CHAPTER 1

INTRODUCTION

Introduction

From a scientific perspective, the effects of anxiety is of growing interest to athletes, coaches and sport psychologists and could now be considered to be one of the most extensively researched areas in sport psychology (Mellalieu, Hanton & Fletcher, 2006). Current research offers a range of approaches to explain why some athletes fail dramatically when they experience high levels of anxiety, whereas others perform outstandingly. Even if not athletic ourselves, many of us have observed how anxiety can have an influence on performance on the day of competition. For instance, the penalty kick that could win the UEFA Champions League or the putt on the 18th for a major golf championship, are both classified as motor skills that, despite hours of practice and perfection in training, can easily go wrong under pressure. Despite a large amount of research examining the anxiety-performance relationship, very few models or theories provide a clear explanation as to *how* performance breaks down under pressure, but merely explain *when* performance breaks down. Consequently, the mechanisms underlying anxiety-related performance impairment remain poorly understood (Janelle, 2002).

Purpose of this Thesis

This thesis consists of a programme of research that involved an examination of performance decrements under conditions of high cognitive state anxiety. The aims of the thesis were to: (1) investigate the process goal paradox as a means of examining conscious processing effects, (2) examine the number of part process goals as a means to inducing conscious processing effects in conditions of high anxiety and (3) to make use of an interdisciplinary approach to uncover the mechanisms underlying performance decrements. Quantitative and qualitative approaches were used to examine the phenomenon of performance decrements. To further explain the aims of the thesis, it is worth clarifying the process goal paradox and how this fits with conscious processing notions. Process goals have been used by sport psychologists to assist athletes in remaining focused on the

behaviours that they engage in during performance (Kingston & Hardy, 1997). However, when process goals, and in particular part process goals, are placed in the context of the conscious processing hypothesis (Masters, 1992), they present a paradoxical effect. In other words, encouraging a performer to focus on the parts of their movements (as reflected in the use of a part process goal) should, within the context of the conscious processing hypothesis, encourage conscious processing effects and result in performance decrements. Alternatively, a holistic process goal which encourages the performer to focus on the whole of the movement, should discourage conscious processing and therefore prevent or discourage performance decrements under conditions of elevated anxiety. This programme of research aimed to further examine performance decrements by using process goals to isolate conscious processing effects.

Structure of the Thesis

This thesis comprises seven main chapters and four empirical studies which are presented as individual research papers. Following this introduction, chapter 2 provides a review of the anxiety literature with a focus on the literature that has investigated conscious processing effects, starting in 1992 with Richard Masters' original study examining the reinvestment of explicit knowledge in golfers under conditions of high anxiety.

Chapter 3 (Study 1) reports a study that extends the work of Masters (1992) and follows on from the work of Mullen, Hardy and Tattersall (2005) to examine the effect of different process goals on the acquisition of simulated driving performance, as well as performance in low and high anxiety conditions. The process goals were designed so that conscious processing effects could be examined in isolation of any alternative attentional overload affects, something that the previous research had failed to consistently do. Psychophysiological measures of heart rate variability (HRV) were used as a measure of mental effort in conjunction with the rating scale of mental effort (RSME; Zijlstra, 1993).

The results of this study suggested that the use of any type of goal helps prevent performance decrements under conditions of high anxiety and provided no support for conscious processing effects.

Chapter 4 (Study 2) reports a study that examines conscious processing and the process goal paradox using novice and expert performers in a basketball free throw task under low and high anxiety conditions. Three process goal conditions were used to examine the potential differing effects of using part process, holistic process and externally referenced goals, in novice and expert performers. The results of the study revealed no differing effects, or performance decrements, when using any type of goal. It was at this stage that the number of process goals were considered to be a factor as research by Jackson and Willson (1999) and Gucciardi and Dimmock (2008) had found that it may not be just the nature of the goals, but the number of goals used that may have an influence on conscious processing effects.

Chapter 5 (Study 3) reports a study that investigates whether the number of part process goals used to guide performance has an impact on tennis serve performance in skilled but anxious tennis players. One, two and three part process goals were used in an attempt to find support for the hypothesised negative effects of part process goals. The findings of the study were consistent with studies 1 and 2, in that no performance decrements were observed in conditions of high anxiety, again providing little support for conscious processing effects as an explanation for performance decrements under conditions of high cognitive state anxiety.

Chapter 6 (Study 4) reports a qualitative study investigating national level trampolinists' perceptions of their personal performance failure experiences, in an attempt to uncover a more thorough understanding of performance failure under pressure. An alternative approach was used in study 4, as no performance decrements had been observed in studies 1, 2 and 3. Qualitative analysis, in the form of semi structured interviews,

allowed the researcher to provide detailed accounts of the perceived mechanisms that contributed to performance failure experiences under pressure in the trampolinists interviewed. The interviews were based around three time phases; pre-competition, on the day of competition and at the time of the performance failure itself. The results revealed antecedents to an overall increase in pressure to perform which was believed to be a key contributory mechanism in the performance failures in all of the participants. Additionally, underpinning mechanisms were identified that were reported to take place at the time of the performance failure. These underpinning mechanisms mainly supported attentional-based explanations, such as processing efficiency theory (PET; Eysenck & Calvo, 1992) and the recently advanced attentional control theory (ACT; Eysenck, Derakshan, Santos & Calvo, 2007) as opposed to self-focused based explanations, such as the conscious processing hypothesis (CPH; Masters, 1992).

Chapter 7 summarises the research programme as a whole and discusses the major theoretical issues addressed, applied implications, strengths and weaknesses of the programme as well as future research directions. Chapter 7 also summarises how the thesis has extended the anxiety-performance literature and furthered our understanding of the impact that anxiety can have on performance and the underpinning mechanisms that contribute to performance failures under stress.

Considerations in the Presentation of the Thesis

Each study contains its own introduction, method, results and discussion sections. For this reason, there are deliberate omissions in sections of the individual study's literature reviews, were the literature has already been presented in the main review of literature (chapter 2). This has been purposefully done in order to avoid repetition and for ease of reading. Specifically, in study 3, a piece of research conducted by Jackson and Willson (1999) investigating global swing thoughts was of particular relevance to the background and the design of the study. However, the influence of global swing thoughts was also of

significance to studies 1 and 2 and was of relevance in the design of the holistic process goals used in these two studies. Rather than withholding the detail of Jackson and Willson (1999) purely for the literature review of study 3, the details of the study are included in chapter 2 and only a summary of the key points are then required to be alluded to in the literature review of study 3. This was conducted to ensure that the key information about the previous research studies which had an influence on the design and execution of the current research programme's studies is logically provided in the overall review of literature (chapter 2). This also helped to avoid research being introduced at various times throughout the thesis where it has not already been discussed in chapter 2. In order to ensure a consistent approach throughout the thesis, the following format was adopted for all seven chapters: (1) American Psychological Association formatting (5th Edition), (2) Table and Figure numbering re-start with each new chapter, and (3) final reference list at the end of the general discussion (chapter 7). Appendices including copies of the measures used in studies 1, 2 and 3, interview guides and copies of exemplar transcripts used in study 4 are provided following the reference list.

CHAPTER 2

REVIEW OF LITERATURE

The aim of this chapter is to review the available anxiety literature and the existing theories that attempt to explain how anxiety affects performance. Before doing so though, it is necessary to put into context some of the terms and definitions that will be used throughout the thesis so that clarity and consistency of terminology is achieved.

Definition of terms

Stress

The term stress has often been used synonymously with anxiety; however the two have distinct characteristics. Martens (1977) noted the inconsistencies in the use of the term stress and identified that stress can be defined in three ways; as a stimulus variable, an intervening variable and a response variable. McGrath (1970) defined stress as a "substantial imbalance between demand (physical and or psychological) and response capability, under conditions were failure to meet that demand has important consequences" (p. 20). McGrath suggested that each individual athlete will perceive a demand or situation differently and this will ultimately impact on their responses and subsequent outcomes of the situation. For instance, one golfer might perceive a competitive game against a strong opponent as a challenge (positive) whereas another might see this as threatening (negative). If the golfer perceives the competition in a negative manner this will result in a negative response, such as debilitating thought processes involving doubts about his ability, leading to an increase in anxiety to perform which is likely to lead to negative outcome behaviour. McGrath (1970) viewed stress as a sequence of events that leads to a specific behaviour, stating that the stress process should be viewed as cyclical in nature and should be considered as a demand that requires a response depending on the performer's perception of ability to cope. This demand-response notion was later supported by Jones (1990) who defined stress as a state in which a demand is placed upon an individual who is then required to respond. It is therefore the individual's perception of how well they feel that they can cope with the situation / demand that is placed on them

that is the salient factor in the stress process. Some individuals appear to be better equipped to deal with the demands of a high pressure situation and are therefore less likely to perceive a situation as "stressful" in comparison to an individual who is unable to cope with the demands of the situation (Fletcher, Hanton & Coughlan, 2005). More recently, there have been clear distinctions made between "stressors" and "strains". Stressors refer to events, situations or conditions, whereas strains are descriptive of an individual's negative response to the stressor (Mellalieu, Hanton & Fletcher, 2006).

Anxiety

Woodman and Hardy (2001) stated that anxiety is generally accepted as being an unpleasant emotion. Additionally, anxiety is seen as an emotion characterised by negative affect that can have a debilitating impact on performance (Eysenck, 1996). Spielberger (1966) defined anxiety in terms of state and trait anxiety, with state anxiety being referred to as "subjective consciously perceived feelings of tension and apprehension, associated with…arousal of the autonomic nervous system" (p. 17). State anxiety therefore refers to the thoughts and feelings that are specific to that moment in time and are subject to fluctuation, essentially more of a "right now" feeling of tension and apprehension in a specific situation (Gould, Greenleaf & Krane, 2002). In contrast, trait anxiety refers to a predisposition to view and interpret situations to be threatening that is more general and not situation specific (Hardy, Jones & Gould, 1996). In extreme cases, anxiety is believed to lead to "choking", a decrement in performance that can occur under conditions where the incentive to perform is heightened (Baumeister, 1984).

Early investigations viewed anxiety as unidimensional, whereas more recent research has suggested that anxiety is multidimensional (cf. Fazey & Hardy, 1988; Martens, Vealey & Burton, 1990), comprising of both a mental component and a physiological component. The mental component of anxiety has been termed cognitive anxiety and the physiological component termed physiological arousal or somatic anxiety.

Morris, Davis and Hutchings (1981) defined cognitive anxiety as "the cognitive elements of anxiety, such as negative expectations and cognitive concerns about oneself, the situation at hand and potential consequences" (p. 541) and somatic anxiety 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" (p. 541). However, physiological arousal is a term that is used more frequently in the research investigating the anxiety-performance relationship, as physiological arousal is suggested to have a more direct effect on performance in comparison to somatic anxiety (Fazey & Hardy, 1988). Physiological arousal is believed to exert an influence on performance via two different mechanisms. Firstly, it can cause a direct effect on performance by changing the performer's activation state and therefore availability of certain resources. For example, increase levels of physiological arousal induced by anxiety are associated with enhanced anaerobic power. Secondly, physiological arousal can influence performance in an indirect manner, and is largely dependent on how the individual interprets their psychological symptoms (Hardy & Parfitt, 1991; Hardy, Parfitt & Pates, 1994). For instance, one athlete could interpret high amounts of physiological arousal such as butterflies in their stomach and an increased heart rate, as an indication that they are ready to perform. This would be more likely to have a positive influence on their forthcoming performance than another performer who may not be able to control or interpret these symptoms in a positive way, and would therefore be likely to interpret them as being a negative precursor to their preparation and performance.

Arousal and Activation

Most sport psychology text books refer to arousal or activation as a unitary construct encompassing both the psychological and the physiological energy systems (cf. Gould et al., 2002). Hardy et al. (1996) distinguished between the concepts by defining activation as the cognitive and physiological activity linked to the preparation of a planned response to

an anticipated situation. In contrast, arousal has been defined as the cognitive and physiological activity that takes place in response to a new input. Hardy et al. (1996) used the example of a gymnast preparing to dismount a balance beam in order to explain the difference between arousal and activation more succinctly. If the gymnast is highly skilled, then it is said that she will possess the appropriate activation state with which to execute her dismount successfully, however if another competitor suddenly screams out in agony (in response to an injury for instance) then the gymnast may experience an involuntary startle (increase in arousal levels), leading to a disruption of the practised activation pattern. This may lead the gymnast to execute her dismount unsuccessfully. In summary, this section has aimed to add clarification as to the definitions used throughout this thesis in order to ensure consistency and aid understanding.

Measurement issues

The quantitative measurement of anxiety has mainly been made possible through the construction of the Competitive State Anxiety Inventory version 2 (CSAI-2; Martens, Vealey, Bump & Smith, 1990), which measures three state subscales; cognitive anxiety, somatic anxiety and self-confidence. Items on the CSAI-2 include, “I feel nervous” and “I am worried about performing poorly”. Recent research examining the validity of the CSAI-2 has led to the production of the Competitive State Anxiety Inventory version 2 revised (CSAI-2r; Cox, Martens & Russell, 2003). There is still debate over which of the two scales is the most effective measurement tool for anxiety; however this is beyond the scope of this chapter (for a review see Lundqvist & Hassmen, 2005). In brief, Lundqvist and Hassmen suggested that the CSAI-2r was the more appropriate measure of the two, based on the fact that the CSAI2-r revealed an improved fit to the data. There were some doubts highlighted with regards to the CSAI-2r but a decision was made to make use of the CSAI-2 in the current research programme, based on the fact that previous research in the

area had made use of the CSAI-2 and therefore continued use of this measure would allow for comparisons between the data and generalisation of the research findings.

Mechanistic explanations for performance decrements

Most theories and models designed to assist our understanding of the anxiety-performance relationship only reveal *when* performance becomes impaired under conditions of high anxiety, but very few are successful in telling us *how* performance becomes impaired. Some theories which have attempted to explain how performance becomes impaired, provide mechanistic explanations, and include Easterbrook's cue utilisation theory (1959), cognitive interference theory (Sarason, 1984; 1988), Wegner's theory of ironic processes of mental control (1989; 1994), processing efficiency theory (PET; Eysenck & Calvo, 1992) and the conscious processing hypothesis (CPH; Masters, 1992). Despite a plethora of research there still remains no single notion that exclusively explains how performance comes to be impaired and drop dramatically under pressure. The aim of the next section of this chapter is to highlight and review some of these existing theories.

Easterbrook's cue utilisation theory

Easterbrook (1959) suggested that increases in emotional arousal narrow the range of cue utilisation in task performance, making an individual's ability to detect both task-relevant and task-irrelevant cues less effective under conditions of high arousal. At low levels of arousal a broad range of cues are capable of being detected by the performer including irrelevant cues, whereas at high arousal the range of detectable cues is drastically reduced, negatively impacting on performance. As shown in Figure 1, a reduction in performance occurs when arousal continues to increase past moderate levels, resulting in a decrease in the individual's ability to attend to the cues and leading to a drop in performance. At high levels of arousal, a continued narrowing of the attentional fields leads to the exclusion of task relevant cues and results in a further decrease in performance.

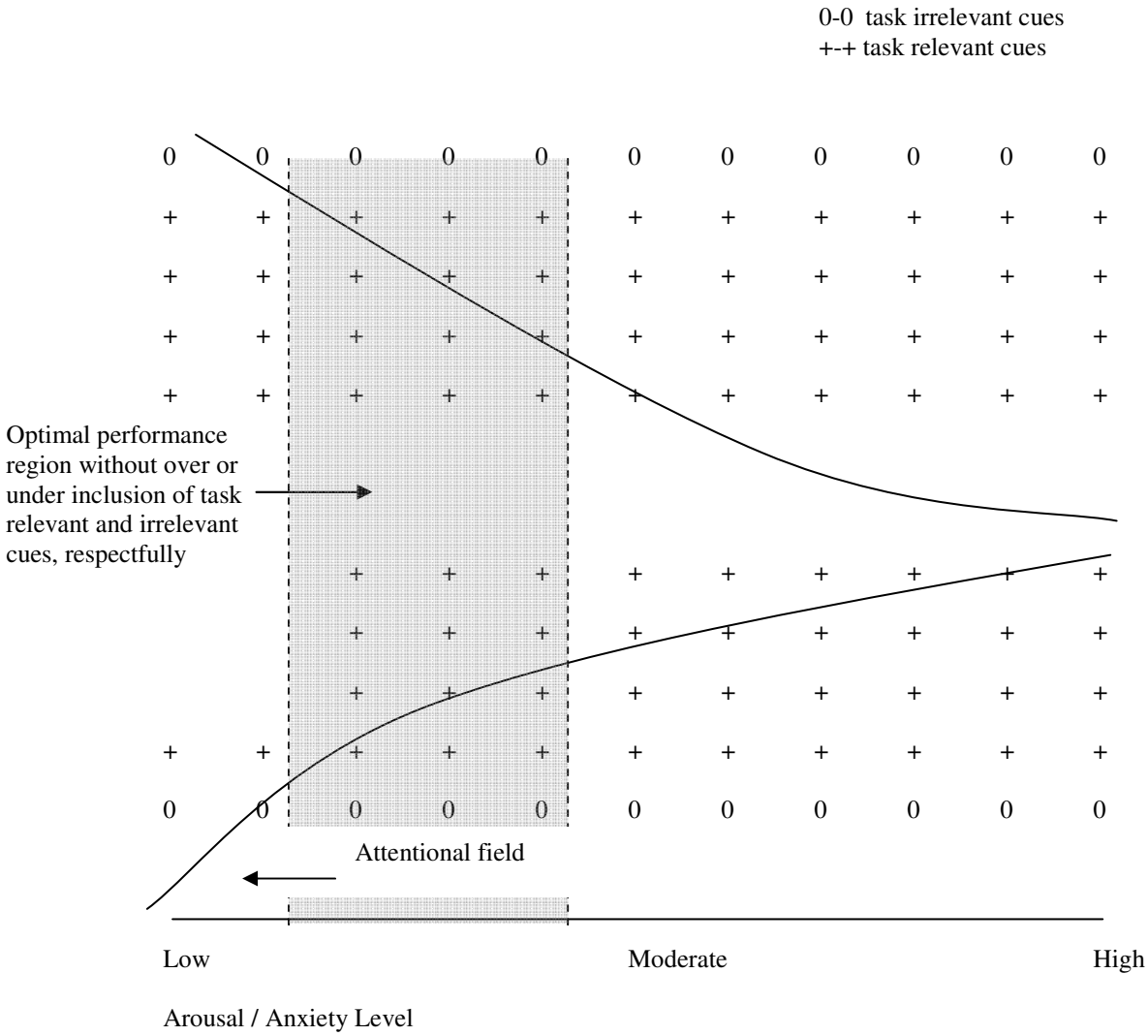

Figure 1. Easterbrook's cue utilisation theory (Source: Cox, 1990, p. 142).

Despite the simplistic appeal of Easterbrook's theory there are a number of criticisms worthy of note. Eysenck (1982) suggested that the dual task paradigm that was commonly used to test the theory was biased and that the attentional narrowing may actually be an active-coping response to an increase in anxiety, not a passive and automatic response as suggested by Easterbrook. Eysenck argued that when an individual becomes anxious, they will purposefully and consciously attempt to ensure success by restricting their processing resources only to those cues that are relevant. Eysenck also indicated that elevated anxiety leads to a lack of ability to concentrate on a task rather than an increase in concentration,

so Eysenck therefore questioned Easterbrook's assumption that anxious individuals are less distractible than non-anxious individuals. Aside from these criticisms, Janelle, Singer and Williams (1999) addressed the selectivity-distractibility question in their study of a dual-task motor racing simulation task. Participants were randomly assigned to one of six conditions; distraction control, distraction anxiety, relevant control, relevant anxiety, central control or central anxiety. The central task was to drive the car around the track as quickly as possible and in addition, the participants in the distraction groups had to identify peripheral lights (which were either relevant or irrelevant to the driving task). Participants in the anxiety conditions were exposed to a stressor designed to increase levels of competitive state anxiety, whereas those in the control groups were not. The findings revealed that distraction and attentional narrowing both occurred, leading to inefficient visual search patterns and decreases in performance in both the central (driving) and the peripheral (response to the lights) tasks in high anxiety condition. Driving performance was found to be greatly affected, particularly when irrelevant cues were presented to the participants during the high anxiety session. The results revealed that as anxiety levels increased so too did the frequency of gazes that participant made to the periphery and to the distracting lights.

The findings have practical implications which suggest that when performers become anxious this can lead to both "tunnel vision", which results in performers being unable to differentiate between relevant and irrelevant cues, as well as increasing susceptibility to being distracted by irrelevant cues. From an applied perspective, strategies that could enable a performer to recognise when attentional narrowing is occurring and ways in which they could broaden their attentional focus could assist in reducing the impact of attentional narrowing in sport (Nidiffer, 1976b). In summary, Easterbrook's cue utilisation theory (Easterbrook, 1959) predicts that an increase in arousal impairs performance as the range of task specific cues is reduced. Optimal performance is

predicted to occur at moderate levels of arousal, as the range of cues detected is at its most advantageous.

