicit knowledge performed significantly worse than those who used implicit knowledge. However, the implicit learning group did not perform the secondary RLG task in the test phase, and therefore they may have improved performance as the test phase was easier (Hardy, Mullen, & Jones, 1996). Therefore, it is unclear whether the performance results were due to the differential practice the groups received or the easier task demands during the test phase for the implicit group.

Consequently, Hardy, Mullen and Jones (1996) extended and replicated Masters' (1992) study, but included a new implicit learning group who performed the RLG task in the stress condition. Therefore, the study included four experimental conditions: implicit learning without RLG in the stress test, replicating Masters' implicit learning group, implicit learning with RLG in the stress test, explicit learning and a non-stressed control group. The inclusion of an implicit learning group with RLG in the stress condition was used to examine whether the implicit learning group in Masters' study improved their performance because of the easier task demands. The same task procedures as Masters' original research were adopted, that is, 400 putts in an acquisition phase over four days and a test phase of 100 putts on the fifth day. The results revealed that in the test phase the performance of both implicit learning groups improved, while the performance of the explicit group was impaired. These results supported the predictions of CPH; however, Hardy et al. suggested that participants might have become desensitized to the RLG task. During the 400 acquisition trials, participants may have become less sensitive to self generated verbal distractions, and become partially immune to the effects of performance anxiety in the stress condition.

Hardy, Mullen, and Martin (2001) attempted to correct for this desensitization in a performance paradigm study. Twelve expert trampolinists performed their competition routines in a shadowing condition. The shadowing condition was designed to invoke conscious processing and involved the coach calling out a coaching point from each move in the routine. The trampolinists were asked to concentrate on the coaching instruction and use the explicit knowledge to guide their performance. The low anxiety condition was conducted during a normal practice session, whilst the high anxiety condition was completed two hours before a competitive event. Results revealed that state anxiety increased from practice to the competition condition. The combination of the increased anxiety and task-relevant cues also led to performance impairments, supporting a conscious processing explanation. While this provides support for the CPH, Hardy et al. suggested that these effects could be attributed to an alternative explanation. Specifically, the reduction in attentional capacity associated with the combination of the task relevant cues and the increase in anxiety may have led to a decline in performance. Increases in anxiety are believed to lead to a reduction in working memory (Eysenck, 1992), thus the performance effects may be attributed to the relevant cues depleting attentional capacity sufficiently to impair performance.

To examine the attentional threshold explanation suggested by Hardy et al. (2001), Mullen and Hardy (2000) conducted a golf putting study using eighteen male golfers. The golfers were required to complete 10 putts in three experimental conditions; task relevant, task irrelevant and control. In the task relevant condition, participants self-selected a coaching instruction, which was verbalized during putting to encourage conscious processing. The task irrelevant condition involved a RLG task to prevent conscious processing. Golfers were split into "better" and "poorer" groups based on putting performance in the low anxiety control condition. Results revealed that those in the poorer group were not adversely affected by increases in cognitive anxiety. In contrast, those in the better group suffered a disruption in performance due to the increase in cognitive anxiety. The better group also suffered performance impairment in the task relevant and task irrelevant conditions under low anxiety. The results suggest that the better performers may have been more adversely affected by increases in cognitive anxiety in both the task relevant and task irrelevant conditions because they possessed a higher level of automaticity than the poorer performers. Automaticity is a key characteristic of expert performers (Fitts & Posner, 1967), so the effects of conscious processing may be more prevalent in these better performers. Mullen and Hardy also included a self-report measure of effort in an attempt to explore the intensity of attentional processing. With regards to conscious processing, changes in effort should be evident when task control is transferred from automatic processes to more attention demanding processes; however, Mullen and Hardy failed to find any increase in effort associated with CPH. Nevertheless, they concluded that measurement of effort may provide a useful insight into the effects of conscious processing, and suggested that further research should adopt more sophisticated measurement methods of effort.

Mullen, Hardy, and Tattersall (2005) also examined the conscious processing hypothesis predictions. In addition, Mullen et al. included heart rate variability (HRV) as a measure of mental effort, which was included to demonstrate the hypothesized increase in attentional processing associated with lapses into conscious processing. Participants completed 60 golf putts, in three different conditions; a control condition, a task relevant shadowing condition and a task irrelevant tone counting condition. All three of the conditions were repeated in low and high anxiety conditions. The task relevant shadowing condition required participants to putt using three coaching points to encourage lapses in to conscious processing. In the task irrelevant condition, participants were required to listen to high and low pitch tones while putting, and to identify the number of high-pitched tones. Tone counting was used in preference to the RLG task used in earlier studies (e.g., Hardy, Mullen, & Jones, 1996; Masters, 1992) because verbalization would interfere with the measurement of HRV, thus, participants indicated the number of high pitched tones with their fingers. Performance declined in both the task relevant shadowing and task irrelevant conditions in the high anxiety condition. It would seem that the task relevant shadowing task did not induce conscious processing, as predicted. The combination of both secondary tasks and the worry caused by the increased cognitive anxiety (Eysenck & Calvo, 1992) may have caused the performance decrements. Thus, an attentional threshold explanation would seem more appropriate as performance was impaired in both groups. The HRV spectral analysis revealed that anxiety-related performance impairment was associated with changes in the high frequency band. Mullen et al. suggested that these changes may indicate an increase in vagal activity, or a decrease in respiratory frequency, or both. Therefore, participants may have coped with the increased demands of the task by employing a breathing based relaxation strategy, which would be reflected in the observed changes in spectral power in the high frequency band. No significant effects were revealed for self-reported mental effort. In summary, Mullen et al. provided evidence to support the attentional capacity explanation; however, the authors suggest that conscious processing may be more evident in tasks that demand more discrete motor control. For instance, the motor control associated with trampolining may be more demanding than golf putting, which may explain the lack of conscious processing effects in this study.

Self-focus explanations have also been reported in research outside of the CPH literature. Beilock and Carr (2001) presented the term *explicit monitoring* and suggested that the term refers to the allocation of attention to skill execution. Furthermore, Beilock and Carr suggested that skills that are proceduralized might be more susceptible to the effects of explicit monitoring during performance. As such Beilock and Carr aimed to explore the cognitive mechanisms responsible for the disruption of a well-learned skill under pressure. Firstly, they established that skilled golf putting is encoded in procedural form, and thus would be susceptible to decrements in performance according to explicit monitoring explanations. Secondly, they examined choking effects in a golf putting task and were able to apply training to ameliorate the explicit monitoring effects. The findings support a self-focus explanation for the decrements in performance in a procedural skill based task. Furthermore, Beilock, Carr, MacMahon, and Starkes (2002) provided further evidence that high-level skill execution is harmed when attention is directed to the step-by-step monitoring of performance. Ford, Hodges, and Williams (2005) also reported performance effects associated with an explicit monitoring explanation. Specifically, they manipulated attentional focus of skilled and less skilled soccer players to explore step-by-step monitoring of procedural performance. The results revealed that the skilled soccer players suffered performance impairment under conditions that focused the attention on skill based features of performance. Explicit monitoring would seem to be one explanation for the mechanisms by which self-focus impairs performance. Crucially, Jackson, Ashford and Norsworthy (2006) made a conceptual distinction between explicit monitoring and reinvestment of conscious control. They argued that while explicit monitoring refers to the allocation of attention to skill execution, it does not necessarily imply that individuals attempt to consciously control performance. Therefore, whilst instructions to monitor and report a particular feature of performance encourage explicit monitoring they do not specifically encourage conscious control. Hence, it is possible that explicit monitoring may have a generally disruptive effect on performance, but additional disruption may occur when individuals apply these explicit rules to consciously control their movements. This distinction is crucial in understanding the mechanisms that underpin self-focus explanations of performance failure.

Process Goals

The ambiguous results reported in the literature do little to confirm the effects associated with conscious processing. In order to support the hypothesised effects of the CPH, research needs to establish methods that invoke the lapse in to conscious processing while also controlling for the alternative attentional explanations that were discussed above. One possible solution to this problem was suggested by Mullen (2000) and involves the use of process goals. Process goals specify the behaviours, skills and strategies that are essential for effective task execution (Kingston & Hardy, 1997). For example, a javelin thrower should ensure that the feet remain in line with the throwing direction. Alongside process goals the goal setting literature also identified two other types of goal (Hardy & Burton, 1994b). Outcome goals, which focus on the outcome of a particular event, for example, winning a gold medal at the Olympics. A performance goal focuses on personal performance standards and is independent of other performers, for example, setting a personal best time. While outcome and performance goals direct the athletes' attention to the end product of performance, process goals act to direct the individual to the task specific aspects that will ensure successful execution.

From an applied perspective, process goals are recommended as a way of helping skilled performers in high anxiety situations as they provide the athlete with a means of focusing attention on important aspects of performance (Hardy, Jones, & Gould, 1996; Kingston & Hardy, 1997). Moreover, process goals provide the perfect solution to Beggs's (1990) "double-edged sword" problem. Beggs claimed that using performance or outcome goals to alleviate competitive state anxiety may intensify the problem. Beggs explained that a focus on outcome and performance goals might actually elicit negative effects as the goals themselves satisfy the criteria for generating stress, that is, they are important, require action, and may not always be achieved. Kingston and Hardy (1997) revealed preliminary evidence that process goals do enhance performance while also reducing a performer's susceptibility to the effects of anxiety. Moreover, using process oriented goals within pre-performance routines has been suggested as a means of enhancing attentional focus (Beggs, 1990; Boutcher, 1990). Kingston and Hardy (1994) also reported empirical support for the use of process oriented goals in pre-shot routines in a sample of golfers. Therefore, it would seem that process goals would serve a useful technique for combating the anxiety that might be present in competitive events. In addition, these process goals can differ in their content, for example, some process goals used in pre-performance routines might be emotion-focused, with the emphasis upon being relaxed (Hardy et al., 1996), whilst other process goals might focus on specific parts of skill execution. However, goals that focus on parts or processes are often laden with explicit information regarding the execution of the skill.

Despite the support for process goals, research has revealed the potentially negative effects associated with focusing on skill execution using explicit knowledge (Hardy, Mullen,

& Jones, 1996; Kingston & Hardy, 1997). In line with the CPH, the focus on explicit knowledge inherent in process goals may disrupt the normal automatic task processing and cause a lapse in to conscious processing. This has created something of a paradox within the literature (Mullen & Hardy, 2010). Jackson, Ashford and Nosworthy (2006) used a soccer dibbling task to examine whether process goals impair performance under stress. A sample of 25 male soccer players completed a set dribbling task under three conditions; single-task, skill-focused, which asked participants to focus on the side of the foot that made contact with the ball and movement-related process-goal, which involved a specific dribbling related goal, in conditions of low and high pressure. The results revealed that movement-related process goals had a negative effect on dribbling performance, regardless of pressure conditions. In addition, Gucciardi and Dimmock (2008) revealed that the performance of golfers who were attending to several explicit cues, deteriorated under increased cognitive state anxiety. Specifically, Gucciardi and Dimmock asked participants to putt golf balls using three part process goals (coaching points), three task irrelevant cues (colours) or a single globally focused cue in low and high anxiety conditions. Performance was better in the global swing thought condition, irrespective of the level of anxiety. These global swing thought goals are examples of holistic process goals. A holistic process goal encourages the performer to conceptualize the whole movement. This global representation encourages "chunking" and allows the appropriate sub-actions of movement to be generated automatically (MacMahon & Masters, 1998). For example, "smooth", or "easy" are examples of holistic process goals for golf putting (Mullen & Hardy, 2010). Therefore, whilst process goals that focus on part of the skill may impair performance, holistically focused goals may aid performance under pressure.

Mullen and Hardy (2010) attempted to compare part and holistic process goals in low and high anxiety conditions, across three experiments. In addition, Mullen and Hardy attempted to invoke the lapse in to conscious processing while also controlling for the alternative attentional explanations. In the high anxiety condition, part process goals were predicted to induce conscious processing effects. In contrast, holistic process goals, focused on the global nature of the movement, were hypothesised to provide a buffer for the effects of increased performance anxiety, helping participants maintain levels of performance demonstrated in the low anxiety condition. Mullen and Hardy conducted three studies that examined the effect of a single part process or holistic process goal on performance. Experiment 1, used a sample of 40 intermediate level long jumpers. Participants were randomly stratified in to either a holistic process group or a part process group; they completed 3 jumps in a warm up, a baseline and a test condition. The results revealed that the holistic process group outperformed the part process group in the test condition. However, no performance impairments were revealed in the part process group at test, as was predicted. Mullen and Hardy argued that the lack of performance impairment could be attributed to a number of reasons, including the nature of the serial task. The CPH effects may be more prevalent in more discrete tasks with a high degree of fine motor skill, for example, basketball free throws (Liao & Masters, 2002). Secondly, as participants were of an intermediate level, they may not have possessed the required level of automaticity to produce CPH effects. Finally, the amount of training and instructions participants received was brief, thus athletes may have reverted back to using their prefabricated mental set.

Mullen and Hardy's (2010) second experiment used a basketball free throw as the motor skill, with extended training in the use of the goals. Twenty female university basketball players were randomly stratified in to a holistic process or part process goal group and completed 5 basketball free throws in a baseline or test condition. The results revealed that goal setting training was effective in increasing participants' use of their assigned goals. In terms of the performance, the results replicated the findings of experiment 1, as the holistic process goal group outperformed the part process goal group at test. The consistency of results in experiment 1 and 2 support the reliability of the performance effect, however, Mullen and Hardy suggested the need to look at the number of trials completed by participants in the experimental conditions. Specifically, 3 long jumps and 5 free throws may not have been sufficient to produce a significant conscious processing effect in the part process goal condition at test. To establish pairwise effects between the low and high anxiety conditions, more trials may be necessary to demonstrate significant performance impairment.

The final experiment presented by Mullen and Hardy (2010) used the fine motor skill of golf putting and asked participants to complete a higher number of trials. On this occasion novice golfers were recruited to address some of the authors' concerns regarding the extent to which experienced athletes' existing mental sets may have predominated in the process goal conditions in the first two experiments. Novices were also recruited as more experienced athletes may become inoculated to the effects of pressure situations due to their competitive experience. Following an acquisition phase and a process goal training stage, participants performed in a baseline and test phase using either a part or holistic process goal. The results revealed that the holistic process group significantly improved from baseline to test and outperformed the part process group at test. In addition, on a measure of putt-to-putt adjustments, the holistic process group made significantly smaller adjustments than the part process group in the test phase compared with baseline.

Taken together, the three studies presented by Mullen and Hardy (2010) revealed that under high anxiety conditions, participants who used holistic process goals consistently performed significantly better than those using part process goals. Across the three experiments the part process goal groups maintained baseline performance levels in high anxiety conditions. These participants did not experience the hypothesized performance decrements associated with CPH. These findings differ to previous research, which has demonstrated performance impairment in athletes who have used process goals (Gucciardi & Dimmock, 2008; Jackson et al., 2006). Mullen and Hardy suggested that the lack of performance effects may be due to the number of goals participants are asked to use. Jackson and Wilson (1999) described how their study of one "swing thought" helped prevent performance impairment, however in their second study when participants used four explicit goals, the performance of anxious participants was disrupted.

Mullen and Hardy's (2010) research offers very strong support for the use of holistic process goals by skilled but anxious performers, as they consistently outperformed participants who used part process goals. In addition, the experiments offer some support for the CPH, in that none of the part process groups were able to improve performance in the same way as the holistic process goal groups. The strength of the work is that it demonstrates the potential benefits of using holistically focused goals in competitive situations. It would seem that the content of process goals is crucial. Process goals that are laden with explicit knowledge clearly create problems for skilled but anxious performers. Goals that focus on the holistic nature of the movement appear to aid performance and provide a buffer for the effects of performance anxiety. To strengthen these findings, Mullen and Hardy suggested using a learning paradigm, incorporating retention and transfer tests.

To summarise, research has demonstrated some support for the predictions of the CPH, but equivocal results have also been reported. Therefore, the purpose of this thesis was to explore the CPH as a mechanistic explanation for performance impairment. To do so, research that purposefully invokes the conscious processing effects hypothesised by the CPH is needed. Ideally, the interventions used to invoke conscious processing should also avoid confounding effects from other theoretical explanations, for example, much of the previous work in this area attempted to examine the competing hypotheses of the CPH and attentional theories (e.g., Mullen & Hardy 2000; Mullen, Hardy, & Tattersall, 2005). In so doing, one of the limitations of this research was that the researchers were unable to equivocally support conscious processing as a causal mechanism for performance failure. Comparing the relative effectiveness of part and holistic process goals affords researchers the opportunity to isolate conscious processing effects. Specifically, the mechanisms of conscious processing suggest that performance will be impaired when athletes utilize part-process goals that are laden with explicit information in pressured situations. Thus, the CPH was adopted as the conceptual basis for this thesis, rather than other mechanistic theories as discussed above. Within this conceptual framework, process goals were adopted as a way of invoking conscious processing in isolation from other potentially confounding effects. Furthermore, the adoption of more sophisticated psychophysiological measures of mental effort, as used in earlier studies that examined the CPH (e.g., Mullen, Hardy, & Tattersall, 2005), may add to our understanding by indexing the shift from automatic to the more effortful conscious processing implicated by the CPH (Mullen et al., 2005).

Summary

In summary this review chapter has attempted to clarify issues surrounding some of the key definitions within the performance anxiety literature. In addition, this chapter reviewed some of the early performance anxiety theories, including unidimensional arousal theories (Hull, 1943; Yerkes & Dodson, 1908), the multidimensional theory (Martens, Vealey, & Burton, 1990) and the catastrophe model (Hardy & Fazey, 1987). A review of mechanistic theories included, cognitive interference theory (Sarason, 1984; 1988), processing efficiency theory (Eysenck & Calvo, 1992), the attentional control theory (Eysenck, Derakshan, Santos, & Calvo, 2007), and Wegner's theory of ironic processes of mental control (1989; 1994). Finally, the review detailed the conscious processing hypothesis (Masters, 1992) and the literature surrounding this model, concluding with a discussion of the process goal paradox and the research that has compared part process goals with holistic process goals (Mullen & Hardy, 2010). This review has highlighted a number of issues within the literature. Most prominent is the issue surrounding the process goal paradox (Mullen & Hardy, 2010) and the conscious processing hypothesis (CPH; Masters, 1992). Crucially, despite claims to the contrary (Mullen & Hardy, 2010), there is still no evidence that demonstrates equivocally that conscious processing directly impairs the performance of anxious athletes.

Chapter 3

The process goal paradox: More evidence for the effectiveness of holistic process goals for learning and performance under pressure. (Study 1 and 2)

Abstract

Mullen and Hardy (2010) recently reported the benefits of using holistic process goals (HPG) over part process goals (PPG) to avoid effects associated with the conscious processing of task relevant information by skilled but anxious athletes. Study 1 investigated the efficacy of HPG relative to PPG for novices in a learning paradigm. Sixteen male undergraduate students between 19 and 23 years of age ($M = 19.58$, $SD = 1.89$) completed a race driving simulation task and were randomly assigned to a HPG group, a PPG group or a control group. Participants completed 8 learning blocks and transfer and retention tests. The results revealed that HPG group outperformed the PPG group at both retention and transfer. Study 2 also examined the relative efficacy of HPG versus PPG for skilled but anxious individuals, with the addition of two psychophysiological measures. Thirty male and female students between the ages of 18 and 50 ($M = 27.77$, $SD = 7.80$) completed a race driving simulation. Participants learned the driving task by "discovery" and then were randomly assigned to a HPG group or a PPG group. On day two, participants completed a baseline and competitive condition. The HPG group outperformed the PPG group in the competition condition. Psychophysiological measures indicated that this superior performance was achieved by investing compensatory effort.

Keywords: *anxiety, holistic, process, goal, learning, psychophysiology*

Introduction

Research examining the effect of anxiety upon motor performance has continued to play a major role in the sport psychology literature. Yet, despite this focus, the mechanisms through which anxiety exerts its influence upon performance remain unclear. One popular approach has focused on the disruptive influence of self-focus on motor skills that are performed in pressurized situations (Baumeister, 1984). Essentially, self-focus models suggest that increased anxiety can cause individuals to turn their attention inwards and focus on the processes supporting skilled performance. A number of self-focus theories have received support in the literature, including the conscious processing hypothesis (CPH; Masters, 1992) and the explicit monitoring hypothesis (Beilock & Carr, 2001). Of these, the CPH has received the most attention in the sport psychology literature. Masters hypothesized that highly skilled but anxious individuals might attempt to ensure task success by adopting a mode of conscious control primarily associated with the early stages of learning. This conscious control is based upon explicit knowledge, which is accessed in a step-by-step manner, resulting in movements that are typically slow and effortful, and in contrast with the more typical automatic functioning of experts, which is more efficient, fluid and less effortful (Shiffrin & Schneider, 1977).

Despite the accruing support for the CPH (e.g., Hardy, Mullen, & Jones, 1996; Mullen, Hardy, & Oldham, 2007), several authors have also noted that the performance deficits credited to conscious processing effects could also be caused by a competing attentional explanation (Mullen, Hardy, & Tattersall, 2005; Wilson, Smith, & Holmes, 2007a). Specifically, the attentional hypothesis posits that the explicit knowledge used to guide performance combines with cognitive anxiety to effectively overload attentional capacity, in contrast to the more active role in performance impairment attributed to explicit knowledge in the CPH. As a result, several studies have attempted to clarify the competing conscious processing and attentional explanations; however, these studies have produced a mixed pattern of findings, with some authors supporting conscious processing effects (Gucciardi & Dimmock, 2008), others supporting an attentional explanation (Mullen et al., 2005; Wilson et al., 2007b) and still others producing equivocal results (Mullen & Hardy, 2000). Mullen et al. (2005) suggested an alternative point of view; in that anxiety-related performance decrements might be caused by both attentional and conscious processing effects, in line with Eysenck's (1988) suggestion that anxiety-related performance failure might be attributable to multiple causes. Consequently, from a conscious processing perspective, Mullen and Hardy (2010) claimed that it is important to establish whether skilled but anxious performers' use of explicit knowledge *does* actually cause lapses into conscious processing. In order to do so, Mullen and Hardy suggested that researchers needed to design studies that isolate conscious processing effects without invoking alternative attentional explanations, proposing that one way of so doing was to examine the effect of process goals upon the performance of anxious individuals.

First proposed by Hardy and Nelson (1988), process goals specify the behaviours, skills and strategies that are essential for effective task execution (Kingston & Hardy, 1997); for example, a basketball player might focus on extending their knees on a free-throw shot. Sport psychologists have recommended process goals as a means of helping skilled performers deal with high anxiety by providing them with a means of focusing their attention on important aspects of performance (Hardy, Jones, & Gould, 1996; Kingston & Hardy, 1997). By their very nature, process goals encourage performers to focus on specific aspects of a task using explicit knowledge about the task, thus creating something of a paradox (Mullen & Hardy, 2010). More specifically, the CPH predicts that a focus on part of a movement using a process goal underpinned by explicit knowledge might disrupt the normal automatic task processing of experts, leading to lapses into conscious processing. Kingston and Hardy (1997) suggested that one way of dealing with this apparent confound is to tailor the goals according to the skill level of the performer, with less able performers using process goals that focus on key elements of performance, while more skilled individuals might use more holistic or globally-focused cues to conceptualize the whole of a movement. Mullen and Hardy suggested the holistically focused goals might avoid conscious processing effects by encouraging chunking, a concept used to describe the automatization of cognitive skills. According to Neves and Anderson (1981), chunking incorporates individual elements of a task into single representations, allowing much smoother performance. MacMahon and Masters (1998) used a serial reaction time task to produce evidence that supported the chunking effect. In addition, MacMahon and Masters also found that increases in pressure resulted in a reversal of this process, with the skill effectively "de-chunking".

The notion of holistic process goals or "swing thoughts" has been well documented anecdotally and empirically in the applied golf psychology literature. Owens and Kirschenbaum (1998) noted that some golfers use a mechanical thought to get through a swing confidently. They add, "the best mechanical thoughts are whole swing thoughts" (p. 23), and that partial swing thoughts on specific swing mechanics can create difficulties and interrupt the smooth flow of the stroke. Such advice is not new and Sarazen (1950) noted that players should avoid disrupting their concentration before a shot by wondering if "thirty-three anatomical parts" would perform their appointed functions. Such advice has some empirical foundation as a number of researchers have provided support for the use of process-oriented goals (Filby, Maynard, & Graydon, 1999; Jackson & Willson, 1999; Kingston & Hardy, 1997; Zimmerman & Kitsantas, 1996). More recent evidence has been provided by Jackson, Ashford, and Norsworthy (2006) who used a soccer dribbling task to examine whether process goals impaired performance under pressure. All of the participants used a single part process goal and those goals that were movement related had a negative effect on the dribbling task, regardless of pressure levels. Gucciardi and Dimmock (2008) asked participants in their study to putt golf balls using three part process goals (coaching points), three task-irrelevant cues (colours), or a single, globally focused cue in low and high anxiety conditions. Performance was better in the global swing thought condition, irrespective of the level of anxiety. Mullen and Hardy (2010) claimed that the mixed results reported in the literature did little to clarify the part process goal paradox. Consequently, they conducted three experiments to directly compare the effectiveness of part and holistically focused process goals, predicting that skilled but anxious performers who used holistic process goals would outperform those who used part process goals. In addition and in line with the CPH, they also predicted that performers who used part process goals would experience performance impairment in a high anxiety condition. The three experiments utilized a number of different motor tasks; golf putting, long jumping, and basketball free throws, which participants performed using either a part or holistic process goal in a low and a high anxiety condition. The results were consistent across all three experiments; a single holistic process goal helped maintain or improve performance in high anxiety conditions. The prediction that part process goals would disrupt task execution under pressure was less clear as performance did not significantly deteriorate from baseline, low anxiety levels, but was significantly lower than that recorded by participants who used holistic process goals in all three experiments. Based on the evidence that participants who used part process goals did not experience the same performance benefits as those who used holistic process goals in the competitive condition, Mullen and Hardy argued that this relative impairment was evidence that conscious processing was activated.

Holistic process goals would appear to serve much the same function as Wulf's external focus of attention (see Wulf, 2007, for a review). An external focus of attention involves directing a learner's attention to the effect of an action, as opposed to an internal focus that involves focusing on the movements or body parts used to produce an action. Wulf and associates have produced a large body of evidence supporting external focus instructions as being more effective for performance and learning than instructions that are internally focused. According to Mullen and Hardy (2010) it is important to distinguish between holistic process goals and an external focus in that, "the former involves a focus on the general feeling of the movement itself, in effect an internal focus, while the latter involves a focus on the environmental effect produced by a movement" (p. 277).

To summarize, outside the work of Mullen and Hardy (2010), there is little evidence to support the use of holistic process goals by skilled but anxious performers. The two studies reported here set out to establish further support for the efficacy of holistic process goals. Our first study addressed Mullen and Hardy's suggestion that one way of strengthening their findings would be to use a learning paradigm to examine the effect of different types of process goals on motor skill acquisition. There are at least two possibilities in this context. It could be argued that part and holistic process goals serve different purposes for individuals with different levels of expertise. For example, novices might benefit from using part process goals that focus attention on key aspects of performance. As expertise develops, holistic process goals might become more important as more skilled performers are able to use the holistic representation of the movement to avoid lapsing into conscious processing (Kingston & Wilson, 2009). Alternatively, holistic process goals used early in learning might accelerate the acquisition of a skill by encouraging chunking. We predicted that the latter position would be supported. The first study reported here also set out to address one of the limitations evident in previous work by including a control condition to examine how effective part and holistic goals are relative to discovery learning. Previous work has also focused primarily on discrete motor skills such as golf putting or basketball free throwing. The present study extends this focus by using the continuous skill of simulated racecar driving.

Experiment 1

Method

Participants. Sixteen male undergraduate students between 19 and 23 years of age (*M* = 19.58, *SD* = 1.89) from a university in the United Kingdom were recruited for the study. Participants reported no experience of the driving game used in the study, had been in possession of a full UK driving license for at least one year (*M* = 2.04 years, *SD* = 0.70), and provided informed consent. Ethical clearance was obtained from the university ethics committee.

Apparatus and Measures. ***Race simulator***. Participants completed a driving simulation task using the Gran Turismo™ video game (Sony Computer Entertainment America; Foster City, CA) presented on an 81cm screen. Participants controlled the simulator using an analogue force feedback steering wheel and pedals and manoeuvred the car around the "High Speed Ring" track option in a Mazda MX5 with automatic gear changes. Participants, who all used the driver's perspective to perform the task, drove in time trial mode to avoid any confounding effects of other cars that appeared on track in other race modes. Driving performance was assessed using lap times recorded by the simulator. Participants were not informed that lap times were being recorded. Performance was also measured using the number of driving errors made. An error was made if two or more wheels left the track, if the car hit a wall or barrier, or if the car spun.

Cognitive state anxiety. State anxiety was measured using the cognitive anxiety subscale of the revised Competitive State Anxiety Inventory-2 (CSAI-2R; Cox, Martens, & Russell, 2003). The CSAI-2R is a sport-specific, self-report inventory that has been shown to be a valid and reliable measure of cognitive and somatic anxiety and self-confidence by Cox et al., who subjected the scale to confirmatory factor analysis (CFA) and reported a good fit of the data to the hypothesized model (CFI = .95, NNFI = .94, RMSEA = .05). Participants rated their cognitive anxiety on a Likert scale ranging from 1 (*not at all*) to 4 (*very much so*). The cognitive anxiety subscale was scored according to the directions provided by Cox et al.; item responses were summed, divided by 5 and multiplied by 10, resulting in a score range of 10 to 40.

Manipulation check. Participants in the holistic and part process goal groups were also asked a single question to determine whether they had maintained their assigned focus, requiring a yes or no response.

Design. Participants were tested on three consecutive days. The first two days comprised the practice phase of the study, during which participants completed eight blocks of two trials (1 trial = 2 laps). Four blocks were completed on day one and four on day two. The third day consisted of two blocks of two trials completed in a retention condition, followed by a further two blocks in a high anxiety transfer condition. In total, each participant completed eight blocks of two trials (32 laps) during the practice phase, and two blocks of two trials (8 laps) in both the retention and transfer conditions. Each trial consisted of 24 corners, so in total, participants completed 384 repetitions of the steering task during practice, prior to retention and transfer tests.

Experimental conditions. Participants were randomly assigned to one of two process goal conditions and received written instructions detailing the cues that they were required to use while steering around bends. Participants in all conditions were instructed to keep their vision focused on the track at all times during the task. The goals were constructed with the assistance of two BASES accredited sport psychologists in line with driving instruction literature (Bentley & Langford, 2000; Senna & Howell, 1993).

Holistic process goal (HPG) group. Participants were instructed to focus on using the hands to turn the steering wheel smoothly when negotiating bends using the cue "smooth turns". Importantly, the focus here was on steering using hand movements and not on the steering wheel to avoid the potentially confounding effect of an internal versus external focus of attention (cf. Wulf, 2007).

Part process goal (PPG) group. Group members were instructed to focus on using the outside hand to turn into the corner in the most efficient way. For a left hand bend, this meant that the right hand (outside hand) primarily turned the steering wheel, while the left (inside) hand merely followed the movement. Participants were asked to use the cue *outside hand* to guide their hand movements. The focus in this condition was on the hand movement and not the steering wheel, which would constitute a proximal external focus.

Control group. Aside from being instructed to keep their visual focus on the track, participants in the control group were given no specific guidance as to how they should steer around bends.

Procedure. Participants were asked to refrain from practicing similar tasks between testing sessions. Participants attended the driving simulator individually and were told that the researcher was interested in the effects of concentration on a simulated driving task.

Day one. Participants completed five warm up laps, and then read instructions about their assigned goal, which they used for the duration of the study. Participants then completed two warm up laps of the track using their goal before completing the practice trials. Participants were reminded to use their goal before each practice block. On completion of the second acquisition block, participants received a three-minute break. When four acquisition blocks were completed, participants completed the manipulation check.

Day two. Participants repeated the procedure from day one but did not complete the familiarization session. During the three-minute break following the second block, participants completed the cognitive anxiety subscale of the CSAI-2R to establish state anxiety levels in a non-threatening condition.

Day three: Retention. Preliminary procedures were the same as day 2. Following two warm up laps, participants then completed the cognitive anxiety measure to provide an indication of state anxiety levels in non-threatening conditions, followed by two blocks of driving.

Transfer. After a three-minute break, participants received instructions informing them that they were involved in a competition and that they had been assigned to a team. Participants were told that the winning team would be the team who produced the fastest aggregate lap time and that each member of the winning team would win £10. Individual target times were assigned to participants, giving them a "false" time that they were told they had to achieve in order for their team to have a chance of winning the task. The target times were calculated by taking the participant's fastest lap time from practice minus 1.5 seconds. Pilot testing had indicated that participants perceived this target as challenging but realistic. In sum, participants perceived the target time as being of both personal and team importance, creating an ego-threatening situation that was likely to increase cognitive state anxiety levels. Following two warm up laps, participants again completed the CSAI-2R, and completed two blocks of driving. At the end of the last block, participants were thanked for their participation and debriefed about the true objectives of the experiment.

Results

Practice lap times and the number of driving errors were analyzed using two-factor mixed model analyses of variance (ANOVA; 3 x 8; Group x Block). Significant effects were followed up using Tukey HSD pairwise comparisons and polynomial contrasts to model the pattern of learning. We predicted that here would be significant linear and quadratic components; therefore, alpha for these contrasts was maintained at .05 for both lap times and driving errors. We had no specific predictions about the cubic trend; consequently, we adjusted alpha for these contrasts using a Bonferroni correction (.05 / 2 = .025). Retention and transfer data were analyzed using one-way ANOVA and significant effects were followed up using Tukey HSD tests. Cognitive state anxiety was analyzed using two-factor mixed ANOVA (3 x 2; Group x Anxiety Condition, with repeated measures on the second factor). Partial eta squared was also calculated, effect sizes of .02 are considered small, .15 are medium and .35 are considered large (Cohen, 1988).

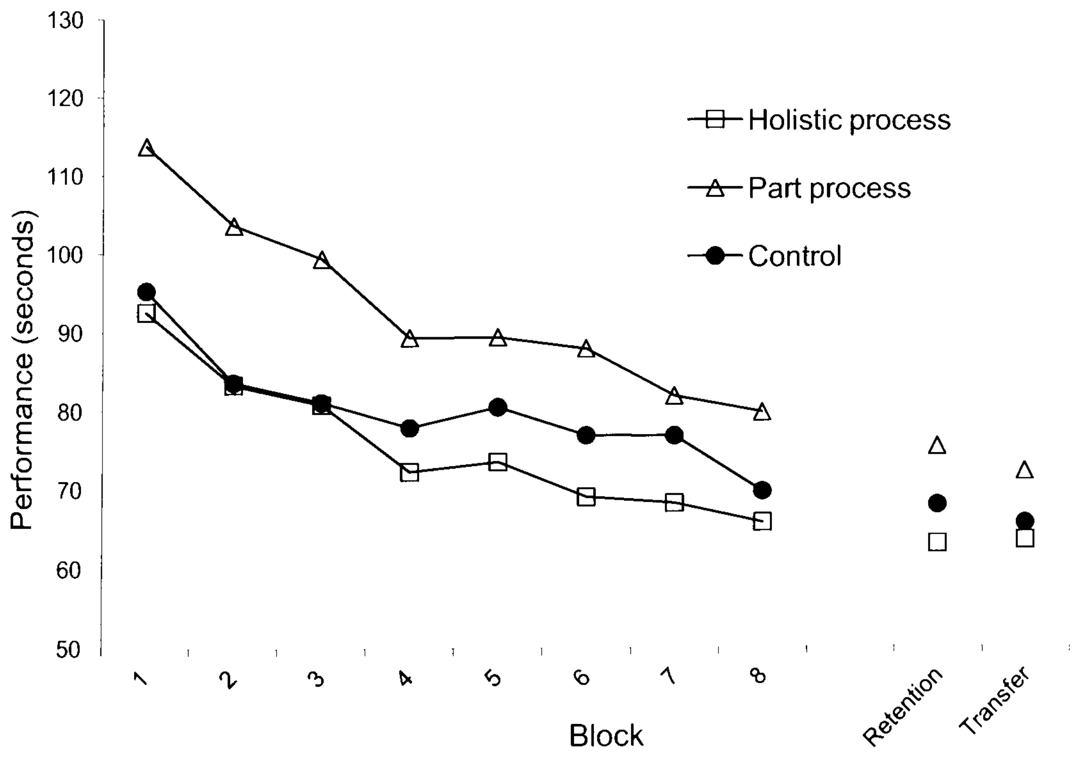

Figure 1. Mean lap time scores (secs) for the acquisition, retention and transfer blocks

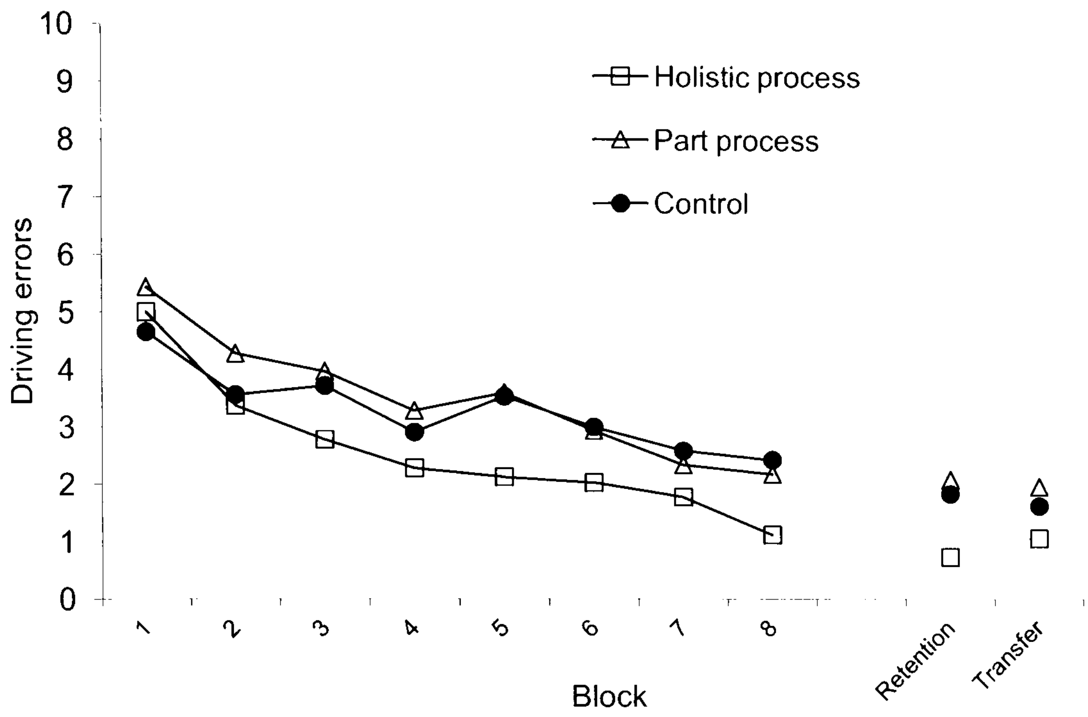

Figure 2. Mean number of driving errors for the acquisition, retention and transfer blocks

Manipulation check. Three participants, one from the PPG group and two from the HPG group, indicated that they did not use their assigned cue on one or more days of the study. The analyses were run with and without the problem participants. The results were identical and the full data set is reported here.

Practice. The equivalency of initial performance was assessed using a one-way ANOVA, with time to complete the first lap as the dependent measure. No group differences were found, $F(2, 21) = 2.14, p > .05$, indicating that the groups were equivalent at the start of the learning trials. Mean values for practice, retention and transfer phases are shown in Figures 1 and 2. For the analysis of the practice phase, Greenhouse-Geisser adjusted degrees of freedom were used to test within-subject F ratios as the sphericity assumption was violated for both lap times and number of driving errors. For lap times there was no significant main effect for group, $F(2, 21) = 3.01$, $p = .07$, $\eta_p^2 = .22$, or Group x Block interaction $F(5.08, 53.30) < 1$, $\eta_p^2 = .08$. The main effect for block was significant, $F(2.54, 53.30) = 30.18$, $p <$

.001, $\eta_p^2 = .59$, indicating that there were significant differences in performance across the learning blocks. These significant differences were explored using polynomial contrast analyses, which revealed significant linear, quadratic and cubic components, $F(1, 21) = 58.32$, $p < .001$, $\eta_p^2 = .73$; $F(1, 21) = 10.26$, $p < .01$, $\eta_p^2 = .33$; and $F(1, 21) = 5.17$, $p < .025$, $\eta_p^2 = .20$, respectively. This pattern was reproduced for the number of driving errors. The significant main effect for block, $F(7, 147) = 30.18$, $p < .001$, $\eta_p^2 = .59$, was also accompanied by significant linear, $F(1, 21) = 30.93$, $p < .001$, $\eta_p^2 = 0.60$; quadratic, $F(1, 21) = 5.59$, $p < .05$, $\eta_p^2 = .21$; and cubic, $F(1, 21) = 18.22$, $p < .001$, $\eta_p^2 = .47$, components. The significant linear and quadratic components represent the typical path of learning, with an initial large increase (linear trend), followed by a levelling off as performance increments became too difficult to achieve (quadratic trend). The significant cubic component indicated that the improvement in performance in the initial 4 blocks, levelled off between blocks 4 and 5 and subsequently increased again from block 5 until the end of the practice phase. Partial eta squared values were all considered either large or medium, indicating that these effects were all of practical significance.

Retention. For lap times, the ANOVA was significant, $F(2, 21) = 4.50$, $p < .05$, $\eta_p^2 = .30$. Tukey HSD pairwise comparisons revealed that the HPG group recorded faster lap times than the PPG group. No other comparisons were significant. There was no significant difference between the groups for the number of driving errors, $F(2, 21) = 2.32$, $p > .05$, $\eta_p^2 = .18$, indicating that the faster lap times were not achieved at the expense of accuracy.

Transfer. Cronbach's alpha coefficients indicated adequate internal consistency for the cognitive anxiety subscale of the CSAI-2R ($r = .76$). Analysis of variance revealed no significant Group x Anxiety Condition interaction or main effect for group, both Fs < 1. There was a significant main effect for anxiety condition, $F(2, 21) = 3.01$, $p = .07$, $\eta_p^2 = .22$, which confirmed that the anxiety intervention successfully increased cognitive anxiety.

Means, with standard deviations in parentheses, were as follows: the holistic process goal group increased from 19 (4.14) to 20.75 (5.44); the part process goal group increased from 17 (3.85) to 20.75 (4.27); and the control group increased from 18 (6.14) to 21.75 (5.50). The ANOVA on lap times yielded a significant difference between the groups, $F(2, 21) = 3.57$, $p < .05$, $\eta_p^2 = .20$. Post hoc tests indicated that the HPG group was faster than the PPG group, with no other differences significant. The medium effect size indicated that the performance difference of 8.73 secs was of practical significance. There were no significant differences between the groups for the number of driving errors, $F(2, 21) < 1$, $\eta_p^2 = .08$, duplicating the effect found in the retention phase and confirming that improvements in performance, i.e., speed, were not achieved at the expense of accuracy.

Discussion

The purpose of this experiment was to establish, relative to part process goals, whether holistic process goals would enhance performance during acquisition of a simulated race-driving task and also at retention and transfer. We also included a control group to examine the impact of discovery learning on acquisition of the driving task. As predicted, the HPG group outperformed the PPG group at both retention and transfer. The results for discovery learning were less clear as performance in the control group was no different from either the HPG or PPG groups at retention and transfer. There was no evidence for the strength of this effect during the practice phase as all three groups improved equivalently. Although there was no pre-test to confirm that the groups were equivalent, the analysis of times for the first lap did confirm that the groups did not differ significantly at the start of practice. The polynomial contrast analyses helped reveal the pattern of learning across practice for all three groups. The significant cubic component is best interpreted as a reflection of the structure of the practice phase. Specifically, the large improvement made during initial practice slowed somewhat over the course of day 1. Performance levels off between blocks 4 and 5, which consist of the final block of day 1 and the first block of day 2. The levelling off of scores represents the effect of warm-up decrement, or in this case, plateau (Schmidt & Lee, 2011). Subsequently, performance begins to gradually improve again across blocks 6 to 8.

The absence of any acquisition benefits for the HPG supports findings elicited with similar tasks in the related field of external and internal attentional focus. For example, Wulf, Hoß, and Prinz (1998) found that an external attentional focus did not impact on participants performing a stabilometer balancing task until retention. More importantly, in this experiment there was a clear advantage at retention and transfer, which supports the utility of HPG over PPG for both learning and performance under pressure. All of the previous research examining the utility of holistic process goals has adopted performance paradigms to compare holistic and part process goals in low and high anxiety conditions (Gucciardi & Dimmock, 2008; Jackson, Ashford, & Norsworthy, 2006; Mullen & Hardy, 2010), with no attention paid to how effective these goals might be for motor learning. The advantage demonstrated by the HPG group over the PPG at retention is the first evidence to show that HPG may be more effective than PPG for the acquisition of motor skills. The superior performance of the HPG over the PPG group at transfer adds further support to the work of Mullen and Hardy (2010) and Gucciardi and Dimmock (2008), who also provided evidence that HPG or global task cues are superior to PPG in conditions where anxiety is elevated. Despite the clear advantage proffered by the use of HPG over PPG, the control condition was no different from either process goal condition during practice, at retention, and at transfer. Further research is required to clarify this effect.

Experiment 2

Despite the positive effects reported in Experiment 1, the advantage enjoyed by the HPG group over the PPG group at transfer requires closer inspection. The adoption of the learning paradigm incorporating retention and transfer conditions enabled us to establish evidence supporting the efficacy of HPG; however, the design of the experiment tells us nothing about possible conscious processing effects hypothesized to be associated with part process goals. This is because the transfer analysis involved a single between-subjects comparison. To examine conscious processing effects, in addition to between-subjects comparisons, a within-subject comparison is required to establish whether the use of part process goals is associated with performance impairment in high relative to low anxiety conditions. Experiment 2 was designed to address this shortcoming using the same design adopted by Mullen and Hardy (2010) in their third experiment. Participants, who were assigned to either a holistic or part process goal group, learned the same simulated race-driving task as Experiment 1 using discovery learning and subsequently performed the task in a baseline condition and a competitive condition designed to elevate state anxiety. We predicted that a movement-focused HPG would be more effective than using a single movement-focused part process goal at preventing performance impairment under pressure. We also predicted that part process goals would lead anxious participants to begin to consciously process task-relevant information with resultant negative effects on task execution.

Furthermore, Mullen and Hardy (2010) failed to include some of the psychophysiological indices used in other studies examining Masters' CPH. For example, Mullen et al. (2005) proposed heart rate variability (HRV), estimated by spectral analysis of the cardiac signal, as a measure of the intensity of attentional processing associated with the shifts from automatic to controlled processing predicted by the CPH. Mullen and Hardy's findings would have been strengthened by the inclusion of such a measure in order to provide some additional insight into the psychophysiological processes underpinning conscious processing effects.

Heart rate variability is typically examined by spectral decomposition of the heart rate signal, which produces periodic components of HRV aggregated within three main frequency bands, each of which is associated with different functional influences in the modulation of heart rate. The first of these, the very low frequency band (.02 - .06 Hz), reflects thermoregulatory control (Grossman, 1992); the low-frequency band (LF; .07 - .14 Hz) is hypothesized to represent the cognitive loading associated with controlled processing (Fairclough & Mulder, 2011); finally, the high-frequency band (HF; .15 - .40 Hz) is related to momentary respiratory influences or respiratory sinus-arrhythmia (Grossman, 1992). Of these three bands, the LF band has more consistently responded to a range of manipulations that cause major changes in task structure and induce changes in the mode of operation, as in the shift from automatic to controlled processing (Jorna, 1992; Veltman, 2002). Evidence supporting this suggestion has been demonstrated in several studies that examined mental workload demands (Neumann, 2002; Veltman & Gaillard, 1998). Neumann and Thomas (2009) found additional support for the sensitivity of the LF band by comparing the HRV response of expert and novice golfers. Neumann and Thomas hypothesized that expert performance would be directed using automatic processes that are not resource-intensive, while that of novices would be under the direction of more resource-intensive controlled processing. The lower HRVLF response of the experts appeared to support this prediction, indicating that they expended less mental effort. In addition, the experts also had lower overall HR than the novices, indicative of lower overall effort expenditure. However, Neumann and Thomas's results should be interpreted with caution as they failed to include resting baseline measures of the cardiac variables. Research in this area is typically conducted using change scores from resting baselines (Mullen et al., 2005), or by including the resting baseline as an additional level in the statistical analysis (Veltman & Gaillard, 1996; Wilson et al., 2007b). The absence of any comparative baseline measure makes the interpretation of the HR power spectrum problematic.

While HRV has not been used to examine the cardiac activation states underpinning the use of holistic and part process goals, it has been used in research examining conscious processing effects. Mullen et al. (2005) found no effects of anxiety upon HRVLF in their study that examined whether conscious processing or attentional explanations could best account for anxiety effects upon the skill of golf putting. While there were no effects of anxiety on HRVLF, anxiety-related performance impairment was associated with changes in the HRVHF band, which the authors suggested might be related to changes in breathing-based relaxation strategies. Also using a golf-putting task, Wilson et al. (2007b) used HRV in a study to examine psychophysiological responses related to attention and anxiety. They also found that anxiety had no effect upon HRVLF but did report that self reported mental effort was sensitive to anxiety effects. Taken together, the results reported by Mullen et al. and Wilson et al. are inconclusive on the effect of attention and anxiety on HRV, although direct comparisons are difficult due to the different ways in which the cardiac data were collected, pre-processed and analyzed. Evidently, more research is required to establish how anxiety and goal focus interact to affect the cardiac activation states that underpin performance.

Part of the problem in using HRV to examine changes in mental effort related to increased anxiety, lies in the physiological origins of fluctuations in the LF band of the HRV power spectrum, which are thought to be reflective of both sympathetic and vagal activity (Berntson et al., 1997). Mullen et al. (2005) suggested that the lack of clarity might be because the hypothesized effort-related reductions[1] in the HRVLF band may have been

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[1] Reductions in HRVLF power from baseline conditions are representative of *increased* effort

masked by the impact of physiological responses to increased cognitive anxiety. Specifically, the sympathetic response to increased state anxiety may have "flooded" the LF band, resulting in large increases in spectral power from baseline, and in so doing, obscured the impact of mental effort in this band. Measures of sympathetic activity would help examine this suggestion. Typically, sympathetic activity is measured using impedance cardiography of the cardiac pre-ejection period (Sherwood, Allen, Obrist, & Langer, 1986), or plasma-borne catecholamine response (Nater et al., 2005). Unfortunately, the measurement of both PEP and plasma catecholamines are fairly invasive and the procedures themselves might lead to increases in state anxiety, confounding the effects of experimental manipulations. As such, a non-invasive marker of sympathetic activity would be preferable. Salivary alpha amylase (sAA) has emerged as a promising candidate to index stress-induced activity of the sympathetic nervous system (Wolf, Nicholls, & Chen, 2008). More specifically, Rohleder, Nater, Wolf, Ehlert, and Kirschbaum (2004) suggested that sAA could be used as an index of sympathetic activity based on the hypothesis that sympathetic and parasympathetic branches of the autonomic nervous system (ANS) innervate salivary glands. Nater et al. (2005) indicated that a significant increase in sAA, with heightened levels immediately after the stressor. Nater et al. also found that HRVLF and HRVHF increased in response to the psychosocial stressor utilized in their study. Chatterton, Vogelsong, Lu, Ellman, & Hudgens (1996) also highlighted that sAA could be an indicator for the activity of the sympathetic system. They revealed a significant correlation between alpha amylase and catecholamines in a physiological stress paradigm.

A measure of sympathetic activity would strengthen our understanding of the autonomic activity related to the HRVLF band. Therefore the second purpose of the present study is to extend previous research by employing both HRV and sAA to explore the psychophysiological activity of participants. Examination of HRV could provide some support for the suggestion that HPG encourage more efficient automatic processing, while PPG are associated with more effortful controlled processing. Using a PPG should result in greater reductions in LF spectral power from baseline relative to those associated with HPG use, reflecting the extra mental effort associated with controlled processing. To date, no previous studies have examined HRV or sAA as indices of the attentional processing associated with holistic and part process goals. We measured inter beat intervals and saliva in resting baseline, task baseline, and competitive conditions. In the competitive condition, we predicted that cognitive state anxiety would increase and that a HPG would enable participants to maintain performance, levels of HRV and self-reported effort close to those observed in the neutral condition, while a PPG would be associated with impairment of performance and increased mental effort.

Method

Participants. Thirty male and female students between the ages of 18 and 50 (M = 27.77, SD = 7.80) were recruited from a university in Wales to take part in the study. All participants had held a full UK driving licence for at least one year, and had minimal or no experience of race driving video games. The institutional ethics committee approved the study. Full informed consent was obtained from each participant.

Apparatus and measures. ***Race simulator.*** The apparatus for the driving task was as specified in Experiment 1, with the exception of the simulation game. In this experiment, participants completed the driving simulation using Colin McRae 2 race software (Codemasters, Warwickshire). A 3km tarmac track was selected that included 32 bends and the car was a Ford Focus. All other settings were as in Experiment 1. Performance was assessed using lap times recorded by the computer software. Performance was also measured using the number of driving errors committed and an index of error severity. An error was recorded if, (a) the car spun, changed direction, or crashed completely, (b) if the entire car came off the track, or (c) the car bumped or scraped the wall causing the fluidity of the car to be hindered but not resulting in a full crash. Error (a) was classed as the most severe and received a penalty of 3 points, error (b) resulted in a 2-point penalty, while error (c) was classed as the least severe and incurred 1 penalty point.

Cardiac variables. Heart rate was recorded by telemetry using a Polar S810s monitor (Polar Kempele, Finland). An elastic band fitted with a transmitter was worn around the chest and a Polar S810s watch was placed next to the participant, but out of their line of sight, to receive the signal. The Polar 810s has been shown to be a reliable and valid measure of R-R intervals (Gamelin, Berthoin, & Bosquet, 2006; Kingsley, Lewis, & Mason, 2005). Heart rate was recorded throughout the resting baseline, task baseline and competitive conditions. To standardize the epoch for spectral analysis, the middle 3 min of each measurement period was used. Artefact correction was conducted according to procedures set out by Mulder (1992) and used in previous research examining attention and anxiety (Mullen et al., 2005). The artefact-free data were detrended using a smoothness priors based approach (Tarvainen, Ranta-Aho, & Karjalainen, 2002).

Power spectrum densities (PSD) were estimated using autoregressive methods (Kubios HRV program, Biosignal Analysis and Medical Imaging Group, University of Kuopio, Finland). Compared to fast Fourier transforms, autoregressive algorithms produce a superior resolution, especially in short samples such as those used in the present study. Heart rate variability was estimated in the LF (07 – .14 Hz) and HF (.15 – .40 Hz) spectral bands. The PSD for the frequency band is reported in normalized units (ms^2). Previous research examining HRV and attention has largely used baseline-condition difference scores as dependent variables in subsequent statistical analyses. In this study, raw condition scores were used and the resting baseline condition is included as an additional repeated measure to ensure statistical analyses were consistent for all psychophysiological dependent variables.

Salivary alpha amylase. Using the passive drooling technique (Navazesh, 1993), unstimulated whole saliva samples were collected over a 4-minute period at three different time points using preweighted universal containers. Participants were given a familiarization session on day 1, prior to any testing. On day 2, a baseline measure of saliva was taken, followed by further samples immediately after the low and high anxiety conditions. Saliva flow is expressed as mg of saliva per min (mg/min) and was calculated by dividing the volume of saliva with collection time. Following completion of the experiment the samples will then be transferred into eppendorfs and stored at -20°C until analysed. Following thawing of samples, sAA was measured by enzyme kinetic method. Samples were diluted with double distilled water, a substrate reagent (α Amylase Assay Kit, Salimetrics, State College, Pennsylvania) was added and the microplate warmed to 37°. The first interference measurement was taken at 60 seconds using a standard ELISA reader (Anthos Labtech HT2, Anthos, Krefeld, Germany) the plate was incubated for another 2 minutes and then a second reading taken. The increases of absorbance were transformed in to amylase concentrations by using a linear regression calculated for the standard curve on each microplate (Curve Expert 1.34, Hyams D.G., Starkville, MS, USA).

Self-reported effort. Perceived mental effort was assessed using the Rating Scale of Mental Effort (RSME; Zijlstra, 1996), which has demonstrated acceptable reliability in laboratory (r = 0.88) and real-life work settings (r = 0.78). This retrospective one-dimensional visual analogue scale requires participants to rate how much mental effort they perceived they invested into a task on a vertical scale ranging from 0 (*not at all effortful*), through 115 (*tremendously effortful*), to 150 (*no anchor*). Participants are required to mark the scale at the point that best reflects the amount of mental effort invested in task performance. The RSME was administered following the task baseline and competition conditions.

General health. The General Health Questionnaire-12 (GHQ-12; Goldberg, 1992) was used to assess participants' psychological health (Rohleder et al., 2006). The questionnaire consists of 12 items that are rated on a 4-point Likert scale. A total score was calculated, with scores ranging from 0 to 36. Typical scores range from 11-12, scores over 15 show signs of some distress and scores of 20 plus, suggest severe problems and psychological distress. If participants reported scores of 20 plus they were excluded from the research.

Cognitive state anxiety. As in Experiment 1, the CSAI-2R was used to measure cognitive state anxiety.

Post-experimental questionnaire. The post-experimental questionnaire consisted of six statements answered on a 9-point Likert scale anchored by 1 (*not at all*) to 9 (*very much so*). The statements were: (a) I think I have completed the task as the instructions outlined; (b) I found it easy to use the goals; (c) The goal was relevant to my driving performance; (d) It was difficult to focus all my attention on my goal; (e) I feel that the use of goals helped my performance; and (f) Did you perceive your goal to be highly kinaesthetic in nature? (Feel of the movement).

Design. The experiment took place on two consecutive days. On the first day, participants were provided with no instructions or feedback on the driving task, and learned the driving task "by discovery", which allowed participants to explore the dynamics of the task (Vereijken & Whiting, 1990). Participants completed 14 double laps of the track, with each double lap consisting of 64 corners. So, in total, participants completed 896 repetitions of the steering task, more than double the amount of practice used in previous studies examining the CPH (Hardy et al., 1996; Masters, 1992; Mullen & Hardy, 2010).

On day 2, participants completed 5 double practice laps using their designated process goal. The practice laps were followed by two double laps in a task baseline condition and two double laps in the competition condition. The conditions were not counterbalanced due to concerns over the sAA measurement. Research demonstrates that levels of alpha amylase do not return to normal for up to 30 minutes post stress (Chatterton et al., 1996; Rholeder, 2006; Rohleder et al., 2004), hence in order to prevent confounding, a fixed order was used.

Procedure. Ethical approval for the study was obtained from the institutional ethics committee. Demographic and responses to the GHQ were collected before arrival at the driving simulator. The experiment consisted of six phases conducted over two days and modelled upon the design of Mullen and Hardy (2010). Phase 1 took place on day 1 and phases 2-6 took place on the second day.

Day 1. Phase 1: Skill Acquisition. During Phase 1, participants learned the driving task by "discovery" (Vereijken & Whiting, 1990). Participants completed 14 double laps of the track with a five-minute rest after laps 5 and 10. Participants then received a brief explanation of the next day's session and the experimenter's intention to pay them £10. Participants were also fully briefed on the procedure for collection of HR and saliva samples and practiced the saliva sampling. Participants were told that the practice sample would not be used for analysis but would simply allow them to become comfortable with the procedure. Participants were asked to sit unrestrained in a comfortable chair, and then asked to rinse out their mouths using de-ionized water. Participants then leaned over and held the universal container against their lips, as to allow a flow from the mouth into the container. The participants were then asked to swallow any saliva that was in their mouth and then began a 4-minute collection period where the saliva was passively transferred into the container without stimulation. Participants were asked to not brush their teeth or chew and to restrict eating to 3 hours before and drinking to 1 hour before attending the laboratory.