Cognitive interference theory

Sarason (1984, 1988) proposed that cognitive interference is an important factor in lowering the performance of highly anxious individuals, through the restriction of the information processing capacity within the cognitive system. Sarason (1984) stated that a test anxious person experiences 'self pre-occupying worry, insecurity and self doubt in evaluative situations' (p. 936). Within the context of cognitive interference theory, anxiety is said to lead to an increase in intrusive thoughts that are task-irrelevant and divert attention away from the task being executed, therefore cognitive anxiety is viewed as having a debilitative affect on performance. As research has evolved, the notion that anxiety can only have a debilitative affect on performance has been questioned. For instance, Eysenck (1992) highlighted that it is unlikely that highly anxious individuals will automatically perform worse at a task just because they are anxious but other factors should be considered, including task difficulty and individual differences. Eysenck's (1992) criticisms are strengthened by more recent research which has uncovered the positive impact that anxiety can have on performance (Hardy & Parfitt, 1991; Hardy et al., 1994; Woodman & Hardy, 2001b). So the notion that worry simply interferes, increases task-irrelevant thoughts and has a negative impact on performance is less probable. In summary, cognitive interference theory states that the greater the range of cues, the greater the debilitating affects of cognitive interference (Sarason, 1984); however more recent research has suggested that consideration must be made as to how an individual interprets their anxiety levels and for the assumption not to be that increases in worry always has a negative impact on performance.

Wegner's ironic processes of mental control

Ironic process theory (Wegner, 1994, 1997) postulates that when an individual attempts to control their mental thought processes, this can lead to counter-intentional states being

triggered. Wegner used an example from Baudouin (1921) to explain this phenomenon of counter-intentional states,

> This law of reversed effort is familiar in all its simplicity to everyone who has learned to ride a bicycle. When we are at length able to wobble painfully along, we see a big stone lying in the middle of the road, and we know that all our attempts to avoid it serve only to direct our steering towards the obstacle, upon which it impinges with deadly precision…this is something more than a quaint experience. It is an illustration of a law valid for all the obstacles we have to encounter in our path through life (pp.116-117).

Ironic process theory has its roots in some traditional approaches to irony, including notions related to movement opposing the will, which provides explanations for curiosities such as Ouija board and the Chevreul pendulum illusion (Easton & Shor, 1976). Ironic process theory also relates to the idea of counter will, something Freud referred to as an explanation for the socially inappropriate slips that occur when in company, such as embarrassing oneself with an inappropriate innuendo at a party.

According to Wegner (1994), ironic process theory states that attempts to control the mind leads to the interaction of two processes; an operating process and an ironic monitoring process. The operating process attempts to create the desired state of mind, such as the perfect putt or chip shot. The operating process is described as being effortful in that it requires conscious control and works until it is overruled by a distraction, in the form of the other process, the monitoring process. The monitoring process searches for thoughts and feelings that are in opposition with the operating process. Given that the operating process works at the conscious level, it is believed to be prone to interference from other attentional demands, which may not necessarily dissipate once distractions do. The monitoring process on the other hand is believed to be unconscious, less demanding of mental effort and is not subject to interruption, therefore once the monitoring process begins it can not be interrupted (Wegner, 1994). Take an example of a golfer who is on the 18th putting for the title. The operating process will typically search for states, thoughts and feelings that will allow the player to successfully sink the ball into the hole. Such thoughts may include thinking about the run of the green, the trajectory of the ball, looking at the

pin and thinking positive thoughts in relation to his ability to putt successfully. At the same time the monitoring process is searching for thoughts that are counteractive to the operating process such as thinking about missing, or worrying about the crowd and how poorly he is playing. Both the operational process and the monitoring processes occur in the same mind and at the same time, and in that way are both in contention with each other in terms of the amount of mental capacity that is available to host them (Navon & Gopher, 1979). Factors that distract an individual from the task of mental control will undermine the operational process and in doing so, this enhances the monitoring process. An important note of interest is that ironic control processes may be more likely under conditions of high mental load. Mental load can take many forms including increases in anxiety levels, time constraints, alcohol-intake or distractions (Janelle, 1999). When mental load increases, interference occurs at the conscious level, consuming attentional resources and ironically triggering the monitoring process. Within the context of sport psychology, this could be a plausible explanation for performance decrements in high anxiety situations.

Sport psychology research into ironic effects is limited but one study looked at golf putting (Wegner, Ansfield & Pilloff, 1998) and revealed that when performing under conditions of mental load (keeping a six-digit number in mind whilst putting and report it after the experimental putt), lead to poorer performance than when under conditions of low mental load. The experimental putt instructions involved players being told to land the ball on the glow spot, but to be careful not to hit the ball past the glow spot. Players under conditions of mental load overshot the spot more than those who were not under mental load. In a more recent study by Dugdale and Eklund (2002), participants were required to watch a series of video clips of Australian Rules football under low and high cognitive load conditions. High cognitive load was induced by feeding commentary and background noise through the headphones of the participants watching the series of video clips in an attempt to disrupt the participants' attentional focus. In contrast, no sound was fed through

the headphones in the low cognitive load condition. Participants were assigned to one of three groups; general-instruction condition, suppression of umpires condition or suppression of intentional harm condition. Results revealed that the suppression of umpires condition who were instructed *not* to pay attention to the umpires during the clips were more aware of what the umpires had done in the clips than the other two conditions. However, the results were not significantly magnified under conditions of high cognitive load as was expected. Again unpredictably, there were no ironic effects found for the suppression of intentional harm condition however, the frequency of these types of images in the video was not as often as that of the umpire condition and intentional harm is likely to have been more open to individual interpretation compared to the actions of the umpires which would have been easier to interpret objectively. In their second study, it was revealed that negative thoughts could be suppressed when participants were given a task-relevant cue to focus on instead of just suppressing the thought. Therefore it was suggested that thought suppression strategies may have a use when used along side a task-relevant cue word. The results should, however, be noted with caution as there was no control condition. To summarise, Wegner's ironic process theory suggests that mental control is achieved through the interplay of two processes, the operational process and the monitoring process. Under conditions of high cognitive load, the monitoring processes supersede the operating process, resulting in individuals thinking about behaviours that they are ironically trying to avoid.

Processing efficiency theory

Processing efficiency theory (PET; Eysenck & Calvo, 1992) predicts that cognitive anxiety, in the form of worry has two main roles. Firstly, worry challenges the processing and storage capacity of working memory and in doing so reduces the resources available to allocate to the task at hand. It is generally accepted that tasks that requiring little or no working memory should be unaffected by increases in cognitive anxiety. Secondly, worry is believed to highlight the importance of the task to the individual and can stimulate

increases in on-task effort which can partially or fully compensate for reduced performance under high anxiety (Wilson, Smith, Chattington, Ford & Marple-Horvat, 2006). Processing efficiency theory makes an important distinction between processing efficiency and performance effectiveness. Performance effectiveness relates to the quality of the task performance whereas processing efficiency is the "relationship between the effectiveness of performance and the effort or amount of processing resources invested" (Eysenck & Calvo, 1992, p. 147). Increases in anxiety have been suggested to have a more severe impact on processing efficiency, as anxiety is believed to reduce the attentional resources available to perform the task; in other words, anxiety affects processing efficiency more than performance effectiveness. One way that performance effectiveness can avoid being negatively effected by conditions of high anxiety, is if an individual applies additional resources to the task. Additional resources comprise many forms, including the application of additional effort to the task. By applying additional effort it is believed that performance levels can be maintained (or even improved) but at the expense of processing efficiency. According to PET, additional resources will only be applied to the task if the individual perceives that their current performance is below that of their personal performance expectations, therefore the individual needs to have the extra resources to allocate to the task in order to compensate for poor performance. However, if the individual perceives themselves to be incapable of succeeding at the task, then they are unlikely to invest additional resources and are more likely to withdraw their efforts (Eysenck, 1982).

Several studies have examined the predictions of PET in the context of motor skills. Murray and Janelle (2003) used a dual task paradigm consisting of a driving simulation task and a response-time task in order to investigate the predictions of PET in low and high trait anxious individuals, under conditions of low and high anxiety. Participants were presented with one of four LED targets and either a valid or invalid cue in the peripheral or central visual field. Cognitive anxiety, heart rate, effort and visual search were measured in

the low and high anxiety conditions and revealed no differences in driving performance between the low trait anxious and the high trait anxious participants, indicating that the high trait anxious group increased their efforts to maintain driving performance. Response time to LED targets (secondary task) was reduced for the low trait anxious group but increased for the high trait anxious group in the high anxiety condition. This result indicated that an increase in anxiety levels led to an increase the high trait anxiety group's attentional allocation to the driving task in order to maintain performance, but reduced the resources available for the response-time task. In other words, support for PET was found as performance effectiveness was maintained at the cost of processing efficiency. Visual search, in the form of the number of fixations and the length of time of these fixations, increased for both groups in high anxiety conditions. This indicated that as cognitive state anxiety increased, this reduced the efficiency of search patterns for both groups, and in particular the highly trait anxious group. The visual search findings also provided some support for Easterbrook's (1959) cue utilisation theory as the results indicated that attentional narrowing took place under conditions of elevated cognitive anxiety. Despite a number of limitations to Murray and Janelle's study, including issues associated with ordering effects, the results supported the notions of PET as driving performance was maintained despite inefficiency of visual search behaviour as a result of increased efforts under conditions of high anxiety.

Wilson et al. (2006) extended Murray and Janelle's (2003) study and used more advanced performance and processing efficiency measures in order to investigate how mental effort might compensate for the negative effects of anxiety. Wilson et al. (2006) included measures of gaze behaviour to assess attentional narrowing, pupillary dilation and the rating scale of mental effort (RSME; Zijlstra, 1993). Additionally, trait anxiety was measured using the Sport Anxiety Scale (SAS; Smith, Smoll, & Schutz, 1990) and to measure competitive state anxiety the Mental Readiness Form-Likert (MRF-L; Krane, 1994) was used in order to create a shorter "in activity" measure in contrast to using the

CSAI-2 (Martens et al., 1990). Efficiency of car control was measured in the form of lateral positioning (positioning on the road) and speed control as well as an overall driving performance score in the form of the time taken to complete the stages of the driving task. The results revealed state anxiety to be higher for both the low trait anxious and the high trait anxious groups in the high anxiety condition, indicating a successful anxiety manipulation. In terms of effort, pupil diameter results revealed significant main effects for pressure and trait anxiety, indicating that pupil dilation was greater under the high pressure condition for high trait anxious drivers than the low trait anxious drivers. The RSME scores revealed a significant main effect for pressure and a significant interaction for Trait Anxiety Grouping x Pressure, indicating that the performance of the high trait anxious participants was affected to a greater extent by the anxiety manipulation than the performance of the low trait anxious participants with all drivers reported expending more effort in the high pressure condition, in particular the high trait anxious drivers. Gaze behaviour, as indicated by the standard deviation of horizontal eye movement, revealed a significant main effect for pressure. In terms of search rate, as depicted by the number of fixations per minute, a significant main effect was found for trait anxiety group, with high trait anxious drivers having higher search rates than low trait anxious drivers. Analysis on efficiency of car control revealed a significant main effect for trait anxiety with high trait anxious drivers having greater variations in their wheel movements. Finally, standard deviation of accelerator pedal was used to measure speed control and results revealed a significant main effect for trait anxiety, indicating that the high trait anxious participants had greater variation in accelerator position. A significant interaction for Trait x Pressure was also revealed, showing that high trait anxious driver's pedal movements were more variable than that of the low trait anxious drivers when under conditions of high anxiety. Overall, the results of Wilson et al. (2006) support PET's prediction that dispositionally high anxious performers will worry more in threatening conditions than low trait anxious performers and this is likely to impact negatively on performance, however highlighted the

need for the development of more sophisticated methods of measurement of performance, effort and performance efficiency, such as the use of movement kinematics to further our understanding of performance decreases in high anxiety conditions.

More recently, Wilson, Smith and Holmes (2007) investigated the role of effort and the influence of anxiety on performance using a golf putting study. Eighteen golfers (*M* = 38.6 years, *SD* = 16.61) took part in the study and had a handicap range of 10-18 (*M* = 14.3, *SD* = 2.77). The golfers were required to putt in a low pressure and a high pressure condition. Participants were required to putt a golf ball, as accurately as possible from a mark on the carpet surface to five different regulation size holes. Two of the holes were 3 m away [Measurement was made in metric units]. Positioning of the holes was at a 35º angle to the left and a 45º angle to the right of the mark, and the two other holes were 3.3. m away, at a 20º angle to the left and a 25º angle to the right of the mark. The fifth hole was 3.6 m away, perpendicular to the mark. Participants completed 20 putts in the low pressure condition and 20 putts in the high pressure condition. Results revealed a number of findings that could be explained by the PET and others more suitable to the predictions associated with conscious processing effects and the CPH (Masters, 1992; the detail and predictions of the CPH will be discussed in more detail in the next section of this chapter). The self-reported state anxiety (MRF-L; Krane, 1994) results revealed significant main effects for test condition, indicating that the anxiety intervention was successful in raising anxiety levels, with an additional significant main effect for trait anxiety grouping which was more marked for the high trait anxiety group. Both groups reported significantly higher mental effort scores (RSME; Zijlstra, 1993) in the high pressure condition and this again was more marked for the high trait anxiety golfers. The time taken to initiate the backswing was found to be significantly higher in the high pressure condition, with the interaction approaching significance, which demonstrated that the time taken to putt appeared to be higher for the high trait anxious golfers compared to the low trait anxious golfers in the high pressure condition. Overall, the results for the mental effort findings

could be explained by both the PET and conscious processing effects. In terms of the behavioural measures, the time spent setting up the putts and glances at the target were significant in the high pressure condition for all golfers, indicating that they took more time and more glances to the target when putting under pressure. This suggests a reduction in visual search efficiency and provides support for the PET. Finally, the performance data is supported in part by both the PET and the CPH. Closer inspection of the data revealed that the high trait anxious golfers did not maintain their performance in the high pressure situation and reported significantly higher levels of effort and less efficient pre-putt behaviour which could be explained by both the PET and CPH as increases in effort could have lead to an increase in inward focus to control their putting technique (Masters, Polman & Hammond, 1993). From a PET perspective, it could be stated that the compensatory effort was not enough to overcome the deficits in working memory that was being imposed on the golfers in the high pressure condition. Therefore, Wilson et al. (2007) concluded that it was difficult to determine which theory best explains the findings and concluded that it could be that the findings are best explained by a combination of two types of theories, PET and CPH.

Recently, Eysenck, Derakshan, Santos and Calvo (2007) have extended the PET and have introduced a more advanced theory namely, attentional control theory (ACT). Attentional control theory still holds the same main predictions of PET in that anxiety impairs processing efficiency of the central executive of working memory; however, ACT expands and explains precisely which functions of the central executive are most adversely affected. The ACT manages to successfully define and distinguish between the functions of the central executive, which according to Eysenck et al. (2007) there are five main functions. Firstly, it is used to switch attention between tasks, (2) involved in the planning of subtasks in order to achieve a goal, (3) used to focus attention on relevant information, processing and inhibition of irrelevant cues, (4) used to update and check the contents of working memory and finally is responsible for coding representations in working memory

for time and place appearance. Within ACT, there are two main systems involved; the goal directed control and the stimulus driven system. Anxiety is believed to increase the influence of the stimulus driven attentional system at the cost of goal directed control (Corbetta & Schulman, 2002). To further explain, ACT makes specific predictions about the lower level functions of the central executive of working memory (Baddeley, 1986, 2001) that are linked to the goal directed attentional system. The goal directed attentional system is governed by two functions, inhibition and shifting. The inhibition function makes use of attentional control to resist disruption or interferences from task-irrelevant stimuli and so is described as being a negative control. In contrast, the shifting function uses attentional control to shift the individual's allocation of attention in order to remain focused on task-relevant stimuli and is referred to as positive control. Impaired functioning of the inhibition and the shifting functions is believed to disrupt the balance between the goal directed and the stimulus driven attentional systems. In summary, ACT overcomes some of the limitations of PET in terms of precision in identifying the specific functions of the central executive most adversely affected by anxiety, namely the inhibition and the shifting functions. Overall though, the main prediction that anxiety impairs processing efficiency more than performance effectiveness still stands as a main prediction of ACT. However, the processing inefficiency caused by the disruption of the inhibition and the shifting functions of the central executive will not necessary lead to a drop in performance effectiveness, as long as the anxious individual responds by investing additional compensatory effort or alternative processing strategies (Eysenck et al., 2007). Until very recently, no studies had considered the predictions of the ACT, many have only investigated the PET, however one study has just been published (Wilson, Vine & Wood, 2009). For this reason, the current research programme has considered the findings in terms of the predictions of PET (Eysenck & Calvo, 1992) rather than ACT but the researcher is aware of the recent developments of PET to ACT.

Conscious processing hypothesis

The CPH (Masters, 1992) has emerged as a possible explanation for anxiety induced performance impairments under conditions of elevated anxiety. A range of previous studies within the area of the CPH are presented and the limitations of these studies will be discussed, in order to provide detailed background information to help explain where the current research programme has developed. Starting with Masters' (1992) study, in which it is suggested that the automatic control processes of the expert performer becomes disrupted under conditions of elevated anxiety. In an attempt to ensure task success, skilled performers are hypothesised to adopt a mode of conscious control primarily associated with the early stage of learning (Fitts & Posner, 1967) and based on explicit knowledge (Magill, 2003). Explicit knowledge is believed to be consciously accessed in a step-by-step manner (Janelle, Singer & Williams, 1999) resulting in movements that are typically slow, effortful and easily verbalised. Fitts and Posner (1967) described the process of learning in terms of three stages: the cognitive phase, associative phase and the autonomous phase. According to Magill (2004) a novice in the cognitive stage of learning, engages in performance that is marked by a large number of errors and is mainly dependent on declarative knowledge, making the movements slow and effortful, easily verbalised and highly variable. As the individual's performance and ability levels progress, they enter the associative stage of learning where the performer has learned to associate certain environmental cues with the movements required to achieve the goal of the skill. There are usually less errors and the skill becomes more refined in the associative state of learning in comparison to the cognitive stage. In the final stage, the autonomous stage, performance becomes automatic, requiring very little, if any conscious attention. A performer would be classified as an expert by this stage given they would be able to perform automatically with few errors in their performance. According to Logan (1988) the three stages of learning should not be considered independent of each other, rather on a continuum of development.

Automaticity is a term used within the context of conscious processing, which indicates that an individual can perform a skill without making excessive demands on attentional capacity (Magill, 2004). If an expert consciously thinks about the movements that he or she is executing, it is likely that this will lead to a disruption of the movements, resulting in a performance which appears more like that associated with a novice performer in the cognitive stage of learning. Langer and Imber (1979) highlighted how explicit knowledge can be used to ensure accurate typing, where typists were requested to consciously monitor finger movements and this resulted in performance decrements. Similarly, Keele (1973) effectively demonstrated how expert performance could be hindered through the use of explicit knowledge in pianists. By instructing the pianists to focus solely on their finger movements, a disruption to performance was observed as a result of an increased conscious attention to finger movements. This disruption and shift in attention from the normal more automatic movements, to a movement investing conscious control under conditions of elevated anxiety, has been termed "deautomatisation" (Deikmann, 1966). The movements of an expert performer are typically more fluid and automatic in nature, performed more implicitly with little or no recourse to conscious attention under "normal conditions" but under conditions of elevated anxiety, shifts can take place that increase conscious attention to the movements being executed and this is believed to result in a drop in performance. It is against the background of these conceptual ideas that Masters (1992) developed the CPH and the subsequent findings which generated interest for the development of the current research programme.

Masters (1992) examined the use of implicit and explicit learning strategies using novice golfers. Forty golfers participated in an experiment consisting of two phases; an acquisition phase consisting of 400 putts divided evenly over four consecutive days and a test phase of 100 putts completed on the fifth day. Participants were assigned to one of five experimental conditions (implicit learning [IL], explicit learning [EL], implicit learning

control [ILC], stressed control [SC] and non-stressed control [NSC]). Both the IL and the ILC groups were required to simultaneously perform a random letter generation task (RLG; Baddley, 1966) while putting in an acquisition phase. The random letter generation task was used as a suppressor of explicit knowledge and as a way of encouraging implicit learning. The RLG task works by preventing the individual from assessing and generating explicit knowledge about the task. The EL group received specific instructions about how to putt before commencing their putting trials and the control groups received no instructions about how to putt the golf ball. As predicted, the results revealed that the EL group had more explicit knowledge about putting and the IL and ILC groups combined had less explicit knowledge about the putts than the SC and the NSC groups, indicating that even in the absence of explicit instructions, individuals are capable of generating their own explicit knowledge about a task. In the test phase, participants were placed in a stressful situation involving a combination of a financial incentive and evaluation apprehension.

The results for putting performance in the test phase revealed a significant interaction, indicating highly significant differences between all of the groups. Performance improvements were observed in the IL and ILC groups in the test phase and the SC and EL groups experienced performance impairments, however both the IL and the ILC groups were released from the RLG task at the time of the test phase. The performance decrement in the EL group was shown to be no different to the performance decrement of the SC group, however the performance decrements of these two groups was significantly different from the performance increments of the IL, ILC and the NSC groups. Masters claimed that the absence of performance improvements in the EL and the SC groups was due to the utilisation of explicit knowledge, providing support for the CPH. However, no consideration was made for the fact that both the IL and the ILC may have simply performed better because the task in the test phase was easier, given that the IL and ILC were both released from the RLG task in the test phase (Hardy, Mullen & Jones, 1996). Additionally, no consideration was made for the fact that the implicit groups

generally performed at a lower level of performance than the explicit groups. Such considerations required addressing and as a result, Hardy et al. (1996) extended and replicated Masters (1992) study.