Day 2. Phase 2: Saliva and HR sampling and process goal training. The second day began with a 5-minute rest period to allow HR to stabilize, followed by a 5-minute recording of HR as a resting baseline. Participants were then asked to provide a saliva sample, which was also used as a resting baseline. Participants were then reminded about the structure of the second part of the experiment and provided with information about the nature and efficacy of process goals. The information served two purposes; the first was instructional and the second was to enhance participants' commitment and motivation to use the goals as requested. Participants self-selected their respective goals from master lists that were created using the procedures outlined in Experiment 1. In both process goal conditions, participants were instructed to keep their vision focused on the track at all times during the driving task. The three HPG all focused on the movement that participants used to manipulate the steering wheel when negotiating bends. Participants self-selected a single goal to use throughout the experiment. The goals were designed to so that they emphasized the feeling of the entire steering movement. The goals, "smooth", "glide", and "easy", were reinforced with instructions that reminded participants that the goal referred to the feeling of turning the steering wheel with their hands. Participants in the PPG group also selected a single goal, the first of which was "9.15 grip", which focused on maintaining a relaxed grip on the steering wheel, with hands in the 9 and 3 o'clock positions on the wheel throughout the turn. The second goal asked participants to use the goal "outside hand", which focused on using the outside hand to turn the steering wheel, so, for a left hand bend, this meant that the right hand (outside hand) primarily turned the steering wheel, while the left hand (inside hand) merely followed the movement. The final goal was "small", which required the participants to focus on making small adjustments to the steering wheel. The steering ratio was low enough to ensure that participants did not have to alter their grip in order to complete any of the turns, ensuring that both "9.15 grip" and "small" were realistic and achievable goals.

Phase 3: Warm-up. All of the participants were provided with the opportunity to practice using their selected process goal over one double lap.

Phase 4: Task baseline. Following the warm up, participants rested for 5-min. At the beginning of the fifth minute, participants were provided with neutral instructions about the next two double laps. Immediately following the rest period, the participants completed the CSAI-2R, and then drove two double laps, followed immediately by provision of a saliva sample. Participants then completed the RSME. There was then a 10-min rest period between the task baseline and competitive conditions, in which participants remained seated. This 10-minute rest period allowed any task-related psychophysiological changes to return to their baseline levels (Nater et al., 2006).

Phase 5: Anxiety intervention. During the final 5-min of the 10-min rest period, participants were provided with an instructional set informing them that they were about to take part in a race challenge and that the £10 they had been offered to participate in the study could change depending on how well they performed in the challenge. The anxiety intervention was structured in the same way as Experiment 1, with the exception that the task baseline time was used as the measure against which the "false" target time was anchored.

Phase 6: Competition phase. After reading the instructions, the participants filled in the cognitive anxiety subscale of the CSAI-2R, completed two double laps, provided a final saliva sample and then completed the RSME and the post-experimental questionnaire. Participants then received their competition prize money, were thanked for their participation and debriefed about the objectives of the experiment.

Results

Performance, CSAI-2R, and RSME scores were analyzed using mixed two-factor analysis of variance (ANOVA; 2 x 2, Group x Competition, with repeated measures on the second factor). Normal distribution of HRV and sAA scores was obtained using logarithmic transformations and main analyses were conducted using two-factor mixed ANOVA (2 x 3, Group x Time, with repeated measures on the time factor). The addition of the third repeated measure on the time factor was to accommodate the resting baseline measures of HR, HRV and sAA. Significant effects were investigated using Tukey's HSD tests.

Before examining the performance and cardiac variables, the post experimental questionnaire scores were examined to confirm that the participants had adhered to the treatment conditions, see Table 1. Mann Whitney U tests revealed that there were no significant differences between the part and holistic process goal groups (all $p > .05$).

Table 1. Mean (*SD*) post experimental questionnaire responses

Question	*M* (*SD*)
Q1	
Part process	8.13 (1.12)
Holistic process	8.14 (0.66)
Q2	
Part process	6.80 (1.65)
Holistic process	6.92 (1.38)
Q3	
Part process	7.73 (1.16)
Holistic process	7.14 (1.46)
Q4	
Part process	6.06 (2.37)
Holistic process	6.00 (2.85)
Q5	
Part process	6.53 (1.99)
Holistic process	5.35 (2.02)
Q6	
Part process	6.80 (1.14)
Holistic process	6.35 (1.39)

For cognitive anxiety, there was a significant main effect for competition, $F(1, 28) = 21.50$, $p < .001$, $\eta_p^2 = .22$, which indicated that both groups recorded higher scores in the competitive condition, see Table 2. Neither the Group x Competition, $F(1, 28) < 1$, $\eta_p^2 = .01$, or the main effect for group were significant, $F(1, 28) = 1.70$, $\eta_p^2 = .06$. In terms of driving performance, ANOVA yielded a significant Group x Competition interaction for lap times, $F(1, 28) = 7.83$, $p < .01$, $\eta_p^2 = .22$. Post hoc analysis revealed the PPG group posted quicker times than the HPG group in the task baseline, while the HPG recorded faster lap times in the competition condition compared to the task baseline. Main effects were not examined in light of the significant interaction. For the error scores, the multivariate test statistics for the Group x Competition interaction and the main effect for competition were not significant, $F(2, 27) < 1$, $\eta_p^2 = 0.02$ and $F(2, 27) < 1$, $\eta_p^2 = .02$. There was a significant multivariate main effect for group, $F(2, 27) = 4.10$, $p < .05$, $\eta_p^2 = .23$. Univariate follow-up ANOVA indicated that for both number of driving errors and error severity, participants in the PPG scored worse than those in the HPG, $F(1, 28) = 5.02$, $p < .05$, $\eta_p^2 = .15$ and $F(1, 28) = 6.47$, $p < .05$, $\eta_p^2 = .19$, respectively. The results indicate that the HPG group were faster in the competition that at task baseline, while the performance of the PPG group did not change. In addition the HPG made significantly less errors that the PPG group during both the task baseline and competition condition, indicating that the quicker lap times in the competition, were not achieved at the expense of driving accuracy. Effect sizes were all in the medium range, indicating the performance improvements, coupled with the fewer and less severe errors recorded by the HPG, were practically meaningful.

Table 2. Means (*SD*) for cognitive anxiety, lap times (seconds), number of errors, and error severity for task baseline and competition conditions

Variable	Task baseline	Competition
Cognitive anxiety		
Part process	13.69 (4.3)	16.46 (3.28)
Holistic process	15.33 (4.11)	18.66 (5.05)
Lap times		
Part process	235.06 (32.18)	237.13 (30.32)
Holistic process	269.20 (52.65)	236.40 (25.91)
Number of errors		
Part process	3.33 (4.15)	4.13 (2.97)
Holistic process	1.73 (2.21)	1.73 (2.05)
Error severity		
Part process	5.73 (7.36)	6.86 (4.79)
Holistic process	2.53 (3.24)	2.46 (3.13)

Turning to the psychophysiological variables, descriptive statistics can be found in Table 3. Due to equipment failure, heart rate data were not recorded for two participants, one in each group. Analysis of the HR data revealed a significant main effect for time, $F(1.51, 39.15) = 24.55$, $p < .001$, $\eta_p^2 = .49$; but no Time x Group interaction or main effect for group, $F(1.51, 39.15) < 1$, $\eta_p^2 = .00$ and $F(1, 26) < 1$, $\eta_p^2 = .02$, respectively. For HRVLF, there was no significant interaction, $F(2, 52) < 1$, $\eta_p^2 = .04$, or main effect for group, $F(1, 26) = 2.37$, $p > .05$, $\eta_p^2 = .01$. The main effect for time was significant, $F(2, 52) = 11.20$, $p < .001$, $\eta_p^2 = .30$. For HRVHF, there were no significant effects. Analysis of sAA revealed no significant Group x Time interaction, $F(2, 56) < 1$, $p > .05$, $\eta_p^2 = 0.02$, or main effect for group, $F(1, 28) = 1.13$, $p > .05$, $\eta_p^2 = .04$. There was a significant main effect for time for sAA, $F(2, 56) = 13.20$, $p < .001$, $\eta_p^2 = .32$. Post hoc analyses on the significant main effect for time for HR and sAA indicated that for both variables there was a significant increase from resting baseline to task baseline and further still from task baseline to the competition condition. For HRVLF, there were also changes across all three conditions, but in each case, these differences were reductions in LF spectral power. Analysis of the RSME scores yielded a significant main effect for competition, $F(1, 28) = 28.32$, $p < .001$, $\eta_p^2 = .50$, with mental effort perceived to be higher in the competition condition. There were no other significant effects (both Fs < 1). In summary, the anxiety intervention caused increases in HR, sAA and RSME, and a significant reduction in the patterning of HRVLF, and these meaningfully large effects (all $\eta_p^2 > .30$) were evident in both the part and holistic process goal groups.

Table 3. Mean (*SD*) HRV, HR, sAA, and RSME for the resting baseline, task baseline, and competitive conditions

Variable	Resting baseline	Task baseline	Competition
HRVLF			
Part process	409.78 (357.41)	217.78 (146.04)	179.67 (162.73)
Holistic process	677.85 (532.81)	394.94 (297.06)	212.57 (181.19)
HRVHF			
Part process	296.50 (317.86)	160.78 (224.33)	81.46 (55.03)
Holistic process	125.07 (53.87)	252.27 (264.77)	145.42 (155.55)
sAA			
Part process	7.66 (5.55)	9.59 (7.56)	13.34 (9.40)
Holistic process	8.97 (6.46)	12.96 (9.49)	18.44 (15.65)
HR			
Part process	72.27 (11.91)	80.41 (23.62)	84.64 (19.54)
Holistic process	69.27 (11.27)	77.44 (11.83)	81.37 (13.44)
RSME			
Part process		89.533 (19.66)	99.33 (17.91)
Holistic process		92.066 (22.90	101.33 (25.14)

Note: HRV values are raw values for ease of interpretation.

Discussion

Our prediction regarding the utility of holistic process goals was supported, as the HPG group outperformed the PPG group in the competition condition. There was a different pattern of effects from those found in Experiment 1 and other process goal studies (Mullen & Hardy, 2010). In this study the HPG group were significantly slower than the PPG group in the task baseline, while in the competitive condition, the HPG group improved their performance to a level equivalent to the PPG group; however, this improvement must be viewed in the context of the error scores. Participants in the HPG group made significantly fewer and less severe errors than the PPG across both task baseline and competitive conditions. Taken together, this pattern of results suggests that performance was equivalent at baseline, while the improvements in lap times made by the HPG in the competitive condition combined with fewer and less severe errors indicates that, overall, this group outperformed the PPG group. As such, the pattern of results for the performance variables supports the existing literature in this area (Gucciardi & Dimmock, 2008; Mullen & Hardy, 2010). The process goal instructions and the differential performance at task baseline suggest that the participants in the HPG and PPG groups may have achieved their performance scores using radically different strategies. In the low anxiety, baseline condition, the slower times recorded by the HPG suggest that they were focused more on driving smoothly and this resulted in less errors, but a slower time than the PPG group. In the competition, however, it appears that the strategy adopted by the HPG group enabled them to improve their lap times, while maintaining the error rate recorded at task baseline. Clearly the different process goals resulted in a different approach to the speed-accuracy trade off and a more detailed examination of how this was achieved would enable us to say more about the how strategies employed affected car control. For example, Wilson, Chattington, Marple-Horvat, & Smith

(2007a) used a potentiometer to measure the displacement of the steering wheel, which could help reveal how the process goal conditions affected the "smoothness" of the steering.

While it appears that HPG do offer a performance advantage over PPG when performers are anxious, there is no evidence that PPG cause lapses into conscious processing that impairs performance. This is in line with the series of experiments reported by Mullen and Hardy (2010) who suggested that the most parsimonious explanation for their findings was that conscious processing *was* activated. They argued that the relative impairment of the PPG group compared to the HPG group provided the basis for drawing the inference that such goals do cause conscious processing. Despite this position, there is still no evidence of direct conscious processing impairment in any of the experiments that have examined the process goal paradox.

Unlike previous studies that have reported no significant effects for the HRVLF band (Mullen et al., 2005; Wilson et al., 2007b), the results reported here indicate that HRVLF power decreased from the resting baseline to the task baseline and further still from the task baseline to the competitive condition. The increases in HR and sAA mirrored those of HRVLF across conditions, and are in line with our prediction that these variables would increase from rest to task and further still from task to the competitive condition as a result of increases in sympathetic activity. The dissociation between HRVLF and sAA and HR is in contrast to research that has examined HRV response to stressors (Nater et al., 2005; Wiethof, 1986, cited in Mulder, 1992). Wiethof recorded large increases in HRVLF in response to stressors and concluded that the achievement of optimal task performance was not associated with increased compensatory effort as reflected by reductions in power in the HRVLF band. In contrast, the results reported here suggest that the maintenance of optimal task performance *is* associated with decreases in HRVLF power. However, it is unclear whether this effort is related to changes in task processing (Fairclough & Mulder, 2011;

Veltman & Gaillard, 1998), or whether the effect is associated with compensatory mental effort (Eysenck & Calvo, 1992). As the decreases in HRVLF power were evident in both groups, we argue that the effect was more in line with Eysenck and Calvo's notion of compensatory effort. This explanation becomes more compelling when examined in light of the performance scores, which revealed that the HPG group improved their performance, while the PPG group maintained theirs in the competition condition; thus, performance effectiveness was maintained or improved but at the expense of processing efficiency in both groups. The RSME scores also add weight to this suggestion as they mirrored the increase from task baseline to competition condition HRVLF.

The inclusion of sAA gives us new insight into the competitive state anxiety response. The increases in sAA in both groups from resting baseline to task baseline and from task baseline to the competitive condition are in line with research that has examined the sAA response to psychosocial stress (Chatterton et al., 1996; Nater et al.; Rohleder et al, 2005). As a result of these studies, sAA has been supported as a measure of sympathetic activity. As such, the pattern of sAA in this experiment appears to support the contention that the decreases in HRVLF power represent increases in compensatory effort as participants appear to have mobilized resources to help deal with the perceived threat indicated by the increase in cognitive anxiety (Eysenck & Calvo, 1992; Eysenck, Derakshan, Santos, & Calvo, 2007). Although activity in the HRVLF band is mediated by both sympathetic and parasympathetic activity (Berntson et al., 1997), the absence of any differences in the HRVHF response, which is reflective of RSA, an established measure of parasympathetic activity (Berntson et al., 1997; Grossman, 1992), suggests that the changes in HRVLF activity in response to the competition stressor were primarily associated with sympathetic reactivity. The HRVLF response contrasts with that found in previous studies examining conscious processing effects (Mullen et al., 2005; Wilson et al., 2007b).

The absence of any clear conscious processing effects in the present study do not allow us to draw conclusions about the role of HRV in shifts from automatic to controlled processing. One solution to this problem may be to use stronger anxiety interventions, as although there were significant increases in cognitive anxiety in both of the experiments reported here, absolute levels of anxiety were lower than those typically reported by athletes in competition (Mullen et al., 2005). Alternatively, it is possible that the CSAI-2R, although a valid and reliable self-report tool, may be insensitive to the full complexity of the anxiety response, which has often been shown to be adaptive in nature (Eysenck & Calvo, 1992). The CSAI-2R, like the CSAI-2, is founded upon the traditional worry-emotionality conceptual framework (Liebert & Morris, 1967). Recent developments in the anxiety literature have suggested that this model is unable to fully capture the anxiety response and have extended the conceptual boundaries of anxiety measurement (Cheng, Hardy, & Markland, 2009). Measures derived from the work of Cheng et al. may prove more fruitful in successfully capturing the full influence of anxiety upon performance.

The post-experimental questionnaire (PEQ) indicated that there were no significant differences between the process goal groups in their experience of using their assigned goals. The questionnaire gave detailed feedback on participants' perceptions about their adherence to their assigned goal and the extent to which the goal helped or hindered their performance. The PEQ was more extensive than the manipulation check used in Experiment 1 and similar studies (Mullen & Hardy, 2010; Wilson et al., 2007b; Wulf, 2007). Manipulation checks are essential to be confident about adherence to treatment conditions and the PEQ indicates that this was adequate in both goal groups. However, the PEQ still only sheds limited light on the issue of participants' experiences and more sensitive open-ended questions need to be employed in future research.

Experiment 2 was not without limitations. The absence of counterbalancing is an issue; however, the rationale for the fixed ordering of conditions was based on pilot work for earlier studies (Mullen & Hardy, 2010), which indicated that where the competitive condition preceded the baseline condition, participants believed that the baseline was in fact a further competitive condition, despite instructions assuring them otherwise. In addition, the fixed order was partially determined by the sAA response to stressors, which can take up to 30-min to return to baseline, while recovery from tasks completed in neutral conditions is much quicker (Nater et al., 2006). One further suggestion made by the supervisory team was to use a within-subjects treatment of the process goal conditions. The author thought that repeated measures on the process goals might confuse participants and where such multiple treatment interference was a possibility, random assignment to separate goal conditions was preferred (cf. Mullen & Hardy, 2010). It is clear that HRV alone provides limited information about the mechanisms underlying changes in mental effort. Measures of sympathetic and parasympathetic activity are necessary to get a more complete picture of the mechanisms underlying changes in HRV. The innovative use of sAA in this experiment goes some way to achieving this.

Whilst both studies provide support for the efficacy of HPG, future research would benefit from considering the methodological differences and results reported in study 1 and 2. Firstly, a control group was included in study 1 to demonstrate differences in learning relative to the HPG and PPG groups and to address the suggestion made by Mullen and Hardy (2010) that future research should include a control group. Study 1 demonstrated that participants in control conditions behave no differently to those in either part or holistic process goal conditions. Having addressed this limitation in study 1, no control group was included in the second study for two reasons. Firstly, study 1 revealed that the results surrounding the control group were equivocal. This is unsurprising, as the goal setting literature has highlighted potential problems with using control groups in research in sport. Specifically, the literature has suggested that those in control groups will set spontaneous goals (Locke, 1991); as such these groups have the potential to produce a confounding effect on the results. Where study 1 was a learning paradigm, the inclusion of a control was essential in attempting to demonstrate the learning effects of HPG and PPG. Study 2 adopted a performance paradigm in which the focus was to establish how the HPG and PPG groups performed under stress. Due to the equivocal effects found in the first study and the issues surrounding control groups discussed in the goal setting literature, a decision was made to return to a design in which only the relative effectiveness of part and holistic process goals was examined. Future research might consider including control groups and examining the focus of participants performing in these conditions.

There were also differences between studies 1 and 2 in terms of how participants used their assigned process goals. In study 1 participants used an imposed holistic or part process goal, while in study 2 participants were able to select from a choice of three holistic or part process goals. Self-selected process goals are the preferred option as Jackson and Willson (1999) demonstrated that participants who use such goals outperform those who use assigned goals. However, in the first study of this thesis, the participants were novices and assigned goals were used as participants would not have possessed sufficient explicit knowledge of the task to formulate meaningful and relevant process goals at the beginning of the learning phase. Study 2 was designed so that after an initial phase of discovery learning participants would be able to select an appropriate goal that was meaningful for them. Finally, differences were also reported in the performance of the HPG groups in study 1 and study 2. Specifically, in study 2 the HPG group was outperformed by the PPG group in the low anxiety condition, while in study 1 the HPG group performed better than the PPG group in the retention condition. This discrepancy can be explained by the suggestion that the HPG group in study 2 were unfamiliar with the concept of a holistic focus, while those in study 1 had used their HPG as they acquired the skill in the practice phase.

Conclusion

In summary, the two experiments reported here provide more evidence for the efficacy of holistic process goals. In addition to extending the literature that indicates that holistic process goals are more effective than part process goals for skilled but anxious performers, experiment 1 indicates that holistic process goals are more effective for learning. Therefore, where process goals form part of a strategy to deal with competitive state anxiety, competitors should be encouraged to use holistic rather than part process goals. Similarly, where pre-performance routines form part of the preparation for task execution, such routines typically have process goals as a central feature (Hardy, Jones, & Gould, 1996). The results presented here suggest that the routines should incorporate HPG. In addition, although it appears that HPG proffer no advantage to performance during practice, the benefits realized at retention in Experiment 1 indicate that such goals should be preferred to PPG, which result in weaker learning and less resilient performance under pressure.

Chapter 4

Literature Review 2

The first two chapters of this thesis offered more promising support for the use of holistic process goals as a means of ameliorating the potentially negative effects of performance anxiety. There are several ways in which the first two experiments could be followed up in subsequent studies. One issue that requires exploration is the role of mental effort, which clearly plays an important role in performance anxiety effects; however, it is unclear whether this role is one of moderation or mediation. One possible avenue for the next study would be to design an experiment to differentiate between possible moderation and mediation effects. Alternatively, or in addition, the psychophysiological measures used in experiment 2 could be expanded to provide a more complete picture of the activation states underpinning performance anxiety effects. For example, respiratory measures would provide a more complete picture of the respiratory effects in the HRVHF spectral band. Similarly, measures of blood pressure and/or the cardiac pre-ejection period would bolster the use of sAA as an indicator of sympathetic activity. There also remain doubts about several aspects of the research paradigm used to examine the effects of process goals. The first of these involves the use of laboratory experiments to examine the effects of competitive state anxiety upon performance (Pinder, Davids, Renshaw, & Araújo, 2011). Field-based studies and qualitative exploration of athletes' goal setting strategies during stressful competitions would complement the experimental research conducted to date. The second, and perhaps more pressing issue involves the measurement of anxiety. The first two studies in this research programme relied upon the manipulation of state anxiety as the basis for the experimental designs. As such, the measurement of performers' anxiety responses is an important issue. The programme has thus far relied upon the revised Competitive State Anxiety Inventory-2 (CSAI-2R; Cox, Martens, & Russell, 2003) to measure participants' response to the anxiety interventions. However, several researchers have questioned the validity of the CSAI-2, issues that have not necessarily been addressed in Cox et al.'s revision. For example, research addressing performers' directional interpretations of their affective state using a modified version of the CSAI-2 has provided empirical evidence that performers can interpret statements in the CSAI-2 quite differently (Jones & Hanton, 1996; Jones, Swain, & Hardy, 1993). Furthermore, the items included in the CSAI-2R may not have represented the most important aspects of performance anxiety for the novice drivers recruited for studies 1 and 2.

Despite the developments outlined above, the absence of an equivocal conscious processing effect in the first two studies of this thesis may be due to the manner in which the performance anxiety response is measured. Whilst the participants in both studies reported significant increase in anxiety, as indicated by the CSAI-2R, there remains a serious question over the integrity of this measurement method. In particular, recent developments have highlighted some important issues with the CSAI-2R and the earlier CSAI-2. Specifically, the integrity of the model on which the CSAI-2 is based on has been criticised (Cheng, Hardy, & Markland, 2009). The CSAI-2 and the CSAI-2r are both derived from a traditional conceptualisation of anxiety based upon worry and emotionality (Liebert & Morris, 1967), which describes a rather simplistic approach to the anxiety response. More specifically, the suggestion that cognitive anxiety is represented by a worry component alone is questionable. Recently, Cheng, Hardy and Markland (2009) have suggested that an alternative model of performance anxiety is needed, a model that may better reflect our current understanding of the complex anxiety-performance relationship. Clearly, measurement of anxiety remains a critical issue within the sport psychology literature, particularly as much of the research relies heavily on the CSAI-2 and CSAI-2R as measurement tools. Addressing this issue is crucial in order to ensure the integrity of experimental research. Therefore, to elaborate on this issue, a more detailed review of issues associated with the measurement of performance anxiety will follow.

Due to its prominence in sport psychology, it is not surprising that the measurement of performance anxiety has received considerable attention (Burton, 1998). However, despite this importance, in a recent publication reviewing measurement in sport and exercise psychology (Tenenbaum, Eklund, & Kamata, 2012) there is no specific section that examines the measurement of performance anxiety. It would seem rather counterintuitive that such an important concept would be absent, especially as anxiety remains to be such a prominent concept in recently developed theories such as attentional control theory (Eysenck, Derakshan, Santos, & Calvo, 2007). The author is of the opinion that the measurement of anxiety does require further attention to ensure an appropriate measurement instrument is available for sport psychology researchers and practitioners.

As discussed earlier, the CSAI-2 (Martens et al., 1990), was developed from multidimensional anxiety theory (MAT; Martens, Vealey, & Burton, 1990) and had become the gold-standard measure of state anxiety in sport. The CSAI-2 has three subscales; cognitive anxiety, somatic anxiety and self confidence. Items on the cognitive subscale include: "I am worried about performing poorly" and "I am concerned about losing", and items on the somatic subscale include: "I feel jittery" and "My heart is racing". Items for the self-confidence subscale include: "I feel self-confident" and "I am confident I can meet the challenge". Typically, the CSAI-2 is administered an hour before a competitive event and produces a score for each of the subscales as an indication of state anxiety. Participants complete the questionnaire by rating the intensity the symptoms they experience, thus the score represents the *amount* of competitive anxiety. However, a number of researchers have recognised that the score of the CSAI-2 is only indicative of the intensity of symptoms and not the meaning of those symptoms to the individual (Burton, 1990; Edwards & Hardy, 1996). Crucially, in relation to the CSAI-2, many of the symptoms listed are worded relatively neutrally, and as such could be characteristic of positive affective states. For example, the cognitive anxiety item "I am concerned about this competition" or the somatic item "I feel nervous", may be both be interpreted by some individuals as negative and detrimental to performance, but some individuals may view the same symptom as positive and facilitative to performance (Jones & Hanton, 1996; Jones, Swain, & Hardy, 1993). Thus, using the intensity only scale, if individuals report a high rating on these symptoms, they are viewed as a reflection of high cognitive or somatic anxiety, and assumed to be a negative response, even though they may actually reflect positive emotional states.

The notion that anxiety can be viewed as a positive emotion with the potential for facilitative effects was first reported by Mahoney and Avener (1977) who revealed that Olympians used their anxiety as a stimulant to better performance. Researchers confirmed the potential positive response, and suggested that anxiety-related symptoms could be perceived as facilitating in mental preparation and performance (Hardy, 1990; Burton, 1990). Moreover, Swain and Jones (1996) revealed that direction of competitive anxiety was a better predictor of basketball performance than intensity. The recognition of interpretations has led researchers to include a directional rating in the CSAI-2, to account for the facilitative and debilitative potential of anxiety (Jones & Swain, 1992). Therefore, the intensity portion reflects the strength of the anxiety symptom, whilst the direction portion reflects whether athletes perceive the symptom to either facilitate or debilitate performance. Despite these developments, several limitations have been noted in the construction of the direction dimension of competitive anxiety symptoms. Firstly, neither intensity, nor direction dimensions have accounted for much variance in performance (Jones, Swain, & Hardy, 1993). In addition, Edwards and Hardy (1996) suggested that the length of the modified CSAI-2 may be excessive with the addition of the direction scale. Finally, from a conceptual perspective, some have questioned whether facilitative anxiety is really a form of anxiety.

Rather, the positive interpretation of anxiety symptoms may be more appropriately labelled as "excitement" or "motivation" (Jones, 1995; Jones & Swain, 1992).

While Jones and colleagues have focused upon developing the directional component of the CSAI-2, others have concentrated upon examining the factor structure of the original inventory. Lane et al. (1999) performed Confirmatory Factor Analysis (CFA) on a sample of 1,213 CSAI-2 questionnaires. The results revealed unacceptable fit indices for the original CSAI-2 model. These results have been attributed to a number of issues; specifically, researchers have debated the inclusion of self-confidence due to its fortuitous emergence during the initial exploratory analysis of the CSAI-2. Martens et al. (1990) retained the self-confidence component within the CSAI-2; however, a number of researchers have argued that there is substantial evidence to suggest that self-confidence is an independent construct (Hardy, 1996a; Woodman, & Hardy, 2003). Furthermore, Woodman and Hardy also suggested that the terminology used in the cognitive anxiety subscale may have contributed to the poor validity of the CSAI-2. Woodman and Hardy reported that eight of the nine cognitive anxiety items in the measures used the initial phrase of "I am concerned". The use of the term "concern" was viewed as ambiguous and it was suggested that it may represent a perception of the importance of an upcoming event, rather than worry or cognitive anxiety. One suggestion would be to begin the initial phrase of items with "I am worried" in order to present a more suitable representation of cognitive anxiety.

In an attempt to improve on the factor structure of the CSAI-2, Cox, Martens and Russell (2003) produced the CSAI-2R. Using CFA and a calibration and validation sample, Cox et al. set out to improve the fit of the CSAI-2. The calibration analysis on a sample of 503 participants' revealed a poor factor structure. However, when 10 items from the CSAI-2 were removed, fit was greatly improved. The remaining items were administered to a validation sample of 331 participants, and this revised CSAI-2 revealed a good fit to the data.

Cox et al. concluded that the CSAI-2R had stronger psychometric properties than the CSAI-2, and should be used in future sport psychology research.

Despite these revisions, fundamental problems still remain with multidimensional models of performance anxiety founded upon the worry emotionality distinction (Liebert & Morris, 1967). Even though the cognitive and physiological responses incorporated in the model appear sound, its suitability to reflect the adaptive nature now acknowledged as a key component of anxiety must be questioned. In response to these issues Cheng, Hardy, and Markland (2009) attempted to address some of the limitations inherent in the CSAI-2 and its derivatives by proposing a new three-dimensional model of performance anxiety. The model was developed in order to account for the advancements in the literature and the potentially adaptive nature of performance anxiety. In addition to the retention of a traditional cognitive and physiological dimension, Cheng et al.'s proposed three-dimensional model included a regulatory dimension to account for the adaptive nature of the anxiety response.

The regulatory dimension included in Cheng et al.'s (2009) model was characterized by perceived control. The idea of control has proven a crucial component in a number of anxiety theories (e.g., Carver & Scheier, 1988; Eysenck & Calvo, 1992). Most recently, attentional control theory (Eysenck et al., 2007) included a control system, which serves to monitor and evaluate performance and consequently plan and regulate processing resources. In addition, Cheng et al. examined the control function from an evolutionary perspective. In that the anxiety response is suggested to stem from a defence mechanism against potential danger (Ohman, 2000), and anxiety achieves this defence by detecting threat and mobilising resources for action (Calvo, Avero, Castillo, & Miguel-Tobal, 2003). Consequently, Cheng et al. claimed that their proposed model was representative of a more balanced and neutral viewpoint that reflects the maladaptive and adaptive nature of the anxiety construct.