Hardy et al. (1996) examined the CPH in a golf putting study involving thirty-two novices assigned to one of four experimental conditions: implicit learning without random letter generation in the stress test (IL), implicit learning with random letter generation in the stress test (ILRLG), explicit learning (EL) and a non-stressed control group (NSC). The rationale for having two implicit learning groups was to uncover whether Master's (1992) implicit learning group performed better because the task was easier in the test phase. Hardy et al. (1996) controlled for this issue using two implicit learning groups, one that continued to generate random letters in the test phase and one that did not. As in Masters' study, participants were required to putt in an acquisition phase consisting of 400 putts divided evenly over four consecutive days and then a test phase of 100 putts completed on the fifth day. The results in the test phase revealed that both the implicit learning groups improved their performance whereas the performance of the explicit group was impaired. Hardy et al. (1996) suggested that given that the participants performed the RLG task over 400 trials, it is possible they may have become desensitised to the RLG task and became at least partially immune to the effects of competitive state anxiety which could have contributed to the performance improvement. Overall, the results added support to the CPH although the desensitisation issue warranted further investigation and was considered in the design of the next conducted by Hardy, Mullen and Martin (2001).

Hardy, Mullen and Martin (2001) used a performance paradigm in their investigation of twelve expert female trampolinists. The trampolinists were required to perform their competition routines whilst shadowing task-relevant cues as a means of encouraging a focus on explicit knowledge in both training and pre-competition sessions. The coaching points used were derived from a coaching manual (Walker, 1988) and were

then individualised for each trampolinist, with one coaching point for each specific move included in the routine, making them task-relevant cues and therefore were predicted to encourage conscious processing of the movements under conditions of high anxiety. The high anxiety condition took place two hours before the trampolinists competed in a national competition and the low anxiety condition was conducted in training one week after the competition, when anxiety levels were reported to have returned to normal. State anxiety increased from training to pre-competition sessions and the performance scores indicated that the combination of task-relevant cues and increased state anxiety encouraged conscious processing, providing support for the CPH. However Hardy et al. (2001) suggested that the anxiety effects may have been caused by a combination of the task relevant cues and anxiety consuming attentional resources, leading to the suggestion that attentional capacity may have a role to play in performance decrements in conditions of high anxiety (Wine, 1971; Eysenck, 1988).

To further investigate the possible attentional overload explanation for performance decrements under high anxiety highlighted in the study by Hardy et al. (2001), Mullen and Hardy (2000) conducted a study examining eighteen male golfers aged 19-62 years (M = 36.3, SD = 16.3) with handicaps ranging from 12-18. Participants were required to putt 10 putts in each of the three experimental conditions; task-relevant, task-irrelevant and control conditions in low and high anxiety conditions. The kinematic processes underlying performance breakdowns were also investigated using kinematic analysis of the putting performance. In the task-relevant condition, participants were asked to putt using task-relevant instructions to guide their performance in an attempt to encourage lapses in conscious processing. Participants selected three coaching points from a list that was presented to them and were instructed they could individualise the coaching points if desired. These coaching points were then paraphrased into verbal cues that the participants repeated out loud as they performed the specific part of the putting action that was relevant

to the cues. In the task-irrelevant group, participants had to generate a random letter every second as they putted as a means to controlling attentional overload. The control group received no instructions about how to putt. At this stage the golfers were divided into two groups, "better" and "poorer" putters based on putting performance in the low anxiety condition with a median split classifying the two groups. Results revealed that the "poorer" putters performance was unaffected by increases in cognitive anxiety, however, the "better" putters performance was disrupted not only by increases in cognitive anxiety but also by the task-relevant and task-irrelevant manipulations under low anxiety conditions. The findings in the low anxiety condition were not predicted and had not been revealed in the pilot tests conducted prior to the actual experiment. The kinematic analysis failed to reveal evidence to suggest that movements were disrupted due to deautomatisation. The main effects for putting condition for club head range of motion and club head backswing and downswing times, suggested that the task-irrelevant and the task-relevant conditions had similar effects on working point behaviour. The results provided some support for disregarding the desensitisation issue highlighted in Hardy et al. (1996) as the task-irrelevant condition using the RLG task helped attenuate performance decrements in the high anxiety condition. Additionally, the use of the RLG task in the task-irrelevant condition supported the notion that the performers had enough attentional capacity in order to carry out the dual task. Given that the "better" putters were more highly affected by increases in cognitive anxiety in both the task-relevant and the task-irrelevant conditions, this led to the suggestion that the "better" putters may have possessed stronger levels of automaticity than the "poorer" putters. In other words, it could be that the more expert putters' potentially possess a stronger level of automaticity making conscious processing effects more prominent and the consequences more obvious in expert performers (Mullen & Hardy, 2000).

Due to the equivocal findings of Mullen and Hardy (2000), Mullen, Hardy and Tattersall (2005) examined the CPH using the same basic design adopted by Mullen and Hardy (2000). Participants were required to putt a total of 60 putts; 10 putts in each of the following experimental conditions; single task, task-relevant shadowing and task-irrelevant shadowing in low and high anxiety conditions. In the task-relevant shadowing condition participants were required to putt whilst making use of three coaching points designed to encourage lapses in conscious processing. Participants paraphrased these coaching points and the researcher read them out loud during the final stages of the participant's pre-performance routine, similar to the methods used by the trampolinists in the task relevant condition in Mullen et al. (2001). The task-irrelevant condition involved the participants listening to high and low pitched tones whilst putting and being asked to identify the number of high-pitched tones that were emitted during each putt. The reason for using the tones was because verbalisation would have interfered with the measurement of heart rate variability (HRV) and so participants were required to indicate with their fingers the number of high-pitched tones per putt rather than verbalise them. Finally, the single task condition required participants to putt as they would normally putt. The use of HRV brought a new dimension to the examination of conscious processing effects, through the measurement of mental effort as an index of conscious processing, something no other study examining the CPH had done up to this point. The use of psychophysiological measures of HRV as a measure of mental effort was unique to sport psychology research where self-reported rating scales were commonly used to assess psychological responses to various factors. An accurate approach to measuring HRV is spectral analysis of the cardiac signal (Bernston et al., 1997). Spectral methods produce decomposition of total variation of a data series with the heart rate signal producing three main frequency bands. Each frequency band is associated with different functional aspects of heart rate (Althaus, Mulder, Van Roon & Minderaa, 1998). The low frequency band (0.02 – 0.06 Hz; HRVLF) relates to vasomotor activity such as body temperature regulation. The mid frequency band

(0.07 – 0.14 Hz; HRVMF) is mainly concerned with the mental effort associated with controlled processing in tasks requiring high mental load (Mulder & Mulder, 1981; Vincente, Thornton & Moran, 1987), and corresponds to baroflex control of heart rate, reflecting both parasympathetic and sympathetic activity (Dishman et al., 2000) and, according to Van der Roon (1988), is influenced, by short term changes in blood pressure. The high frequency band (0.15 – 0.50 Hz; HRVHF) is the most established and widely investigated band and has been used to infer parasympathetic activity. Changes in parasympathetic output result in an increase or decrease in HRVHF activity depending on what is happening to the parasympathetic activity at the time. Whereas changes from the sympathetic division are more likely to cause decreases in HRVMF activity, as would be expected if shifts from automatic to controlled processing took place (Jorna, 1992; Veltman, 2002). Whether increases or decreases in activity are likely to take place is difficult to predict, as changes in sympathetic activity might confound any changes in parasympathetic activity, meaning increases in one band does not necessarily mean that the other is not activated but could mean that either the band is less activated or that the activity in the band is being overruled by the activation in the other. For this reason HRV measurement and interpretation is difficult. The results of Mullen et al. (2005) revealed that performance was impaired in the high anxiety shadowing and tone-counting conditions. The HRV data revealed that compensatory effort increases in spectral power in the HRVHF band in the dual task, low anxiety condition were not present in the high anxiety tone-counting and shadowing conditions. No effects were found for the self-reported mental effort scores and in summary the results supported an attentional threshold explanation over a CPH explanation. Given that little support was found for the CPH in Mullen et al. (2005) study, suggestions were made that conscious processing effects may be more evident in tasks which demand more motor control. For instance, the motor control demands of a trampolinist would be considered more than putting a golf ball and

this was a consideration as to why conscious processing effects may not have been revealed, as was predicted.

The main studies that investigated conscious processing effects have been presented and their findings, limitations and recommendations discussed. In light of this, the current research programme was developed in order to further investigate conscious processing but also attempted to uncover what else may contribute to performance decrements under conditions of high cognitive state anxiety. In addition, a number of other avenues of research were explored in an attempt to highlight a variety of factors that could be considered to have a part to play in performance decrements.

Additional relevant literature

Masters, Hardy and associates focused upon the use of explicit knowledge in performance impairment. In contrast, Wulf and colleagues concentrated upon the notion of attentional focus (for a review, see Wulf, 2007). Attentional focus can be directed internally or externally. Wulf and colleagues have found consistent support for an external focus of attention, which encourages novices to focus on the effects of their movements rather than to the body movements itself (an internal focus). Research indicates that when novice participants make use of an external focus, learning is more effective and therefore performance is enhanced. For example, in a series of balancing tasks evidence was found for external focus instructions including in a ski simulator task (Wulf, Hob & Prinz, 1998; Experiment 1), a stabliometer task (McNevin, Shea & Wulf, 2003; Wulf et al., 1998, Experiment 2; Wulf & McNevin, 2003; Wulf, Shea & Park, 2001) a Pedalo style task (Totsika & Wulf, 2003) and tasks requiring participants to stand still on compliant surfaces (e.g. Wulf, Mercer, McNevin & Guadagnoli, 2004), were postural sway was found to reduce when individuals standing on moving platforms focused externally rather than internally (e.g. Landers, Wulf, Wallmann & Guadagnoli, 2005). Wulf and colleagues therefore indicated that explicitly focusing on the movements (internal focus of attention)

when acquiring a skill can be less beneficial than focusing on something external to the person, for instance a target or marker 1 m away. Other studies have repeatedly shown externally focused goals to be effective in both acquisition (Wulf, Lauterback & Toole, 1999) and transfer test conditions (Totsika & Wulf, 2003). Wulf, Lauterbach and Toole (1999) investigated novices learning a golf-chipping task using either an internal or an external focus of attention. The external focus of attention participants were instructed to focus their attention on the club during the swing and the internal focus of attention participants were instructed to focus their attention on their arms during the swing. Results revealed that participants who focused their attention on the club (external) performed better than those who took an internal focus of attention. As is common in most research, alternative results have been uncovered to suggest that the use of an external focus may not always be of benefit to performance. Perkins-Ceccato, Passmore and Lee (2003) investigated performance, rather than learning and revealed a different conclusion to the majority of the Wulf research, indicating that an internal focus may be more advantageous for novice golfers than an external focus. What should be noted, however, was that this study revealed differences between the internal and external conditions in the trial-to-trial variability of the shots, not in accuracy. In addition, no retention tests were conducted and the instructions were criticised for being vague, highlighting the real need for clear instructions to avoid equivocal interpretations. Aside from golf putting and balancing orientated tasks, other tasks investigating an internal and an external focus have included; American Football (Zachry, 2005), a jump and reach task (Wulf, Zachry, Granados & Dufek, 2007) and Basketball shooting accuracy (Al-Abood, Bennett, Hernandez, Ashford & Davids, 2002; Zachary, Wulf, Mercer & Bezodis, 2005). Despite the large body of evidence that is supportive of the benefits of an external focus of attention, there are some limitations to the research that should be noted including a consistent lack of manipulation checks to confirm adherence to the different conditions (Wulf, Weigelt, Poulter & McNevin, 2003). If no manipulation checks are implemented, then there is no way to

assess or monitor whether the participants have made use of the assigned focus of attention when executing the prescribed task. If the participants have not focused their attention appropriately, then this ultimately questions the accuracy of the findings and this should be considered when reporting the findings and controlled for in future research. Furthermore, Maxwell and Masters (2002) and Poolton, Maxwell, Masters and Raab (2006) have failed to consistently replicate the benefits of an external focus of attention. Poolton et al. (2006) concluded that an internal focus leads to the accumulation of explicit knowledge about the task, which could lead to the performer being more likely to consciously process information. Thus the evidence is equivocal but mainly points towards the benefits of an external focus for both learning and performance. If this research is taken within the context of CPH, a type of focus that directs a performer's attention away from the movement itself and discourages accessing explicit knowledge about the task is more likely to prevent conscious processing effects, so it would be expected that an external focus of attention would be more beneficial under conditions of elevated anxiety than an internal focus of attention.

A related, but slightly different branch of research from that centred on the CPH, investigates the use of a specific type of self-focus, labelled explicit monitoring (Beilock & Carr, 2001). Beilock and Carr (2001) demonstrated that an increase in pressure lead to impaired performance in a golf putting task, providing evidence that self-focus leads to performance impairment when combined with increases in pressure. Beilock and Carr demonstrated that single task golf putting performance was impaired by pressure, while training under conditions designed to promote self-focus (in front of a video camera) eliminated performance decrements when tested under pressure. However, several limitations to Beilock and Carr's study existed. Firstly, and similarly to Wulf and colleagues' early work, there were no manipulation checks in place for either perceived pressure or self-focus. Additionally, there has been some discussion over the use of a video

camera to induce a focus on the self involving explicit task monitoring. Research on self-consciousness has distinguished between private and public aspects of self-consciousness and, as a result, Carver and Scheier (1998) suggested that certain treatments focus attention selectively on one aspect of the self. Video cameras appear to focus attention on the public side of the self, which is unrelated to an awareness of internal states. Interventions designed to focus attention on the private side of the self, which involves a tendency to be aware of one's thoughts and feelings and appears to be related to conscious processing, includes the use of mirrors (Liao & Masters, 2002). In this context, Beilock and Carr's (2001) evidence suggests that performance in their single task condition may have been influenced by a focus on task-irrelevant cues associated with public rather than private self consciousness and it is this effect that may be attenuated by the (public) self focus training.

Extending the work of Beilock and associates, Jackson, Ashford and Norsworthy (2006) investigated the moderating effects of pressure and the tendency to consciously process task-related information (dispositional reinvestment) on motor performance in a number of experiments. In Experiment 1, Jackson et al. (2006) examined the explicit monitoring task used by Beilock and Carr (2001), but in addition looked at whether process goals caused performance disruption under pressure in a second experiment. Process goals are commonly defined as focusing on the behaviour that the performer will engage in during performance (Kingston & Hardy, 1997). Jackson et al. (2006) examined field hockey players performing a dribbling task under single task, dual task and skill-focused conditions under both low and high pressure conditions. Thirty-four field hockey players completed the Reinvestment scale (Masters, Polman & Hammond, 1993) and the CSAI-2 (Martens et al., 1990) before taking part in an indoor dribbling task comprising of an "Indian dribble" around a U shaped slalom course consisting of 10 equally spaced cones at 1 m intervals. Participants completed 6 sets of 5 trials, with each trial being timed. If a significant error was made, such as missing a cone or use the wrong side of the stick then

the trial would be repeated. This was in line with procedures by Beilock, Carr, McMahon and Starkes (2002). The single task condition instructed the participants to complete the task as quickly and as accurately as possible, and the time taken to complete the task would be recorded. In the skill-focus condition, participants were instructed the same as the single task condition but were also informed to attend to the movement of their hands throughout the trial. Participants were asked to verbally indicate whether their left hand was "up" or "down" when they heard a tone that sounded on a 6-second variable interval schedule. Finally, the dual-task condition involved participants had to follow the single task condition instructions but in addition, had to generate a random letter of the alphabet each time they heard a tone that sounded every 6 seconds (same interval as the skill-focused condition). As with previous studies, the RLG task was used as it has been shown to place demand on the central executive component of working memory (Baddley, 1986) and has been shown to minimise the generation and use of explicit knowledge in motor tasks (MacMahon & Masters, 2002). The low and high pressure manipulations were induced by the presence of an individual who filmed the trials using a video camera mounted on a tripod. Participants were also told that the video was going to be used for a field hockey video for the national governing body and would be distributed nationwide. The use of video cameras have been used to induce pressure in other studies such as Baumeister (1984), Liao and Masters (2002) and Mullen and Hardy (2000). Participants then completed 30 experimental trials. The results revealed that performance was slower in the high pressure condition, regardless of experimental group. Performance in the dual-task condition was faster than the single task condition, which in turn was faster than the skill-focus condition. A significant three way interaction between attention condition, pressure and reinvestment group was revealed and subsequent follow up tests revealed that in the single task condition there was a significant interaction between pressure and reinvestment group as a result of the negative impact of pressure being greater in the high reinvesters than in the low reinvesters. In the skill-focus and the dual-task conditions, there was a

significant main effect for pressure. Performance was found to be significantly slower in the skill-focus than the single task condition and significantly faster in the dual-task condition than in the single task condition. A significant main effect was also found for attention condition in the high pressure trials. When compared to the single task conditions, slower performance times were revealed under skill-focus and faster performance times for dual-task conditions. Overall, the results were consistent with the findings of Beilock et al. (2002), in particular the finding that in low pressure conditions, performance was faster under dual-task condition and slowest under skill-focused conditions. Of particular interest, was why the performance of the participants was superior under dual-task conditions in comparison to a single task condition. One explanation provided was that the dual-task condition could have induced an external focus of attention which could have served as beneficial for learning as has been demonstrated by Wulf, Lauterbach and Toole (1999) amongst others (for a review, see Wulf, 2007). In terms of the pressure, the results were consistent with the prediction that high reinvesters would be more likely to choke under pressure than low reinvesters in the high pressure trials.

Experiment 2 aimed to replicate the findings of Experiment 1 whilst examining the effects of focusing on a task-relevant secondary task in the form of process goals. When placed in the context of explicit monitoring theories, part process goals in particular, present an apparent paradox as they encourage individuals to focus consciously on parts of their performance that would normally be performed automatically (Hardy et al., 1996) but it may be that different types of process goals serve differing functions depending on the ability level of the performer and the nature of the process goals. It has been suggested that the use of part process goals may serve to enhance performance in less skilled performers and may be less beneficial for more expert performers. Experiment 2 therefore predicted that the use of process goals would be helpful under conditions of low pressure but would induce explicit monitoring under conditions of high pressure. Twenty-five male soccer players took part in the study and were considered to be experienced players based on

competitive playing experience (*M* = 12.44 years, *SD* = 2.71). As in Experiment 1, the Reinvestment scale (Masters, Polman & Hammond, 1993) and the CSAI-2 (Martens et al., 1990) were used. The soccer dribbling task required the participants to dribble a ball as quickly and as accurately as possible through a series of six equally spaced cones, each at a 1.5 m interval, using the instep and out step of their dominant foot. The procedure was the same as Experiment 1 except the participants completed three trials in each of the three conditions, totalling 18 trials. The three conditions were single task, skill-focus and process goal. The first two conditions were similar to that detailed in Experiment 1, however were specific to soccer. The process goal condition however required participants to set a single goal that was linked to their dribbling behaviour that they wanted to try and maximise in order to ensure success on the task. The pressure manipulation of a video camera was the same as in Experiment 1. Overall, the results revealed that the use of a process goal was unfavourable under low and high pressure conditions for both low and high reinvesters. In addition to this, the nature of the process goals were examined and it was revealed that movement related process goals, which included reference to a specific technique or movement , e.g. “keep loose with knees bent” (p. 61) were found to have a detrimental effect and position related process goals did not. An example of a position related process goal included, “keep over the ball with my body” (p. 61). In summary, the hypothesis that process goals would have differing effects on performance depending on dispositional reinvestment and pressure was not supported. However, movement related process goals were found to have a detrimental effect on performance regardless of dispositional reinvestment or situational pressure. The differing affects of the different types of process goals, brought to light the need to distinguish between types of process goals. Suggestions were made that process goals related to skilled movements may encourage explicit monitoring, whereas process goals related to positioning may direct a performer’s attention away from the physical movements and aid performance (see Kingston & Hardy, 1997; Jackson & Willson, 1999).

In order to expand on the notion of different types of process goals, Jackson and Willson (1999) found in their study of golf putting performance, that performance levels could actually be maintained when participants were asked to make use of single process goals, but each being slightly different in content. In the first of three experiments, Jackson and Willson (1999) assigned forty male golfers (*M* = 19.7 years, *M* handicap = 9.6) to one of four "swing thought" conditions; a verbal swing thought cue, which required participants to verbalise, "a phrase relating to one or two aspects of putting techniques" (p. 168); a visual swing thought cue which required participants to focus on either the dimple pattern on the ball or the texture of the putting surface, a task-irrelevant swing thought cue which required subjects to verbalise the colour sequence red, yellow, green, blue (R-Y-G-B) or a control condition where no strategy was given. The assigned process goals in Jackson and Willson's study were a mixture of part process and holistic process goals and it was predicted that focusing on 'one or two aspects of the putting technique' (p. 168) or attending to a visual swing thought cue related to golf, could help prevent the performer from trying to consciously control too many aspects of their putting performance. Participants were required to putt a golf ball, landing it as close as possible to the centre of a target inside five concentric circles. Participants had 20 warm up putts followed by 20 baseline measure putts, then 20 putts in the intervention phase and finally 20 putts in the competition phase. The results revealed that the verbal swing thought cue group and the visual swing thought cue group performed significantly better than the control group in the competition condition, while the scores of the task-irrelevant swing thought cue group were not significantly different from any of the other three groups. The findings suggested that the use of verbal or visual swing thought cues helped prevent choking in high anxiety situations in golf putting.

Jackson and Willson (1999) conducted a second experiment to test the assumption that thinking about several aspects of putting performance in the seconds *before* the initiation of the putt would disrupt performance. Put simply, they aimed to test if thinking

about aspects of the set up of the putt would have a negative impact on performance when compared to thinking about aspects of the putting stroke. Twenty male golfers (*M* = 20.3 years, *M* handicap = 7.5) were assigned to putt in five different conditions; two set up conditions, which required the participants to verbalise four rules that related to the correct set up for adopting a putt and two swing conditions. The four rules were subdivided into shortened versions that split the rules up into eight or 16 syllables. Jackson and Willson (1999) failed to provide any examples of the four rules or the shortened versions for future use or inspection for other researchers. The two swing conditions required participants to verbalise shortened versions of the four rules related to the putting stroke (again comprising of either eight or 16 syllables) which was specific to the swing aspect of the putt. The choice to divide up the four rules that related to the set up and the swing of the putt into shortened eight and 16 syllable cues was used to test whether the amount of disruption to performance was due to the length of the stimulus, rather than the content of the stimulus. The fifth condition was a baseline condition in which the participants received no instructions about what to attend to when putting. Participants putted 20 putts in each of the five conditions, with the order of the conditions counterbalanced for each participant. The results revealed that only the rules relating to putting action were disruptive to performance when compared to rules that focused on the set up of the stroke. This supported the prediction that when rules concerning the putting action are focused on, conscious processing would take place. There was no significant difference found between the eight and 16 syllable conditions, indicating that the number of cues did not have an impact on how severely affected performance was disrupted, rather it was more the content of the cues (i.e. what they were focusing on, either set up or swing) which disrupted performance. The results of Jackson and Willson (1999) support the notion of reinvestment (Masters, 1992). Reinvestment or reinvestment theory, as also supported by Liao and Masters (2002), states that explicit knowledge raises self consciousness about performing correctly when under pressure and in doing so, the performer focuses on the processes of

their performance in an attempt to exert more explicit control than they would if faced with a non pressure situation (Baumister, 1984; Beilock & Carr, 2001; Lewis & Linder, 1997). In other words, Jackson and Willson (1999) believed that by focusing on the putting action, this encouraged the use of explicit knowledge about the swing and lead to increased conscious control of the putting movement. Jackson and Willson (1999) conducted a third study, which had three main aims. The first was to replicate the findings of experiment one which revealed that using a task-relevant cue is effective in preventing performance disruption under conditions of high anxiety. The second was to test the hypothesis that by attending to a verbal swing thought cue related to the set up of the putt, this too would prevent performance disruption. Finally, the third was to assess whether the source of the swing thought had an impact on performance, in other words did it make a difference if the swing thought used was assigned to the participants by the researcher, or self formulated by the participant. Fifty male golfers (M = 21.5 years, M handicap = 7.0) were assigned to one of five experimental conditions; set up (self), set up (given), swing (self), swing (given) and control. The putting task and experimental procedure followed the same format as the previous two studies by Jackson and Willson (1999). The results revealed a significant main effect for group, which indicated that the swing (self) group performed better than the swing (given) and the control group. The results therefore suggest that there may potentially be other factors that can influence the effectiveness of swing thoughts under pressure, indicating that participants could benefit from self selecting their swing thoughts in order to prevent performance disruption under pressure. Of additional interest was that neither of the set up groups showed signs of choking under pressure, indicating that using such swing thoughts also appeared to prevent performance disruption. In summary, the third study revealed that self selected swing thoughts produced better performance scores than assigned swing thoughts and the control group. It was also revealed that the source of the swing thought is important and should relate to the actual swing of the putt and not the set up of the putt. Jackson and Willson's results suggested

that some level of conscious processing, in the form of swing thoughts, might actually facilitate performance. They argue that by using a higher level (global) cue word which represents the explicit rules, this can help prevent regression to conscious control. To conclude, the three studies by Jackson and Willson's provide support for reinvestment theory (Masters, 1992) and the notion that swing thoughts can assist in preventing performance decreases in conditions of high anxiety. Their third study also suggested that there may be other factors or indeed multiple factors, which influence the effectiveness of certain concentration strategies and suggest that future research into the area of choking is required.

It appears that the burgeoning research base within the context of the CPH is generally supportive on the issue of task focus being detrimental to performance. Despite this support, there is little empirical evidence for conscious processing effects. In congruence with Eysenck's (1988) position paper, it is possible that skilled but anxious performers may be susceptible to conscious processing and distraction effects. In addition, the work of Beilock and associates and Jackson et al. (2006) suggests that explicit monitoring of skills may cause performance impairment that occurs independently of conscious processing. Consequently, to effectively examine the CPH, there is call for studies that isolate conscious processing effects without invoking distraction or explicit monitoring. Examining the effect of part process goals upon the performance of skilled but anxious individuals may offer researchers a way of achieving this. Additionally, making use of part process goals to examine the CPH offers the opportunity to examine the process goal paradox identified by Hardy et al. (1996) by differentiating more clearly between different types of process goal. Process goals that are part orientated have the potential to cause lapses into conscious processing, process goals that are holistically focused might help avoid conscious processing effects. A holistic process goal encourages the performer to focus on the whole of the movement that they are performing and avoids the focus being drawn to the individual parts of the movement, which is what takes place when a part

process goal is used. An example of a holistic process goal in golf could include "smooth swing" or in a basketball free throw could include "extend" or "reach" as the ball is elevated towards the basket. A part process goal in basketball could include "bend knees" and "straighten arms". It is this differentiation between the type of process goals and their potential differing effects on performance in different pressure conditions that is central to this thesis. A series of studies are presented which investigate performance decrements in conditions of elevated anxiety and further examines the process goal paradox.

Summary

In summary, this review chapter has attempted to clarify some of the definitions relating to the terminology within the area of stress and anxiety in the sport psychology literature and those which are subsequently used throughout this thesis. The chapter outlined several theories which offer mechanistic explanations for performance decrements in conditions of high anxiety including Easterbrook's (1959) cue utilisation theory, cognitive interference theory (Sarason, 1984, 1988), Wegner's ironic process theory (1994, 1997), processing efficiency theory (PET; Eysenck & Calvo, 1992) and the conscious processing hypothesis (CPH; Masters, 1992). Following this, an in depth discussion of the existing research on the CPH was presented and it is largely suggested that more thorough investigation of the CPH is required given a lack of unequivocal support for its predictions as an exclusive explanation for performance decrements under pressure.

CHAPTER 3

AN INVESTIGATION OF THE PROCESS GOAL PARADOX

(STUDY 1)

Abstract

This study investigated the process goal paradox by assessing different attentional focus instructions in the form of process goals on: 1) the acquisition of simulated driving performance and 2) driving performance in neutral and competition conditions. Thirty-two novice participants completed eight driving blocks in the acquisition phase and a further two blocks in the competition phase while making use of one of four attentional focus conditions. During acquisition, a two-factor ANOVA revealed that using part process goals was the least effective strategy. In competition, cognitive anxiety and self-reported mental effort increased and driving performance improved significantly. The findings suggest that using part process goals may be beneficial in preventing performance impairment in acquisition and across neutral and competition conditions.

Introduction

The purpose of study 1 was to examine conscious processing and the process goal paradox as an explanation of motor performance impairment in conditions of high anxiety. The conscious processing hypothesis (CPH; Masters, 1992) and the relevant research in the area has been extensively discussed in chapter 1 of this thesis, so the attention now turns to the notion of the process goal paradox. In order to understand the notion of the process goal paradox it is necessary to discuss the different types of goals and how they potentially impact on performance.

The use of goals within sport was first introduced by Locke (1968). There are typically three main categories of goals that are commonly referred to within the context of sport psychology namely; outcome goals, performance goals and process goals (Hardy & Jones, 1994). Outcome goals focus primarily on the outcome of an event and usually involve the performer comparing themselves and their performance to another competitor. A typical outcome goal would be to win a particular competition, match or race. In slight contrast are performance goals, which specify an end product of performance in the same way as outcome goals do, but performance goals involve a measure of success that tends to be viewed in terms of absolute performance standards. For instance, a performance goal for a golfer could be to achieve a net score of 74, which does not indicate that the golfer wants to win the competition, but states what score the golfer wants to achieve. This establishes a measure of performance that can be used to compare previous performances,

to current performance in order to access whether any improvements have been made. Finally, process goals specify the behaviours that the performer will engage in during performance (Kingston & Hardy, 1997). For example, the golfer may focus on getting the right tension in his wrists in order to ensure a smooth swing, or he may focus solely on keeping his breathing under control in order to remain relaxed. Assigning a focus to these processes of performance is likely to increase the chances of task success. Although each type of goal has its distinguishing characteristics, they are all somewhat related, in that by setting process goals, an athlete is more likely to achieve a performance goal and ultimately the outcome goal for the task in which they are involved.

One possible way of counteracting the paradox of process goals is to clearly distinguish between the different types that exist. A part process goal encourages an individual to focus on one single part of a movement and might therefore be expected to encourage "dechunking", or "deautomatisation" (Deikman, 1966), potentially causing performance disruption. In golf, an example of a part process goal could be focusing solely on "grip". Due to the nature of these part process goals, it would be fair to predict that their use would, paradoxically, be detrimental to performance, despite previous support from sport psychologists. In contrast, a holistic process goal may encourage performers to encapsulate the movement as a whole and perform using more automatic control structures. The use of holistic process goals should, in effect, discourage conscious processing and help maintain performance under conditions of increased state anxiety. Holistic process goals may function by encouraging "chunking", a word that has been used to describe the automatisation of cognitive skills where individual elements of a task are gradually incorporated into single representations, thus allowing smoother performance (Neves & Anderson, 1981). Holistic process goals should not induce conscious processing given that conscious control can only be exerted over parts of a movement, not the movement in its entirety (Hardy, Jones & Gould, 1996). A process goal that has an external focus (cf., Wulf, 2007) could also potentially encourage skilled but anxious performers to

avoid consciously processing their movements and thus prevent performance disruption. For the purpose of this research programme, an external goal and its definition, stems mainly from the work of Wulf (for a review see Wulf, 2007; Wulf & Prinz, 2001). The details of Wulf's work are extensively covered in chapter 1 of this thesis. In brief, Wulf's work compares the effectiveness of an internal and an external focus of attention on guiding performance. The research has indicated that when novices focus externally, learning and performance is enhanced. It has been identified that novices acquired a stabliometer and ski simulator task skill quicker when utilising an external focus of attention in comparison to an internal focus of attention. Wulf and colleagues indicated that explicitly focusing on the movements and thus making use of an internal focus of attention when acquiring a skill, can be less beneficial than focusing on something external to the person, for instance a target, a marker 1 m away or an external focal point on the apparatus e.g. club head in golf. Other studies have shown externally focused goals to be effective in both acquisition (Wulf, Lauterback & Toole, 1999) and high anxiety transfer test conditions (Totsika & Wulf, 2003).

It has been suggested that process orientated goals form part of the strategy and technique development that is required in order to achieve automation of performance. Orlick and Partington (1988) reported some additional uses of process goals, which included assisting performers in maintaining motivation levels in training. The quote below by a rifle shooter, demonstrates how process goals can be sub-divided, into two main types; specifically part process goals and holistic process goals. In addition to demonstrating the division of goals, the quote also highlights how novices might start making use of a part process goal to guide their performance in the early stages of skill acquisition, but as skill level increases and automatic functioning takes over, a shift may be made to utilising holistic process goals:

> This strategy started out very mechanically, with a physical list of words which I have on the shooting table and which I read exactly. These words represented every single step involved in shooting a shot. Then I reduced these to key words so that I

> could go through the list faster. Finally I didn't need the list anymore. I would usually write one word to emphasise what I wanted, such as "trigger" or "smooth" (Orlick & Partington, 1988, pp. 111-112).

The words "trigger" and "smooth" that the shooter refers to in the quote, could be classified as holistic process goals. Holistic process goals and words are considered to be more facilitative to performance under conditions of high cognitive anxiety, as they are believed to prevent the individual from assessing explicit knowledge in the way that a part process goal would be expected to. To further explain, when using a holistic process goal, little explicit knowledge is being used to guide performance and therefore this is likely to encourage more automatic movement. Within the context of the CPH, the use of part process goals should lead to a disruption in performance under conditions of stress, as the performer makes use of more explicit knowledge about the task in order to guide their performance. However, the work of Liao and Masters (2002) suggests that the use of part process goals may be affective in assisting performance in novice performers and it is only when performance becomes automatic that the use of a part process goal would be considered ineffective.

The use of holistic process goals have been anecdotally documented within the applied golf psychology literature and have been commonly dubbed "swing thoughts". Owens and Kirschenbaum (1998) reported that some golfers use a mechanical thought when executing a swing and described these mechanical thoughts as "whole swing thoughts" (p. 23). Owens and Kirschenbaum went on to state that partial swing thoughts, or swing specific mechanical thoughts, interrupt the smooth flow of the stroke and create performance difficulties, which would be considered similar to the anticipated effects of using a part process goal. The notion of "swing thoughts" were further examined in Jackson and Willson's (1999) study of golfers with results revealing that making use of swing thoughts helped golfers maintain a high level of performance under pressure by preventing the reinvestment of explicit rules. Jackson and Willson posited that by using a swing thought, which collectively represents the explicit rules of the skill being executed

(and in this case was a mixture of both part and holistic goals), lead to a reduction in the likelihood for regression to conscious control thus maintaining performance despite an increase in pressure.

More recently, Gucciardi and Dimmock (2008) compared a single swing thought group with an explicit knowledge cue group and a task-irrelevant cue group in an attempt to compare the CPH and the attentional threshold hypothesis (ATH) as an explanation for performance breakdown under pressure. Specifically, Gucciardi and Dimmock (2008) investigated the use of three explicit knowledge cues, three task-irrelevant cues and one single swing thought in a golf putting study conducted under low and high anxiety conditions. The predictions of the study were that if the CPH was a valid explanation for performance decrements under high anxiety, then performance decreases should only be seen in the explicit knowledge group. Whereas if an ATH was a valid explanation for performance decrements under high anxiety, then performance decreases should be seen in both the explicit knowledge group and the task-irrelevant group, as both groups would then demonstrate inadequate attentional capacity to carry out the task under pressure. Gucciardi and Dimmock (2008) found support for the CPH as an explanation as performance decreases were only found in the explicit knowledge group. Given that the same amount of cues were used by participants in both the explicit knowledge and task-irrelevant cue group, an ATH explanation could be confidently ruled out. Had the groups focused on a different number of cues then an ATH explanation would have been harder to disregard. A lack of a single global process goal in Guacciardi and Dimmock's (2008) study prompted such considerations to be made in the current study.

Further exploration of conscious processing effects has been investigated using psychophysiological measures of mental effort. Mullen, Hardy and Tattersall (2005) predicted that an increase in effort being assigned to a task is associated with a shift from automatic to controlled processing (Mulder, 1992). The extra effort participants assign to a task in response to increased anxiety can be measured using a traditional "pen and paper"

scale such as the rating scale of mental effort (RSME; Zijlstra, 1993) or psychophysiologically through the measurement of heart rate variability (HRV) via spectral analysis of the cardiac signal (Bernston et al., 1997). Spectral methods produce decomposition of total variation of a data series with the heart rate signal producing three main frequency bands. Each frequency band is associated with different functional aspects of heart rate (Althaus, Mulder, Van Roon, & Minderaa, 1998). For instance, the mid frequency band (0.07 – 0.14 Hz; HRVMF) is mainly concerned with mental effort associated with controlled processing and in tasks requiring high mental load (Mulder & Mulder, 1981; Vincente, Thornton & Moran, 1987). Changes in activity in the HRVMF band are mainly controlled by changes in the sympathetic division of the autonomic nervous system and result in a decrease in activity levels, as shifts from automatic to controlled processing take place (Jorna, 1992; Veltman, 2002). Therefore, when increases in mental effort take place, it would be expected that decreases in activity levels in HRVMF band should be mirrored by an increase in self-reported measures of mental effort.

Previous research has revealed mixed results in terms of being able to confidently explain what causes performance to fail under pressure. To date, there are no studies that the researcher is aware of that make a direct comparison between a single process goal which is part process, holistic process or external in nature, in acquisition conditions as well as high test anxiety conditions. A lack of research investigating these variables resulted in the design of the current study. The purpose of the current study was to examine the predictions of the CPH using part process, holistic process, an externally referenced goal and a control condition to allow further investigation of the process goal paradox. It was hypothesised that all participants would improve their performance as a function of practice; however, it was predicted that holistic process and external goals would encourage accelerated learning in the acquisition phase due to the promotion of more automatic movements. In the high anxiety test condition, it was predicted that participants

using a part process goal would experience performance decrements, while those using a holistic process goal and an external goal would maintain or even improve on the performance scores registered in the acquisition phase. In terms of mental effort, conscious processing and shifts from automatic to controlled processing should be associated with reductions in activity in the HRVMF band and increases in self-reported mental effort. Specifically, in the competition condition an increase in effort was expected to be more prominent in the part process goal group in comparison to the holistic process, external goal group and the control group.

Method

Participants

Thirty-two male undergraduate students between 18 and 26 years of age (M = 19.68, SD = 1.82) from a British University were recruited for the study. All participants were novices at the driving simulated task and did not participate in driving computer games. At the time of the study all participants had a full UK driving license for at least one year (M = 2.21 years, SD = 0.93). Informed consent was gained before commencing the study (Appendix A). Ethical clearance was obtained from the departmental ethics committee. Participants were instructed to refrain from consuming caffeine up to three hours prior to participating in the research experiment and were also asked to abstain from practicing the task.

Apparatus

Participants completed the driving simulation game, Gran Turismo™ (Sony Computer Entertainment America; Foster City, CA) presented on a 32” television screen. Participants controlled the driving simulator using a steering wheel, brake and accelerator pedals in order to make the simulation game as realistic as possible. Participants manoeuvred the car around the “High Speed Ring” track in a Mazda MX5 with automatic gear changes. Participants viewed the car and track from a driver’s perspective, making the participants feel like they were inside the car. Participants drove in the time trial mode to avoid any confounding effects of other cars that were racing on the track. Heart rate data were

collected using Ag/ACl pre-gelled electrodes that were attached to three sites on the participant's chest: the sternum, the lower right rib cage and the lower left rib cage (V5/V6). Interbeat intervals were determined using a dedicated R-peak trigger which detected the QRS complex in the electrocardiogram. The data recorder was positioned so that it did not interfere with the participants driving movements.

Design

Participants were tested on three consecutive days. The first two days comprised the acquisition phase of the study during which participants were required to complete four blocks of four laps on each day. The third and final day consisted of two test blocks completed in a competition scenario which was specifically designed to increase competitive state anxiety. In total each participant completed eight acquisition blocks of four laps of the track across day one and day two, and two blocks of four laps on day three in the competition condition.

Measures

Performance

Driving performance was assessed using lap times as recorded by the driving simulation game. The participants were deliberately not informed that lap times were being recorded as it was anticipated that this might have distracted them from focusing on their prescribed goals. Performance was also measured using the number of driving errors made. An error was made if, (1) the two wheels closest to the grass verge came off the track, (2) if the entire car came off the track, (3) the car bumped or scraped the wall causing the fluidity of the driving to be hindered or (4) the car hit the wall or the grass verge and this caused the car to spin or change direction.

Heart rate variability

Heart rate (HR) data was recorded throughout each block of laps in both the acquisition and competition conditions. Both data collection and sampling epochs were controlled using the same computer clock. To standardise the epoch over which spectral analyses were conducted, the middle three minutes of each driving block were used. The length of time taken to complete each block ranged from 4.49 to 6.00 minutes. Artefacts were corrected in accordance with guidelines produced by Mulder (1992). The interbeat interval was corrected if it was greater than twice the expected interval or shorter than 300 ms. Prolonged interbeat intervals were corrected by interpolating between two preceding and two succeeding intervals, with the sum of the new interbeat interval value equal to that of the missing segment. Short interbeat intervals were removed from the data set. The CARSPAN programme (Mulder, Van Roon, & Schweizer, 1995) was used for spectral analysis of the cardiac signal and spectral profiles were obtained by moving a 30-second time window through the heart rate series in 30-second steps. The main advantage of using spectral profiling is that it overcomes the problem of signal stationarity (Berntson et al., 1997). Changes in HR and mean spectral power from baseline to task were computed for the HRVMF band and the HRVHF band, by subtracting baseline values from the values obtained in the experimental conditions. The resulting difference scores were used as dependent variables in subsequent analyses. Dependent variables used in the main analyses were, mean spectral power in the HRVMF band (0.07 – 0.14 Hz) and mean spectral power in the HRVHF band (0.15 – 0.4 Hz). Spectral measures are expressed in relative terms equivalent to the squared coefficients of variation for the measurement period (squared modulation index, mMI^2). Data were not collected for the low frequency band given the problems associated with non-stationarity (Bernston et al., 1997).