Within sport psychology, some attempts have been made to represent this adaptive capacity within integrated models of anxiety. Hardy and Whitehead (1984) included an "activation" dimension in their measure of rock climbing anxiety. Specifically, the activation dimension referred to cognitive and physiological activity geared towards preparing a planned response to an anticipated situation (cf. Pribram & McGuiness, 1975). In addition, Jones' (1995) control model of competitive sport anxiety, adapted from Carver and Scheier's (1986, 1988) theory of self-regulation, included a directional interpretation of anxiety symptoms, which is representative of the adaptive feature. Despite empirical evidence supporting Jones' model, the regulatory dimension outlined by Cheng et al. differs in two fundamental respects. Firstly, the directional interpretation proposed by Jones was not integrated into a model of anxiety. Moreover, some researchers have suggested that the notion of "facilitative" anxiety is a mislabelling of positive affective states (Jones, Hanton & Swain, 1994; Jones & Hanton, 2001). In Cheng et al.'s model, anxiety was viewed as being potentially adaptive, which may lead to positive effects. Secondly, Jones' model is characterized by the athlete's interpretation of their anxiety symptoms. Crucially, athletes may be incapable of interpreting their symptoms in certain circumstances, for instance athletes may repress or deny their anxiety symptoms as a form of coping (Hippel et al., 2005) and/or may simply be unable to detect their current psychological state due to poor insight (Egloff & Schmukle, 2002). Thus, the model proposed by Cheng et al. differs as it represents the regulatory dimension through perceived control, rather than indirectly via symptom interpretation.

In addition to the inclusion of a regulatory dimension, Cheng et al. (2009) also wished to expand the traditional worry-emotionality model on which the cognitive and physiological dimensions are based (Liebert & Morris, 1967). Cheng et al. included more components to better reflect the performance anxiety construct. In the physiological dimension, Cheng et al.

adopted the criteria used for generalized anxiety disorder in the *DSM-III-R* (APA, 1987). The criteria are characterized by a distinction between the voluntary and involuntary muscle structures of the anatomical structure and Cheng et al. suggested that the physiological dimension should reflect this distinction. As a result, Cheng et al.'s physiological dimension comprised autonomic hyperactivity to reflect the involuntary response, and somatic tension to reflect the voluntary response. This differentiated approach fits with longstanding suggestions that different arousal states may impact different aspects of performance (Hockey & Hamilton, 1983; Neiss, 1988). In terms of the cognitive response, Cheng et al. suggested that the cognitive dimension should be reflected by a worry component and a self-focus component. Again, this is in line with much of the performance anxiety literature, which suggests that different cognitive responses may impact on different aspects of performance. Specifically, worry is acknowledged as a major component of processing efficiency theory (Eysenck & Calvo, 1992), while self-focused attention is central to Carver and Scheier's (1988) anxiety perspective.

Cheng et al.'s (2009) model of performance anxiety consisted of three dimensions and five subcomponents; cognitive anxiety, reflected by worry and self-focused attention; physiological anxiety, reflected by autonomic hyperactivity and somatic tension and a regulatory dimension, reflected by the single subcomponent of perceived control. Cheng et al. developed their Three Factor Anxiety Inventory (TFAI) to test the proposed hierarchical model. Initial testing with two independent sample groups attempted to support this five-factor model. Although the authors provided a strong conceptual argument for the five distinct components of performance anxiety, CFA did not support the hypothesized model; hence, worry and self focus, and somatic tension and autonomic hyperactivity were merged in to two respective single factors. This final parceled three-dimensional model exhibited an excellent fit to the data, with Robust χ^2 (32) = 47.9, p = .01; RMSEA = .04, NNFI = .99, cfi =

.99 and SRMR = .05. As such, the hierarchical relationships between the second and first order factors were not supported. Instead, the results supported a first-order three-dimensional model of performance anxiety.

In addition to the favourable CFA results, the three-dimensional model has demonstrated promising predictive validity (Cheng, Hardy, & Woodman, 2011). Cheng et al. used a sample of 99 tae-kwon-do competitors and administered the TFAI 30 minutes prior to competition, and a subjective measure of performance within 30 minutes following competition. The results of a moderated hierarchical regression analysis revealed initial support for the predictive validity of the three factor model as a measure of performance anxiety. The regulatory dimension accounted for a large proportion of performance variance. Performance was best under high perceived control, which supports Cheng et al.'s (2009) proposition that the regulatory dimension of anxiety would have a crucial impact on performance. In addition, the results provide some support for the suggestion that cognitive anxiety may positively predict performance. This effect was only significant once the interaction of perceived control and physiological anxiety was included, suggesting that the importance of cognitive anxiety was enhanced by the other predictor variables. The interactive effects of the anxiety variables made a significant contribution to performance variance once the main effect had been accounted for. Interestingly, the interaction between perceived control and physiological arousal was a significant predictor of performance.

In addition to the theoretical issues associated with the accurate measurement of performance anxiety, there has been little focus on the *specification* of measurement models. Specifically, the issue of causality has received little attention. Traditionally, behavioural researchers have typically studied latent factors thought to cause measured variables (Hair, Black, Babin, & Anderson, 2010); however, in certain constructs the causality can be reversed. These two approaches are known as reflective measurement models and formative measurement models. Reflective measurement models are based on the assumption that latent constructs cause the measured variables. Formative measurement models are based on the assumptions that the measured variables cause the construct (Bollen, 1984).

Typically, in measurement and conceptual development researchers have focused on the structural elements of models rather than on the relationship between measures and their relevant latent constructs (Jarvis, Mackenzie, & Podsakoff, 2003). This has resulted in many constructs being treated alike, regardless of whether a construct was inherently formative or reflective. This is an issue that has been overlooked in sport psychology measurement. Often measurement models are tested using CFA, which specifies models as reflective (Chin, 1998). Whilst, it is appropriate to model some conceptual measures like this, reflectivity does not apply to all constructs (Bollen & Lennox, 1991). This potential misspecification in measurement models results in researchers making inaccurate conclusions between the structural relationships linking constructs. In terms of performance anxiety measurement, the correct specification of future models may prove a necessary method in accurately representing performance anxiety. This issue will be revisited in more depth in the introduction to Chapter 6.

Summary

In summary, the measurement of performance anxiety has remained a challenge, and this review has presented some of the developments and issues discussed in the more recent literature. The CSAI-2 and the CSAI-2R have continued to be the gold-standard measures of performance anxiety, despite the limitations highlighted in the literature (Cheng, Hardy & Woodman, 2009; Woodman & Hardy, 2001), and up until recently research has not challenged the dominance of this measurement method. Specifically, the CSAI-2 is based on an outdated and simplistic conceptual model, thus, it is unclear if researchers are accurately measuring the whole anxiety experience manifested in research studies. Cheng et al. (2009) model is the first to challenge the CSAI-2 and presents an alternative three-dimensional conceptualization to represent performance anxiety. The model proposed by Cheng et al., is the first to account for the adaptive nature of performance anxiety and to extend the traditional worry-emotionality dimensions, in an attempt to reflect a more accurate picture of performance anxiety. Although Cheng et al. make considerable advancements in the representation of performance anxiety, further research is required. Cheng et al.'s originally proposed a five dimensional hierarchical model, which was not supported statistically; however, a more detailed examination of these dimensions may produce more satisfactory statistical results. Furthermore, the establishment of construct validity is an ongoing process (Smith & McCarthy, 1995), warranting continued research into the conceptual representation and measurement of the performance anxiety construct.

Therefore, the purpose of the second half of this thesis is to re-examine the model of performance anxiety presented by Cheng et al. Thus the focus of the thesis shifts from an examination of process goals to validation of a new measurement model of performance anxiety. As noted above (p.77) in order to extend the research presented in study 1 and 2, the author feels that this validation process is required to ensure the inclusion of a strong measurement tool in future experimental and field-based research. There are already too many studies that criticize the measurement of anxiety and then continue to use these tools in subsequent research (e.g. Mullen, Hardy, & Tattersall, 2005). The following two studies will use both qualitative and quantitative methods to re-examine the measurement model presented by Cheng et al.

Chapter 5

A qualitative investigation of the cognitive dimension of performance anxiety

(Study 3)

Abstract

Cheng, Hardy and Markland (2009) proposed a three-dimensional model of performance anxiety, consisting of cognitive, physiological and regulatory dimensions. The cognitive dimension was hypothesized to consist of two subcomponents; worry and self-focus. Confirmatory factor analysis revealed weak discriminant validity between worry and self-focus and the two components became part of an overall cognitive dimension within the model. In pursuit of a clearer understanding of the cognitive component of anxiety and its impact on performance, a qualitative analysis of athletes' thoughts and feelings regarding a highly anxious competitive event, aimed to further explore this area. Worry, private self-focus and public self-focus were predicted to account for the cognitive anxiety response of the athletes. Eleven elite athletes, who reported experiencing high state cognitive anxiety before competing, took part in semi-structured interviews. Modified analytic induction was adopted to explore athletes' thoughts and feelings in regards to a competitive event, in which they experienced high levels of anxiety. Results revealed support for three subcomponents of cognitive anxiety; worry, private self-focus and public self-focus. These three factors suggest that Cheng et al.'s original conceptualization of the cognitive component of anxiety may have been too narrow.

Keywords: *anxiety, worry, private self-focus, public self-focus.*

Introduction

The study of performance anxiety has been a consistent feature of the last 20 years of sport psychology research. Despite this attention, the nature of the performance anxiety response is still a contentious issue (Cheng, Hardy, & Markland, 2009; Woodman & Hardy, 2001). Typically, anxiety is conceptualized as a multidimensional construct consisting of worry and emotionality subcomponents (Liebert & Morris, 1967) that are measured using the Competitive State Anxiety Inventory-2 (CSAI-2; Martens, Vealey, & Burton, 1990) and its derivative, the revised CSAI-2 (CSAI-2R, Cox, Martens, & Russell, 2003), which have become the gold standard measures. Recently, Cheng et al. (2009) proposed a three-dimensional model of performance anxiety that set out to account for some of the limitations inherent in the conceptualizations of anxiety underpinning traditional measurement tools such as the CSAI-2. In addition, Cheng et al. also set out to construct a model that was able to account for the mixture of positive and negative consequences of increased anxiety for sports performance consistently reported in the sport psychology literature but outside the explanatory scope of measurement tools built around traditional worry-emotionality models.

To underpin their model, Cheng et al. (2009) defined anxiety as "an unpleasant psychological state in reaction to perceived threat concerning the performance of a task under pressure" (p. 271). Cheng et al.'s model of performance anxiety consisted of three dimensions and five subcomponents; cognitive anxiety, reflected by the subcomponents of worry and self-focused attention; physiological anxiety, reflected by autonomic hyperactivity and somatic tension and a regulatory dimension, reflected by the single subcomponent of perceived control. The inclusion of the regulatory dimension reflected the adaptive nature of the anxiety response, which is potentially mediated through mechanisms such as compensatory effort (Eysenck & Calvo, 1992) and energizing and focusing effects (Carver & Scheier, 1986). In addition, Cheng et al. argued that the inclusion of the regulatory dimension is more in line with the evolutionary perspective, which views anxiety as a defense mechanism (Ohman, 2000). Furthermore, the mobilization of resources to provide energy for action, has become a key feature of other contemporary anxiety theories (e.g., attentional control theory, Eysenck, Derakshan, Santos, & Calvo, 2007).

In addition to the regulatory dimension, Cheng et al.'s (2009) framework also included a multidimensional approach to both physiological and cognitive anxiety, built on the premise that a conventional model based upon worry and emotionality would fail to fully capture the complexities of the anxiety response. Indeed, many researchers have identified other important variables and argued that the complexity of the anxiety response may be better reflected by the inclusion of more components (e.g., Hatgvet & Benson, 1997; Schwarzer & Jerusalem, 1992). To differentiate the subcomponents of physiological anxiety, Cheng et al. applied the criteria used for generalized anxiety disorder in the *DSM-III-R* (APA, 1987). The two physiological subcomponents of autonomic hyperactivity and somatic tension were defined in accordance with the anatomical structure of voluntary versus involuntary muscle structure. This differentiated model of physiological anxiety is also in line with suggestions that different arousal states may impact different aspects of performance in dissimilar ways (Hockey & Hamilton, 1983; Neiss, 1988). In terms of the cognitive anxiety dimension, Cheng et al. also provided a strong conceptual argument for the separation of worry and self-focus as distinct subcomponents of cognitive anxiety, contending that individuals manifest anxiety differently in different performance contexts. For example, increases in self-focus might lead highly-skilled but anxious individuals to attempt to consciously control movements, interfering with normal task automatic processing (Masters, 1992), an effect not obviously implicated in the content of worry. Thus, Cheng et al.'s cognitive dimension contained worry and self-focused attention, which was defined as an attentional shift to a self-evaluative state with an increased awareness of self-shortcomings concerning performance of a task under pressure.

Initial testing, with two independent sample groups, attempted to support this hierarchical model. The confirmatory factor analysis (CFA) results did not support the hypothesized dissociation, between the cognitive subcomponents (worry and self-focus) or the physiological subcomponents (somatic tension and autonomic hyperactivity), which resulted in the authors presenting a three dimensional model of performance anxiety. Somatic tension and autonomic hyperactivity were merged in to a single factor to represent the physiological dimension. Similarly, worry and self-focus were merged into a single factor to represent the cognitive dimension. While this merged model provided further support for the importance of the cognitive dimension in models of performance anxiety, it lends little support to a two-subcomponent (worry and self-focus) approach. A multidimensional approach to the cognitive dimension appears to be worthy of further investigation, as not all cognitions that are experienced by athletes in competitive events are manifested as worries (Dunn & Syrotuik, 2003).

The conceptual development of cognitive anxiety is particularly important, as it is commonly perceived to be one of the most significant influences on performance (Eysenck & Calvo, 1992; Woodman & Hardy, 2003). For example, a central assumption in Eysenck and Calvo's (1992) processing efficiency theory is that individuals in an anxious state regularly worry about the threat to current goals. As a result, these "worrisome" thoughts have the potential to interfere with performance as they use up attentional resources ordinarily allocated for the demands of the performance. These performance effects have received significant support and evidence for the inclusion of worry within a cognitive anxiety dimension is clear; however, researchers have argued that more components are needed to better reflect the complex nature of the cognitive dimension of anxiety (Sarason, 1984; Schwarzer & Jerusalem, 1992). For example, Sarason proposed an empirically derived model of anxiety that included four components, worry, test-irrelevant thinking, tension and bodily symptoms.

Self-focused attention has also been reported as an important component in understanding anxiety (Gibbons, 1990), and its inclusion alongside worry in Cheng et al.'s (2009) model would appear to be conceptually sound. Cheng et al. suggested that self-evaluation provides the theoretical link between self-focus and anxiety. Specifically, the theory of objective self-awareness (Duval & Wicklund, 1972) suggests that self-focus leads to a self-evaluative state, which researchers suggested might be one of the main processes of anxiety (Gibbons, 1990). In addition, self-related cognitions have been viewed as an integral part of the anxiety process (Gibbons, 1990; Sarason, 1984), with research suggesting that anxious individuals scan the environment for cues related to the self (Schwarzer & Jerusalem, 1992) and often become self-preoccupied with weaknesses and shortcomings (Wicklund, 1991). Furthermore, Carver and Scheier (1986) proposed that self-focus rather than worry was the main component of cognitive anxiety. This is evident in their anxiety control model, which indicated that anxiety is determined by an excessive focus on the self (Carver & Scheier, 1988). This excessive self-focus may indeed cause an athlete to worry, but it is also possible that self-focus can lead to additional effects that could not be ascribed to worry, such as a critical self-awareness or as a preoccupation with significant others (Wicklund, 1991). Reflecting these differential effects, self-focus has been categorised into two discrete aspects; private self-focus and public self-focus (Fenigstein, Scheier, & Buss, 1975). Fenigstein et al. defined private self-focus as a factor that is "concerned with attending to one's inner thoughts and feelings" (p. 523) and public self-focus as "a general awareness of the self as a social object that has an effect on others" (p.523). Cheng et al.'s (2009) model appears to reflect these two distinct aspects of self-focus as both private and public facets are represented within the items that comprise the cognitive dimension of their Three-Factor Anxiety

Inventory. For example, "I find myself evaluating myself more critically than usual" is indicative of a private self focus, whilst "I am very aware of the possibility of disappointing important others" is indicative of a public self-focus. Despite using items derived from conceptually distinct sources of self-focus, Cheng et al. made no formal distinction between private and public self-focus within their model, rather the two aspects were combined in a unidimensional self-focus factor.

The distinction between private and public self-focus could be especially pertinent as the psychological underpinnings and behavioural effects of these two states are unique. Private self-focus serves to clarify and intensify the affect, motives, or personal standards that are currently salient to that individual (Fenigstein, Scheier, & Buss, 1975). Thus, individuals who experience high levels of private self-focus may experience heightened awareness of behaviours and movements in an attempt to maintain the aspect of a movement that is most salient to the individual (Masters, 1992). In contrast, Fenigstein et al. suggest that those who experience high levels of public self-focus generally feel a level of discomfort, and evaluation apprehension because they see themselves as the subject of appraisal. These individuals may experience a broadening of focus, as they may be scanning the environment to focus on those who are watching them (Schwarzer & Jerusalem, 1992). In addition, they may attempt to modify their behaviour to meet the perceived expectations of others. Consequently, a model that fully captures the distinct differences between private and public self-focus should yield a more robust cognitive dimension of performance anxiety.

Worry and self-focus are undeniably two distinct constructs, and the evidence for their inclusion in a model of cognitive anxiety is compelling. However, these two constructs alone may fail to fully represent the complex nature of the cognitive anxiety response. In pursuit of strengthening the cognitive dimension in Cheng et al.'s (2009) model, a worry component should be retained, but a more differentiated approach to self-focus should be adopted. Therefore, future models may benefit from including both public and private aspects of self-focus. As such, it does appear that more work is required to fully delineate the construct of performance anxiety, and in particular, the cognitive dimension, which research suggests plays a significant role in the performance anxiety relationship (Hardy, Jones, & Gould, 1996; Mullen & Hardy, 2010). The purpose of the present study was to explore athletes' experiences of the cognitive dimension of performance anxiety more fully. In line with the rationale presented above, we predicted that the cognitive dimension would consist of worry and private and public self-focus, extending Cheng et al.'s conceptualization. The investigation also had an exploratory element as it set out to examine whether any further aspects of the cognitive anxiety dimension would emerge. In order to achieve these aims and to fully capture the dynamic nature of the cognitive anxiety response, we used qualitative interviews and a combination of deductive and inductive analysis.

Method

Design

The methodology used in this study, modified analytic induction (MAI; Bogdan & Bilken, 1992; Gilgun, 1995), incorporates deductive and inductive analysis strategies. Based on the original principles of analytic induction (Bogdan & Bilken, 1992), MAI is a flexible qualitative approach that allows researchers to challenge, develop and refine existing conceptual models against the reality of individual's experiences. Crucially, the method also accounts for researchers' existing knowledge and experience in an area of study, avoiding the common pretence of the researcher as tabula rasa (Patton, 2002). Participants are purposefully sampled to challenge the validity of existing conceptual models (Gilgun, 1995). Inductive analysis is used to label concepts that emerge from the data. These emergent data are then fitted to a hypothesized model this fit is assessed using deductive analysis. Where data do not fit the model, due in part to the presence of negative cases, inductive analysis is used to further explore information that has been unaccounted for by the original model (Patton, 2002). On the strength of this additional information the hypothesis or model is refined to provide greater meaning (Gilgun, 1995). We used MAI to test our prediction that the cognitive dimension would be comprised of worry and private and public self-focus. While this theoretical framework guided our research; we assumed that through the process of emergence, we would uncover constructs not accounted for in the proposed model.

Participants

Participants (male, n = 4; female, n = 7) were aged between 19 and 29 years (M = 22.3, SD = 3.6), had been participating competitively in their sport for a number of years (M = 7.1, SD = 3.4), and all were, or had participated, at an international or professional standard. In addition, athletes were purposefully sampled based on two criteria; (i) they were regularly competing or had competed in the last 6 months, and (ii) they reported experiencing high levels of cognitive anxiety. This information was ascertained through the initial email contact, in which participants were asked questions exploring the criteria.

The sample represented a range of sports, including netball and shooting (both n = 2); and football, rugby, basketball, badminton, table tennis, golf, and judo (all n = 1). A heterogeneous sample was used in order to achieve a broad exploration of key themes relating to cognitive anxiety (Mellalieu, Neil, Hanton, & Fletcher, 2009). The participants provided written informed consent and ethical approval for the study was obtained from the institution's ethics committee. Data collection ceased after 11 interviews as theoretical saturation was achieved and no new themes emerged from the data (Auerbach & Silverstein, 2003).

Interview Guide

A semi-structured interview guide was developed specifically for the study with the aid of two experienced sport psychology researchers who were trained in qualitative methods. A semi-structured interview was preferred as it allowed for an athlete driven process, facilitated by open-ended questions. A pilot interview (n = 1) was conducted, following which the interview guide was refined and adjustments made to the interviewer's technique. Prior to the interview, to allow a clear expression of thoughts and feelings regarding cognitive anxiety, the athletes were asked to recall a stressful competition that they felt they would be happy to use as a focus for discussion during the interview. Allowing the athletes to choose a self-selected event encouraged athletes to choose an event they wanted to recall and could remember vividly and accurately. Event recall is an established form of eliciting information regarding competitive events (Thatcher & May, 2008), with the aim not to "test" athletes but rather to collaborate and better understand the in-depth information they provide. Participants were also encouraged to recall an event that had occurred in the last 12 months to ensure that recall was as accurate as possible.

The interview guide had 3 sections. The first section included questions regarding the athlete's sporting background, providing demographic information and easing the athletes into the interview. Subsequently, the athletes were asked to describe the event they had chosen to recall. The interview then followed the event in a chronological order, and asked athletes to recount their thoughts and feelings at several points leading up to and during, the event (a week before, the night before, the day of the event, immediately before and, finally, during the event). In accordance with the competitive anxiety research, these time points were chosen to reflect the presence of elevated cognitive anxiety up to 7 days before a competitive event (Martens, Vealey, & Burton, 1990), and would allow participants to discuss the full range of cognitive anxiety experiences associated with the build up to their chosen stressful event. Evaluative questions were predominantly used, in order to gain an insight into athletes' thoughts and feelings regarding the event (Patton, 2002). For example, "what were your thoughts at this point?" and "how were you feeling at that time?". To support this process, specific clarification and elaboration probes were also used to enable athletes to expand on their initial responses (Patton, 2002). For example, "were your feelings different to the night before?" and "can you elaborate on your thoughts?". The final section allowed participants the opportunity to discuss their interview experience and any other important information that might have been overlooked during the interview process.

Procedure

Participants were contacted in person, and were provided with details of the study, including the interview format and how the data would be collected. Before attending the interview, athletes were sent a copy of instructions that outlined the structure of the interview. These instructions asked athletes to recall a recent stressful sporting competition that had occurred in the last 12 months. In addition, the interviewer ensured that the participants were comfortable talking about the event that they had chosen. The interviews were conducted at a time and location convenient to the athletes. On arrival, full informed consent was obtained; athletes were assured of confidentiality and were provided with contact details if they wished to obtain the results of the study. Athletes were informed that the interview would be recorded and that the recordings would be confidential.

Data Analysis

Interviews lasted between 38 and 115 minutes, were tape-recorded, transcribed verbatim, checked for accuracy of transcription and subsequently sent to the interviewee for the purpose of member checking (Patton, 2002). The transcribed interviews yielded a total of 292 pages of 1.5-spaced text. The initial phase of analysis proceeded inductively and involved the author immersing herself in the transcripts and extracting raw-data quotes relating to cognitive anxiety. The raw data was then grouped together around common threads to form themes. The next stage of the analysis was deductive and consisted of a process of pattern matching, which involved using the three main components in the hypothesized conceptual model of cognitive anxiety; worry and private and public self-focus, as a theoretical screen that was placed over the data. The pattern matching enabled the comparison of the themes that emerged from the data with the three main components. Where themes did not appear to fit with one of the 3 main components, they were set-aside for the next phase of the analysis, which proceeded inductively. A frequency analysis was conducted to illustrate how often each theme was mentioned. Finally, manual handling of the data was preferred to computer-assisted analysis as the latter can distance the researcher from the data (Davis & Meyer, 2009). Peer debriefing was employed at each stage of the study to test and refine working hypotheses and to protect against researcher bias. Peer debriefing was conducted with the author's main supervisor, who fulfilled a protagonist role (Lincoln & Guba, 1985). In addition, the author and supervisor independently analysed the data and discussion ensued until full agreement was reached on the interpretation of the findings.

Results and Discussion

The purpose of this study was to determine if the predicted model of cognitive anxiety, consisting of worry, private and public self-focus could be used to define athletes' thoughts and feelings surrounding a competitive event that they perceived to be stressful. Preliminary inductive analysis of the raw data revealed 12 themes. The subsequent deductive phase of the analysis, which consisted of pattern matching, successfully placed all of the emergent themes within one of the three main components, see Table 1. Worry comprised of 7 themes; performance failure, making mistakes, consequence of mistakes, uncertainty, outcome, re-injury and expectations. Three themes represented the private self-focus

Table 1. Incidence of cognitive anxiety properties experienced across participants

Component	Theme	1	2	3	4	5	6	7	8	9	10	11
Worry	Performance failure	X		X		X	X	X	X		X	X
	Making mistakes	X	X	X			X		X		X	
	Consequence of mistakes	X	X	X	X	X	X	X			X	X
	Uncertainty	X		X	X	X		X	X		X	
	Outcome	X	X	X	X	X		X	X			X
	Re-injury							X			X	X
	Expectations	X		X	X	X	X	X	X		X	X
Private Self-Focus	Self awareness	X	X		X	X			X	X	X	
	Weaknesses	X	X	X	X		X	X		X	X	X
	Explicit monitoring		X		X	X	X			X		
Public Self-Focus	Evaluation	X	X	X	X	X	X	X	X	X	X	X
	Self-presentation	X	X	X	X		X					X

component; self awareness, weaknesses and explicit monitoring. Public self-focus consisted of two themes; evaluation and self-presentation. The number of participants providing instances of each theme is presented in table 1.

The following sections address the salient features of the cognitive anxiety dimension under the headings of the predicted model; worry, private self-focus and public self-focus. The results and discussion of this chapter are presented together, to allow discussion following each theme (cf. Thatcher & Day, 2008).

Worry

Deductive analysis supported worry as a prominent component of the cognitive anxiety dimension. Athletes consistently used the term "worry" and the 7 themes listed in table 1 indicate that worry related to a wide range of situations and circumstances. The results of the current study suggest that Cheng et al.'s (2009) unidimensional conceptualization of worry may be too narrow. There is some evidence of a multidimensional approach within the literature (Dunn, 1999, 2003), which is consistent with our findings. In order to provide more detail, each of the underlying themes is discussed in turn.

Performance Failure. Eight athletes reported experiencing worries relating to poor performance, not playing to the best of their ability, and the possibility of failure. For example, athlete 4 reported worrying about performing poorly; "I wanted to be beaten playing my best, so that's the only thing I always worry about is, is the fact that I don't want to play badly". These findings are consistent with research that revealed that one of the most typical worries experienced by wrestlers related to performance failure (Gould & Weinberg, 1985). More recently, Dunn et al. (1999, 2003) highlighted performance failure as one of four specified situational anxiety dimensions proposed as a framework for worry in ice hockey.

Crucially, this theme was reflective of a global worry about performance failure, rather than a more specific form of performance failure as indicated in the themes below.

Making mistakes. Athletes consistently reported worrying about making mistakes. For example, participant 7 reported worrying about making mistakes during their performance: "it's only when it is towards the end and its quite level (the score), that's when I'm nervous and I start worrying about making a mistake". Some parallels can be drawn with the theme of performance failure; however, this theme is focused on the specific act of making a mistake, for example, "the worry, if the ball comes over and you drop it, and drop it straight to the centre forward, and he puts it in, in the last minute of the game to make it one nil..." (Participant 3). This theme depicts a worry relating to making a specific mistake, such as dropping the ball. These worrisome thoughts differ from the global worry of performance failure indicated in the previous theme, which is concerned with a more generalised worry of performing poorly. Indeed, this form of worry may have different behavioural consequences, such as ironic effects (Toner, Moran, & Jackson, 2013; Wegner, 1994), compared to a global worry of performance failure. Specifically, the heightened awareness surrounding the worry of making a mistake may result in athletes thinking about the behaviours they are ironically trying to avoid, causing counter-intentional states to be triggered.

Consequence of making mistakes. Athletes also reported worrying about the consequences associated with making a mistake. For example, participant 3 reported, "just a sort of worry I'm not going to get a new contract. I've lost my clean sheet bonus, money wise, you know what I mean" when talking about making a mistake. These worries varied from how a mistake would affect subsequent performance to how a mistake would affect teammates and coaches and, as the above example denotes, potential financial implications. Similar properties have been revealed in a framework of failure identified by Conroy, Poczwardowski, and Henschen, (2001). The framework included experiencing tangible losses, important others losing interest, and upsetting important others, which is consistent with our athletes reports of worry in this theme. Moreover, the measure of fear of failure developed from Conroy et al.'s (2001) findings was associated with high levels of worry and cognitive disruption (Conroy, Willow, & Metzler, 2002). In contrast to the previous theme of making a mistake, these worries focused on how the athlete perceives the potential consequence associated with making a mistake. Nine athletes reported this theme, of which 5 also reported the theme of worry of making a mistake. Therefore, the data suggests that worries about the consequences of making a mistake do not always follow worries about making a mistake.

Situational uncertainty. Another category of worry focused upon uncertainty surrounding the athlete's performance or situation. It seems that when athletes had no prior knowledge of their opposition or playing environment this elicited worry for 7 out of the 11 athletes. Participant 11 consistently reported feeling worried because of her lack of knowledge:

> just nerves, worry, I don't know, I didn't know what was coming next so I was a bit, I don't know, apprehension...like I didn't know what was to come, I didn't know anything about the opposition and things, so I was thinking, are they going to be easy? Am I going to be ok?