Competitive state anxiety

State anxiety was measured using the Competitive State Anxiety Inventory-2 (CSAI-2; Martens, Burton, Vealey, Bump & Smith, 1990). The CSAI-2 is a sport specific, self report

inventory that has been shown to be both reliable and valid in its measurement of cognitive and somatic anxiety and self-confidence. The original CSAI-2 was preferred to the Competitive State Anxiety Inventory-2 Revised (CSAI-2r; Cox, Martens & Russell, 2003) and was used so that comparisons could be made with scores collected from previous research in the area (cf., Hardy, Mullen & Jones, 1996; Mullen & Hardy 2000; Mullen, Hardy & Tattersall, 2005). Alpha reliability coefficients range from 0.79 – 0.9 (Martens et al., 1990). For the purpose of the study, the instructions at the start of the CSAI-2 and some of the items on the scale were adapted to be driving specific in order to make them more relevant to the task and also to assist the participants in answering the statements as accurately as possible. For instance, "I am concerned about performing poorly" was altered to read "I am concerned about driving poorly". Participants rated their anxiety symptoms on a likert scale ranging from 1 (*not at all*) to 4 (*very much so*) for each of the 27 items. Only the cognitive anxiety subscale was used for analysis in this study. A general copy of the CSAI-2 used is provided in Appendix B.

Effort

Mental effort was assessed using the RSME (Zijlstra, 1993). This retrospective self report measure requires participants to rate on a scale of 0 (*not at all effortful*) through 115 (*tremendously effortful*) to 150 (*no anchor*), how much mental effort they perceived to put into the task at the end of each testing day. A copy is provided in Appendix C.

Manipulation check

A single question was used as a manipulation check. Participants were asked whether they managed to sustain their focus on their assigned process goal, requiring a simple yes/no response.

Experimental conditions

Participants were randomly assigned to one of four process goal conditions. All participants received written instructions informing them of the process goal which they were required to make use of for the duration of the task. The process goals provided the

participants with cues to use while negotiating the corners of the track. In total there were 12 corners per lap of the track, totalling 48 corners per block of practice. Participants were instructed to complete the laps of the track as quickly and as accurately as possible. The process goals for all groups were designed with the assistance of two BASES accredited sport and exercise psychologists in line with literature based on formula one driving (Senna & Howell, 1993).

External goal group. Participants completed laps of the track whilst focusing on a single external goal. They were asked to focus on the correct driving procedure when on corners. This movement is technically considered the fastest way to drive a car around a bend (Senna & Howell, 1993).

Holistic process goal group. Participants were asked to complete laps of the track using a single holistic process goal. The goal was designed to encapsulate the steering movement as one whole movement and was communicated to the participants as, "smooth on corners" (Senna & Howell, 1993).

Part process goal group. Participants completed laps of the track whilst focusing on a single part process goal. The goal required the participants to focus on "small hand movements" on the wheel, which is considered to be effective for manoeuvring the car around the corners of the track (Senna & Howell, 1993).

Control group. This group received no specific instructions and were asked to complete the laps of the track as quickly and accurately as possible.

Procedure

Participants attended the research laboratory individually and were told that the researcher was interested in the effects of attention on a driving simulation task.

Day one

On arrival, the participants were fitted with the ECG electrodes and were informed that they would initially have some time to familiarise themselves with the equipment. They were then asked to complete a number of warm up trials as a familiarisation session which

consisted of a driving sequence, repeated five times around the "High Speed Ring" track. Following this familiarisation session, participants were presented with an instructional set informing them of their process goal, which they were instructed to utilise for the duration of the study. Participants then completed two warm up laps of the track. The driving simulation task was completed whilst participants used their assigned process goal, of which they were reminded to focus on this before each acquisition block. Measures of performance, in the form of lap times and errors made, were recorded by the researcher on a score sheet but were not disclosed to the participants. On completion of the second acquisition block, participants received a three minute break. When four acquisition blocks were completed, participants completed the RSME (Zijlstra, 1993) and the manipulation check.

Day two

Participants were fitted with the ECG electrodes and were required to sit quietly for three minutes to allow heart rate to stabilise before six minutes of resting heart rate were recorded. The middle three minutes of the resting baseline were used for subsequent spectral analysis. Resting heart rate was measured at this stage in the experiment as it was believed that it would be the most reliable measure of baseline heart rate, as participants had already completed one day of testing and were therefore more likely to be relaxed in the laboratory environment. Participants repeated the procedure from day one but did not complete the familiarisation session and on completion of the second acquisition block in the three minute break, participants were required to complete the CSAI-2 (Martens et al., 1990). The CSAI-2 was administered at this stage to measure competitive state anxiety levels in a non-threatening condition.

Day three (anxiety intervention)

On the third day participants received instructions informing them that they were involved in a competition and that they had been assigned to teams according to the type of process goal they had been using throughout the driving simulation task. Participants were told that

the winning team would be the team who produced the fastest average lap time and each member would win £10. Individual target times were assigned to each participant giving them a "false" time that they were told they had to achieve in order for their team to have a chance at winning the task. The individual target times were calculated by taking the individual's fastest lap time from the previous two days and subtracting 1.5 seconds from it, making it a challenging, but not totally impossible time to achieve. In doing so, the individual was made to believe that the target time was of both personal and team importance thus making it an ego-threatening situation which was likely to increase cognitive state anxiety levels. Following two warm up laps participants completed the CSAI-2 and proceeded to complete two blocks of driving. Following the session, the participants were thanked for their participation and debriefed about the true objectives of the experiment. A copy of the debriefing sheet is provided in Appendix D.

Data analysis

For the acquisition phase of the study, performance and cardiac variables were examined using mixed two factor Analysis of Variance (ANOVA; 4 x 8; Group x Block with repeated measures on the second factor). Self-reported effort was also examined using a mixed two factor ANOVA (4 x 2; Group x Day; with repeated measures on the second factor). For the competition condition, all variables were examined using mixed two-factor ANOVA (4 x 2; Group x Anxiety Condition; with repeated measures on second factor). Significant interactions and main effects were followed up using Tukey's tests.

Results

Assumption testing

For all of the results, appropriate assumption testing took place in order to ensure normality, independence and sphericity of the data sets as well as satisfying equality of covariance matrices. Where an assumption was not met, the appropriate correction method was employed.

Acquisition phase

One way between group ANOVA was used to assess differences in ability at the start of the task. The ANOVA showed no significant differences across the groups (F 3, 28) = 2.23, $p > .05$) confirming that the driving ability across the groups was similar, in other words no group was significantly better at the driving task at the start of the task.

Performance

Lap times and driving errors across acquisition and competition blocks are shown in Figures 1 and 2 respectively. For lap times the two way ANOVA revealed no significant interaction but revealed a significant main effect for block (Table 1) confirming that performance significantly improved over the acquisition phase as indicated by a decrease in lap times. The main effect for group approached significance ($p = .06$, $\eta_p^2 = .23$) and this was likely to be attributed to the slower times produced by the part process goal group. For driving errors, the two way ANOVA revealed no significant interaction but similar to the results of the lap times, there was a significant main effect for block indicated that driving errors decreased over the acquisition phase. The results are summarised in the ANOVA summary table (Table 1).

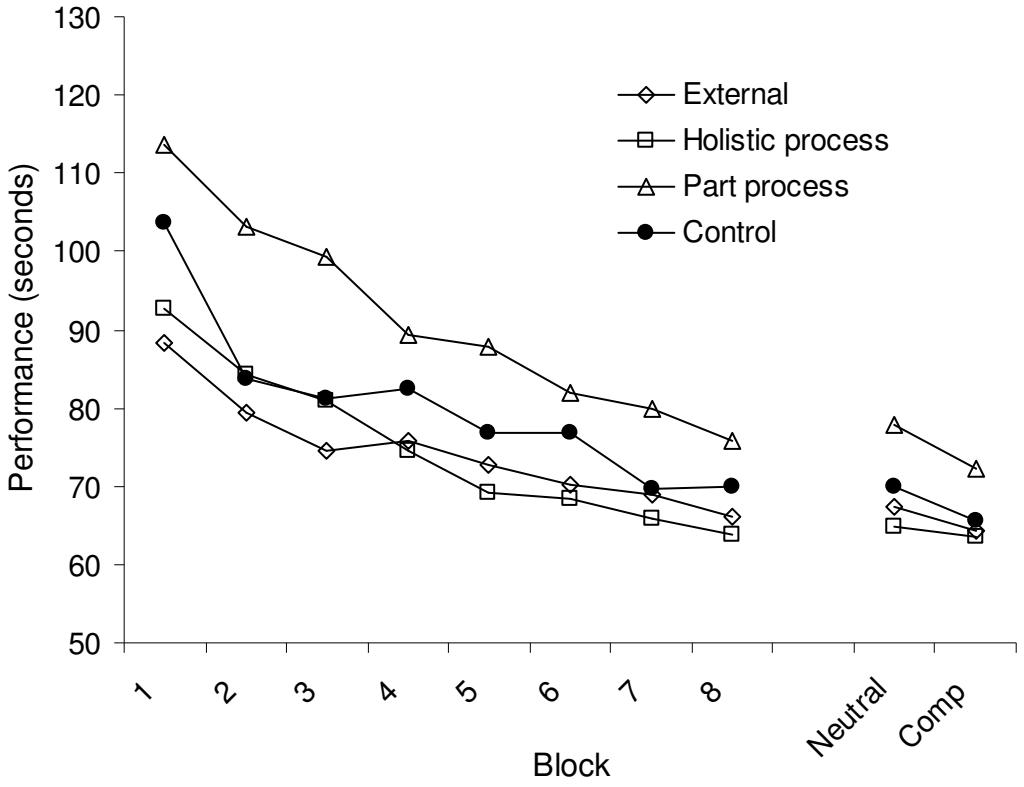

Figure 1. Mean lap time scores (in seconds) for the acquisition and competition per block

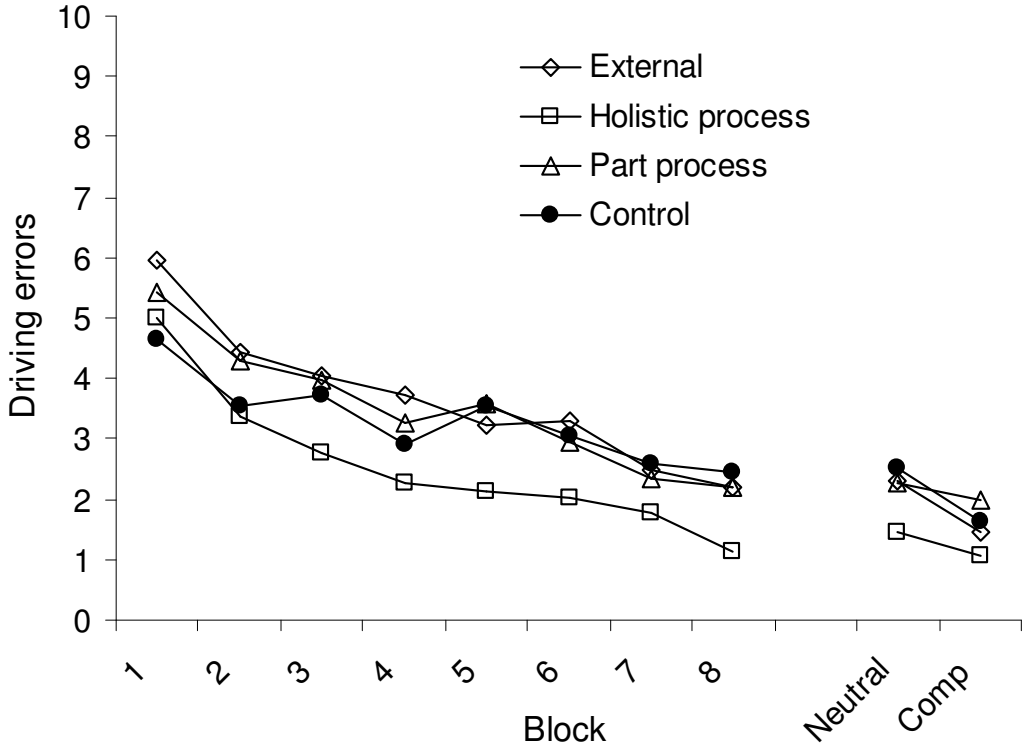

Figure 2. Mean driving error scores per lap for the acquisition and competition blocks

Table 1. ANOVA summaries for acquisition and competition conditions

	Acquisition			Competition			
Variable	*d.f.*	*F*	η_p^2		*d.f.*	*F*	η_p^2
Lap times							
Group	3, 28	2.75	0.23	Group	3, 28	3.52*	0.27
Block	2.82, 78.99+	36.15*	0.56	AC++	1, 28	20.01**	0.42
Group × Block	8.46, 78.99+	1.02	0.10	Group x AC	3, 28	1.28	0.12
Driving errors							
Group	3, 28	0.56	0.06	Group	3, 28	1.09	0.10
Block	2.34, 65.38+	29.77**	0.52	AC	1, 28	0.63	0.02
Group x Block	7.01, 65.38+	0.46	0.05	Group x AC	3, 28	1.66	0.15
HRVMF							
Group	3, 28	2.27	0.20	Group	3, 28	5.40*	0.37
Block	2.82, 79.02+	2.14	0.07	AC	1, 28	4.97*	0.15
Group x Block	8.47, 79.02+	1.39	0.13	Group x AC	3, 28	0.64	0.06
HRVHF							
Group	3, 28	2.06	0.18	Group	3, 28	4.17*	0.31
Block	3.69,103.24+	3.75*	0.12	AC	1, 28	2.52	0.08
Group x Block	11.06,103.24+	1.35	0.13	Group x AC	3, 28	0.49	0.05
Heart rate							
Group	3, 28	5.00*	0.35	Group	3, 28	3.76*	0.29
Block	1.94, 54.33+	6.52*	0.19	AC	1, 28	19.21*	0.41
Group x Block	5.82, 54.33+	2.00	0.18	Group x AC	3, 28	1.30	0.12
Self-reported effort							
Group	3, 28	0.63	0.06	Group	3, 28	0.37	0.04
Day	1, 28	4.48*	0.14	AC	1, 28	18.53*	0.40
Group x Day	3, 28	0.48	0.05	Group x AC	3, 28	1.93	0.17
Cognitive anxiety							
				Group	3, 28	0.31	0.03
				AC	1, 28	29.47**	0.51
				Group x AC	3, 28	0.26	0.03

* = significant at $p < .05$; ** significant at $p < .001$; + corrected for lack of sphericity using Greenhouse-Geisser epsilon; ++AC = Anxiety Condition

Heart rate variability and Heart rate

As indicated in Table 1, there was no significant interaction or main effects found in the acquisition phase for the HRVMF band. In the HRVHF band a significant main effect was found for block. Follow up Tukey's *post hoc* tests revealed that increases in HRV activity occurred between the 4th and 5th acquisition blocks, a decrease in activity was then observed between the 5th and 6th acquisition blocks with a final increase occurring from the 6th to the 8th acquisition blocks. No significant interaction or main effect was found for group. For the HR data, a significant main effect was revealed for block. Tukey's *post hoc* tests revealed the differences to lie between the 5th, 6th and 8th learning blocks with HR levels increasing significantly from baseline during these blocks. A significant main effect for group was also found. Tukey's *post hoc* tests indicated that the part process goal group had significantly larger increases in HR from baseline compared to the external goal group and the control group ($p < .01$). No significant interaction was found. The mean HRV and HR scores over the acquisition phase are presented in Table 2.

Table 2. Mean (*SD*) HRV and HR values for the acquisition blocks

		Acquisition Blocks							
Variable	Group	1	2	3	4	5	6	7	8
HRVMF	External	5141 (3794)	7030 (6595)	4112 (1928)	7759 (10463)	4930 (4386)	2961 (1906)	4009 (2279)	3397 (2556)
	Holistic	10315 (7402)	7898 (5810)	9806 (5661)	11037 (7438)	9247 (8588)	10299 (9250)	6229 (6311)	4726 (2296)
	Part	12080 (8655)	9798 (3231)	8784 (6050)	11297 (7589)	8338 (8892)	10324 (10452)	6086 (3412)	11974 (9795)
	Control	6130 (5437)	3218 (1382)	4873 (1810)	4091 (3553)	8462 (6917)	10504 (9369)	3270 (1538)	6177 (4490)
HRVHF	External	12683 (11394)	13074 (12514)	4195 (2263)	10405 (13165)	9475 (9834)	9062 (9471)	4979 (4901)	9089 (8141)
	Holistic	17251 (11287)	15502 (11552)	12941 (8538)	16140 (10583)	13160 (10235)	15114 (12295)	9760 (11452)	12645 (9976)
	Part	20819 (12431)	26091 (4023)	17260 (11890)	21089 (11186)	15779 (12512)	17129 (12145)	13803 (11468)	17198 (12042)
	Control	11155 (11609)	5976 (3563)	6783 (6652)	10580 (13355)	15877 (12314)	16687 (13038)	6496 (6873)	13006 (11412)
HR	External	6.76 (12.85)	8.89 (12.07)	0.90 (8.13)	5.89 (10.58)	4.83 (6.31)	4.98 (7.47)	0.58 (6.21)	3.90 (6.92)
	Holistic	15.63 (11.18)	13.44 (11.19)	7.13 (12.22)	14.41 (17.37)	13.97 (15.99)	13.82 (16.67)	-1.36 (5.63)	9.51 (12.03)
	Part	28.98 (15.73)	34.34 (22.84)	21.39 (11.47)	26.76 (15.51)	35.11 (39.28)	33.76 (38.28)	9.30 (14.10)	34.94 (39.53)
	Control	-1.33 (4.91)	-3.22 (5.94)	1.66 (6.76)	-0.49 (5.24)	12.88 (16.59)	12.94 (17.17)	2.37 (12.38)	17.28 (23.66)

Self-reported mental effort

No significant interaction was found ($p > .05$) between acquisition of driving skills on day one and day two and no main effect was found for group.

Competition condition

Competitive state anxiety

Cronbach's alpha coefficients indicated adequate internal consistency for the cognitive anxiety subscale of the CSAI-2 (0.76). The significant main effect for anxiety condition confirmed that cognitive anxiety levels increased following the anxiety manipulation for all of the groups ($p < 0.001$). Means (with standard deviations in parentheses) were as follows; external goal group increased from 15.25 (4.23) to 18.25 (5.23); the holistic process goal group, increased from 15 (3.02) to 18 (4.00); the part process goal group increased from 14.13 (3.27) to 18.63 (4.03); and control group increased from 16.13 (4.29) to 19.50 (4.21). No other significant findings were observed (Fs < 1).

Performance

The mean performance scores for the last two acquisition blocks were compared with the mean performance scores of the two blocks completed in the competition condition (Figure 1). The ANOVA revealed a significant main effect for anxiety condition, indicating faster times in the competition condition. A significant main effect for group was also found, indicating that across the low and high anxiety conditions, the holistic process goal group performed better than the part process goal group. No significant interaction or main effects were revealed for driving errors. The ANOVA summaries are presented in Table 1.

Heart rate variability and heart rate

For the HRV data, the ANOVA revealed that in the HRVMF condition, a significant main effect was found for group. Tukey's *post hoc* tests indicated that the part process goal group to have higher HRVMF activity than the external goal group (0.003) and the holistic process goal group (0.04). A significant main effect was also observed for anxiety condition with Tukey's analysis confirming an increase in activity in HRVMF band

following the anxiety intervention as depicted in Table 3. In the HRVHF band a significant main effect was revealed for group with Tukey's tests revealed the part process goal group having a significantly greater amount of activity in the HRVHF band than the external goal group (0.01). There was no interaction or significant main effect for anxiety condition.

For the HR data a significant main effect was found for anxiety condition showing an increase in HR following the anxiety intervention. A significant main effect was also found for group with Tukey's tests revealed the part process goal group to have significantly higher HR than the external goal group (0.03). It is worth mentioning that the significance values between the part process goal group and the other two groups approached significance; holistic process goal group (0.07) and control group (0.06). No significant interaction was found.

Table 3. Mean (SD) HRVMF and HR values for the competition condition

	Low anxiety	High anxiety
Variable		
HRVMF		
External	3767.87 (2174.07)	4626.05 (1860.37)
Holistic process	5554.84 (4155.19)	6596.73 (4089.24)
Part process	9093.79 (6075.92)	13297.84 (7709.97)
Control	4791.69 (2934.54)	8626.72 (6053.87)
HRVHF		
External	9577.73 (8337.83)	12901.89 (7722.51)
Holistic process	16118.43 (15926.36)	18824.73 (13079.48)
Part process	22457.91 (15708.22)	31515.99 (15000.78)
Control	13064.90 (11355.60)	21797.63 (13788.93)
HR		
External	2.24 (6.24)	18.43 (22.92)
Holistic process	4.07 (8.50)	21.73 (19.95)
Part process	22.12 (25.63)	46.69 (30.28)
Control	9.83 (16.11)	14.60 (12.67)

Self-reported mental effort

A significant main effect was found for anxiety condition indicating that levels of mental effort increased in the competition condition (Table 4)**.** No significant interaction or main effect for group was found.

Table 4. Mean (SD) self reported mental effort scores in the competition condition

	Condition	
Group	Low anxiety	High anxiety
External	95.88 (13.64)	112.87 (5.62)
Holistic process	105.00 (18.32)	113.50 (16.33)
Part process	104.25 (12.77)	118.75 (16.42)
Control	100.00 (36.45)	101.87 (41.57)

Manipulation check

On each of the three days, participants were asked to report whether they managed to maintain their focus of attention on the process goal cues they were assigned to. A small minority of the participants (6%) reported that their attention drifted slightly and they were unable to totally focus all the time on where they instructed. The analysis was run with the problematic participants removed. Doing so did not impact on the results and therefore the full data set is reported here.