Situational uncertainty was also a feature of Dunn et al.'s, (1999) framework of competitive worry. Anxiety of the unknown has been reported as a factor in early measures of trait anxiety (Endler, Edwards, & Vitelli, 1989), and more recently in a study of stressful appraisals in sport (Thatcher & Day, 2008). Using Lazarus and Folkman's (1984) stress framework, Thatcher and Day deductively analysed their results and reported that novelty was a frequent occurrence in their participant's reports of a stressful competitive situations. In this study participants reported that they worried about novel situations or changes to established routines or environments, which matches the findings of Thatcher and Day's research.

Outcome. Athletes also reported worries related to the competition outcome. For instance, athlete 4 reported worrying about the outcome of the badminton event they were taking part in; "it was just all on the outcome, all I was thinking about like my score, where I was placed and just like really worried". Within the early sources of stress literature, the outcome of an event was cited as a source of worry (Weinberg & Gould, 1985). Consistent with research examining outcome goals, the transcripts suggested that a focus on the outcome of competitive performance is associated with increases in performance anxiety (Burton, 1989; Kingston & Wilson, 2009). A focus on the outcome has been suggested to elicit negative effects, because it meets the three stress criteria outlined by Beggs (1990), that is, the outcome is important, it requires action and it may not always be achieved. Eight out of the eleven participants reported this type of worry, thus it would seem to be a significant component of the worry response.

Expectations. Finally, athletes reported being worried over the expectations of important others, such as, coaches, teammates and parents:

> Um, worry of letting people down, worry of letting your team mates down, worry of letting managerial staff, fans down, you know quite a lot of expectations lying on you, could actually potentially let down a lot of people, do you know what I mean. (Participant 3)

James and Collins (1997) highlighted that the pressure to attain external standards by meeting others expectations was an important factor in sources of competitive stress. Moreover, Gould and Weinberg's (1985) research also identified "expectations to perform" as a significant source of stress. The worry attached to expectations of significant others is clearly a significant factor in the worry process and is closely related to the public self-focus component of the cognitive dimension. This relationship will be discussed further in the public self-focus section below.

Re-injury. The inductive analysis also revealed worries over re-injury as a theme among three of the athletes. Athletes were concerned about past injuries: "depending on if I am injured or not. If I'm injured it would be exactly the same, but if I'm not, I would have no worry what so ever, it's only if I'm injured that I get nervous" (Participant 10). This theme draws parallels with Dunn et al.'s (1999) conceptual framework of worry, which included worry about injury. In contrast to Dunn et al.'s conceptualization, which included concerns regarding the potential of getting injured, the present results suggested that the athletes' concerns were related to previous injuries and the possibility of re-injury. Interestingly, this re-injury worry was evident in sports that required a high level of contact, or were high in impact and known for the prevalence of injury (Grimmer, Jones, & Williams, 2000; Fong, Hong, Chan, Yung, & Chan, 2007) such as judo, rugby and netball. Future research should seek to explore differences between worry of injury and worry of re-injury, and what place it has within future representations of worry.

These findings suggest that it is important to distinguish between the different types of worry that athletes may experience. Early research by Gould and Weinberg (1985) reported that athletes worried about a number of factors, including, fear of failure/feelings of inadequacy, external control/guilt, and social evaluation. Subsequent research revealed that the most typical worries experienced by wrestlers related to performance failure and negative social evaluations (Gould & Weinberg, 1985). Furthermore, as discussed, Dunn and colleagues (1999, 2003), have also attempted to determine whether specified situational anxiety dimensions (physical danger, performance failure, negative social evaluation and situational uncertainty) can provide a framework for structuring worry in sport (ice hockey). Tallis and Eysenck (1994) also presented a model of worry and suggested worry could serve a number of functions, including, alarm, prompt and preparation. Clearly, worry is a unique concept, and a multidimensional approach is entirely possible; however, the aforementioned research focuses on worry alone as the major factor in the anxiety response. Specifically, no consideration is made of the possible influence of other components, such as self-focus. Whilst this research confirms that athletes worry about a variety of aspects related to performance, adopting a multidimensional approach in measurement of performance anxiety may be conceptually inappropriate. Theoretically, worry is unified in its internal underlying processes (Eysenck, 1992), and diversified content does not justify representing worry as multidimensional. Therefore, to account for the diverse nature of worry, it would be more appropriate if future representations of cognitive anxiety include a variety of worry related items, to reflect the complexity of the worry response.

In addition, it is important to recognise that some of the themes discussed above draw parallels with some of the themes that will be discussed in the private and public self-focus sections that follow. The defining factor in distinguishing between these themes is that athletes reported worrying about the factors discussed above, which the author argues is different to the self-focus depicted in the themes below. Based on the literature we proposed that Cheng et al.'s (2009) unidimensional theme of self-focus was not adequately representative of the experiences of anxious athletes, or of current theoretical perspectives. Consequently, private and public aspects of self-focus (Fenigstein, Scheier, & Buss, 1975) were included as two components in the hypothesized model of cognitive anxiety. In addition to this hypothesized separation, the preliminary inductive analysis revealed that both types of self-focus are underpinned by a number of themes. Below is a detailed presentation of both private and public self-focus and their underlying themes.

Private Self Focus

Within the component of private self-focus, three themes were evident; self-awareness, weaknesses, and explicit monitoring of movements.

Self-awareness. Athletes reported a heightened general self-awareness, which was characterized by being in a self-evaluative state: "I thought you have got to up your performance now and then that's when I got a bit nervous about it" (Participant 10). In addition athletes also engaged in questioning of their own performance "I didn't do it that time, why didn't I do it that time? I like talk to myself in my head and I'm like why didn't I do it? I just don't know why I didn't do it". These findings are in line with Duval and Wicklund's (1972) theory of objective self-awareness, which suggests that focusing attention on the self induces a state of self-awareness. This then initiates an automatic comparison of the self against personal standards; these are referred to as mental representations of the correct behaviours and what a "correct" person is (Duval & Wicklund, 1972, pp. 3-4). This self-awareness leads to a self-evaluative state, hence, self-focus has a link to anxiety through its impact on emotional awareness and through the self-evaluation it causes (Gibbons, 1990). Self-evaluation was evident in the athletes interviewed in the present study, as they reported frequently engaging in evaluation of their own performance and what they perceived as the correct response or behaviour. This theme depicts a general self-awareness associated with the increased anxiety of a stressful event. In addition, the athletes also reported more specific elements of private self focus, which manifested themselves in two ways; (i) as a focus on weaknesses and (ii) as an explicit monitoring of task relevant aspects of the skill. These two features of private self-focus are discussed below.

Weaknesses. Athletes reported a focus on weaknesses within their performance and ability, "but you don't want to mess up all the hard work...it would be a lot of pressure to keep up the performance...I don't want to mess it up or do anything wrong" (Participant 7). Wicklund (1991) suggested that anxious individuals become self-preoccupied with weaknesses and shortcomings, this again is apparent in athlete's reports, with individuals often talking about failure and not performing as well as they should. This theme would seem to be representative of a more specific element of self-awareness that manifests as a focus on weaknesses. As discussed in the section on worry, performance failure is often reported as a source of worry within athletes (Gould & Weinberg, 1985); however, it would seem that participants in this study reported an awareness of these weaknesses or performance failures without starting to worry about them. It is entirely plausible that some worries relate to the self, but it is also possible that self-focused attention does not result in worry. Worry and self-focus are independent constructs with the potential for different manifestations and performance effects.

Explicit Monitoring. Athletes reported explicitly monitoring their performance: "I needed to think about it, in the sense that it had to be good, it had to be clinical, and I had to really think about the technique and stuff. So that was playing on my mind" (Participant 4). The term explicit monitoring refers to the allocation of attention to skill execution (Jackson, Ashford, & Norsworthy, 2006), which is indicated in the above quote. In addition to explicit monitoring of performance, athletes' also reported that this monitoring had the potential to lapse further into some form of conscious control (Masters, 1992);

> I think I thought too much about what I was doing about my strokes. So I think I was just over thinking everything....yeah the natural things, I was thinking right this is how I play a forehand, you know going back to basics, as though I am a twelve year old again. (Participant 9)

The results of this section suggest firstly that athletes explicitly monitored performance and secondly, that this explicit monitoring may lead to conscious control of performance. Clearly, some debate still surrounds the specific mechanisms associated with this conscious processing, but a clearer distinction within models of cognitive anxiety, may allow researchers to more adequately manipulate this aspect to test these self-focus theories. Thus, explicit monitoring refers to the increased attention on skill execution, whilst conscious control may be the behavioural effects associated with this increased attention on skill execution. This is consistent with Jackson, Ashford and Nosworthy's (2006) suggestion that explicit monitoring and conscious control are conceptually distinct in that a focus on skill execution encourages explicit monitoring but does not always lead to conscious control. Thus, Jackson et al., suggest that explicit monitoring might have a more general disruptive effect on motor performance and that additional disruption might occur when athletes attempt to consciously monitor their movements.

Public Self-Focus

Within the component of public self-focus, two themes were evident; significant others and self-presentation.

Evaluation. This theme was categorized by an athlete's awareness of significant others, which included; teammates, coaches, managers, and parents. Athlete 2 talked about this extensively; "being recognised by other coaches, I was trying to get into the GB squad, you need to shoot well". It appears that the athletes were focused on being evaluated, this is similar to findings by James and Collins (1997), which identified significant others as stressors in athletes reports of a stressful event. The stressors in James and Collins results were represented by, "teammates", "coach/manager pressure", "parental demands", "officials" and "evaluative others", which has similarities to the current findings. For example, "yeah, not being able to fullfill my team mates expectations as well, because obviously they had been putting pressure on me, and oh I can't let them down, got to do my best and things" (Participant 10), is an example of teammate as a stressor. This theme was reported by all 11 athletes, therefore, plays a prominent role in athletes' cognitive anxiety response.

Self-presentation. This category was characterized by the process of athletes monitoring and trying to control how other perceive them:

> they are obviously all going to watch you, so it adds a little bit more pressure as well to think that they are actually going to a venue to watch you play, so maybe that it is kind of the more people that are watching, the more added pressures. (Participant 3)

Specifically, athletes reported a focus on managing the impression others had of them. These reports are consistent with self-presentational process suggested by Leary (1992). According to Leary in competitive situations, self-presentational concerns arise when athletes undertake a process in which they become aware of how they are perceived by other people. James and Collins (1997) also examined the self-presentational mechanisms that underpin competitive stress. They reported self-presentational concerns was one of the major sources of stress during competition, with "pressure to attain external standards", "significant others directed concerns" and "implied and over criticism" as elements of this response. The findings reported here parallel the issues reported in the literature; for example; Participant 9's comment "That was the pressure I wanted to keep up with the number one, and just kind of keep up with him and let people see that I am as good as him, so I think that was my extra pressure" is consistent a pressure to attain external standards. The critical factor that identifies this theme from the evaluation theme above is that athletes are attempting to control the impressions others form of them, as opposed to the awareness of significant others being a stressor, which is evident in the evaluation theme above.

Our results suggest a clear distinction between private self-focus and public self-focus. This differentiation is consistent with Fenigstein, Scheier and Buss's (1975) distinction of two types of self-focus; private and public. Fenigstein et al. defined private self-focus as a factor that is "concerned with attending to one's inner thoughts and feelings" (p. 523), and public self-focus as "a general awareness of the self as a social object that has an effect on others" (p.523). Several studies (e.g., Liao & Masters, 2002) have supported the involvement of both types of self-focused attention in the anxiety process. In light of Fenigstein et al.'s distinction, we suggest that future development of Cheng et al.'s model should fully acknowledge this distinction in self-focus.

Furthermore, the themes presented above open up the suggestion that these two aspects of self-focus have unique psychological and behavioural effects (Fenigstein et al., 1975). As previously discussed the associated behavioural effects of these two components may differ. For example, individuals who have high levels of private self-focus may experience heightened awareness of movements and consequently may attempt to consciously control their performance (Masters, 1992), and individuals who experience high levels of public self-focus broaden other attentional focus, scanning the environment to focus on those who are watching them (cf., Schwarzer & Jerusalem, 1992).

Conclusions

This study examined the cognitive anxiety response experienced by elite athletes. Modified analytic induction supported worry, private self-focus and public self-focus as central features of this response. Crucially the results provided evidence that a differentiated approach should be adopted in representing self-focus, consistent with Fenigstein et al.'s (1975) bipartite model. The evidence reported here suggests that Cheng et al.'s (2009) two-component approach (worry and self-focus) may be too narrow and not fully representative of the cognitive dimension of performance anxiety. Adopting a three-component model of the cognitive dimension may lead to a more complete understanding of performance anxiety. Indeed Cheng et al., originally attempted to model performance anxiety as a five factor model, with two factors of worry and self-focus to represent cognitive anxiety, however poor CFA results did not support this hypothesized separation. The differentiated approach presented here may strengthen Cheng et al.'s original model of performance anxiety.

A number of the themes identified have the potential to overlap with one and other. In particular, the theme "worries relating to expectations" of others is similar to aspects of public self-focus. Although it is possible for athletes to worry about dimensions relevant to the self, it is also possible that self-focused attention may not result in worry. As previously mentioned self-focus may have effects independent of worry, such as conscious control and preoccupation with others. Thus, we view worry and self focus as separate constructs with the possibility for different manifestations. Consequently, we deemed it important to separate cognitions related to worry and self-focus, in order to remain sensitive to the overall aims of the study. Future research should attempt to assess each component independently, in order to provide support for their inclusion within future models of cognitive anxiety.

The study is not without limitations. Despite the hypothesized separation of private and public self-focus, there is a lack of sport specific empirical literature to support this distinction. Participant recall must also be considered as a potential limitation of the current study; however, a number of procedures were put in place to help ensure accurate recall. Specifically, athletes recalled a competitive event that had occurred in the last 12 months, and were asked to think about this event prior to the interview. In addition, although the research purposefully set out to examine a heterogeneous sample, some further investigation is needed in relation to the worry of re-injury and the relationship with non-contact and contact sports, as our findings indicated that re-injury worries were only evident in sports with a high prevalence of injury.

The development of more complex anxiety measurement models with greater differentiation has both theoretical and practical implications. Theoretically, contemporary models that fail to fully represent the performance anxiety response may explain the equivocal results found in much of the research examining the relationship between anxiety and performance (Wilson, Smith, & Holmes, 2007). Indeed, a more differentiated model would permit a greater understanding of the specific components of the cognitive anxiety response that may affect performance. For example, greater differentiation would allow researchers to make links between components of the cognitive anxiety dimension and the causal mechanisms through which anxiety is hypothesized to exert a negative influence on performance, e.g., distraction (Wine, 1971) and conscious processing (Masters, 1992), to be represented. From a practical perspective, practitioners would be better placed to understand athletes' experiences of anxiety before and during competition. Consequently, this might allow more focused and effective intervention programs, based on a more refined diagnosis of the anxiety symptoms experienced by athletes can be designed. Some athletes may only report high levels of private self-focus, and subsequently might try to explicitly monitor performance, therefore these athletes might benefit from adopting a holistic focus in skill execution. In contrast, athletes who express high levels of public self-focus may experience a broadening of focus and become pre-occupied with people in the crowd; therefore an attentional focus strategy may be appropriate. In conclusion, the present investigation emphasized the need to consider worry, private and public self-focus as separate components within the cognitive dimension of performance anxiety. Future model development may benefit from adopting such as distinction in conceptualizing performance anxiety.

Chapter 6

Towards a hierarchical conceptualization of performance anxiety: Rationale and measurement development

(Study 4)

Abstract

An integrated hierarchical model of performance anxiety was constructed to offer further support to Cheng, Hardy, and Markland's (2009) three-dimensional model. In particular the adaptive potential of anxiety was acknowledged and a multidimensional approach to cognitive and physiological anxiety was included. The proposed model here consisted of three second order dimensions and six first order subcomponents. The second order dimension was formed by three reflectively measured subcomponents of worry, private self-focus and public self-focus. The second order physiological dimension was formed by two reflectively measured subcomponents of somatic tension and autonomic hyperactivity. Finally, the regulatory dimension was formed by a single reflectively measured subcomponent of perceived control. Partial least squares (PLS) analysis was used on a prospective sample of 192 questionnaires, collected from participants competing in 11 different sports. The results revealed support for a fully differentiated hierarchical model represented by the underlying subcomponents. Further research is required to fully explore the predictive power of this hierarchical model.

Keywords: *hierarchical, cognitive, physiological, regulatory, formative.*

Introduction

Despite the plethora of models purporting to explain the anxiety-performance relationship, there remains little consensus concerning the exact nature of anxiety. For example, research examining performance anxiety using multidimensional anxiety theory (Martens, Burton, Vealey, Bump, & Smith, 1990), catastrophe models (Hardy, 1996) and Jones's (1995) control model has produced inconsistent results. The majority of this research has used the Competitive State Anxiety Inventory-2 (CSAI-2; Martens et al., 1990) and its derivatives (Revised Competitive State Anxiety Inventory-2, CSAI-2R; Cox, Martens, & Russell, 2003; CSAI-2 with directional scale; Jones & Swain, 1992) to index performance anxiety responses. Despite the evolution of the CSAI-2, more widespread developments in the measurement of anxiety have been less evident and consequently the CSAI-2 has continued to dominate the research landscape.

Recently, Cheng, Hardy, and Markland (2009) developed a new measure of performance anxiety that set out to address some of the limitations of the CSAI-2. The measure developed by Cheng et al. was based upon a three-dimensional model of performance anxiety, which the authors claimed more accurately reflected the complex phenomenon of anxiety. Within Cheng et al.'s model, the construct of performance anxiety was defined as an unpleasant psychological state in reaction to perceived threat concerning the performance of a task under pressure. The model itself consisted of three dimensions represented by five subcomponents; a cognitive dimension, reflected by worry and self-focused attention; a physiological dimension, reflected by autonomic hyperactivity and somatic tension and a regulatory dimension, reflected by the single subcomponent of perceived control. Cheng et al. retained the cognitive and physiological dimensions to reflect the traditional worry-emotionality model (Liebert & Morris, 1967), whilst the regulatory dimension was included to account for the potential adaptive nature of anxiety. Cheng et al.'s performance anxiety model is the first theoretical approach that tries to fully account for the adaptive and maladaptive nature of anxiety. This positive adaptation is in line with both the evolutionary account of anxiety as a defense mechanism (Ohman, 2000) and accounts for the suggestion that anxiety accomplishes this protective function by mobilizing resources (cf., Eysenck & Calvo, 1992).

In terms of the development of the performance anxiety measure, Cheng et al. (2009) tested two independent sample groups in an attempt to support their proposed hierarchical model. Although the authors provided a strong conceptual argument for the five underlying subcomponents, the confirmatory factor analysis (CFA) results did not support the hypothesized dissociation. As a result, worry and self-focus, were merged into a single cognitive dimension. Similarly, somatic tension and autonomic hyperactivity were merged into a single physiological dimension. These subcomponents were retained at a conceptual level until further discriminant validity was obtained. While this merged model provides support for the three major processes proposed activated in the dynamics of the anxiety experience, Cheng et al. noted that further investigation is needed to support the fully differentiated hierarchical model that they originally proposed. One suggestion was to increase the length of each subscale, although this would have a deleterious effect upon the applicability of the scale at a practical level. Cheng et al. also suggested that researchers could examine the differential impact of the performance anxiety subcomponents on different aspects of performance. For example, private self-focus may affect performance differently to worry. Specifying differential effects of the subcomponents on different aspects of performance suggests that an alternative measurement model might best capture the full complexity of the differentiated model proposed by Cheng et al.

Within the three-dimensional model proposed by Cheng et al. (2009), the cognitive dimension consisted of a worry and a self-focus component. The construct of self-focus warrants further attention due to its centrality in Cheng et al.'s model and other anxiety models (e.g. Carver and Scheier, 1978). Cheng et al. defined self focus as a self-evaluative state with an increased awareness of self shortcomings concerning the performance of a task under stress and was represented as a unidimensional construct. Furthermore, self-focus is suggested to manifest itself as a critical self-awareness or as a preoccupation with significant others, which suggests two differential aspects. On closer inspection of the self-focus items used in Cheng et al.'s model, it is clear that these items relate to two unique factors. Specifically, some items focused on self-awareness, for example, "I find myself evaluating myself more critically than usual", while other items were concerned with significant others "I am very aware of the possibility of disappointing important others". This differentiation is consistent with Fenigstein, Scheier, and Buss (1975), who defined two aspects of self-focus (i) a private self-focus as a concern about one's inner thoughts and feelings, and, (ii) a public self-focus as an awareness of the self as a social object that has an effect on others. The proposed differentiation by Fenigstein et al. was supported in study 3 of this thesis. Crucially, it would seem that these two self-focus components are characterized by different concerns and have the potential for different behavioral consequences. Therefore, adopting this self-focus distinction in future conceptualizations of cognitive anxiety may prove fruitful.

As is evident in Cheng et al.'s (2009) model, researchers in sport psychology place careful emphasis on explaining causal relationships among constructs; however, according to Roberts and Thatcher (2009), there is often less attention paid to the nature and direction of relationships between constructs and indicators, resulting in less than ideal testing of theory. In establishing the relationship between constructs and indicators, research in psychology has relied upon classic test theory (Novick, 1966) and the assumptions this approach adopts regarding the relationships between constructs and their measures. Specifically, classic test theory assumes that the variation in scores on measures is a function of the true score, plus error. Such a specification assumes that meaning flows from the latent construct to the measures, and that each measure is viewed as an imperfect reflection of the underlying construct. Therefore, any variation in a construct is reflected in variation in its indicators (Bollen, 1989). This type of model is known as reflective as it represents reflections, or manifestations of a construct. A reflective model is based on the assumption that all indicator items are caused by the same latent construct. Therefore, all items would be highly correlated and if one item were dropped the construct would not change. Despite the pervasiveness of this approach to model testing, not all latent constructs can be conceived of as being reflected by their first-order subcomponents (Bollen & Lennox, 1991). Rather, it often makes sense to view meaning as emanating from the measure in a definitional sense rather than vice versa (MacKenzie, Podsakoff, & Jarvis, 2005). Such constructs are labelled as being formative.

In order to distinguish between reflective and formative constructs, Jarvis, Mackenzie, and Podsakoff (2003) developed the following guidelines. Firstly, direction of causality between constructs and its indicators should be established. Formative measurement models, suggest that the direction emanates from the indicators to the construct, whilst the opposite is correct for reflective models. Secondly, the interchangeability of items needs to be addressed, for formative models, indicators should not be interchangeable as dropping an item may alter the conceptual domain of the construct, whilst reflective indicators are interchangeable and items are likely to reflect the same content, therefore, dropping one of these items will not alter the conceptual domain. Thirdly, covariation among indicators should be established. Formative models do not require items to covary as they represent unique aspects of the construct, whilst indicators on reflective models are expected to covary. Finally, researchers need to establish whether constructs have the same antecedents and/or consequences. For formative models, it is not necessary for items to have the same antecedents and consequences because formative indicators are not necessarily interchangeable and may tap different aspects of the conceptual domain. In contrast, reflective models are required to have the same antecedents and consequences as they reflective a similar nature.

MacKenzie et al. (2005) cited the example of transformational leadership as a construct that is traditionally conceptualized as being reflected by charisma, idealized influence, inspirational leadership, intellectual stimulation, and individualized consideration (Bass, 1998). In terms of the criteria put forward by Jarvis et al. (2003), Mackenzie et al. argued that these forms of leadership behaviour are conceptually distinct, are likely to have different antecedents and/or consequences, and are not interchangeable. As a result, MacKenzie et al. claimed that transformational leadership would be better portrayed as a formative rather than a reflective construct. This potential misspecification in direction, results in researchers making inaccurate conclusions about the structural relationships between constructs. In turn, this measurement misspecification causes measurement error, which has a negative impact upon model testing.

The preceding discussion has focused upon the relationships between latent variables and their indicators or measures. MacKenzie et al. (2005) noted that the distinction between reflective and formative indicator models can also be generalized to more abstract higher-order factor structures. With hierarchical models, there is also the possibility of multiple first order dimensions serving as either reflective or formative indicators of the higher order constructs. For example, hierarchical models that have formative second order constructs may have first order constructs that consist of reflective items, and vice versa. These hierarchical models can make both a theoretical and empirical contribution by better representing complex models (Petter, Straub, & Rai, 2007).

Cheng et al. (2009) adopted a traditional reflective approach in the construction of their model of performance anxiety. In their model, the first-order constructs of worry, self-focus, autonomic hyperactivity, somatic tension and perceived control were measured using reflective indicators. All of these are psychological constructs and as such, have been consistently suggested as being suitable for reflective measurement (Diamantopulos & Winklhofer, 2001). While Cheng et al.'s second-order cognitive and physiological dimensions are also psychological constructs; there is the possibility that these variables may have been miss-specified as reflective constructs.

The present study was designed to re-examine Cheng et al.'s (2009) model of performance anxiety using a hierarchical structure constructed using Jarvis et al.'s (2003) guidelines to establish a more refined foundation for measurement testing. The proposed model consists of five first order factors, worry, public self-focus, private self-focus, somatic tension, autonomic hyperactivity and perceived control, which are measured reflectively. In line with the approach adopted by Cheng et al., and the recommendations of Diamantopoulos and Winkholfer (2001), the first order latent constructs are measured by reflective indicators as each construct has a common theme and, therefore, items are interchangeable and unidimensional. Furthermore, it is likely that the reflective indicators for the first order latent constructs will covary with each other, as suggested by Jarvis et al. (2003). In the proposed model, these first order constructs serve as formative indicators for the second-order latent variables. The latent variables are specified as formative at the second order as the direction of causality flows from the first order latent constructs to the second order constructs of cognitive and physiological anxiety. That is, these first order constructs are defining characteristics of their higher order latent constructs, and changes in these constructs are likely to cause changes to the second order construct. In addition, the first order variables are also unlikely to have the same consequences. For example, not all athletes who score highly on private self-focus will score highly on public self-focus and it is entirely possible for athletes to have high levels of private self-focus and low levels of public self-focus and vice-versa. Furthermore, the associated behavioural consequences of these two components may differ; notably those who experience high levels of private self-focus may experience heightened awareness of movements in an attempt to maintain performance (Baumeister, 1984; Masters, 1992). Similarly, those who experience high levels of public self-focus may experience a broadening of focus, as they may be scanning the environment to focus on those who are watching them (Schwarzer & Jerusalem, 1992). Both of the effects specified for self-focus differ from the hypothesized effects of increased worry, which primarily affects tasks that are reliant upon working memory for successful performance (Eysenck, Derakshan, Santos, & Calvo, 2007). Similarly, somatic tension and autonomic hyperactivity are likely to vary in consequences. For example, somatic tension may directly impact upon the processing of movements through increased muscle tension, which might potentially cause degrees of freedom to "freeze" (cf. Vereijken, van Emmerik, Whiting, & Newell, 1992). In contrast, autonomic hyperactivity may have a different effect on performance through physiological reactions involved with the involuntary muscles that are associated with the body's inner organs, such as increased breathing and heart rate. Changes to these functions might affect performance by impacting upon an individual's preferred activation state (Hardy, Jones, & Gould, 1996; Hockey & Hamilton, 1983).

In order to test measurement and structural properties, the model was placed within a wider nomological net with constructs from the competitive subscale of the Test of Performance Strategies-2 (TOPS-2; Hardy, Roberts, Thomas, & Murphy, 2010). Figure 1 represents the conceptual model; this is followed by the operationalization of the constructs and the associated hypotheses. The structural model was constructed to examine the overall effect of anxiety upon some of the psychological processes supporting performance. Based on our prediction of separate effects for the first-order subcomponents on various aspects of task performance, it would be possible to specify a structural model to account for these hypothesized effects. However, as an initial stage of development that examined both measurement and structural elements of the hypothesized model of performance anxiety, more general effects are specified. In order to achieve this aim, the following hypotheses were formalized:

Hypothesis 1: The second order cognitive dimension of performance anxiety is formed by the three lower order reflective constructs of worry, private self-focus and public self-focus.

Hypothesis 2: The second order physiological dimension of performance anxiety is formed by two lower order reflective constructs of somatic tension and autonomic hyperactivity.

Hypothesis 3: The second order regulatory dimension of performance anxiety is formed by a single lower order reflective construct of perceived control.

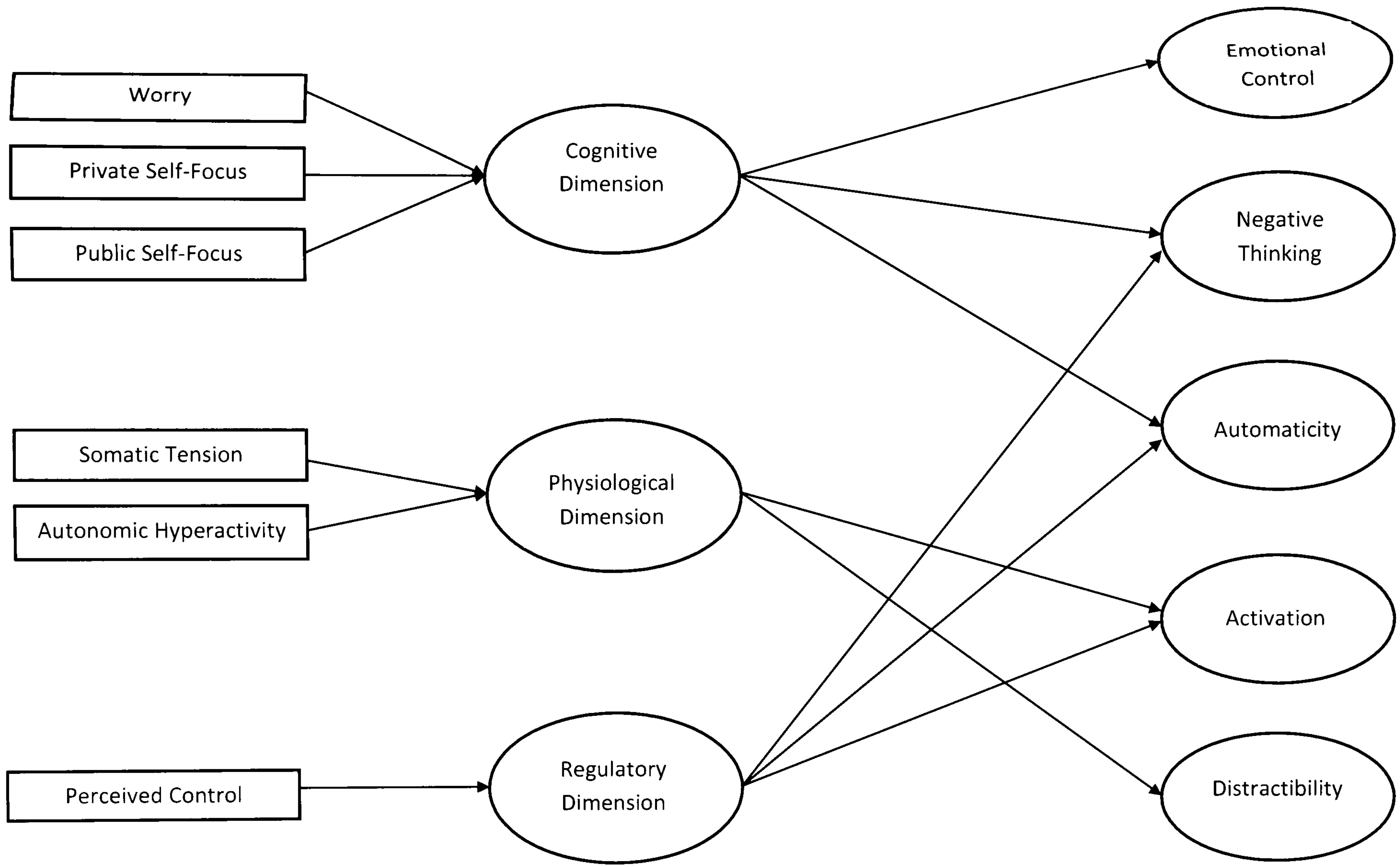

Figure 1. A proposed model of performance anxiety

In addition, a number of hypotheses were generated to represent the relationships between the two second-order (cognitive and physiological) and the single order (regulatory) constructs of performance anxiety and the TOPS-2 constructs. These have been formed by a review of performance anxiety literature and research on the competitive dimensions of the TOPS-2 inventory.

Hypothesis 4: Cognitive anxiety will have a negative relationship with emotional control.

Hypothesis 5: Cognitive anxiety will have a positive relationship with negative thinking.

Hypothesis 6: Cognitive anxiety will have a negative relationship with automaticity.

Hypothesis 7: Physiological anxiety will have a negative relationship with activation.

Hypothesis 8: Physiological anxiety will have a positive relationship with distractibility.

Hypothesis 9: The regulatory dimension will have a negative relationship with negative thinking

Hypothesis 10: The regulatory dimension will have a positive relationship with automaticity.

Hypothesis 11: The regulatory dimension will have a positive relationship with activation.

Method

The first step was to develop the construct of performance anxiety and generate items that represent the underlying dimensions of cognitive anxiety, physiological anxiety and the regulatory dimension. Next, using structural equation modelling, measurement and structural properties of the measure were tested.

Item and scale development

An initial item pool with approximate 83 items was generated to assess worry, public self-focus, private self-focus, autonomic hyperactivity, somatic tension and perceived control. The first stage of this process involved retaining items from Cheng et al.'s (2009) final model, if they demonstrated a significant factor loading. Additional items were generated based on Cheng et al.'s definitions of worry, autonomic hyperactivity, somatic tension and perceived control. In addition, and in contrast to Cheng et al.'s model, self-focused attention was extended to include a distinction between private and public elements of self-focus (Fenigstein, Scheier, & Buss, 1975). A range of items was included for each subcomponent in order to fully capture the dimensions of each construct. To ensure consistency, the original definition of terms made by Cheng et al. were adopted here for worry, somatic tension, autonomic hyperactivity and perceived control. For private and public self-focus, the definitions proposed by Fenigstein et al. were adopted. Below, is a definition of each construct.

Worry: a cognitive form of apprehension associated with possible unfavourable outcomes.

Private Self-focus: concern with attending to one's inner thoughts and feelings.

Public Self-Focus: an awareness of the self as a social object that has an effect on others.

Somatic Tension: physiological reactions involved with the voluntary muscle groups that are motor-oriented.

Autonomic Hyperactivity: physiological reactions involved with the involuntary muscles that are associated with the body's inner organs.

Perceived Control: perception of one's capabilities (involving ability and resource) of being able to cope, and of goal-attainment, regarding the performance of a task under stress.

Each item was evaluated in terms of face validity, clarity of wording, and sentence structure. Items were also assessed for item difficulty (Clark & Watson, 1995), reversed-worded items (Gana, Martin, Canouet, et al., 2002) and item quantity (Smith & McCarthy, 1995). Finally, these combined items were subject to extensive scrutiny by the author and supervisory team, which consisted of two British Psychological Society Chartered Psychologists. The final item pool of 25 items was agreed by all parties. The final item pool consisted of 11 items to represent the cognitive dimension (5 items representing worry, 3 representing private self focus and 3 representing public self focus), 10 representing the physiological dimension (5 items representing somatic tension and 5 representing autonomic hyperactivity) and 4 representing perceived control.

Participants

In total, 192 questionnaires were collected from participants competing in 11 sports (Archery = 21, Badminton = 10, Basketball = 10, Cheerleading = 3, Football = 8, Hockey = 6, Karate = 3, Netball = 109, Rugby = 15, Touch Rugby = 2, Volleyball = 5). Mean age was 20.22 (*SD* = 5.72). The sample included a total of 141 females and 51 males, and was drawn from a wide variety of sources in the United Kingdom, including the British Universities Sport Association, and national governing bodies representing the sports listed above. Consequently, the sample consisted of a wide range of skill levels, including, international (*n* = 23), national (*n* = 36), regional (*n* = 38), county (*n* = 56) or club (*n* = 39). Participants were all taking part in a competitive event (university = 110, regional = 40, club = 42), and had an average of 9.60 (SD = 4.73) years of competitive experience. All participants were English speaking and informed consent was obtained before data collection. Ethical approval for the study was obtained from the institution's ethics committee.

Procedure

Prospective data was collected; hence, initial contact for participant recruitment took place before they attended competitive events. The relevant coach, athlete, team or institution was approached before data collection and provided with study details and a brief overview of the procedures. Following this initial contact, individuals were contacted again and were given the opportunity to ask any questions about the study and its procedures. Once participation was agreed, arrangements were made for the researcher to meet with athletes an hour before competition to complete the questionnaire pack. At this stage, informed consent was obtained from all participants. Participants then completed the demographic information and the performance anxiety measure. Following this initial data collection, all participants were subsequently contacted via email and asked to complete and online version of TOPS-2. Subsequent to the completion of the online survey, participants were thanked and debriefed about the true purpose of the study. Participants were also provided with contact details if they subsequently had any further questions.

Data Analysis

The model was examined using Partial Least Squares (PLS), which is a structural equation modelling approach that uses a least squares estimation procedure (Wold, 1974, 1982). The proposed model was tested using the SmartPLS version 2.0 (M3) software (Ringle, Wends, & Will, 2005). The PLS approach maximises the variance of the dependent variables explained by the independent variables, as opposed to reproducing the empirical covariance matrix (Haenlein & Kaplan, 2004) and was adopted as the method of data analysis in the present study for three reasons. First, PLS is preferred when looking at constructs that are measured primarily by formative indicators (Haenlein & Kaplan, 2004). The use of formative scales is easily accomplished with PLS, but it presents challenges in covariance-based models (Chin, Marcolin, & Newsted, 2003). Secondly, PLS path modelling allows the specification of hierarchical models through the use of repeated manifest variables (Wetzels, Odekerken-Schröder, & van Oppen, 2009). Finally, covariance-based structural equation models are often used to test models based upon strong theory; however, Chin (2010) notes that a well established baseline model, where both theory and measures have been rigorously developed, does not preclude the use of PLS, especially in incremental studies in which prior models are extended to include new measures and structural paths, as is the case with the present study.

The PLS analysis was conducted in two stages; the first stage estimates the measurement model, while the second stage focuses upon examining the structural model (Roberts & Thatcher, 2009). Researchers can choose to conduct a one-step analysis that joins the measurement and structural stages, or a two-step analysis, completing the measurement and structural stages separately (Gefen, Straub, & Boudreau, 2000). In the present study, the analysis was completed in a single step. First, the weight relations were analysed, these estimate the case values for the latent variables (Chin & Newstead, 1999). This is known as individual item reliability, and is assessed by inspecting the loading of the items on their respective latent variables. It has been suggested that items should be rejected if they have more error variance than shared variance with their latent variable (Hair, Black, Babin, & Anderson, 2010), and thus items of .70 or greater should be retained. However, Chin and Newsted (1999) report that PLS structural parameter estimates are more stable and converge on the true population values with larger numbers of indicators of the latent variables. Based upon Chin and Newsted's recommendation, items of .40 or greater were retained if they were statistically significant. Secondly, analysis of how latent variables and indicators were related was achieved by an examination of the internal consistency, convergent validity and discriminant validity of the scales. Composite reliability (CR) was assessed as a measure of internal consistency and is considered superior to Cronbach's alpha reliability coefficient, as it provides a better estimate of variance shared by a set of indicators because it uses item loadings to calculate their internal consistency. It has been suggested that a CR of .70 or higher represents acceptable internal consistency (Fornell & Larcker, 1981). The average variance extracted (AVE) for scales were used to assess convergent validity. This statistic refers to the average amount of variance in a set of indicators explained by their latent variables, this should be at least .50 or greater (Fornell & Larcker, 1981). The AVE statistic can also be used to calculate discriminant validity. Fornell and Larcker (1981), suggest that a latent variable should better explain the variance of its own indicators than the variance of other latent variables. Hence, the squared AVE should be greater than the correlations between the latent variable and all other latent variable constructs in the model.

The second stage was to test the structural part of the model. This stage tests the relationship between the latent variables. The cognitive dimension, physiological dimension and regulatory dimension were modelled as formative higher order latent variables. All TOPS-2 dimensions were modelled as reflective lower order latent variables. When assessing structural models with formative constructs the standardized path coefficients are assessed to examine their significance. This evaluates the strength of the relationship between the focal formative construct and related endogenous constructs (Roberts & Thatcher, 2009). If structural paths were significant they were retained in the model, and further examination of the standardised path coefficients (β) and the variance explained in the endogenous variables (R^2) took place.

In order to generate a test of significance, SmartPLS implements a bootstrapping procedure. Estimates means and standard errors for the PLS estimates are generated and these are tested for significance by the *t*-statistic. In this analysis a 500 bootstrap samples replacement was requested. SmartPLS does not generate significance tests for the variance explained in the dependent latent variables. Instead, effect sizes of the R^2 values (Cohen's $f2$) were calculated (Ringle, Sarstedt, & Straub, 2012). Effect sizes of .02 are considered small, .15 are medium and .35 are considered large (Cohen, 1988).

Results

Measurement Model

Analysis revealed that all factor loadings were greater than .40 and significantly greater than zero in all cases. Only five loadings were below .70. Table 1 shows the PLS and bootstrapped estimates for each factor loading.

Table 1. Measurement model factor loadings.

Factor and Loadings	PLS estimate	Bootstrap estimate
Worry		
I am worried that I may make mistakes	.82	.82***
I am worried about the uncertainty of what may happen	.66	.66***
I am worried about the outcome of my performance	.86	.86***
I am worried that I may not perform to the best of my ability	.81	.81***
I am worried about the consequence of failure	.72	.71***
Private Self-Focus		
I tend to dwell on shortcomings in my performance	.72	.72***
I am aware that I will scrutinise my performance	.78	.78***
I am aware that I will be conscious of every movement I make	.63	.62***
Public Self-Focus		
I am conscious about the way I will look to others	.77	.77***
I am conscious that others will be judging my performance	.80	.80***
I am worried that I may not meet the expectations of important others	.82	.82***
Somatic Tension		
I feel physically nervous	.80	.80***
I find myself trembling	.72	.71***
I have a slight tension headache	.65	.65***
I feel lethargic	.50	.49***
My body feels tense	.81	.81***
Autonomic Hyperactivity		
My chest feels tight	.70	.70***
I feel tense in my stomach	.83	.83***
My heart is racing	.70	.70***
I feel a lump in my throat	.70	.71***
My hands are clammy	.63	.62***
Perceived Control		
I believe in my ability to perform	.83	.83***
I am prepared for my upcoming performance	.79	.79***
I am confident that I will be able to reach my target	.79	.79***
I feel I have the capacity to cope with this performance	.75	.75***

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

Acceptable convergent validity was achieved as all lower order constructs within the measurement model had CR values greater than .70. All lower order constructs had AVE's greater than .50, see Table 2.

Table 2. Quality overview

First-order Construct	AVE	AVE Sq	Composite Reliability	Cronbachs Alpha	Communality
Worry	.61	.78	.88	.83	.62
Private Self-focus	.51	.71	.76	.52	.51
Public Self-focus	.64	.80	.84	.72	.64
Somatic Tension	.50	.70	.88	.83	.61
Autonomic Hyperactivity	.51	.71	.84	.76	.51
Perceived Control	.63	.79	.87	.80	.63

Discriminant validity was checked by looking at the squared AVE'S for each latent variable against the bivariate correlations of all other variables, see Table 3. All latent variables demonstrated adequate discriminant validity, apart from autonomic hyperactivity, with somatic tension. However, on further inspection of the item cross loadings, there was no violation across items. The Fornell-Larcker approach is a very conservative test of discriminant validity, therefore, on the basis of inspection of the item cross loadings, all latent variables demonstrate adequate discriminant validity. With this in consideration, and in view of the results as a whole, these findings suggest that the measurement model was acceptable. The measurement model of TOPS-2 was also assessed in order to examine the statistical properties of the competitive subscales within the measure (see Appendix I). Two of the item loadings were not significant and 8 were below .70, and the automaticity and distractibility sub-scales reported AVE's lower than .50.

Table 3. Inter item correlations.

First-order Construct	1.	2.	3.	4.	5.	6.
1.Worry	.78					
2.Private Self-Focus	.53	.71				
3.Public Self-Focus	.67	.57	.80			
4.Somatic Tension	.60	.36	.47	.71		
5.Autonomic Hyperactivity	.56	.32	.43	.75	.71	
6.Perceived Control	-.44	-.24	-.27	-.44	-.28	.79

(i.e., weak – 0.20, moderate – 0.50, and strong – 0.80)

Structural Model

Our results show that all path coefficients were significant in the proposed performance anxiety model (see figure 2). All of the first order reflectively measured latent constructs were positively related to the cognitive, physiological and regulatory formative second order latent constructs. Therefore, hypotheses 1, 2, and 3 were all supported. In the larger nomological net, the anxiety constructs were significantly related to a number of the TOPS-2 dimensions. Specifically, hypothesis 4, 5, 8, 9, 10 and 11 were supported. There was no support for hypotheses 6, and 7, therefore, there was no significant relationship between the cognitive dimension and automaticity, the physiological dimension and activation[2]. The model explained between 6% and 31% of the variance in the endogenous dependent variables. Effect sizes were large for negative thinking (f^2 = .47), and medium for automaticity (.20), activation (.12), resistance to disruption (.09), and emotional control (.07).

[2] In accordance with suggestion made by Gefen et al. (2011) a saturated model is included within the appendices (Appendix J) to allow comparisons between the theoretical model and an alternative model. All pathways are specified, even those assumed to be unrelated in the model. This allows the researchers to verify that no significant path has been left out of the model.

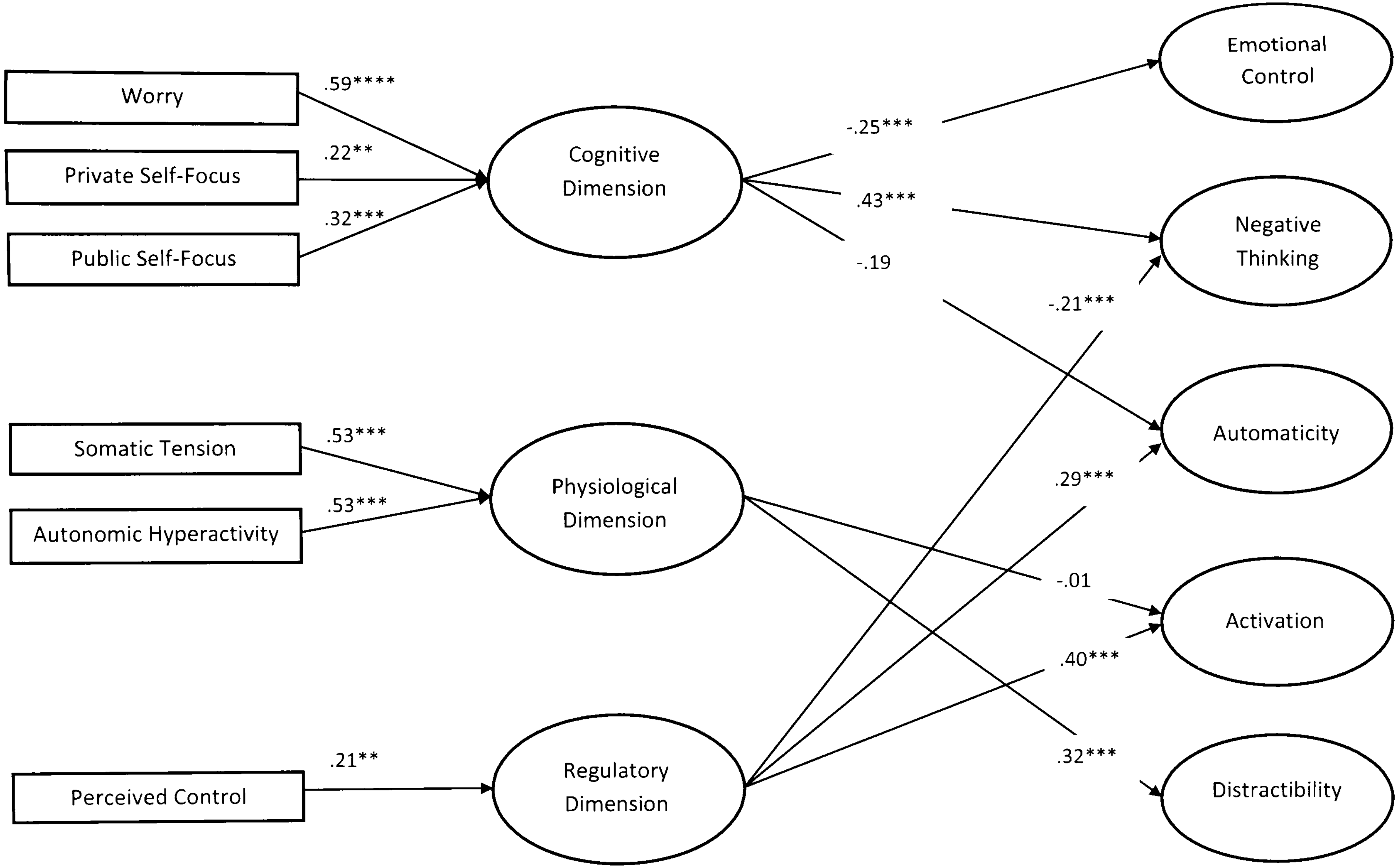

Figure 2. Structural model with parameter estimates. *Note*: For the paths, the value is the standardised PLS estimate,$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

The purpose of this study was to re-examine Cheng et al.'s (2009) model of performance anxiety using a hierarchical structure. Employing Jarvis et al.'s (2003) guidelines, the proposed model consisted of six first order subcomponents (worry, private self-focus, public self-focus, somatic tension, autonomic hyperactivity, and perceived control), which were measured reflectively, and three second-order formative dimensions (cognitive anxiety, physiological anxiety and the regulatory dimension). The results of the PLS analysis revealed support for a fully differentiated hierarchical model represented by the underlying subcomponents. The findings will be discussed in relation to each of the stated hypotheses.

In relation to hypothesis 1, the results revealed that the second order cognitive dimension was formed by the three lower order reflectively measured constructs of worry, private self-focus and public self-focus; supporting the suggestion that meaning emanates from the lower order constructs to the higher order construct of cognitive anxiety. More specifically, cognitive anxiety is formed by its three lower order constructs. The model presented here is in line with Cheng et al.'s (2009) originally proposed five factor hierarchical model, rather than the final merged model presented by Cheng et al. that contained 3 dimensions. Thus, the results support the multidimensionality of the cognitive dimension. This may allow researchers to explore the possibility that these conceptually distinct subcomponents can have differential effects on performance. For example, researchers may hypothesis that the worry subcomponent may affect tasks that rely heavily on working memory (Eysenck, Derakshan, Santos, & Calvo, 2007). Whilst high levels of private self-focus may heighten awareness of skill execution in order to maintain performance (Baumeister, 1984; Masters, 1992). Alternatively, high levels of public self-focus may cause a broadening of focus directed at important others (Schwarzer & Jerusalem, 1992). The inclusion of a private and public component of self-focus demonstrated good discriminant validity; including both types of self-focus in models of performance anxiety may be crucial to understanding the whole anxiety response. Taken together the findings support the representation of cognitive anxiety as a hierarchical structure with three first order factors of worry, private self-focus and public self-focus.

In relation to hypothesis 2, the results supported the hierarchical structure of physiological anxiety, underpinned by two lower order reflectively measured constructs of somatic tension and autonomic hyperactivity. Like the cognitive dimension, the results suggest that physiological anxiety is formed by its two lower components. The differentiation this model presents allows somatic tension and autonomic hyperactivity to be viewed as conceptually distinct with the potential for different behavioural effects upon performance. Specifically, somatic tension may have an effect through increased muscle tension, which has the potential to cause degrees of freedom to "freeze" (cf. Vereijken, van Emmerik, Whiting, & Newell, 1992). Whilst, an increase in autonomic hyperactivity may affect an individual's activation state, due to increases in breathing and/or heart rate (Hardy, Jones, & Gould, 1996; Hockey & Hamilton, 1983). Similar to the cognitive dimension, a hierarchical structure with two first order components of somatic tension and autonomic hyperactivity should be adopted in future conceptualizations.

The results also support hypothesis 3 in that the single factor of perceived control was supported as a formative subcomponent of the regulatory dimension. Although only one subcomponent was specified for the regulatory dimension, the same procedures were used as the cognitive and physiological dimensions. The results provide further support for the integration of a regulatory dimension in a model of performance anxiety. The inclusion of a regulatory dimension highlights the adaptive potential of anxiety and adds weight to Cheng et al.'s original suggestion.

With regard to the hypothesis generated to test the performance anxiety structure alongside the competitive subscales of TOPS-2, hypotheses 4, 5, 8, 9, 10 and 11 were supported. Furthermore, the performance anxiety model was able to explain and predict some of the variance in the TOPS-2 constructs. The consideration of the relationship between the focal concept and other constructs in the context of a theoretical structure is an important step in establishing construct validity (Bagozzi, 1980). These results indicate that the performance anxiety model has demonstrated sound structural properties within the larger nomological network. Despite support for the majority of the predictions, hypotheses 6 and 7 were not supported. Hypothesis 6 predicted that cognitive anxiety would have a negative relationship with automaticity, that is, the more cognitive anxiety experienced the less automaticity would be experienced. In addition, hypothesis 7, predicted that physiological anxiety will have a negative relationship with activation, i.e., the more physiological anxiety experienced the less an athlete will report being in the appropriate activation state. Both of these predictions are theoretically appropriate; however, the predicted relationships have not been produced in this instance. On closer inspection of the statistical properties of TOPS-2, it would seem that both the activation and automaticity competitive subscales have been problematic in both versions of the instrument (Thomas, Murphy, & Hardy, 1999; Hardy et al., 2010). Furthermore, Hardy et al. refer to the measure as a fairly "blunt" instrument, which may explain the findings in our structural predictions. Inspection of the measurement properties of the TOPS-2 sub-scales confirms our suspicions (see Appendix H and J). It is therefore unsurprising that some of the hypothesised relationships have failed to reach significance. The TOPS-2 questionnaire was used so that the nomological validity of the performance anxiety model could be established (Chin, 1998), and although the hypotheses are theoretically driven, the fact that TOPS-2 is relatively unstable may explain the lack of significance.

Turning to theoretical issues, in terms of the performance anxiety model, the results support the adoption of a hierarchical structure, with five lower order reflective constructs and three higher order formative constructs. In contrast to Cheng et al.'s (2009) analysis, the results of the current study were able to support a hierarchical structure. Thus, the results add support to the re-conceptualization of performance anxiety suggested by Cheng et al., whilst also providing support for the multidimensionality associated with both the cognitive and physiological dimensions. Theoretically, this allows for greater differentiation in our understanding of each dimension of performance anxiety, which will allow more meaningful testing of theories. Whilst the greater differentiation may prove useful in theoretical terms, there is also a practical significance in these findings. Specifically, if more defined diagnosis of anxiety can be made; sport psychologists can adopt more precise intervention strategies to facilitate task success in pressure situations.

From a measurement perspective, the results of this analysis suggest that modelling performance anxiety using a mix of reflective and formative methods may provide a more accurate reflection of the factors associated with the performance anxiety response. Moreover, the results provide clear support for modelling the relationship between the lower order and higher order constructs as formative. This is crucial as the lower order constructs of worry, private self-focus, public self-focus and of somatic tension and autonomic hyperactivity are conceptually distinct, are likely to have different antecedents/consequences, and are not interchangeable. Therefore, adopting a formative approach will reduce the potential for misspecification of relationships between constructs and the associated measurement error. This will result in researchers specifying appropriate relationships and making accurate conclusions about the structural relationships between constructs.

The current study is not without limitations, and most notable are the issues surrounding the physiological dimension. As reported, the measurement results revealed a violation of inter-item correlation between somatic tension and autonomic hyperactivity. Although a marginal violation, the predicted relationship between the second order physiological dimension and the activation sub scale of TOPS-2 were also not supported. Taken together, these results, indicate a potential issue with the physiological dimension. The approach of measuring perceptions of physiological anxiety in performance contexts has previously received criticism (e.g., Woodman & Hardy, 2001) and research has demonstrated that individuals are fairly poor at accurately reading their own physiological symptoms, unless trained to do so (e.g., Yamaji, Yokota, & Shephard, 1992). Therefore, measuring physiological symptoms via self-report instruments may not be most effective method, which may go some way to explain the issues reported here. Consequently, further validation of the physiological dimension is required.

A further limitation relates to the method employed to test the hierarchical model. The guidelines for establishing hierarchical models have not been fully established, thus information is sparse (Ringle et al., 2012). Although the indicator reuse approach is suitable for hierarchical component models (Wetzels et al., 2009), this method works best when all lower order components have the same number of indicators. In the proposed model, the worry, somatic tension and autonomic hyperactivity subcomponents have 5 items each, perceived control has 4 and private and public self-focus have 3 each. Although every effort was made by the author to follow the literature as closely as possible, it would seem that the lack of clear guidance has hindered the process. Ringle et al. highlighted the problem of unequal indicators and reported that in their analysis of hierarchical models, five of the seven studies examined, had an unbalanced number of indicators. This is clearly something that needs to be addressed in future testing. In addition, the sample used within the current study features predominately female athletes. While no analysis was conducted on gender within this sample, future research should seek to explore gender differences. Some gender differences have been reported within the literature (e.g. Jones, Swain, & Cale, 1991); however, the majority of these studies have relied on the CSAI-2 to explore these differences. Thus, future research should seek to explore gender differences adopting the hierarchical model proposed here.

Future research should also seek to establish the predictive power of the proposed hierarchical measure of performance anxiety. Specifically, in terms of the relationship with performance, research should seek to establish if specific components of the model can predict performance. This is an important element of establishing validity of the proposed model (Cheng et al., 2011). Cheng et al. tested the predictive validity of their three-dimensional model in a sample of elite tae-kwon-do competitors. Using a self-report measure of subjective performance, Cheng et al. examined the interactive influence of anxiety subcomponents upon performance. A similar design could be adopted to test the predictive validity of the hierarchical model proposed in the current thesis. Whilst Cheng et al. examined the three dimensions of performance anxiety, the model proposed here allows for a more detailed examination of the three second order dimensions as well as the first order subcomponents of performance anxiety. Further to this, more tests using field and laboratory-based designs should be developed to fully examine the model. Gefen et al. (2011) suggest that an important step in model development is exploring the constructs using experimental manipulations. For further validation, scores on sub-scales should correlate with the aspect of the model that is being manipulated. In erms of the current performance anxiety model, manipulation of the lower order constructs of cognitive anxiety would be one method of achieving this validation. For example, manipulation of public self-focus using audiences or film clips, should produce an increase in scores on the public self-focus subcomponent, while the use of a mirror should result in increased private self-focus.

Finally, some may question the integrity of the regulatory dimension and its first order factor of perceived control. The term perceived control was adopted by Cheng et al. to reflect the control system proposed in a number of anxiety theories (e.g., Eysenck et al., 2007). Conventionally, the notion of perceived control has been reflected as a coping related factor that is an unrelated to anxiety; however, Matthews (1992) argued that a voluntary stage regarding coping is involved in the final process of the anxiety response. Moreover, perceived control is also involved with self-evaluation, a key process underlying anxiety dynamics (Gibbons, 1990; Izard, 1972). Specifically, anxious individuals may evaluate not only environmental and internal threats (including cognitive/physiological anxiety) but also their capabilities for coping with them and meeting the task demands in reaction to perceived stress. As such, perceived control is hypothesized to be a characteristic of anxiety. Thus, in this model of performance anxiety it is proposed that the factor that differentiates perceived control form coping and conventional theories of control (Skinner, 1996), is the integrated nature within anxiety, which is concerned with the response to stress.

In summary, both the measurement and structural results provide support for hierarchical model of performance anxiety, represented by fiver lower order reflectively measured constructs and three second order formative constructs. This lends further support to modelling of constructs such as performance anxiety as a formative model, in order to fully represent the complexities of the model under investigation.

Chapter 7

Summary and concluding comments

The purpose of this final chapter is to synthesise the findings of the thesis. The chapter is divided into five sections; (1) a synopsis of the aims and major findings of the research programme (2) a discussion of the major theoretical issues, (3) an examination of the applied implications generated by the research, (4) identification of the strengths and limitations of the research programme, and (5) recommendations for future research.