Discussion

The aim of the current study was to examine the process goal paradox and the CPH (Masters, 1992), by assessing the effectiveness of different attentional focus instructions, in the form of process goals, on the acquisition of a simulated driving task and performance across low and high anxiety test conditions (competition condition). It was hypothesised that all participants would improve their performance as a function of practice; however, it

was predicted that holistic process and external goals would encourage accelerated learning in the acquisition phase due to the promotion of more automatic movements. In the high anxiety test condition, it was predicted that participants using a part process goal would experience performance decrements, while those using a holistic process goal and an external goal would maintain or even improve on the performance scores registered in the acquisition phase. In terms of mental effort, conscious processing and shifts from automatic to controlled processing should be associated with reductions in activity in the HRVMF band and increases in self-reported mental effort. Specifically, in the competition condition an increase in effort was expected to be more prominent in the part process goal group in comparison to the holistic process, external goal group and the control group.

Starting with the acquisition phase, the findings did not fully support the predictions that accelerated learning would occur exclusively for the external goal group and the holistic process goal group, although the main effect for group did approach significance (p = 0.06). Further examination of the group means indicated that the instructions provided to the external and holistic process goal groups appeared to be slightly more effective, for acquisition in comparison to the part process goal instructions and the instructions provided to the control group. Although the researcher was aware that there was not a significant main effect for group, it is worth drawing some parallels with these findings to that previously uncovered by Wulf and colleagues (Wulf, 2007) who have revealed support for the use of an external focus of attention for successful skill acquisition in novice performers. Wulf, Lauterbach and Toole (1999) investigated the use of either an internal or an external attentional focus in individuals learning a golf-chipping task, with the results revealing that participants who focused their attention on the club (external) performed better than those who took an internal focus of attention (focusing on arms in the swing). Similarly Singer, Lidor and Cauraugh (1993) stated that learning a skill or conducting a movement using an external focus of attention lowered the chances of performance becoming disrupted. In addition to supporting the notions of Wulf and

colleagues, given that an externally reference goal was found to be beneficial in guiding performance, the current study suggests that holistic process goals may also be effective at encouraging learning and assisting performance. A note of caution however is needed with regards to the current study's findings. Although the instructions provided to the external goal group and the holistic process goal group appeared to be slightly more effective for performance in the acquisition phase, the use of part process goals did not induce conscious processing or have an adverse effect on performance in the acquisition phase. This supports the literature which suggests that novices make use of explicit information in the early stages of learning (c.f. Liao and Masters, 2002). Turning to the HRV data in the acquisition phase, no significant findings were revealed in the mid frequency band. The high frequency band revealed a main effect for block indicating increases in activity levels between the 4^{th} and 5^{th} blocks, decreases between the 5^{th} and 6^{th} blocks and increases between the 6^{th} and 8^{th} blocks. However overall, no consistent pattern of effects was discernible and additional research using HRV as a measure of mental effort is warranted if its affects are to be better understood.

The focus of the discussion now turns to the findings in the competition condition (across low and high anxiety conditions) and the prediction that participants using a part process goal would experience performance decrements, while those using a holistic process goal and an external goal would maintain or even improve on the performance scores registered in the acquisition phase. The results revealed that all four groups continued to improve their performance suggesting no lapses in conscious processing took place in any of the four groups, so failure to produce performance decrements in all four groups was unexpected. It was particularly surprising to find performance improvements in the part process goal group given that the use of part process goals should, in line with the predictions of the CPH (Masters, 1992), have lead to performance disruption under conditions of high anxiety. The results did indicate a main effect for group, revealing that

the holistic process goal group were more effective than the part process goal group in improving performance across the low and high anxiety conditions. This provides some evidence to suggest that focusing on a global cue word or holistic aspect of performance assists in maintaining, and in this case even improving, general performance. These finding support previous research by Gucciardi and Dimmock (2008) and Jackson and Willson (1999) who found that focusing on a single global cue word or just one or two aspects of performance, helped to maintain performance under high anxiety in golf related tasks. It still remains however, that no performance decrements were observed in the competition condition, making it difficult to identify the effectiveness of holistic process goal in preventing lapses in conscious processing.

A number of explanations could be used to infer why no performance decrements took place in the competition condition. One explanation could be attributed to the continuous nature and lengthy duration of the driving task. The participants took, on average, between 4.49 and 6.00 minutes to complete the each block of driving. This averaged a total of between 35.92 and 48.00 minutes of continuous driving performance with very few natural breaks between each block of driving. This could be considered a lengthy period of time in comparison to other studies such as Mullen and Hardy (2000) and Mullen, Hardy and Tattersall (2005), who both used golf putting tasks. The golf putting tasks would have taken a shorter length of time to complete, on average between 20 and 30 seconds per putt. It may be that conscious processing effects are more evident in more discrete, fine motor skill tasks rather than continuous skills. Given that the study made use of a learning paradigm, it is also possible that the participants may have become disengaged or disinterested in the process goal they were being asked to focus on, and this too may have had an influence on the overall findings, despite the manipulation checks suggesting that all participants remained engaged in using the assigned goals for the duration of the task. Future research could consider using more discrete tasks such as

basketball free throws or netball shooting to help avoid issues with the length of the task in future studies.

From a slightly different perspective, a possible explanation for the results of the current study could reside with the mental effort scores. It was hypothesised that, conscious processing and shifts from automatic to controlled processing should be associated with reductions in activity in the HRVMF band and increases in self-reported mental effort. Specifically, in the competition condition an increase in effort was expected to be more prominent in the part process goal group in comparison to the holistic process, external goal group and the control group. Although the HRV data did not manage to wholly reflect the self reported mental effort scores, the identified increases in mental effort indicated by the participants across low to high anxiety conditions, could go some way to explaining why no performance decrements were detected in the competition condition. Processing efficiency theory (PET; Eysenck & Calvo, 1992) states that high state anxiety encourages participants to invest more effort into a task if the participant perceives themselves to have at least a moderate chance of success. Eysenck and Calvo (1992) predict that increased state anxiety produces a dynamic response from individuals as they strive to maintain task performance at acceptable levels. In order to accomplish this acceptable level of performance, individuals are believed to allocate extra resources to the task and this can be in the form of an increase in effort levels to maintain performance effectiveness. However, an increase in effort in order to maintain performance effectiveness can be at the expense of efficient processing. In the present study, the increased effort may have helped prevent performance impairments in the competition condition, supporting a processing efficiency interpretation of the present data and could explain why performance continued to improve regardless of the reported increase in competitive state anxiety. To explain further, both lap times and driving errors were considered measures of performance. This was purposefully designed to encourage the participants to complete the laps both quickly and accurately and its success was reflected

in that the amount of driving errors decreased as the time taken to complete the laps decreased. It was predicted that decreases in HRVMF activity would be observed in the competition condition, as mental effort increases should have reflected a shift from automatic to controlled processing (Mulder, 1992) but this was not observed for any of the four groups. The HRVMF band did, however reveal a main effect for group indicating that the part process goal group had higher activity levels than both the external and the holistic process goal group. The main effect for anxiety condition revealed that activity levels increased in the HRVMF band following the anxiety intervention, showing that variability increased as a function of elevated anxiety. This should, theoretically be interpreted as a decrease in mental effort; however the decrease in HRVMF activity levels could be attributed to the notion that activity in this frequency band is associated with both sympathetic and parasympathetic activity (Berntson et al., 1997) of the autonomic nervous system. To explain further, the decreases in activity levels in the HRVMF band could have been the result of the interactive effects of both branches of the autonomic nervous system, so it is possible that any predicted reductions in the HRVMF band may have been masked by the impact of physiological responses to increased cognitive anxiety (Mullen, Hardy & Tattersall, 2005), which are sympathetic in nature. In the HRVHF band, the main effect for group revealed that the part process goal group had significantly higher activity levels than the external group. This difference in activity levels could have been attributed to the participant's use of a variety of coping mechanisms across the low and high anxiety conditions. If, as the data suggests, the participants in the part process goal group were better able to cope with the demands of the high anxiety condition then increases in HRVHF activity could be attributed to factors such as changes in respiration frequency (Veltman, 2002) across low to high anxiety conditions. According to Sroufe and Morris (1973) breathing deeper than normal causes increases in HRVHF activity and shallower breathing causes a decrease in HRVHF activity. The increases in HRVHF activity could be attributed to the participants in the current study making use of breathing based relaxation

strategies in order to remain relaxed and in control of their breathing during the competition condition. Engaging in a relaxation strategy would have ultimately lead to an increase in vagal activity resulting in an increase in the activity in the HRVHF. This is likely given that the participants were under pressure to perform and would have wanted to try and remain relaxed in order to perform well.

To try and further explain why the predicted HRV changes were not detected, it is worth considering other factors that can have an influence on HRV data other than just respiration and mental effort. Increases in HRV are said to be linked to and influenced by increases in HR. An increase in HR in the competition condition would have been likely to lead to an increase in sympathetic activity and this could have over ruled any possible sympathetic activity effects. For instance, the HR data revealed a significant main effect for anxiety condition, indicating that HR levels increased significantly following the anxiety intervention for all four groups. The data also revealed that HR levels were higher in the part process goal group compared to the external group. It was no coincidence therefore that both the HRVHF activity levels and the HR levels were significantly higher for the part process goal group compared to the external group and approached significance for the other two groups. These findings further support the notion that increases in HR have a direct impact on HRVHF activity as indicated by Bernston et al. (1997) who also indicated that experimental conditions which induce stress or exercise may have an influence on respiration. In support of this Patwardhan, Valluruplli, Evans, Bruce and Knapp (1995) reported that breathing control increases mean heart rate and arterial pressure, thus reducing mid and high frequency R-R interval power moderately. Therefore the changes witnessed in the HRV data in the current study could be attributed to the nature of the breathing patterns of the participants through either more controlled breathing or a breathing based relaxation strategy, which may have been altered in response to the increases in cognitive anxiety levels. One method of controlling for this in future studies could be the measurement of respiration using a respiration belt which has

been used in previous research studies such as that by Veltman (2002). The influences of HR, respiration and stress all go some way to explaining the increases in activity in the HRVHF band given the influential nature of HR on HRV activity, and to suggest why the use of a part process goals appears to produce a different activation state than that created when using either a holistic process or an external goal.

Some additional and alternative reasons why the self-reported mental effort and HRV findings did not mirror each other could be attributed to measurement issues with the experimental design. For instance, self-reported effort was only recorded by the participants on completion of day one and day two. The values reported may have actually been more reflective of the overall mental workload expended by the participants over each full day of testing, rather than per block of driving. In contrast, HRV and HR scores were recorded for each block. The rationale for only measuring mental effort at the end of each day was due to the concern that the participants would not reflect fully and accurately on the amount of mental effort they assigned to each block of driving, so by only measuring mental effort once per day, it was predicted this would give a more accurate account of how much mental effort the participants felt they had used. In hindsight, the mental effort scores could have been measured more frequently in order to be more accurately matched to the HRV and HR data and to give a more precise indication of effort expended per block of driving. An additional factor to consider in light of the amount of effort assigned to the task is the structure of the anxiety intervention. In the competition condition, the anxiety intervention successfully increased cognitive anxiety levels but the inclusion of financial incentive may have actually served as a motivation to perform. Eysenck (1985) suggests that financial incentives can increase motivation without generating an anxiety response. It could have been that greater levels of anxiety could have been evoked by relying upon competition and individual performance targets as the sole components the anxiety intervention. It is also important to acknowledge that the levels of cognitive anxiety represented in the study are likely to be lower than the anxiety levels one

would expect in a real life high pressured situation. However, the method used in the current study which combined both competition, financial incentive, and individual performance targets are in line with the methods used by previous researchers to attain similar responses (Mullen & Hardy, 2000; Beilock & Carr, 2001; Jackson, Ashford, & Norsworthy, 2006).

In terms of explicit knowledge generation, the current study failed to measure the amount of explicit knowledge acquired by participants following the acquisition of driving performance. Previous studies have used verbal protocols (Hardy, Mullen, & Jones, 1996; Masters, 1992) or generic and episodic protocols (Beilock & Carr, 2001) to establish the extent of explicit knowledge acquired by participants in practice conditions. The present study may have benefited from the inclusion of this type of measure and could be considered for future studies. As a final consideration, had the sample size been larger, it is possible that the main effect for group that approached significance in the acquisition phase may actually have been significant.

In conclusion, the current study suggests that the use of holistic process goals and external goals may be more beneficial for the acquisition of simulated driving performance when compared to the use of part process goals and a control group. When considering conditions of high anxiety, it was surprising to find that the use of part process goals was not debilitating to performance despite the predictions of the CPH (Masters, 1992) and revealed that a holistic process goal appeared to significantly assist performance across low and high anxiety conditions. Additionally, the results suggest that the use of part process goals are beneficial in maintaining and even improving performance in acquisition phases and across low and high conditions of anxiety however, the use of part process and holistic process goals should be further explored. Increases in self-reported mental effort had a positive effect on performance, suggesting that shifting effort levels assigned to the task can have a positive influence on performance. There remain many unexplored avenues that are worthy of investigation with the context of process goals and could include the

investigation of more discrete tasks, as well as more thorough investigation of the impact of attentional focus goals in expert performers, as it is expected that different goals would have varying effects on performance depending on ability level and also in light of a limitation of the current study, the practice time allocated to the driving task may not have been sufficient in order to ensure a degree of driving expertise.

Finally, due to the equivocal current research findings, it would be irresponsible to recommend any advice to coaches or athletes' regarding which type of goal is most beneficial for performance. More research evidence would be needed in the area of process goals as currently the research is limited and more "real world" examples are required if more is to be understood about the various uses of part and holistic process goals and their potential influence on performance. Future research should also consider more seriously the notion that the CPH (Masters, 1992) and PET (Eysenck & Calvo, 1992) may not work in isolation or opposition with one another, but that there is a possibility that the two might interact and work in tandem with each other. This notion has been suggested previously by Hardy (1999; 2007) and Graydon (2002) and given the results of the current study, could be considered an alternative, potentially interactive explanation for performance decrements in conditions of high anxiety.

CHAPTER 4

A NOVICE VERSUS EXPERT INVESTIGATION OF THE PROCESS GOAL PARADOX

(STUDY 2)

Abstract

This study examined the process goal paradox by assessing a part process, holistic process and an external focus goal in basketball free throw performance in novice and expert performers. Forty-eight males (24 novices, 24 experts) aged 18-29 years (mean ±s: 21.5 ± 3.04) from a British University executed basketball free throws in low and high anxiety conditions. Within each level of expertise, participants were randomly assigned a process goal group. Self reports and heart rate variability were used to measured mental effort. The results were supportive of study one, suggesting that the use of any type of goal and increases in mental effort assisted in preventing performance decrements under conditions of high cognitive state anxiety.

Introduction

The purpose of the current study was to examine the predictions of the conscious processing hypothesis (CPH; Masters, 1992) using part process, holistic process and external goals to allow further examination of the apparent process goal paradox. The current study aimed to extend the findings of study 1 by comparing novice and expert performers in conditions of low and high anxiety. To recap, the aim of study 1 was to examine the process goal paradox and the CPH by assessing the effectiveness of different attentional focus instructions in the form of process goals on: 1) the acquisition of simulated driving performance and 2) driving performance in neutral and competition conditions. In the acquisition phase, practice using part process goals appeared to be the least effective strategy and a significant main effect was found for block, indicating that performance improved over the eight acquisition blocks. Additionally the heart rate (HR) data revealed a significant main effect for group with the part process goal group having higher activity levels in comparison to the external group. Across the neutral and competition conditions, cognitive anxiety and self-reported mental effort increased and driving performance (lap times and errors) improved significantly, revealing no performance decrements. Additionally, evidence was found for the use of goals to assist performance in competition conditions. Heart rate variability (HRV) in both the mid (HRVMF) and high (HRVHF) frequency bands indicated that using part process goals produced a different activation state compared to the other conditions and the HR data

revealed a significant main effect for anxiety condition with increases in heart rate across the low and high anxiety condition and a significant main effect for group indicating that the part process goal group had higher heart rates than the external group. The findings of study 1 provided overall support for the use of holistic process goals in assisting performance, regardless of anxiety condition. Most interestingly, evidence was found to suggest that the use of part process goals may actually be beneficial in preventing performance decrements in competition conditions, which contradicts the CPH but sheds more light on the use of process goals which has not been detailed in previous research.

Much of the research in the area of conscious processing has made use of learning paradigms to investigate the use of explicit knowledge to guide performance (c.f. Masters, 1992; Hardy, Mullen & Jones, 1996; Liao & Masters, 2002; Mullen, Hardy & Oldham, 2007). However, one of the predictions of the CPH relates to the failure of performance under pressure with a specific reference to expert, highly skilled performers as a result of the reinvestment of explicit knowledge. As study 1 made use of novices and in light of the fact that performance decrements failed to be produced under conditions of high anxiety, it was considered necessary to carry out further investigation of the use of process goals. In particular, it was decided that further examination of the use of process goals across different ability levels was required in order to ascertain whether the use of different types of process goals would impact differently on novices and expert performers in low and high anxiety conditions. It was expected that the use of a single part process goal would have more severe debilitating effects on experts under conditions of high anxiety, with holistic process and external goals assisting performance in high anxiety conditions. For novices, it was expected that the use of part process, holistic process and external goals would assist performance under both low and high anxiety conditions; however recent research by Liao and Masters (2002) has suggested that the use of part process goals may also have a detrimental affect on novice performances as well as expert performers. In addition, it was believed that the practice time in study 1 may not have been sufficient

enough to achieve expertise at the driving task so the use of experts was considered for use in study 2.

To further expand on the CPH and process goal paradox and provide a frame for the current study, it is necessary to highlight in more detail some additional research which has investigated proceduralised skills. For instance, Fisk and Schneider (1984) argued that well learned skills do not require constant online attention in the same way as new skills do and therefore novel and well learned skills require differing levels of attention. This argument has been supported by Leavitt (1979) and Smith and Chamberlin (1992) in their studies of ice hockey and soccer players respectively. Once a skill becomes proceduralised, conscious attention to the skill is said to be likely to lead to performance disruption (Baumeister, 1984; Beilock & Carr, 2001; Kimble & Perlmuter, 1970; Langer & Imber, 1979; Lewis & Linder, 1997). More recently, Beilock, Carr, MacMahon and Starkes (2002) investigated the differences in divided attention and skill-focused attention in novice and expert performers in two experiments; a golf putting task and a soccer dribbling task. In the golf putting study, 21 undergraduate students from Michigan State University, with two or more years experience of high school varsity golf experience, or a Professional Golfer's Associations (PGA) handicap less than eight, were required to putt a golf ball as accurately as possible from nine different points located at three different distances away from the target; 1.2 m, 1.4 m and 1.5 m. Participants took part in both a skill-focused condition and a dual-task condition. The skill-focused condition required participants to attend to a particular part of their golf swing and were asked to verbalise the word "stop" when the club head reached its finishing point. The dual-task condition involved the participants putting whilst listening to a series of recorded tones. Participants were required to say the word "tone" out loud when they heard a tone being played. Participants completed 20 practice putts then 20 putts in the skill-focused condition and 20 putts in the dual-task condition, the order of which was counterbalanced for each participant. The golfers were found to perform significantly better in the dual-task

condition compared to the skill-focused condition, in addition to this the performance of the participants in the skill-focused condition was significantly less accurate than the practice condition, but performance in the dual-task condition did not differ from the practice condition. The findings demonstrated that expert golfers do not need to attend to putting performance at all times, and could therefore perform well in the dual-task conditions. Essentially, Beilock, Carr et al. (2002) suggested that conditions that impose step-by-step monitoring and control on complex procedural knowledge that would typically operate automatically, results in impaired performance which is supportive of the notions of the CPH (Masters, 1992). However, the researcher of the current research programme believes that there are a number of criticisms worth considering with this study, including potential cross over effects given the participants took part in both conditions. In addition, it would not be considered "normal" practice for golfers to vocalise at the end of a putt, so more realistic measures should be considered.

In the second experiment by Beilock, Carr et al. (2002), novice and expert performance was compared in a soccer dribbling task. Twenty undergraduate students from McMaster University, half which were novices with less than two years soccer experience and half which were experienced players with eight or more years of playing experience took part in the study. The study required the participants to dribble a soccer ball around a slalom course of six cones, set 1.5 m apart for a total of 10.5 m from start to finish. Prior to each trial, participants were instructed to dribble the ball with either their right foot (dominant) or their left foot (non-dominant). Mirroring the first experiment, participants were required to complete the dribbling task in both a skill-focused condition and a dual-task condition. Performance was measured in terms of time taken to complete the slalom course and participants completed two practice trials with their right foot and two practice trials with their left foot. Subsequently, participants carried out four sets of two trials, alternating the foot and attentional focus (skill-focused or dual-task) used on every trial, resulting in eight trials in total. The results revealed that the novices did not

significantly differ in dribbling time between their right and left feet during the practice condition. The expert participants were significantly quicker with their right foot compared to their left foot in the practice condition, which would be expected given most experts are better with one foot. The results also revealed that the experts were quicker than the novices and, in terms of right foot dribbling, experienced performers were faster than the novices during the dual-task condition. In contrast, the two ability levels were found to perform at a more similar speed in the skill-focused condition. In terms of left foot dribbling, the expert performers were faster than the novices in the dual-task condition and skill-focused conditions and additionally, both novice and experts performed better in the skill-focused condition compared to the dual-task condition. Therefore, regardless of ability level, in left foot dribbling a higher level of performance was found to take place in the skill-focused condition, which was designed to draw attention to the skill execution, compared to the dual task condition, which was designed to distract attention away from skill execution. The results of the soccer study support the notion that proceduralised skills do not require constant online attention, which is supported by many (e.g. Anderson, 1983; Fitts & Posner, 1967; Logan, 1988).