Synopsis of the aims and major findings of the thesis

The aim of this research programme was to address two issues within the performance anxiety literature. The first issue surrounded the process goal paradox (Mullen & Hardy, 2010) and the conscious processing hypothesis (CPH; Masters, 1992). The second aim was to revisit the debate concerning the measurement of anxiety. Thus, this thesis was split into two sections; the first section included a review of the anxiety-performance literature and two studies that added to the knowledge base supporting the use of holistic process goals by anxious athletes. The second section began with a short review of the current state of the performance anxiety measurement literature. The review is followed by two studies that examine the recent re-conceptualization of performance anxiety proposed by Cheng, Hardy, and Markland (2009). The two studies aimed to: (i) revisit the cognitive dimension of Cheng et al.'s proposed model, and (ii) attempted to situate a revised version of the cognitive dimension within a hierarchical model of performance anxiety. All four empirical studies will be discussed in more detail below.

Study 1 and 2

The first two studies of this thesis set out to examine the effectiveness of holistic process goals (HPG), relative to part process goals (PPG). Research has highlighted the potentially negative effect that PPG, which are laden with explicit knowledge, can have on skilled but anxious athletes (Hardy, Mullen, & Jones, 1996;

impairment, HPG have been reported as an alternative strategy to PPG (Mullen & Hardy, 2010); however, there is relatively little evidence to support this proposal. Experiment 1 addressed Mullen and Hardy's suggestion that research examining the relative efficacy of HPG and PPG could be strengthened by using a learning paradigm to examine the effect of both types of process goals upon skill acquisition. The author predicted that HPG used early in learning would aid skill acquisition. Therefore, the purpose of this study was to establish if, relative to PPG, HPG would enhance performance at retention and transfer. In addition, a control group was included to examine how effective part and holistic goals are relative to discovery learning.

The results of experiment 1 supported the use of HPG over PPG for both learning and performance under pressure, as the HPG group significantly outperformed the PPG group at retention and transfer. In terms of discovery learning, the findings were not as clear, as the control group did not differ from the HPG group or the PPG group at retention or transfer. There was also no evidence of differential performance during the practice phase as all three groups improved equivalently. The absence of any differences between the groups in practice is similar to findings presented in the attentional focus literature (Wulf, Hoß, & Prinz, 1998). The superiority of the HPG group compared to the PPG group at retention is the first evidence that HPG allow novices to learn motor skills more effectively. In addition, the HPG group outperformed the PPG group in the transfer condition in which state anxiety was elevated, providing further support for the efficacy of HPG in competitive situations.

Despite the positive effects reported here, the single between-subjects comparison used in experiment 1 to examine performance at transfer was not able to tell us anything about the possible conscious processing effects hypothesized to be establish whether the use of PPG is associated with performance impairment in high relative to low anxiety conditions.

Experiment 2 set out to address this limitation and extend the research conducted by Mullen and Hardy (2010). Specifically, Mullen and Hardy produced consistent evidence supporting the use of HPG over PPG for skilled but anxious athletes; however, they failed to include some of the more sophisticated psychophysiological measures adopted in previous studies examining CPH (e.g., Mullen, Hardy, & Tattersall, 2005; Wilson, Smith, & Holmes, 2007). Psychophysiological measures such as heart rate variability (HRV) have previously been used to examine the intensity of attentional processing associated with shifts from automatic to controlled processing related to the CPH (Mullen, et al., 2005). Experiment 2 replicated the design of Mullen and Hardy's third experiment and also included HRV and salivary alpha amylase (sAA) as psychophysiological measures. Salivary alpha amylase was collected as Mullen et al. suggested that the hypothesized reductions in the HRV low frequency (HRVLF) band might be masked by the physiological responses associated with increased anxiety. The increases in sympathetic activity associated with state anxiety may "flood" the HRVLF band, resulting in large increases in spectral power from baseline. This increase in spectral power potentially obscures the impact of mental effort, which is reflected as a reduction in power in this frequency band.

The results of experiment 2 provided further support for the efficacy of HPG for skilled but anxious individuals; however, the pattern of results differed from those reported in other process goal studies (Mullen & Hardy, 2010). In the baseline condition the HPG was significantly slower than the PPG, but in the competition condition, the HPG improved performance so that they were at an equivalent level to than the PPG group across both baseline and competitive conditions. Taken together, the combination of improved lap times and fewer and less severe errors suggest that the HPG outperformed the PPG as reported in similar studies (Gucciardi & Dimmock, 2008; Mullen & Hardy, 2010). Although the results provide further support for the efficacy of HPG, there is no evidence that the PPG caused lapses into conscious processing. The fact that no direct evidence was found for the impairment of performance through the application of PPG is consistent with the findings of Mullen and Hardy.

The results of the HRV analysis also differed from those reported in previous studies (Mullen et al., 2005; Wilson, Smith, & Holmes, 2007). Mullen et al. reported significant differences in the HRV high frequency band (HRVHF), whilst the results of experiment 2 in this thesis revealed differences in the HRVLF band. The reductions in LF spectral power were hypothesized to accompany shifts in task processing from automatic to controlled processing that were predicted to occur in the HPG group. However, the HRV changes were evident in both the HPG and PPG. Two explanations could account for these differences. The first explanation is that the effects could be due to changes in task processing (cf. Fairclough & Mulder, 2011; Veltman & Gaillard, 1998); however, as the reductions in HRVLF power occurred in both process goal groups, the author argued that a second explanation is more likely; the effect is more likely to be associated with compensatory mental effort (cf. Eysenck & Calvo, 1992). The performance results revealed that the HPG group improved, while the PPG group maintained task baseline levels in the competitive condition. The increased compensatory mental effort in both process goal groups may have allowed them to maintain and improve performance effectiveness but at the expense of processing efficiency. In addition, sAA reflected the changes evident in sympathetic activity. The patterning of sAA further supports the contention that decreases in HRVLF power represent increases in compensatory effort as participants mobilized resources to help deal with the perceived threat indicated by the increase in cognitive anxiety (Eysenck & Calvo, 1992; Eysenck, Derakshan, Santos, & Calvo, 2007). In summary, the two studies presented here provide further support for the efficacy of adopting HPG for skilled but anxious individuals. In addition, experiment 1 indicates that a holistic focus is more effective for learning than a part process focus.

Study 3

The third study in this research programme examined issues associated with the measurement of performance anxiety identified in the literature discussed in chapter 4. Cheng et al. (2009) proposed a three-dimensional model of performance anxiety, which included cognitive, physiological anxiety dimension, and regulatory dimensions. Cheng et al. hypothesised that each of the three dimensions was represented by lower order sub-components. The cognitive dimension included a worry and self-focus component, the physiological dimension was represented by somatic tension and autonomic hyperactivity and the regulatory dimension was characterized by perceived control. In an attempt to confirm their hypothesized model, Cheng et al.'s results did not support the predicted separation of these subcomponents; consequently, somatic tension and autonomic hyperactivity were merged in to one overall physiological dimension. Worry and self-focus were also merged in to one factor that represented cognitive anxiety. Cognitive anxiety is often reported as having the most significant influence on performance (Eysenck & Calvo, 1992; Woodman & Hardy, 2001), thus a comprehensive representation of the cognitive response is crucial for model development. With this importance in mind, study 3 aimed to re-examine dimension. It was predicted that the single self-focus dimension proposed by Cheng et al. would be better represented by two subcomponents of private and public self-focus (Fenigstein, Scheier, & Buss, 1975). Qualitative interviews were utilised to test the prediction

The findings of study 3 supported the inclusion of worry and self-focus as subcomponents of cognitive anxiety, as suggested by Cheng et al. (2009). However, the qualitative data indicated that Fenigstein et al.'s (2009) bipartite model of self-focus, including private and public components better represented the athletes' experiences. There has been some recognition of this distinction in the sport psychology literature. For example, Ashford, Karageorghis, and Jackson (2005) modelled the relationship between self-consciousness and competition anxiety using Fenigstein et al.'s model. Despite being concerned with trait measures of competition anxiety, the inclusion of a private-public differentiation by Ashford et al. highlights the importance of both elements within athletic samples. In addition, Wang, Marchant, Morris, and Gibbs (2004) reported that those with high levels of private self-focus were more susceptible to poor performance under pressure. Clearly, private and public self-focus would seem to be relevant in a sporting context; however, further research is required to justify this distinction within models of performance anxiety.

The results also suggest that each of these subcomponents is represented by a number of themes and so a unidimensional approach to worry, private self-focus and public self-focus may be an over-simplification. The data from the worry dimension supported this suggestion, as seven themes emerged from the data. Although there is some evidence for the multidimensional nature of worry in sport (Dunn, 1993, 2003), research has generally not adopted this approach in contemporary models of performance anxiety. Despite the evidence suggesting that worry might be multidimensional, the author argues that while it may be important to distinguish between the different types of worry that athletes may experience, it remains debatable whether this diversified content is sufficient to represent multidimensionality from a theoretical perspective. A multidimensional approach is justified when the multiple dimensions of a construct differ in their internal underlying psychological processes (Eysenck, 1992). So, while it is appropriate to specify the cognitive dimension as multidimensional; as worry, private self-focus and public self-focus differ in their underlying psychological processes, it would be conceptually inappropriate to model worry as multidimensional in models of performance anxiety. The author argues that the psychological process of worry is conceptually unified; therefore it would be more appropriate to recognise the diversified content of worry reported by athletes within measurement models.

Study 4

The fourth study aimed to re-examine Cheng et al.'s (2009) model of performance anxiety using the extended cognitive dimension highlighted in study 3. A hierarchical model of performance anxiety was presented that retained the three prime dimensions of cognitive anxiety, physiological anxiety and the regulatory dimension. These second order dimensions were represented by six reflectively measured first order subcomponents: cognitive anxiety; formed by worry, private self-focus and public self-focus; physiological anxiety, formed by somatic tension and autonomic hyperactivity; and a regulatory dimension, formed by a single subcomponent of perceived control. Guidelines proposed by Jarvis, Mackenzie, & Podsakoff (2003) were adopted to specify the relationship between the first order subcomponents and the second order dimensions, whereby the first order subcomponents were measured reflectively, while the second order dimension were modelled as formative constructs.

The results of Partial Least Squares structural equation modelling fully supported the predicted hierarchical model of three second order dimensions and six first order subcomponents. Furthermore, this performance anxiety model was supported within a larger nomological network and was able to predict some of the variance in the Test of Performance Strategies-2 constructs (TOPS-2; Hardy, Roberts, Thomas, & Murphy, 2010). This lends further support to the structural properties of a three dimensional performance anxiety model. In summary, the hierarchical model presented in study 4 was fully supported, and extends the reconceptualization of performance anxiety suggested by Cheng et al. (2009).

Theoretical Issues

The following section will discuss the main theoretical issues that emerged from the research programme, which include; (1) the use of HPG for learning and performance in competitive situations, (2) the lack of support for conscious processing effects, (3) the use of interdisciplinary research in this thesis, and (4) the hierarchical model of performance anxiety.

Process goals

As discussed in study 1 and 2, the results of the research programme offer further evidence for the use of HPG in competitive situations, adding support to the findings of Mullen and Hardy (2010), Gucciardi and Dimmock (2008), and Jackson and Wilson (1999). Clearly there is growing evidence for the efficacy of HPG; therefore, the mechanisms that underpin these goals are worthy of further examination. Mullen and Hardy suggested that the concept of "chunking" (MacMahon & Masters, 1998) might help explain the mechanisms that underpin HPG. Chunking has been used to describe the automatization of cognitive skills, in which individual elements of a task are gradually incorporated into a single representation (Neves & Anderson, 1981). Therefore, HPG may function by allowing the appropriate sub-actions of a movement to be generated automatically (Mullen & Hardy, 2010). This in turn may promote smoother, more automated performance. MacMahon and Masters (1998) supported the concept of chunking in motor skills using a serial reaction time task. They also demonstrated that under pressure, the process of chunking was reversed and the skill effectively "de-chunked", which is in line with the CPH explanations of performance impairment. Therefore, the global focus that HPG encourages might allow skilled but anxious individuals to avoid de-chunking effects. In addition the global representation that HPG promotes should not induce conscious processing, given that conscious control can only be exerted over parts of a movement, and not the movement in its entirety (Hardy et al. 1996). This chunking explanation may also explain why the HPG group in experiment 1 learnt more effectively. The promotion of a global movement representation early in learning may have encouraged more automatic processing. Despite the strength of this explanation, there is currently no evidence to confirm that HPG encourages more automatic processing. One way of examining this would be to utilise measures that index automatic functioning. Kinematics may provide researchers with such insight, by indexing the fluency of movement. It would be predicted that those who are functioning automatically using HPG would retain a higher degree of fluency than those who employed PPG and lapse into conscious control. Electroencephalography would also enable researchers to examine the brain activity associated with the automatic processing of motor skills and the predicted lapses into conscious processes. Similarly, electromyography (EMG) would provide further insight into how motor control is organized by the nervous system when individuals use holistic and part process goals, with HPG possibly resulting in more efficient muscle activation patterns.

The current findings can also be viewed in the context of the internal and external attentional focus literature (Wulf, 2007). Mullen and Hardy (2010) suggested that holistic goals might operate in the same way as an external focus, in that they prevent a specific focus on the mechanics of movement. However, Mullen and Hardy argued that the holistic focus represented in their research is innately different to an external focus. Participants in Mullen and Hardy's studies were encouraged to focus on the general *feeling* of the whole movement, rather than the *effect* of the movement, as would be the case for an external focus. The same consideration was taken in development of the holistic goals for the current research programme. In addition, a number of strategies were employed, such as the post experimental questionnaires, to ensure that participants continued to use their assigned / selected goal throughout the testing and did not make use of alternative strategies.

With regards to the lack of performance impairment in the PPG group, the results reported in this thesis are consistent with similar research investigating the process goal paradox (Mullen & Hardy, 2010). Part process goals were predicted to impair performance, as they contain explicit knowledge that should encourage athletes to consciously control movements (Masters, 1992). However, no performance impairment was reported in either of the PPG groups. An alternative explanation for the results of this study situates itself within the explicit monitoring literature. Jackson, Ashford, and Norsworthy (2006) addressed the conceptual distinction between explicit monitoring and conscious control and suggested that while instructions to monitor and report a particular feature of performance encourage explicit monitoring they may not specifically encourage conscious control. In addition, Jackson et al. suggested that there could be varying degrees to which performers explicitly monitor performance, which can result in varying degrees of performance disruption. In the context of the results of this research programme, it might be argued that the PPG caused participants to explicitly monitor movement, rather than consciously control performance. This may explain why there was no impairment of performance in the PPG group. It is unclear whether consciously controlling performance is more disruptive to performance than explicit monitoring, but researchers need to be sensitive to the subtleties of the different subtypes of self-focus. Crucially, research needs to examine whether explicit knowledge causes a conscious control of performance or if it simply causes an athlete to explicitly monitor movement, with less severe consequences. Isolating the effects of individual theories has become increasingly problematic for researchers, and authors often conclude that a number of theories can be used to explain the mechanisms of performance failure. Using more than one mechanistic theory to explain performance impairment may be justified on some occasions, however, researchers should continue to establish methods that allow the isolated predictions of each theory to be examined. In order to ensure that experimental designs and manipulations are effective, researchers also need to consider the strength of the anxiety interventions used. These need to be strong enough to replicate the demands placed upon athletes in competitive situations. Another issue to consider is the measurement of performance anxiety, which is dealt with in some depth below.

Interdisciplinary research

Turning to the psychophysiological measures used in this study, it would seem that the inclusion of both HRV and sAA provide an insight into the psychophysiological responses associated with anxiety. Whilst the results in this thesis are different to those reported elsewhere (Mullen et al., 2005) the decrease reported in the HRVLF here are indicative of an increase in mental effort. The dissociation reported between HRVLF and sAA was something of a new finding. The author argues that these effects reflect the increased compensatory mental effort and provide us with some insight into the mechanisms that might underpin performance. As this is only the first empirical evidence of such a dissociation, further research should seek to confirm these findings.

Activity in the HRVLF band is mediated by both sympathetic and parasympathetic activity (Berntson et al., 1997). As such, the author suggests that the absence of significant differences in the HRVHF band, which is an established indicator of parasympathetic activity (Berntson et al., 1997; Grossman, 1992), when viewed in combination with the sAA results, indicate that the changes in HRVLF activity in response to the competition stressor were primarily associated with sympathetic reactivity. To confirm these suggestions, research should seek to include further measures of both parasympathetic activity, such as respiration, and more direct measures of sympathetic activity, including plasma catecholamines and the cardiac pre-ejection period. These psychophysiological measures, in tandem with the EEG, EMG and kinematic measures outlined above, would provide researchers with a comprehensive interdisciplinary picture of the processes underlying the superiority of HPG.

Hierarchical model of performance anxiety

The findings of this thesis provide further support for the reconceptualization of performance anxiety. The results support a hierarchical model, with three second order dimensions and six first order subcomponents. Cheng et al. (2009) originally attempted to support a hierarchical five-factor structure; therefore the results of this thesis support the differentiated approach originally predicted by Cheng et al. In addition, the results provide support for the multidimensionality associated with both the cognitive and physiological dimension, as represented by the first order subcomponents. The present thesis extends the model presented by Cheng et al. by including a private and a public self-focus component alongside worry in the cognitive dimension. The multidimensional nature of cognitive anxiety is consistent with several lines of conceptual argument (Carver & Scheier, 1988; Schwarzer & Jerusalem, 1992) and empirical evidence (Derakshan & Eysenck, 2001; Liao & Masters, 2002). Similarly, the adoption of a multidimensional approach to physiological anxiety is consistent with the criteria used for generalized anxiety disorder in the *DSM-III-R* (APA, 1987). The results suggest that the worry-emotionality model (Liebert & Morris, 1967) on which the Competitive State Anxiety Inventory-2 (CSAI-2; Martens, Vealey, Bump, & Smith, 1990) is based fails to account for the multidimensional nature of the cognitive and physiological response. Clearly a cognitive and physiological distinction is critical in representing the anxiety response; however, the author argues that there is a need to recognise the multidimensional nature of the dimensions within models of performance anxiety.

The results of this thesis also support the inclusion of a regulatory dimension within the performance anxiety model, providing further support for importance of a dimension that recognises the adaptive potential of anxiety. Whereas the predictions of multidimensional anxiety theory for the effects of anxiety upon performance are additive, the proposed model affords the examination of both singular and interactive effects of the different components of the anxiety model on performance. Cheng, Hardy, & Woodman (2011) have examined such effects using Cheng et al.'s (2009) three-dimensional model. Cheng et al. were limited to examining effects of a three-dimensional model, whereas the fully differentiated model presented in this thesis allows for an examination of both the separate and interactive effects of the underlying subcomponents.

The appeal of the regulatory dimension is clear, however, it is likely that some researchers may also question the inclusion of such a feature within models of performance anxiety. It could be argued that perceived control is actually part of a separate concept of coping. However, the author argues that although perceived control may be viewed as a positively toned, coping-related construct, it remains appropriate to integrate it within a model of performance anxiety. Specifically, much has been established on the importance of a control component in the anxiety response. For example, the explanatory power of perceived control has aided our understanding of variations in the effects of anxiety (Jones & Swain, 1995; Swain & Jones, 1996). Moreover, the notion of control is reported as a key factor in some anxiety theories, such as processing efficiency theory (Eysenck & Calvo, 1992) and attentional control theory (Eysenck, Derakshan, Santos, & Calvo, 2007). A control system in these theories monitors and evaluates performance and consequently plans and regulates the use of processing resources. Therefore, the author argues that the inclusion of perceived control as an indicator of the regulatory dimension is entirely appropriate and consistent with the literature.

Despite the attraction of the three second order dimensions (cognitive, physiological and regulatory) presented here, some may question the integrity of the proposed hierarchical model. Specifically, one might challenge the similarity to factors measured in the CSAI-2 and CSAI-2R (cognitive anxiety, somatic anxiety and self-confidence). However, the model presented in this study differs from the CSAI-2 for two fundamental reasons. Firstly, the cognitive anxiety dimension and the physiological dimension have been extended to represent a wider scope of the anxiety response. The cognitive anxiety dimension was extended to represent a private and public self-focus alongside worry, and the physiological anxiety dimension included the two subcomponents of somatic tension and autonomic hyperactivity to represent the involuntary and voluntary responses associated with anxiety. Secondly, the current model integrates a regulatory dimension to highlight the adaptive nature of anxiety. The CSAI-2 and the CSAI-2R are based on two components (worry-emotionality) and does not make reference to a coping capacity. However, it could be argued that the self-confidence factor included in the CSAI-2 is similar to the perceived control factor presented in the new model. The self-confidence sub scale within the CSAI-2 differs from the perceived control component in this model in several ways. Firstly, self-confidence was not included to represent the adaptive capacity; rather it was included due to fortuitous emergence in measurement development (Martens, Vealey, Bump, & Smith, 1990). Secondly, factor analysis of the CSAI-2 operationalized self-confidence as having two themes; positive performance expectations and a sense of calmness (cf., Lane, Sewell, Terry, Bartram, & Nesti, 1999). Positive performance expectations share some similarities with perceived control, as they both focus on goal attainment; however, the suggestion that a sense of calmness is similar to perceived control is far less conceivable. Specifically, the emotional calmness depicted in the self-confidence factor contradicts the anxiety response depicted within the current model. What is more, Cheng et al. (2009) suggest that it is unlikely that an individual could feel anxious and mentally relaxed simultaneously when under pressure. Therefore, the inclusion of a regulatory (coping) dimension in the current model is considered inherently different and superior to that contained within multidimensional models built upon the worry-emotionality distinction.

From a measurement perspective, the results of the structural analysis suggest that modelling performance anxiety using a mix of reflective and formative methods may provide a more realistic representation of the anxiety response. This approach may be crucial in understanding complex psychological concepts such as performance anxiety. Traditionally, structural analysis specifies models as reflective (Chin, 1998), and suggests that all indicator items are caused by the same latent construct. This approach is not always appropriate for the construct under investigation, rather it is more appropriate to model constructs with the meaning emanating from indicators to the construct. The author thought it was particularly important to model performance anxiety as formative at the second order level, as the sub-components of each dimension are clearly unique. For example, worry, private self-focus and public self-focus are conceptually distinct and should therefore be represented in a way that reflects this in models of performance anxiety. Likewise, the somatic tension and autonomic hyperactivity components of the physiological dimension are conceptually unique. It was hoped that this approach would provide a more conceptually appropriate reflection of the complex dimensions inherent in the anxiety response. To date, PLS and formative models have been notable by their absence from the sport psychology literature. This research represents the first empirical study that adopts such innovative measurement models and methods. Future research should seek to adopt such methods in development of similar measurement models.

Applied Implications

The eclectic empirical approach adopted in this research programme has highlighted a number of practical implications for sport psychologists, athletes and coaches. Firstly, the current findings support the use of HPG for skilled but anxious athletes in competition. Process goals are often used within pre-performance routines in preparation for skill execution (Hardy, Jones, & Gould, 1996). Often these routines include part-process oriented information, and although there is no evidence that these goals might impair performance, there is evidence that adopting HPG may enhance performance in competitive situations. Thus, athletes may benefit from more globally focused information in their pre-performance routine. Holistic process goals are not the only solution to the process goal paradox. Hardy et al. (1996) suggested that the process goals used in pre-performance routines might not always be task focused. For example, some athletes may include emotion-focused goals, such as being relaxed, which serve to keep an athlete's focus away from task execution. Applied practitioners should remain sensitive to the variety of process goals available to performers within pre-performance routines and be especially vigilant where athletes use routines that contain task-focused goals. In such circumstances, the goals should be holistically focused.

In addition, the evidence presented here suggests that holistic process goals can be beneficial for the acquisition of motor skills in addition to the promotion of greater resilience under pressure. Researchers have demonstrated similar effects using analogy learning in comparison to more traditional learning reliant upon explicit knowledge (Lam, Maxwell, & Masters, 2009). Lam et al. suggested that movement analogies are intended to reduce multiple task-relevant "rules" into a single "all encompassing biomechanical metaphor" (Masters, 2000, p. 538). In a similar way to HPG, analogy leaning may be successful as it helps to "chunk" or consolidate knowledge into a single rule. In addition, HPG also appear to be similar to metaphors (Butler, 1996). Both analogies and metaphors have been used as triggers and cues in imagery routines and have been described as "the labelling of movement components and instructions to code movement information symbolically" (Bird & Cripe, 1986, p. 204). Despite the similarity between HPG and analogies and metaphors, Mullen and Hardy (2010) argued that a holistic focus differs from both concepts, as the latter approaches appear to be coded symbolically. For example, the image of the pendulum used by Wulf et al. and Lam et al.'s (2009) description of "Shoot as if you are trying to put cookies into a cookie jar on a high shelf." (p. 345), appears to promote a symbolic representation of the task. This differs from HPG, which focus on encapsulating the feeling of performing the whole movement, which is more akin to kinaesthetic imagery (Mullen & Hardy, 2010). Research should seek to establish whether promotion of an external focus via the use of metaphors and analogies is more effective than movement-oriented HPG.

To date sport psychologists have relied on the CSAI-2 or the CSAI-2R when measuring the anxiety response. The development of a new theoretical model of performance anxiety creates a more appropriate measure for applied practitioners. The differentiated approach adopted in this model permits a greater understanding of the performance anxiety response. In adopting the proposed theoretical model, practitioners would be better placed to understand athletes' experiences before and during competition. Consequently, this will allow a greater diagnosis of the anxiety response, and for more appropriate strategies to be tailored to the athletes' individual anxiety response. For example, athletes who report high scores on the public self-focus component may benefit from an attentional focus strategy to prevent them from attending to significant others who are watching them, such as parents or friends. In contrast, athletes who report high levels of autonomic hyperactivity may benefit from a relaxation based strategy focused on rhythmic breathing, which could decrease an individual's breathing and heart rate. Therefore, the differentiated approach this measure allows has significant implications for the design and implementation of intervention strategies. In addition, applied practitioners may benefit from adopting a broader approach to the three subcomponents of cognitive anxiety. The results of this research suggest that there are a number of public and private self-focus domains within the response, as well as a number of sources of worry. Whilst a multidimensional approach is not appropriate for measurement models of performance anxiety, sport psychologists should remain sensitive to the underlying factors that an individual worries about or focuses on.

Research Strengths

This research programme exhibits several strengths. The research programme has engaged with a number of research methods to explore the aims and objectives, including quantitative and qualitative methods. The variety of methods adopted includes experimental design, qualitative interviews, and structural equation modelling, which taken together demonstrate the researcher's ability to conduct well-controlled laboratory and field-based studies. The willingness to engage in a number of innovative methods also demonstrates the researcher's desire to contribute to the development of high quality research. Furthermore, the research programme has made a number of contributions to the performance anxiety research area. The use of two psychophyiologoical measures highlights the benefits of adopting an interdisciplinary approach. These approaches may offer further insight into the processes and mechanisms associated with anxiety effects.

The inclusion of spectral analysis of heart rate variability provides an opportunity to explore links between psychological processes and physiological functions (e.g. Bernston et al., 1997). Salivary alpha amylase is a novel approach, and to the author's knowledge, it is the first time such a measure has been employed in the sport psychology literature. The results of study 2 suggested that sAA is a reliable and valid indicator of psychological stress. In addition, the sAA offers a useful insight into the activity of the sympathetic nervous system (Chatterton et al., 1996; Nater et al.; Rohleder et al, 2005). More direct measures of sympathetic activity could have been employed, such as plasma catecholamines or the cardiac pre-ejection period; however, the invasive nature of these data collection methods is problematic. The interdisciplinary approach utilised in this thesis, is both novel and innovative and the findings clearly demonstrate the validity of including such measures in future research.

The theoretical strength of this thesis includes the construction of a conceptual model of performance anxiety that incorporates a number of developments within the literature. Moreover, the development of the new model of performance anxiety was conducted on a large prospective data set. Cheng et al.'s (2009) research was based on retrospective data. Participants were asked to recall their state response to a competitive event two days to one week after the event, while in this thesis, data was collected an hour before competition. Furthermore, the thesis proposes an alternative method for specifying relationships between constructs in measurement models in sport psychology. This specification of formative and reflective models has been largely ignored in the sport psychology literature. The adoption of PLS analysis allows researchers to specify the relationships between variables. Not only has this approach made a significant impact on the way performance anxiety has been modelled, but it also provides other researchers a method to examine specification of similar constructs within sport psychology. In addition, the current research programme has adopted a number of recommendations for future research that have been identified by previous researchers, including the following:

1. Adopting post-experimental questionnaires to check for treatment adherence.
2. The use of heart rate variability as an index of mental effort.
3. Salivary alpha amylase as an indicator of sympathetic activity.
4. Modified analytic induction as an innovative deductive and inductive approach to qualitative data analysis.
5. Adopting formative and reflective measurement methods in model development.
6. Using partial least squares as an alternative to covariance based structural equation modelling.

Research Limitations

The research programme is not without its limitations. A number of the limitations have been addressed in the discussion sections of each chapter; therefore these will only be briefly mentioned here. Limitations reported in study 1 and 2 relate to the lack of counterbalancing between treatment conditions. Study 3 reported limitations concerning participant recall, whilst study 4 reported problems with self-report as a measure of physiological symptoms. In addition, it is recommended that the following limitations should be considered in future research (1) part process goal that do not cause lapses into conscious processing (2) lack of clear methods for specifying hierarchical models.

The results of study 1 and 2 failed to find any direct evidence that performance is impaired when using PPG. This is consistent with the findings of Mullen and Hardy (2010), but does little to support the predictions of the CPH (Masters, 1992). Mullen and Hardy suggested that the part process goals developed in their studies might not actually elicit the effects associated with conscious processing; the same problem may have occurred in this thesis. The author developed the PPG from technical race driving materials; however, these specific instructions may have failed to capture the explicit knowledge required to complete the task. Alternatively, as discussed earlier, these goals may have increased explicit monitoring of movements but not conscious control of performance. Another suggestion would be to adopt a within-subject design, so participants perform using both a HPG and PPG. The author previously suggested that this may cause confusion for participants, so to prevent such problems, research designs should conduct the experimental goal conditions on separate days with counterbalancing of conditions.