Ford, Hodges and Williams (2005) conducted a study that compared skilled and less-skilled soccer players' ability to dribble through a slalom course after receiving instructions to direct their attention to an internal, skill relevant feature (foot), or an internal skill irrelevant feature (arm). Results revealed that both sets of internal instructions disrupted the performance of the skilled players. For the less-skilled players however, only the irrelevant instructions impaired performance, again providing evidence for the disruption of proceduralised tasks. Such findings provide support for the notions of deautomatisation and highlight the differences between experts and novices.

Research from a slightly different perspective to that of Beilock and colleagues, and that of Ford, Hodges and Williams (2005) is Perkins-Ceccato, Passmore and Lee (2003). Perkins-Ceccato et al. (2003) extended Wulf's internal-external focus research by

examining the influence of internal and external attention instructions on pitching performance in golfers. The golfers were either highly skilled (*M* handicap = 4) or low skilled (*M* handicap = 26). Participants were required to chip a ball as close to a marker from four different locations; 10 m, 15 m, 20 m and 25 m whilst making use of an internal or an external focus of attention. The participants completed 40 shots in one of the two focuses of attention conditions, the order of which was counterbalanced across participants within each group. The internal focus of attention instructions required the participants to focus on the form of their swing and to adjust the force of the swing according to the distance of the shot (in other words more force would be needed for the shots from 25 m compared to the shots from 10 m). In contrast, the external focus of attention instructions required the participants to focus on hitting the ball as close to the target marker as possible. Occlusion goggles were used to prevent the participants from receiving visual feedback on each shot. The results revealed that the external focus of attention instructions were better for performance for the more highly skilled gofers and the internal focus of attention instructions was more beneficial for the lower skilled golfers. The findings support the suggestions of Bernstein (1996) who predicted that the use of an external focus of attention could be more favourable for highly skilled athletes as levels of automatisation are high. Therefore, if experts were being asked to make use of an internal focus of attention, it was suggested that this was likely to result in performance decrement.

Another study that successfully distinguished between low and highly skilled individuals was conducted by Castaneda and Gray (2007), but again came from a slightly different research perspective in that it incorporated the use of both an internal and external focus of attention as well as task-relevant and task-irrelevant cues used to direct attention to the environment. Sixteen male baseball players, eight of which were highly skilled as determined by competitive playing experience (*M* = 13.2 years, *SE* = 0.7 years) for a College Baseball team affiliated with the National Junior College Athletic Association (NJCAA). The eight less skilled players were not involved with or playing in, college

baseball of any level. The participants were divided into two groups that directed attention to skill execution; skill/internal and skill/external and two that directed attention to the environment; environmental/irrelevant and environmental/external. Participants completed a baseball simulation task where they were required to hit a virtual ball in a series of two blocks of 20 practice trials followed by two blocks of 20 trials for each of the four conditions. All participants were presented with auditory tones while they were simultaneously engaging in the batting task. In the skill/internal condition attention was directed to the execution (skill) and to the movement of their body (internal). Participants were asked to judge whether their hands were moving upwards or downwards at the moment when the auditory tone was presented. Participants were also instructed to respond to whether the auditory tones were high frequency or low frequency. In the skill/external group, attention was directed to execution (skill) and to an effect of the batter's bodily movement (external). This was identical to the skill/internal group but the participants were instructed to indicate whether the bat was up or down at the time of the auditory tone. In the environmental/external group, attention was directed away from the execution (environment) and to the effect that the batter's body movement (external). Participants had to make a judgement about the ball leaving their bat and then judge whether the simulated ball travelled to the right or to the left of the probe location shown in the pre-swing event. Batters did not have to comment on the auditory tones in this condition. Finally, in the environmental/irrelevant group, attention was directed away from the skill (environmental) and away from the effect that the batter's body movement (irrelevant). Similar to the skill/internal group, participants in the environmental/irrelevant group were asked to judge whether the tone frequency was high or low. The results of Castaneda and Gray (2007) appeared to be more consistent with the findings of Wulf and colleagues (see chapter 1 for an overview of Wulf's research), as batting performance was significantly better when attention was focused to the flight of the ball leaving the bat (environmental/external) than when it was directed to an auditory tone

(environmental/irrelevant) for both less skilled and highly skilled players. In addition, performance was significantly better when highly skilled participants attended to the movement of the bat (skill/external) compared with the movement of their hands (skill/internal). However, the results also revealed that there was no real difference in performance between the skill/external and skill/internal for less skilled players, supporting the notions of Beilock, Gray and colleagues. To conclude, Castaneda and Gray (2007) recommended that highly skilled players would benefit most from directing their attention to the ball leaving the bat (environmental/external) as this does not appear to interfere with proceduralised knowledge and it allows the link between action and affect to be strengthened. But Castaneda and Gray (2007) also recommend directing attention to any aspect of skill execution (internal or external focus) will result in optimal performance in less skilled players. The results of Castaneda and Gray therefore provide mixed support for the two dominant accounts for the role of attention in skilled and unskilled performance. The results also appear to be partially supportive of Wulf's work for the highly skilled players in terms of support for an internal or external focus of attention and the role that it plays in assisting performance. Whereas, for the less skilled players, the results appear to fit better with Beilock, Gray and colleagues accounts which argue attention to be more directed towards either a skill focused versus environmental focused stimulus.

Despite the findings of Castaneda and Gray (2007), there is evidence to suggest that an internal focus on mechanics may be unproductive for novices. Such research provided a rationale for the inclusion of novice and expert performers in the current research study. One set of researchers who have suggested that an internal focus may be detrimental for novice performers is Liao and Masters (2002). Liao and Masters (2002) investigated novice basketball players and found that novices who focused on the mechanics of the free throw shooting process during practice experienced significant performance decrements in a high anxiety test phase in comparison to those who were instructed to only do their best during practice (discovery learning). Such findings indicate that focusing on the mechanics

of the movement can have detrimental effects on novice performance, which raised the question about how novices should be instructed to approach and learn new tasks.

There are a number of difficulties associated with trying to compare expert and novice performers and the impact that process goals may have on performance. Most of the research conducted to date in the area (e.g., Mullen at al., 2005) has suggested that a task focus is detrimental to performance, but these studies have failed to isolate the effects of conscious processing. Failure to isolate conscious processing effects makes it hard to confidently distinguish exactly what causes performance decrements to take place. To explain, Wulf and colleagues are concerned with the investigation of an internal versus an external focus of attention on performance, and generally support the use of an external focus of attention for both novice and expert performers (see chapter 2 for detail). Perkins-Ceccato, Passmore and Lee (2003) would also support Wulf's general predictions but have found additional support for an internal focus of attention in novice performers and an external focus of attention in expert performers. A contrasting view is that held by Beilock, Carr et al. (2002) who focus more on the impact that the skill-focused and dual-task focused have on performance and generally support the use of explicit monitoring to be disruptive to performance in skilled athletes but conditions that allow automatic performance are shown to assist in maintaining performance. All of these studies put a different emphasis on the use of explicit knowledge and focus of attention but none manage to successful isolate conscious processing effects. Therefore, in order to effectively examine whether conscious processing results in performance decrements in both novices and experts, there is a need to isolate conscious processing effects without invoking distraction or explicit monitoring under conditions of high anxiety.

In addition to investigating the use of different process goals and how these may impact on novice and expert performance, mental effort was investigated as a means of assessing how it may potentially assist performance under conditions of high anxiety. The global use of psychophysiological measures of mental effort within the field of sport

psychology is still in its infancy but study 1 of this thesis examined its use with novice participants. Although study 1 failed to produce the predicted mental effort findings its use in the current study was deemed appropriate and of importance as the role of effort is central to the predictions of processing efficiency theory (PET; Eysenck & Calvo, 1992). Previous studies that have examined mental effort using heart rate variability (HRV) have either used novices who have acquired a skill over a relatively short period of time (study 1) or participants who are already skilled at the task (Mullen et al., 2005). Differences in the mental effort associated with the use of different types of process goal maybe more discernible in an experiment that compares novice and expert performers. The data from study 1 indicated that the novices who used a part process goal appeared to experience high levels of activity in the both the HRV mid frequency (HRVMF) and HRV high frequency (HRVHF) bands. It will be interesting to see whether similar affects are observed in expert performers, as the results of study 1 and Mullen et al. (2005) found no direct support for conscious processing effects and no increases in effort as indicated by the HRVMF data. It is expected that novices performers will have lower HRVMF activity levels than the expert performers due to increases in mental effort associated with the controlled processing used by performers in the early stages of learning (Shifferin & Schierer, 1977). Further lowering of HRVMF activity is expected in the high anxiety condition as additional mental effort is expected to be assigned to the task in order to maintain performance levels and this is expected to be particularly prominent in the experts making use of a part process goal.

In summary, the present study aims to use part process, holistic process and external goals to allow further examination of the process goal paradox using novice and expert performers under conditions of low and high anxiety, in order to further examine the CPH (Masters, 1992). Previous results in this thesis have suggested that the use of part process goals are slightly less effective for performance in comparison to the use of holistic process and external goals across both low and high anxiety conditions; however, no

conscious processing effects were evident. In this study, it was anticipated that the effects of the part process goals will be more pronounced in the expert performer given higher levels of automatic functioning. To conclude, a number of hypotheses have been identified with specific regards to the type of goals utilised. It was hypothesised that in line with Castaneda and Gray (2007), any of the three types of focus may be beneficial for novice performers in low anxiety conditions. Secondly that conscious processing is only predicted to occur in expert performers, so the use of part process goals among the experts is expected to lead to increased conscious processing and subsequent decreases in performance in the high anxiety test condition. In addition, based on the work of Liao and Masters (2002), it is expected that the use of part process goals may prove to be disruptive for the novices in the high anxiety condition, but the effect will be more pronounced for experts. Experts will outperform novices in both the low anxiety condition and the high anxiety condition. Finally, that novices should have lower HRVMF than experts due to the increased effort associated with conscious processing that occurs in the early stage of learning. In the high anxiety condition lapses into conscious processing among the experts is expected to be associated with further reductions in power in HRVMF activity and increases in self reported mental effort scores.

Method

Participants

Forty-eight males between the ages of 18 and 29 years of age (M = 21.5, SD = 3.04) from a British University and local basketball clubs in South Wales were recruited for the purpose of the study. Twenty-four of the participants were expert basketball players (M = 21.63, SD = 3.02) according to the following criteria; University 1st team level, which involves a minimum of county standard with at least two years experience at this level. The remaining twenty-four participants were novice basketball players (M = 21.41, SD = 3.12) and were recruited based on having no competitive basketball playing experience. All participants signed a consent form prior to commencing data collection and were informed that they were free to withdraw from the study at any time. Ethical approval for the study was secured from the departmental ethics committee. Participants were instructed to refrain from consuming caffeine up to three hours prior to participating in the research experiment and were also asked to abstain from practicing basketball free throws for the duration of the study.

Experimental conditions

Within each level of expertise, participants were randomly assigned to one of the three process goal conditions; part process, holistic process or external. All participants were presented with a written list of the process goals specific to their assigned experimental condition and were instructed to select one process goal to focus on for the duration of the task. The process goals for all groups were designed with the assistance of two British Association for Sport and Exercise Science (BASES) accredited sport psychologists in line with literature based on basketball free throw shooting (Wissel, 1994). The list was then approved by the Head University basketball coach.

External goal group. Participants in the external goal group were instructed to select one of the following goals to focus on while performing the basketball free throws; “rim”, “backboard”, “net” or “basket”.

Holistic process goal group. Participants were asked to complete the free throws whilst making use of one of the following holistic process goals; "smooth", "extend", "soft", "push", "up" or "reach". These goals were designed to encapsulate the whole of the free throw shooting movement and once again participants were encouraged to make use of the goal when performing the task.

Part process goal group. Participants completed free throws whilst focusing on one of the following part process goals; "straighten legs", "push fingers up and forward through the ball at release", "snap the wrist just before release", "release the ball at a 60^0 angle" or "move balance hand out of the way". Given the lengthy nature of the part process group's goals, participants in this group were encouraged to shorten their goal to a two word phrase in an attempt to make it easier to use and to ensure that all the groups would have approximately the same amount of information to focus. This allowed for an attentional overload explanation to be controlled for. The goals were shortened to "straighten limbs", "fingers up", "snap wrist", "angle" and "move hand", respectively. All participants were asked to write their selected goal down and focus on it for each free throw.

Apparatus

A standard backboard was used, consisting of the following dimensions; 1.83 m x 1.22 m standing on poles centred between the sidelines, 2.74 m off the ground, the ring of the basket was 46 cm in circumference, positioned 15 cm in front of the backboard and standing 3.05 m above the ground. The distance from the free throw line to the backboard was 4.57 m; however the rim protrudes forward from the backboard so the actual distance from the free throw line to the front of the rim was 3.96 m (not including the elevation factor). Free throw shots were taken from behind the line in the free throw circle, which is considered standard practice for a free throw.

Basketball

A standard "Errea" basketball measuring 76.2 cm in circumference with between 3.4–3.86 kg of pressure was used throughout the experiment.

Measures

Performance scores

Participants' shooting ability was recorded by the researcher. Points were awarded for each free throw in accordance with Hardy and Parfitt's (1991) five point scoring system, which comprised of the following; complete miss = 0 points, hits backboard and misses = 1 point, hits rim and bounces out = 2 points, hits backboard and goes in = 3 points, hits rim and goes in = 4 points or a clean basket = 5 points. Hardy and Parfitt (1991) reported the test-retest reliability of this five-shot test to be $r = 0.54$ across a three day interval ($N = 10$) and this was deemed acceptable for use. Participants were familiarised with the scoring system and were informed that the points system would be used as a measure of performance.

Anxiety

Anxiety was measured using the Competitive State Anxiety Inventory version 2 (CSAI-2; Martens, Burton, Vealey, Bump & Smith, 1990). This is a sport specific, self report inventory consisting of 27 items that assesses cognitive anxiety, somatic anxiety and self-confidence on a scale of 1 (*not at all*) to 4 (*very much so*). The CSAI-2 was preferred to the Competitive State Anxiety Inventory version 2 Revised (CSAI-2r; Cox, Martens & Russell, 2003) in order to be consistent with previous research studies into conscious processing. Alpha coefficients ranged from 0.79-0.90 (Martens et al., 1990) which have been deemed acceptable for research purposes. Measures of cognitive anxiety were of primary interest for the present study and, as such, only the cognitive anxiety subscale was used.

Heart Rate Variability

The HRV data was collected using a S810i Polar Heart Rate Monitor (Polar Electro Oy). A transmitter was attached using the chest strap provided and was adjusted in order to fit

neatly around the participant's chest. In doing so, this decreased the chances of interference with the signal which could have lead to a less accurate measure. Interbeat intervals were recorded and downloaded to a Toshiba Satellite Pro laptop and were collected every second using the heart rate monitor throughout the participants' free throw attempts. As was conducted in study 1 of this thesis, in order to standardise the epoch over which spectral analysis were conducted, the middle three minutes of the total time taken to throw twenty free throws was used. The length of time taken to complete twenty free throws ranged from 3.20 minutes to 5.10 minutes. The CARSPAN programme (Mulder, Van Roon & Schweizer, 1995) was used for spectral analysis of the cardiac interval signal and spectral profiles were obtained by moving a 30-second time window through the heart rate series in 30-second steps. The advantage of using spectral profiles is that it overcomes the problem of stationarity (Berntson et al., 1997). The mean spectral power of each of the two frequency bands were used in the main analysis, the mid frequency band (HRVMF; 0.07 – 0.14Hz) and the high frequency band (HRVHF; 0.15 – 0.40Hz). Spectral measures are expressed in relative terms, equivalent to the squared coefficients of variation for the measurement period (squared modulation index, mMI^2). Data was not calculated for the low frequency band given the problems associated with this band (Mulder, 1988).

Self- reported mental effort

Mental effort was measured used the rating scale of mental effort (RSME; Zijlstra, 1993). The RSME is a unidimensional rating scale asking performers to indicate the mental effort they perceive themselves to have invested in the task. The scale ranges from 0 (*not at all effortful*) through 115 (*tremendously effortful*) to 150. Cronbach's alpha values indicate that the reliability of the scale in both laboratory and real life setting is acceptable ($r = 0.88$ in laboratory and $r = 0.78$ in work settings; Zijlstra, 1993). Participants were required to complete the RSME at the end of each set of free throws in order to get a psychological measure of perceived mental effort in both the low anxiety condition and the high anxiety test condition.

Manipulation checks

Generic and Episodic memory protocols

Beilock and Carr (2001) devised two memory protocols used to assess levels of explicit knowledge about a task prior to and following task completion. Generic knowledge is the prescriptive information about how a task is typically carried out, whereas episodic knowledge captures a specific memory or task. Generic knowledge should, typically increase with expertise, with experts having more explicitly available general knowledge about the task they are completing than their novice counterparts (Beilock & Carr, 2001). Declaratively accessible episodic memories should decrease with expertise as performances become automated and proceduralised movements are believed to required little attention (Beilock & Carr, 2001). The generic memory protocol was used before the task commenced in order to identify the amount of explicit knowledge participants had about free throw shooting. The episodic memory protocol was completed at the end of the free throws on day one and at the end of the high anxiety test condition. A copy of the generic and episodic manipulation checks is provided in Appendix E.

Manipulation check

A manipulation check was devised in order to assess whether participants managed to maintain their focus on their assigned process goal for the duration of the task. This was simply a single question that stated, "Did you focus your attention on the goals you were assigned to throughout the task?" and a yes/no response was required. No participants reported any difficult in maintaining their focus on their assigned process goal.

Anxiety Manipulation

Both novices and experts received the same anxiety intervention although it was expected that it would be more difficult to make the expert basketball players anxious in comparison to the novices. To compensate for this, some additional methods were needed in order to ensure increases in anxiety in the experts. Both novices and experts were informed that on

the second day they would be taking part in a competition against their peers in order to win money, both for themselves as an individual but also for their team. Teams were allocated within process goal groupings and participants were informed that their individual scores would contribute to their team's overall score, with the team that scored the highest winning a team prize. Within each level of expertise there were eight participants in each team. Individuals also had the opportunity to win money and participants were informed that whoever had the highest individual score would win £25, £15 or £10, for 1st, 2nd and 3rd place respectively within their levels of expertise. In addition to using these methods to increase anxiety levels, the experts were told that their coach had highlighted a score that he felt the participant should be able to achieve and that this was then matched against a fellow expert's performance.

Procedure

Day one

Participants attended the gym individually and on arrival were presented with the generic memory protocol (Beilock & Carr, 2001) assessing the amount of explicit knowledge that they had about the free throw task prior to receiving any information about the study. Participants were then fitted with the heart rate monitor and informed that the aim of the session was to successfully shoot as many of the 20 free throws as possible. Participants were then presented with instructions informing them in more detail of what they had to do and novices were provided with some technical instructions and video footage on how to perform a free throw (Appendix F). Following the presentation of all instructions, participants were presented with a list of their assigned process goals, from which they selected one that they felt they could focus their attention on for the remainder of the task and were instructed to perform the free throws as accurately as possible whilst making use of their selected process goal. The CSAI-2 (Martens et al., 1990) was then administered before participants commenced 10 warm up free throws. Following the warm up the heart rate monitor was activated and participants were reminded to use their chosen process goal.

Participants then completed 20 free throw shots, with a five second break between each throw. On completion of 10 shots, participants received a thirty second break and were reminded of their process goal. The researcher scored each of the free throws according to the Hardy and Parfitt (1991) point system but did not feedback any of this information to the participants. On completion of the final ten free throws, participants completed the RSME (Zijlstra, 1993), the episodic memory protocol (Beilock & Carr, 2001) and the focus of attention manipulation check.

Day two

The procedure was the same as day one except that on arrival at the gym, baseline measures of resting HR were taken, which required participants to sit quietly for three minutes to stabilise heart rate. Five minutes of resting HR were then recorded. As in study 1, resting HR was taken at the beginning of day two as it was believed that participants would be more relaxed at this point in the study, compared to day one, as they would be more familiar with the testing conditions. On completion of the warm up, participants received the competition instructions designed to elevate their levels of anxiety. Once the participants had read and understood the competition instructions they were required to complete the CSAI-2. The competition condition then began and, on completion of the 20 free throws, participants completed the RSME, the manipulation check and the episodic memory protocol. Participants were then debriefed about the true nature of the study, given a contact email for the researcher, provided with the opportunity to ask questions about the study and thanked for their time.

Data analysis

A series of mixed three factor Analyses of Variance (ANOVA; 3 x 2 x 2; Group x Level x Anxiety Condition, with repeated measures on the third factor) were used to analyse the data. Significant two way interactions and main effects were followed up with Tukey's *post hoc* tests. The episodic manipulation checks were examined using a mixed three factor ANOVA (3 x 2 x 2; Group x Level x Anxiety Condition, with repeated measures on

the third factor for the episodic manipulation checks and a two factor ANOVA (3 x 2; Group x Level) was used to examine the generic manipulation check.