With regards to the measurement analysis, the guidelines on specifying hierarchical models are relatively sparse (Ringle, Sarstedt, & Straub, 2012). The lack of clarity in specific guidelines has proved problematic in this study. The model proposed in this thesis used a combination of reflective and formative methods; however, similar models in the literature often fail to provide details on how models were specified. Although the indicator reuse approach adopted in this study is suitable for hierarchical component models (Wetzels, Odekerken-Schröder, & van Oppen, 2009), there were relatively little guidelines on how to use this method. However, due to the growing popularity of partial least squares, more detailed information is currently emerging from the literature that researchers are likely to be able to use in the future (Hair, Hult, Ringle, & Sarstedt, 2013).

Future research directions

The research on HPG is in its infancy, thus, researchers should continue to examine the benefits of adopting a holistic focus. Specifically, researchers should seek to address the problem of multiple treatment interference and ensure the counterbalancing of stress conditions is achieved. In addition, research should attempt to explore HPG across a number of different tasks and levels of practice. Further research should also seek to compare the effectiveness of HPG alongside an external focus of attention. In addition, researchers should consider potential moderator/mediator variables in the relationship between goals and anxiety. One such variable could be the notion of "learning styles". Learning styles refer to the concept that individuals differ in regard to what mode of instruction is most effective for them (Pashler, MacDaniel, Rohrer, & Bjork, 2008). Despite the potential applicability to the goal setting literature, some caution must be reserved as there is little to no empirical support for this practice (Pashler et al., 2009; Fuelscher, Ball, & MacMahon, 2012). Fuelscher et al. (2012) suggest that in order to explore learning styles in athletes, researchers need to design an assessment tool specific to motor skills and test the learning style hypothesis for specific sport skills. Future research should consider both of these suggestions before exploring learning styles in the goal setting literature.

Further research is required to firmly establish the validity of the proposed model of performance anxiety. Cheng et al. (2011) have been successful in providing initial support for the predictive validity of Cheng et al.'s (2009) three-dimensional performance anxiety model. To extend the development of the proposed model, research should first of all establish predictive validity using a single sport sample. In addition, establishment of construct validity is an on-going process (Smith & McCarthy, 1995); thus, research should continue to test the model proposed in this thesis. Further research should also seek to establish whether the construct of perceived control is truly unidimensional. Finally, future research should also explore how perceived control influences performance, that is, whether it exerts a moderating or mediating influence.

Conclusion

The purpose of this research programme was to address two issues within the performance anxiety literature. Taken together, the thesis makes a significant contribution to the performance anxiety literature. First, the results of this thesis support the superiority of HPG for the acquisition of motor skills. The results also provide further support for the efficacy of a holistic focus for skilled but anxious individuals. Secondly, the thesis supports a hierarchical model of performance anxiety. The testing of this measurement model is in its infancy; however, the model has the potential to make a significant contribution to the performance anxiety literature. In addition, the methods employed within this thesis also contribute significantly to the research area. Firstly, the use of two psychophysiological measures has proven a useful insight to the mechanisms that underpin the anxiety response. Secondly, the use of PLS analysis, which allows the specification of formative and reflective models has been crucial in representing the hierarchical model presented in this thesis. In summary, the current thesis reports both theoretical and methodological strengths that make a significant contribution to the performance anxiety research area.

Chapter 8

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APPENDICES

APPENDIX A

INFORMED CONSENT TO PARTICIPATE IN A RESEARCH PROJECT OR EXPERIMENT

Title of Research Project: ___ Conscious processing and motor performance: Examining the part process goal paradox

The researcher conducting this project subscribes to the ethics conduct of research and to the protection at all times of the interests, comfort, and safety of participants. This form and the information sheet have been given to you for your own protection and full understanding of the procedures. Your signature on this form will signify that you have received information which describes the procedures, possible risks, and benefits of this research project, that you have received an adequate opportunity to consider the information, and that you voluntarily agree to participate in the project.

Having been asked by ____________Eleri Sian Jones_________ of the Humanities and Social Science department at the University of Glamorgan, to participate in a research project experiment, I have received information regarding the procedures of the experiment.

I understand the procedures to be used in this experiment and any possible personal risks to me in taking part.

I understand that I may withdraw my participation in this experiment at any time.

I also understand that I may register any complaint I might have about this experiment to the Humanities and Social Science department and that I will be offered the opportunity of providing feedback on the experiment using standard report forms.

I may obtain copies of the results of this study, upon its completion, by contacting:

__________ejones2@glam.ac.uk ___________________________________

I confirm that I have been given adequate opportunity to ask any questions and that these have been answered to my satisfaction.

I have been informed that the research material will/will not **[SELECT ONE]** be held confidential by the researcher.

I agree to participate in the study

Signature:____

NAME (please type or print legibly): ______________________________

ADDRESS: (Optional)_____________________________________

____

PARTICIPANT'S SIGNATURE: ______________________ **DATE:** __________

SEARCHER'S SIGNATURE: ______________________ **DATE:** __________

o sheets should be completed - one for the participant and one for the researcher

APPENDIX B

The effects of highly competitive sports can be powerful and very different among athletes. The inventory you are about to complete measures how you feel at this moment. Please complete the inventory as honestly as you can. Sometimes athletes feel that they should not admit to any nervousness, anxiety or worry they experience before competition because this is undesirable. Actually, these feelings are quite common, and to help me understand them I want you to share your feelings with me openly. If you worry about competition or have butterflies or other feelings that you know are signs of anxiety, please indicate these feelings accurately on the inventory. Equally, if you feel calm and relaxed, indicate those feelings as accurately as you can. Your answers will not be shared with anyone. I will be looking only at group responses. Please remember that you are responding to how you feel now.

Instructions : A number of statements which athletes have used to describe their feelings before competition are given below. The questionnaire is divided into 2 sections. Read each statement and then circle the appropriate number, in each of the two sections, to the right statement to indicate how you feel.. There are no right or wrong answers. Do not spend too much time on any one statement, but choose the answer which describes your general feelings / feelings right now.

When you have this thought/ feeling do you normally regard it as negative (debilitative) or positive (facilitative) in relation to your upcoming performance. NB. if you have scored '1' (not at all) on the first scale, then respond in relation to that feeling e.g. If you respond 'not at all' to question 4, then you would respond on this scale as if you had no self-doubts

DIRECTION SCALE

INTENSITY SCALE

		not at all	somewhat	moderately so	very much so	Very negative (i.e. debilitative)		Unimportant			Very positive (i.e. facilitative)	
---------	1. I feel jittery	1	2	3	4	-3	-2	-1	0	+1	+2	+3
---------	2. I am concerned that I may not do as well in this competition as I could	1	2	3	4	-3	-2	-1	0	+1	+2	+3
---------	3. I feel self confident	1	2	3	4	-3	-2	-1	0	+1	+2	+3
---------	4. My body feels tense	1	2	3	4	-3	-2	-1	0	+1	+2	+3
---------	5. I am concerned about losing	1	2	3	4	-3	-2	-1	0	+1	+2	+3

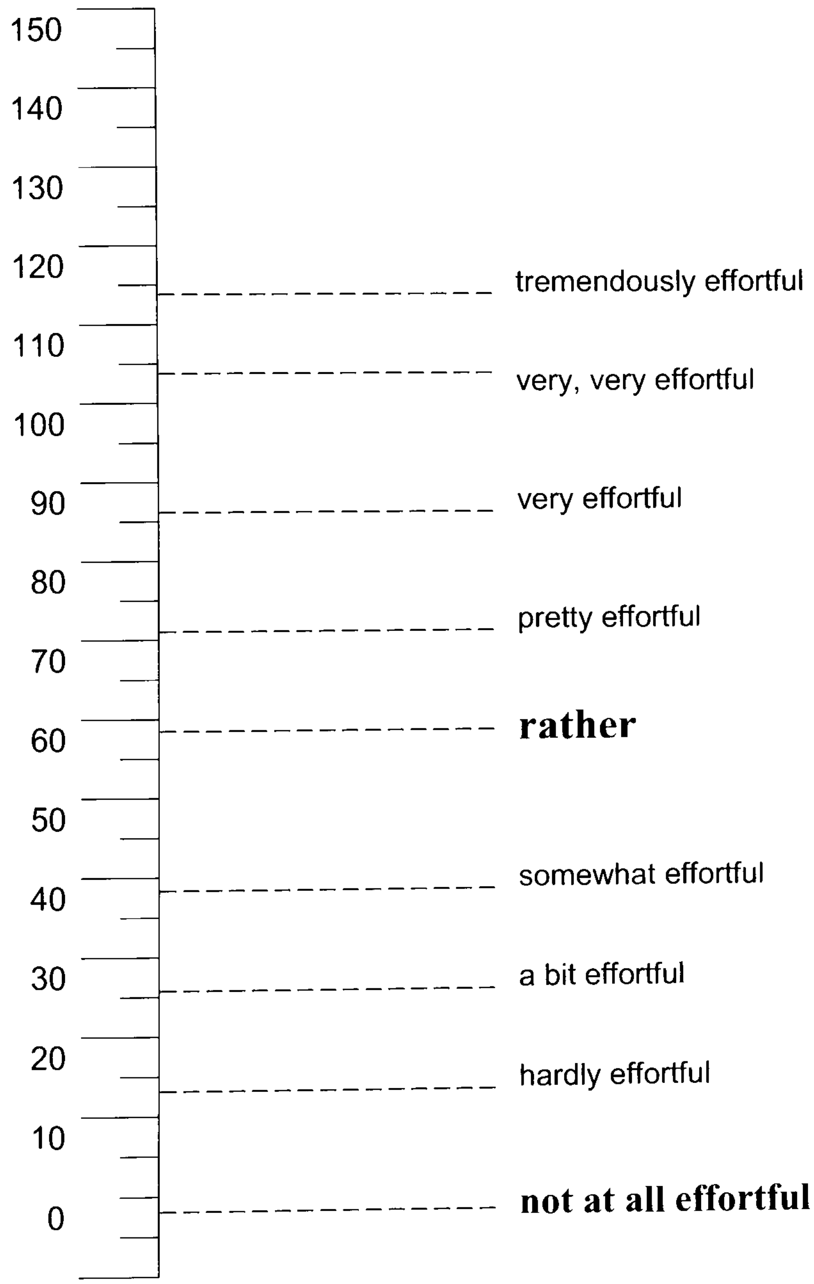
	not at all	somewhat	moderately so	very much so	Very negative (i.e. debilitative)		Unimportant			Very positive (i.e. facilitative)	
6. I feel tense in my stomach	1	2	3	4	-3	-2	-1	0	+1	+2	+3
7. I am confident I can meet the challenge	1	2	3	4	-3	-2	-1	0	+1	+2	+3
8. I am concerned about chocking under pressure	1	2	3	4	-3	-2	-1	0	+1	+2	+3
9. My heart is racing	1	2	3	4	-3	-2	-1	0	+1	+2	+3
10. I'm confident about performing well	1	2	3	4	-3	-2	-1	0	+1	+2	+3
11. I'm confident about performing poorly	1	2	3	4	-3	-2	-1	0	+1	+2	+3
12. I feel my stomach sinking	1	2	3	4	-3	-2	-1	0	+1	+2	+3
13. I'm confident because I mentally picture myself reaching my goal	1	2	3	4	-3	-2	-1	0	+1	+2	+3
14. I'm concerned that others will be disappointed with my performance	1	2	3	4	-3	-2	-1	0	+1	+2	+3
15. My hands are clammy	1	2	3	4	-3	-2	-1	0	+1	+2	+3
16. I'm confident at coming through under pressure	1	2	3	4	-3	-2	-1	0	+1	+2	+3
17. My body feels tight	1	2	3	4	-3	-2	-1	0	+1	+2	+3

APPENDIX C

RSME

Please indicate on the scale below how much effort you put into the task you have just completed.

Please circle a number on the left-hand side of the scale as appropriate.



APPENDIX D
General Health Questionnaire

Name...

We want to know how your health has been in general over the last few weeks. Please read the questions below and each of the four possible answers. Circle the response that best applies to you. Thank you for answering all the questions.

Have you recently:

1. been able to concentrate on what you're doing?

better than usual	same as usual	less than usual	much less than usual
(0)	(1)	(2)	(3)

2. lost much sleep over worry?

Not at all   no more than usual   rather more than usual   much more than usual

3. felt that you are playing a useful part in things?

more so than usual   same as usual   less so than usual   much less than usual

4. felt capable of making decisions about things?

more so than usual   same as usual   less than usual   much less than usual

5. felt constantly under strain?

Not at all   no more than usual   rather more than usual   much more than usual

6. felt you couldn't overcome your difficulties?

Not at all   no more than usual   rather more than usual   much more than usual

7. been able to enjoy your normal day to day activities?

more so than usual   same as usual   less so than usual   much less than usual

8. been able to face up to your problems?

more so than usual   same as usual   less than usual   much less than usu

9. been feeling unhappy or depressed?

not at all   no more than usual   rather more than usual   much more than usual

10. been losing confidence in yourself?

not at all | no more than usual | rather more than usual | much more than usual

11. been thinking of yourself as a worthless person?

not at all | no more than usual | rather more than usual | much more than usual

12. been feeling reasonably happy, all things considered?

more so than usual | same as usual | less so than usual | much less than usual

APPENDIX E

Interview Guide

Date:________ Time Began:________ Time Ended:________

SECTION 1

INTRODUCTION

Thanks for agreeing to participate in this project. As previously stated the purpose of this project is to gain an understanding of how athletes respond to potentially stressful, high-pressure competitions. Specifically, I am interested in exploring how anxious or nervous athletes feel in such situations and the emotions, thoughts and feelings that they experience in response to the pressure.

The information gained in this study will be used as part of my PhD thesis as well as potentially for publication in a scientific journal so that other sports scientists, coaches and athletes can benefit from it.

I must stress that the information you provide will remain **completely confidential**. We may want to use selected quotes from the interviews in order to illustrate important themes but these will remain strictly anonymous, and your identity will be fully protected. I am using a Dictaphone to record the interview to get complete and accurate information, and to make the interview process more efficient.

As a participant in this study, your participation in this interview is entirely voluntary, and you are free to decline to answer any questions or to stop the interview at any point. There are no right or wrong answers to the questions that I will be asking; therefore I hope that you will answer the questions in a frank and straightforward way. If there are any questions you do not feel comfortable answering I would rather you declined to comment than to tell me what you think I or others want to hear. So if you would prefer not to answer a question, simply state "no comment", and no further questions related to that area will be asked.

If you have any questions as we go along please ask them. Similarly, if at any time you do not understand what I am asking, please do not hesitate to ask for clarification.

ORIENTING INSTRUCTIONS: As I explained earlier, I will be asking you about your experiences of a high pressure, competitive event. Specifically, I am interested in talking to you about the anxiety that you may experience in response to such situations. By anxiety, I mean the emotions, thoughts and feelings that you experience in response to the pressure of the event. Athletes often experience nervousness and anxiety, and these feelings are quire common. To help me understand them, I would like you to share your feelings with me openly.

Hopefully, you now have an event in mind? Just to re-cap, I would like to explore your thoughts and feelings in the build up to, and during this event. To help you do this, I will be asking you about how you were feeling at specific points in time; a week before the event, the night before the event, the day of the event, the immediate preparation period before you actually competed, for example, arriving at the venue, changing and warming up, and finally, the event itself. I would like you to try to recall in detail what you were thinking and how you felt at these time points. There are no right or wrong answers, so I would like you to be as open and honest as possible. Since you may have to think back in time, you might not be able to immediately remember some things. Take your time to recall the past. If you can't remember after trying to think back, then just tell me, I would prefer you don't guess.

At the end of the interview there will be an opportunity for you to add anything that you felt was important and not covered in the interview.

Do you have any questions now about what I have talked about so far? OK, let's get started.

SECTION 2

DEMOGRAPHICS & BACKGROUND

(1) I would like to start by talking about the sport that you play. Can you tell me a little bit about your sporting history?

PROMPTS:

- How long have you taken part in this sport?
- Is this your main sport?
- How did you get in to it?
- How often do you train for this sport?
- What are your goals/what do you hope to achieve in your sporting career?
- What is the highest level that you have competed at?

SECTION 3

THE COMPETITION EXPERIENCE

Ok, let's talk about the stressful event that you have chosen to recall. Take your time to remember this event. With this event in mind try your best to recall in detail your feelings and thoughts. To begin, I would like you to try and recall what you were thinking and how you felt in the build up to the event. First of all, can you tell me about the event/competition that you have chosen to recall?

PROMPTS:

- What was the event?
- Where and when?

- The outcome of the event?

(2)Ok, let's work through the event in detail now. Can you begin by talking about the week before the event; can you talk me through your preparation?

PROMPTS:

- Can you tell me about your thoughts related to the competition at this point?
- Ok, talk to me about how you felt at that point?

(3)Let's look closer to the event; can you talk to me about the night before the event?

PROMPTS:

- What thoughts were running through your head at this point?
- And how were you feeling?
- Are they similar to the week before? If not, how are they different? How did your experience change?

(4) What about the morning of the event?

PROMPTS:

- What are you doing?
- What are you thinking?
- How do you feel?
- How is this different to the night before?

(4) OK, let's look at closer to the event, talk to me about how you felt during the immediate preparation for the event, perhaps starting with when you arrived at the venue and then describe form this point until the start of the event? Take your time to provide details of what you were doing throughout.

PROMPTS:

- Warm up/Changing room/Immediately before the event?
- What were your thoughts at this point?
- And, how were you feeling at this point?
- Same/different?

(5)Please take your time to recall during the event now. Can you describe to me what happened during the event?

PROMPTS:

- What were you thinking about during the event?
- How did you feel?
- What were you focused on?
- Same/different?

(6)Is there anything else related to your competitive experience that you would like to discuss?

PROMPTS:

- Other time points?
- Anything else that affects you?

(7) Ok, we have talked primarily about one event here, but competing at your level I'm sure you have experienced many different competitive events. If we were to discuss another event, would there be anything different that you would report regarding your feelings and thoughts?

- Same/Different?
- Why are there differences?
- Why did it feel different?
- What were you thinking differently?

Additional PROMPTS:

- Was there anything else that you were thinking about?
- I think I understand, could you elaborate on.....?
- Could you say more about how you were feeling?
- What effect did this have on you?
- Ok, I am beginning to get the picture; can you talk to me in a little more detail about those thoughts?
- Could you elaborate on your thoughts here?
- Could you expand on how you felt?
- Can you talk to me exactly what you were thinking?

SECTION 4

CONCLUSION

Thank you for your time and effort; this is nearly the end of the interview. I would just like to take this opportunity to ask you a few questions about the interview itself.

(1) How do you feel the interview went?

(2) Do you feel I led you in anyway in terms of your responses?

(3) Were you comfortable in the interview environment?

(4) Is there anything you feel we have failed to discuss?

Many thanks once again for your co-operation and efforts during the interview.

APPENDIX F

T
O
P
S

TEST OF PERFORMANCE STRATEGIES ©

Name ______________________________ Age ________ Gender M F

Sport ______________________________ Event(s)/

______________________ Position

Years participating in sport ______________________ Today's Date

____

Current performance level (circle one):

International	National	Collegiate
Regional	Junior National	Club
Recreational	Other ______________________	

This questionnaire measures performance strategies used by athletes in various sport situations. Because individual athletes are very different in their approach to their sport, we expect the responses to be different. We want to stress, therefore, that there are no right or wrong answers. All that is required is for you to be open and honest in your responses.Throughout the questionnaire, several terms are used which may have different meanings for different individuals. Because of this, these terms are defined below with specific examples to sport where appropriate. Please keep these definitions in mind when responding to items with these terms.

COMPETITION: a tournament/meet where individuals or teams perform against each other.

SKILL: a specific element of your sport performance. For example, free throw shooting in basketball or a jump in figure skating.

PERFORMANCE: your execution of specific sport skills during training and competition.

ROUTINE: a set of behaviours that is performed regularly in preparation for your performance in sport. An example may be going through specific stretches while listening to a song on your walkman prior to every performance.

WORKOUT: a structured practice session to work on various elements of your sport.

VISUALIZATION/IMAGERY/REHEARSAL: these terms refer to the act of picturing in your mind some aspect of your performance. An example would be seeing and feeling yourself execute a specific skill perfectly.________

TOPS 2

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:

1 = Never
2 = Rarely
3 = Sometimes
4 = Often
5 = Always

Please put a circle around your answer

		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.	During competition I set specific result goals for myself.	1	2	3	4	5
7.	My self-talk during competition is negative.	1	2	3	4	5
8.	I rehearse my performance in my mind before practice.	1	2	3	4	5
9.	During competition I have thoughts of failure.	1	2	3	4	5
10.	I use practice time to work on my relaxation technique.	1	2	3	4	5
11.	I manage my self-talk effectively during practice.	1	2	3	4	5
12.	I visualize my competition going exactly the way I want it to go.	1	2	3	4	5
13.	I am able to control distracting thoughts when I am training.	1	2	3	4	5
14.	I get frustrated and emotionally upset when practice does not go well.	1	2	3	4	5
15.	I have specific cue words or phrases that I say to myself to help my performance during competition.	1	2	3	4	5
16.	I evaluate whether I achieve my competition goals.	1	2	3	4	5
17.	I set very specific goals for competition.	1	2	3	4	5
18.	At practice, I can allow the whole skill or movement to happen naturally without concentrating on each part.	1	2	3	4	5
19.	I keep my thoughts positive during competitions.	1	2	3	4	5
20.	I say things to myself to help my competitive performance.	1	2	3	4	5
21.	At competitions, I rehearse the feel of my performance in my imagination.	1	2	3	4	5

22.	I manage my self-talk effectively during competition.	1	2	3	4	5
23.	I set goals to help me use practice time effectively.	1	2	3	4	5
24.	At practice, when I visualize my performance, I imagine what it will feel like.	1	2	3	4	5
25.	During practice I focus my attention effectively.	1	2	3	4	5
26.	I set personal performance goals for a competition.	1	2	3	4	5
27.	I motivate myself to train through positive self-talk.	1	2	3	4	5
28.	I have trouble maintaining my concentration during long practices.	1	2	3	4	5
29.	I talk positively to myself to get the most out of practice.	1	2	3	4	5
30.	I have very specific goals for practice.	1	2	3	4	5
31.	I imagine my competitive routine before I do it at a competition.	1	2	3	4	5
32.	I imagine screwing up during a competition.	1	2	3	4	5
33.	I talk positively to myself to get the most out of competitions.	1	2	3	4	5
34.	I don't set goals for practices, I just go out and do it.	1	2	3	4	5
35.	I rehearse my performance in my mind at competitions.	1	2	3	4	5
36.	I have trouble controlling my emotions when things are not going well at practice.	1	2	3	4	5
37.	My emotions keep me from performing my best at competitions.	1	2	3	4	5
38.	My emotions get out of control under the pressure of competition.	1	2	3	4	5
39.	At practice, when I visualize my performance, I imagine watching myself as if on a video replay.	1	2	3	4	5
40.	I can allow the whole skill or movement to happen naturally in competition without concentrating on each part.	1	2	3	4	5
41.	I use relaxation techniques as a coping strategy at competitions.	1	2	3	4	5
42.	I can psych myself to perform well in practice.	1	2	3	4	5
43.	I am able to perform skills at practice without having to consciously think about them.	1	2	3	4	5
44.	I can get myself ready to perform when I am at competitions.	1	2	3	4	5
45.	I have difficulty with my emotions at competitions.	1	2	3	4	5
46.	During training sessions I use relaxation techniques to improve my performance.	1	2	3	4	5

47.	I need to monitor all the details of each move in order to successfully execute skills in practice.	1	2	3	4	5
48.	I have difficulty controlling my emotions if I make a mistake at competitions.	1	2	3	4	5
49.	Visual distractions during competition would affect my performance.	1	2	3	4	5
50.	My emotions keep me from performing my best during practice.	1	2	3	4	5
51.	My competition performance would be impaired by sleep loss.	1	2	3	4	5
52.	I have difficulty getting into an ideal performance state during training.	1	2	3	4	5
53.	I can psych myself to perform well in competitions.	1	2	3	4	5
54.	I use relaxation techniques during competitions to improve my performance.	1	2	3	4	5
55.	I can get myself "up" if I feel flat at practice.	1	2	3	4	5
56.	I am unable to perform skills at competition without consciously thinking about them.	1	2	3	4	5
57.	If I'm starting to "lose it" at a competition, I use a relaxation technique.	1	2	3	4	5
58.	I can get my intensity levels just right for competition.	1	2	3	4	5
59.	During practice, I can perform automatically without having to consciously control each movement.	1	2	3	4	5
60.	I am able to trust my body to perform skills in competition.	1	2	3	4	5
61.	I relax myself before competition to get ready to perform.	1	2	3	4	5
62.	In competition, I am sufficiently prepared to be able to perform on automatic pilot.	1	2	3	4	5
63.	I can get myself "up" if I feel flat at a competition.	1	2	3	4	5
64.	Loud noises during competition would not affect my performance.	1	2	3	4	5
65.	My practice performance suffers when something upsets me at training	1	2	3	4	5
66.	I use workouts to practise relaxing.	1	2	3	4	5
67.	Environmental conditions like weather and temperature affect my performance in competitions.	1	2	3	4	5
68.	I can get my intensity levels just right for practice.	1	2	3	4	5

APPENDIX G

Psychological Performance States Inventory

Instructions – Complete approximately an hour before competition

The effects of highly competitive sports can be powerful and very different among athletes. Some very common statements that athletes have used to describe their psychological states when anticipating or performing sports under pressure are given below. The inventory you are about to complete measures how you feel at this moment. Please complete the inventory as honestly as you can. Read each statement and then circle the appropriate number. There are no right or wrong answers. Your answers will be kept completely confidential, and we will only be looking at group responses. Do not spend too much time on any one statement, but choose the answer which describes your feelings right now.

	Totally disagree				Totally agree
1) My heart is racing..	1	2	3	4	5
2) I feel I have the capacity to cope with this performance...	1	2	3	4	5
3) I am conscious that others will be judging my performance	1	2	3	4	5
4) I believe in my ability to perform..............................	1	2	3	4	5
5) I am worried that I may make mistakes............................	1	2	3	4	5
6) I feel physically nervous..	1	2	3	4	5
7) My chest feels tight...	1	2	3	4	5
8) I am worried about the uncertainty of what may happen....	1	2	3	4	5
9) I find myself trembling..	1	2	3	4	5
10) I tend to dwell on shortcomings in my performance........	1	2	3	4	5
11) I am worried about the outcome of my performance.......	1	2	3	4	5
12) I feel tense in my stomach....................................	1	2	3	4	5
13) I am prepared for my upcoming performance..............	1	2	3	4	5
14) I am conscious about the way I will look to others.........	1	2	3	4	5
15) I have a slight tension headache..............................	1	2	3	4	5
16) I am worried that I may not perform to the best of my ability	1	2	3	4	5
17) I am confident that I will be able to reach my target.........	1	2	3	4	5

18) I am aware that I will scrutinise my performance...........	1	2	3	4	5
19) I feel lethargic..	1	2	3	4	5
20) My body feels tense..	1	2	3	4	5
21) I feel a lump in my throat...	1	2	3	4	5
22) I am aware that I will be conscious of every movement I make	1	2	3	4	5
23) I am worried about the consequence of failure...............	1	2	3	4	5
24) I am worried that I may not meet the expectations of important others..	1	2	3	4	5
25) My hands are clammy...	1	2	3	4	5

APPENDIX H

Table 1. Measurement factor loadings for TOPS-2

Factor loadings	PLS estimate	Bootsrap estimate
Emotional Control		
My emotions keep me from performing my best at competitions.	0.88	0.88***
My emotions get out of control under the pressure of competition.	0.85	0.84***
I have difficulty controlling my emotions if I make a mistake at competitions.	0.87	0.87***
Automaticity		
I can allow the whole skill or movement to happen naturally in competition without concentrating on each part.	0.64	0.62***
I am unable to perform skills at competition without consciously thinking about them.	0.25	0.26
I am able to trust my body to perform skills in competition.	0.83	0.81***
In competition, I am sufficiently prepared to be able to perform on automatic pilot.	0.67	0.63***
Activation		
I can get myself ready to perform when I am at competitions.	0.85	0.85***
I can psych myself to perform well in competitions.	0.63	0.6***
I can get my intensity levels just right for competition.	0.82	0.82***
I can get myself "up" if I feel flat at a competition.	0.57	0.56***
Negative Thinking		
I keep my thoughts positive during competitions.	0.69	0.68***
I imagine screwing up during a competition.	0.82	0.82***
My self-talk during competition is negative.	0.65	0.64***
During competition I have thoughts of failure.	0.83	0.82***
Distractibility		
Visual distractions during competition would affect my performance.	0.75	0.71***
My competition performance would be impaired by sleep loss.	0.70	0.66***
Loud noises during competition would not affect my performance.	-0.06	-0.08
Environmental conditions like weather and temperature affect my performance in competitions.	0.55	0.52***

*p < 0.01, **p <0.001

APPENDIX I

Table 2. Quality overview of TOPS-2 subscales

TOPS-2 constructs	AVE	AVEsq	Composite Reliability	Cronbachs Alpha	Communality
Emotional Control	.76	.87	.90	.84	.76
Automaticity	.41	.64	.71	.48	.41
Activation	.54	.73	.82	.73	.54
Negative Thinking	.57	.75	.82	.73	.57
Distractibility	.34	.58	.59	.25	.34

APPENDIX J

Table 3. Path coefficients for saturated model

Hypothesised relationship	PLS estimate	Bootstrap estimate
Cognitive -> Emotional Control	-.24	-.24**
Cognitive -> Automaticity	-.19	-.19
Cognitive -> Activation	-.06	-.06
Cognitive - >Negative Thinking	.46	.46***
Cognitive - > Distractibility	.06	.06
Physiological -> Emotional Control	-.03	-.04
Physiological -> Automaticity	.03	.03
Physiological -> Activation	.01	.01
Physiological -> Negative Thinking	-.04	-.04
Physiological -> Distractibility	.20	0.22**
Regulatory -> Emotional Control	-.01	-.01
Regulatory -> Automaticity	.22	0.23**
Regulatory -> Activation	.38	0.39***
Regulatory -> Negative thinking	-.22	-0.22**
Regulatory -> Distractibility	-.15	-.16

For the paths, the value is the standardised PLS estimate,*$p < .05$, **$p < .01$, ***$p < .001$.