Results

Assumption testing

For all of the results, appropriate assumption testing took place in order to ensure normality, independence and sphericity of the data sets as well as satisfying equality of covariance matrices. Where an assumption was not met, the appropriate correction method was employed.

Cognitive anxiety

The three way ANOVA revealed no significant three way or two way interactions but did reveal a main effect for anxiety condition, indicating that anxiety levels were higher on the second day (high anxiety condition) in comparison to the first day (low anxiety condition). No other significant main effects were found. Table 1 presents the three way ANOVA summary findings for cognitive anxiety. Table 2 summarises the mean and standard deviations for cognitive anxiety scores for each of the three groups across the low and high anxiety conditions.

Table 1. ANOVA summaries for cognitive anxiety

Variable	*d.f.*	*F*	η_p^2
Cognitive anxiety			
Group	2,42	2.06	0.12
Level	1,42	0.02	0.00
Anxiety Condition	1,42	37.25*	0.47
Level x Group	2,42	0.84	0.04
Anxiety Condition x Level	1,42	0.15	0.00
Anxiety Condition x Group	2,42	0.29	0.01
Anxiety Condition x Level x Group	2,42	0.97	0.39

* significant at $p < .05$

Table 2. Mean (*SD*) cognitive anxiety scores for experts and novices in low and high anxiety conditions

	Experts		Novices	
Group	Low anxiety	High anxiety	Low anxiety	High anxiety
External	12.25 (3.41)	18.88 (5.33)	13.13 (3.27)	16.13 (4.49)
Holistic process	15.00 (6.19)	20.88 (6.24)	17.25 (4.17)	23.00 (7.23)
Part process	16.38 (5.28)	19.75 (6.67)	13.63 (3.11)	18.88 (6.62)

Performance

A three way ANOVA examining performance scores in low anxiety and the high anxiety conditions, revealed no significant three or two way interactions. A significant main effect for level revealed that the experts outperformed the novices. No other significant main effects were found. Table 3 shows a summary of the ANOVA results. Table 4 shows the descriptive statistics for the performance variables for each of the three process goal groups in low and high anxiety conditions.

Table 3. ANOVA summaries for performance

Variable	*d.f.*	*F*	η_p^2
Performance			
Group	2,42	1.05	0.05
Level	1,42	186.00*	0.82
Anxiety Condition	1,42	0.18	0.00
Level x Group	2,42	1.04	0.05
Anxiety Condition x Level	1,42	0.41	0.01
Anxiety Condition x Group	2,42	2.24	0.00
Anxiety Condition x Level x Group	2,42	0.21	0.01

* significant at $p < .05$

Table 4. Mean (*SD*) performance scores for experts and novices for low and high anxiety conditions

	Experts		Novices	
Group	Low anxiety	High anxiety	Low anxiety	High anxiety
External	73.00 (8.98)	70.50 (7.48)	42.75 (5.37)	44.13 (9.88)
Holistic process	77.38 (6.95)	75.38 (8.65)	46.75 (8.65)	44.25 (8.21)
Part process	70.50 (9.58)	74.13 (8.69)	45.75 (5.80)	51.25 (11.54)

Generic and episodic manipulation checks

For the generic scores, a two way ANOVA revealed a significant difference between the two ability levels on the amount of generic knowledge they had about the task prior to being given any information on the task. The experts had more generic knowledge

than novices at the start of the task. There was no significant interaction or main effect for group. For the episodic manipulation check, a three way ANOVA revealed no significant three way interaction or two way interactions and no significant main effects. Table 5 summarises the ANOVA findings for the generic and episodic manipulation checks.

Table 5. ANOVA summaries for generic and episodic manipulation checks

Variable	*d.f.*	*F*	η_p^2
Generic			
Group	2,42	0.66	0.03
Level	1,42	26.81**	0.39
Level x Group	2,42	0.78	0.04
Episodic			
Group	2,42	0.36	0.02
Level	1,42	0.21	0.01
Anxiety Condition	1,42	0.53	0.01
Level x Group	2,42	0.12	0.01
Anxiety Condition x Level	1,42	0.82	0.02
Anxiety Condition x Group	2,42	0.43	0.02
Anxiety Condition x Level x Group	2,42	0.82	0.04

* = significant at $p < .05$; ** significant at $p < .001$

Self-reported mental effort

The three way ANOVA for self-reported mental effort revealed no significant three way interaction or two way interactions. There was a significant main effect for anxiety condition indicating that mental effort scores increased from low anxiety to the high anxiety condition. No other significant main effects were revealed for group or level. Table

6 summarises the ANOVA findings for self reported mental effort and Table 7 shows the mean self reported mental effort scores in low anxiety and high anxiety conditions.

Table 6. ANOVA summary for self reported mental effort

Variable	*d.f.*	*F*	η_p^2
Self reported mental effort			
Group	2,42	1.55	0.07
Level	1,42	0.003	0.00
Anxiety Condition	1,42	56.97*	0.58
Level x Group	2,42	1.29	0.06
Anxiety Condition x Level	1,42	1.40	0.03
Anxiety Condition x Group	2,42	1.67	0.07
Anxiety Condition x Level x Group	2,42	1.24	0.06

* = significant at $p < .05$

Table 7. Mean (SD) self reported mental effort scores for experts and novices for low and high anxiety conditions

	Experts		Novices	
Group	Low anxiety	High anxiety	Low anxiety	High anxiety
External	60.63 (25.70)	82.50 (16.26)	79.38 (21.29)	88.75 (19.78)
Holistic process	85.00 (17.73)	98.13 (23.90)	83.13 (11.63)	91.25 (17.48)
Part process	79.38 (23.82)	97.50 (16.04)	70.63 (22.12)	91.88 (19.99)

Cardiac variables

HRV

For the HRVMF band, a three way ANOVA revealed no significant three way interaction. A significant two way interaction was found for Level x Group ($p < .05$). Tukey's tests

revealed that the interaction was the result of a significant difference between low and high anxiety conditions in the novice group, between the external and the holistic process goal groups ($p < .05$). This significant difference revealed HRVMF activity to be significantly higher in the external goal group ($M = 704.15$) compared to the holistic process goal group ($M = -1153.03$). Figure 1 shows the significant interaction. No other significant findings were revealed. In the HRVHF band, there was no significant three way interaction, two way interactions or significant main effects found. Table 8 summaries the ANOVA results for self reported effort and the cardiac variables.

Table 8. ANOVA summaries for cardiac variables

Variable	*d.f.*	*F*	η_p^2
HRVMF			
Group	2,42	0.34	0.02
Level	1,42	0.00	0.00
Anxiety Condition	1,42	0.04	0.001
Level x Group	2,42	3.94*	0.16
Anxiety Condition x Level	1,42	0.01	0.00
Anxiety Condition x Group	2,42	0.51	0.02
Anxiety Condition x Level x Group	2,42	0.48	0.02
HRVHF			
Group	2,42	0.50	0.02
Level	1,42	0.01	0.00
Anxiety Condition	1,42	0.28	0.01
Level x Group	2,42	0.51	0.02
Anxiety Condition x Level	1,42	0.30	0.01
Anxiety Condition x Group	2,42	0.27	0.01
Anxiety Condition x Level x Group	2,42	0.10	0.01

* significant at $p < .05$

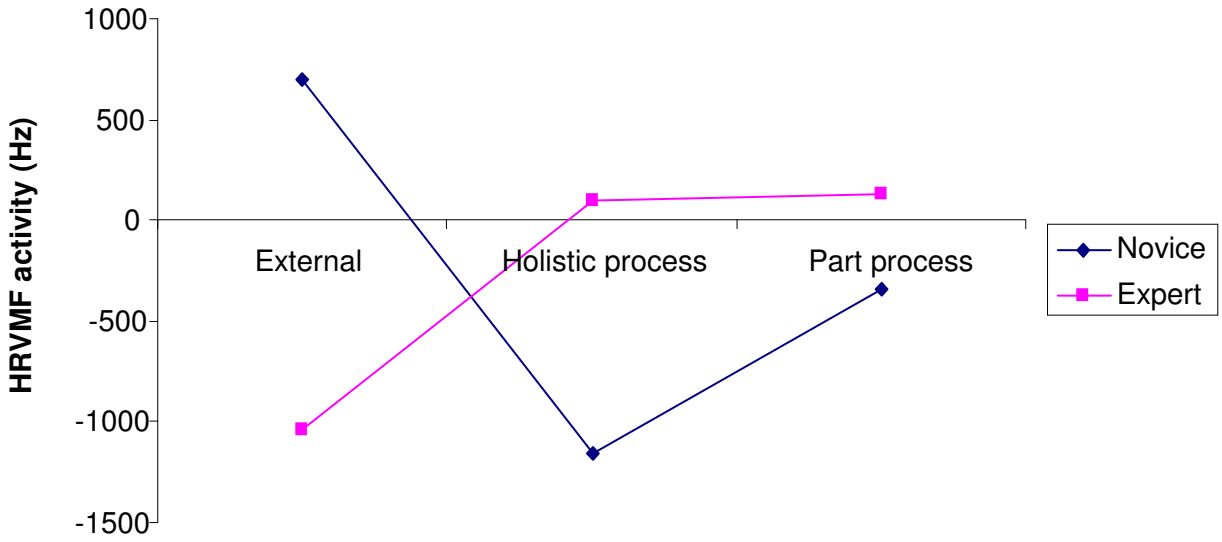

Figure 1. Level x Group interaction for HRVMF spectral power

Discussion

The purpose of the current study was to further examine the process goal paradox and the predictions of the CPH (Masters, 1992) using part process, holistic process and external goals to allow further examination of the process goal paradox in novice and expert performers. Novice and expert basketball players made use of a single part process goal, a single holistic process goal or a single external goal whilst executing free throws in low and high anxiety conditions. Specific hypotheses included that any of the three types of focus may be beneficial for novice performers in low anxiety conditions. Secondly the use of part process goals by the experts was expected to lead to increased conscious processing and subsequent decreases in performance in the high anxiety test condition. The use of part process goals may prove to be disruptive for the novices in the high anxiety condition, but the effect will be more pronounced for experts. Experts will outperform novices in both anxiety conditions. Finally, novices should have lower HRVMF than experts. In the high anxiety condition lapses into conscious processing among the experts was expected to be associated with further reductions in power in HRVMF activity and increases in self reported mental effort scores. As was revealed in study 1, the results from the current study

evidenced no conscious processing effects in any of the groups in the high anxiety condition, despite a successful anxiety intervention, supporting the second hypothesis. Although no significant performance effects were found, closer inspection of the data revealed that this may have been a result of mixed performance scores for the three goal groups across low and high anxiety conditions. To explain, in the high anxiety condition, performance for both novices and experts increased with the use of a part process goal and decreased when using a holistic process goal. To further explain, when using a part process goal, the novices average performance scores increased on day one from an average of 45.75 to 51.25 and for experts, 70.5 to 74.13. In contrast, when novices made use of a holistic process goal, performance scores decreased from, on average, 46.75 to 44.25 and experts scores decreased from 77.38 to 75.38. In contrast, the use of an external goal resulted in a decrease among expert's performance from 73.00 to 70.50 and increase in performance for the novices from 42.75 to 44.13. Although these differences were not significant and the observed power is low, it is believed that the mixed results could have masked any significant findings and therefore it was worth highlighting the differences in goal use among the novices and the experts. Despite an overall lack of performance decrements observed in the high anxiety condition, the results of the current study could go some way to providing support for the use of part process goals in both expert and novice performers, rather than the expected negative impact that part process goals should have on performance according to the predictions of the CPH (Masters, 1992) and in light of previous research such as Baumeister (1984), Langer and Imber (1979) and Liao and Masters (2002).

In the introduction of the current study, the use of a part process goal has already been described as being similar in content, as a skill-focus (Beilock, et al, 2002). The results of the current findings support the use of a part process goal in benefiting performance in novices as was revealed in study 1 of this thesis, but did not support the notion that the use of part process goals use would disrupt the performance of experts in

conditions of high anxiety. So the prediction that the use of a part process goal would lead to performance decrements under conditions of elevated anxiety were not supported for novices or experts, and there was no support for the prediction part process goals would have a more pronounced effect on experts.

Contrary to the second prediction, there was also little evidence to support the prediction that holistic process goals and external goals would be of more benefit to performance under conditions of elevated anxiety in comparison to the use of part process goals, given that the use of all three types of goals helped prevent performance decrements. There were no significant effects on either novices or experts. One of the reasons why performance decrements were not witnessed in the high anxiety condition could have been attributed to the participant's interpretation of the process goals. To further explain, although methods were put in place by the researcher to ensure that the goals designed were explicitly part process, holistic process or external in nature, it is plausible that the participants may have interpreted and used the goals in a manner that was different to what the researcher had intended. Fundamentally, it is believed that if the goals were used in ways other than that originally intended, it is possible that the use of the part process, holistic process or external goals could have served as a positive focus of attention rather than either encouraging or discouraging conscious processing, which they were designed to do. Although a manipulation check was in place which successfully identified that participants did manage to successfully focus their attention on the assigned process goal, there is no way to control what the participants *actually* focused their attention on, or how they interpreted the assigned goals. In addition to this, no control was made over what the participants, particularly the experts, thought about when executing a free throw under "normal" circumstances, away from the experimental conditions, meaning that the effect of the assigned goals may not have been strong enough to disrupt the established pre-performance routines of the experts. Although this explanation is slightly speculative, the current study did managed to successfully isolate the effects of conscious processing and

distraction effects, so a more plausible explanation for a lack of performance decrements under pressure could be linked to mental effort and how it appeared to assist in the maintenance of performance in the high anxiety condition. All participants made use of the same number of goals so, had performance decreases been observed, we could have attributed this to conscious processing effects and not distraction effects. However, given we did not see evidence of performance decreases in the high anxiety test condition so it is necessary to look to other explanations to try and decipher what happened.

One plausible explanation for the lack of performance disruption could be attributed to the increases in self reported mental effort that the participants reported expending in the competition condition, as was found in study 1. This explanation lies within the context of PET (Eysenck & Calvo, 1992). Processing efficiency theory predicts that anxiety has a role to play on performance and can serve as a motivation. If an individual is anxious about a task they are said to be more likely to invest effort, if they believe they have at least a chance of success at the task (Eysenck & Calvo, 1992), so it is possible that the participants may have used effort as a compensatory strategy in order to maintain task performance despite levels of high anxiety. The increases in mental effort were not mirrored in the HRVMF data as was predicted and therefore it is worth discussing the utility of HRV as a measure of mental effort. Use of HRV within sport psychology has been limited (Mullen, Hardy & Tattersall, 2005) and there has been little consistent evidence of effects related to different attentional foci or stress conditions, so it is worth considering some alternative measures of mental effort. Such measures could include the use of electroencephalography (EEG; e.g. Deeny, Hillman, Janelle, & Hatfield, 2003) to detect changes in brain activity with variations in mental effort investment, or indeed the measurement of cortisol levels in participant's saliva. Cortisol levels have been shown to increase as mental effort to a task increases (Veltman, 2002) so would sit well with the type of research being conducted within the field of sport psychology.

It was evident that the participants found the basketball free throw task challenging given the increases in anxiety levels were observed in both the novices and the experts, but this is not necessarily to say that the task was considered taxing on working memory. Tasks that demand little or no working memory are predicted to be unaffected by increases in cognitive anxiety (Eysenck & Calvo, 1992). Failure to observe decrements in performance could have been down to the fact that basketball free throw shooting simply failed to tax working memory to a high enough level in order to be affected by the increases in cognitive anxiety. The degree to which any performance is affected depends on task difficultly and the individual's appraisal of the given situation. Considering this, the free throw task may not have been considered particularly difficult, even for the novices, given that all the performers were sports students and therefore it is plausible that regardless of ability level, the participants were able to continue to perform by investing more effort into the task, as indicated by the perceived mental effort scores, despite the increases in anxiety. The participants may have also been relatively familiar with participating in research experiments and may have appraised the situation and their own personal ability to complete the task, in a more positive manner than less sport-oriented individuals. In order to try and make sense of this issue, post hoc analysis was carried out on the self-confidence scores and revealed that both the novice and the expert participants reported high levels of self-confidence in both low and high anxiety conditions. High self-confidence levels may have had a role to play in the prevention of performance decrements, however self-confidence can only partially account for the lack of performance decrements in the high anxiety, as the only significant main effect found for the self-confidence scores confirmed that the experts were more confident than the novices. As has already been alluded to Eysenck and Calvo (1982) indicate that anxious performers will only invest more effort into a task if they perceive themselves as having at least a moderate chance of succeeding. It therefore appears that in line with PET (Eysenck & Calvo, 1992) increases in effort can compensate for the negative effects of anxiety on

performance and this is a plausible explanation for the current research findings. The third hypothesis predicted that the experts would outperform the novices in both low and high anxiety test conditions. This prediction was satisfied however, there was no significant difference found across the low anxiety condition and the high anxiety test condition when considering process goal effects. In other words, no process goal group performed significantly better or worse than the other.

In conclusion, the current results suggest that the use of any type of goal assists performance for both novices and experts under conditions of high anxiety, providing little support the CPH (Masters, 1992). Performance levels under conditions of high anxiety were unaffected by the type of process goal, regardless of level of expertise. The current research findings are consistent with the results of study 1 of this thesis and add additional support to previous research such as Hardy, Mullen and Jones (1996), Hardy, Mullen and Martin (2001) and Mullen, Hardy and Tattersall (2005), in that no clear evidence of conscious processing was found. Given a lack of support for the CPH, the mechanisms that contribute to performance decrements under conditions of high anxiety are still poorly understood and it is becoming apparent that performance decrements are not explicitly the result part process goals. If conditions of elevated anxiety, combined with the use of part process goals does not induce conscious processing, then future research should aim to address exactly what causes performance to fail when anxiety levels are raised. Considerations could include investigating whether the number of goals focused on in high anxiety conditions impacts significantly on performance as a method of examining whether issues related to attentional overload are a more pragmatic explanation. For instance, it would be expected that the use of a large number of part process goals should induce higher levels of conscious processing under high anxiety than maybe only making use of one part process goal. Additionally, there is a strong need for a more in-depth approach to the investigation of performance decrements beyond the popular quantitative experimental designs. Perhaps a qualitative approach is required in order to provide a richer

understanding into the notion of conscious processing effects under stress in order to encourage athletes, coaches and sport psychologists to increase their understandings of the mechanisms that cause performance decrements under conditions of high anxiety.

CHAPTER 5

AN INVESTIGATION INTO THE NUMBER OF PART PROCESS GOALS AS AN EXPLANATION FOR PERFORMANCE DECREMENTS UNDER CONDITIONS OF HIGH ANXIETY (STUDY 3)

Abstract

Studies one and two supported the use of part process, holistic process and external goals in preventing performance decrements in high anxiety conditions. This study aimed to further investigate the process goal paradox by attempting to establish whether the performance of anxious athletes is impaired by the number of part process goals rather than the part or holistic nature of the goals. Twenty-four tennis players were assigned to one of three part process goal conditions and completed the Avery Richardson Tennis Serve Test (ARTST; Avery, Richardson & Jackson, 1979) consisting of 20 serves in low and high anxiety conditions. Results revealed that the number of part process goals did not have a differing affect on performance in high anxiety conditions.

Introduction

The findings from studies 1 and 2 of this thesis provides evidence to suggest that the use of any type of goal prevents performance disruption for novices and experts, when novices are learning a new skill and across low and high anxiety test conditions for both ability levels. Study 1 offered some evidence in support of the use of a single holistic process and single externally focused goals to be more effective when acquiring skills in the driving simulation task when compared to using a single part process goal. In addition, the use of a single holistic process goal was found to assist the improvement performance more effectively than a single part process goal across low and high anxiety conditions. In study 1 all of the goal groups continued to improve their performance in the high anxiety condition, including the part process goal group but, these performance improvements were believed to be at the expense of increases in mental effort. As a result of the mental effort data, the findings were interpreted as offering support for Eysenck and Calvo's (1992) processing efficiency theory (PET) rather than the conscious processing hypothesis (CPH; Masters, 1992). Similar trends emerged from the results of the second study of this thesis, in that performance levels did not suffer as a function of increased cognitive state anxiety but at the expense of processing efficiency, which was reflected by the increased effort that the participants expended in the high anxiety condition. The absence of any significant performance impairments when anxious participants were asked to use a single part process goal to guide their performance offered little support for the CPH (Masters,

1992) but provided more evidence for the use of process goals in assisting performance maintenance under high anxiety.

Similar evidence to that produced in studies 1 and 2 of this thesis was accrued by Jackson and Willson (1999) in their study of golf putting performance (see chapter 2 for more detail). Jackson and Willson found that putting performance levels were maintained when participants used a verbal swing thought cue and when using a visual swing thought cue. In Jackson and Willson's (1999) second experiment, which tested the assumption that thinking about several aspects of putting performance in the seconds *before* the initiation of the putt would disrupt performance, the results revealed that only the rules relating to putting action were disruptive to performance and not the rules that focused on the set up of the stroke. In the third and final study, fifty male golfers were assigned to one of five experimental conditions in order to establish whether being assigned thoughts by the researcher that are either relevant to the set up of the swing or the actual swing, were more detrimental to performance than if the participant self selected the cues themselves. Results revealed that the self selected swing thoughts group produced better performance scores than assigned swing thoughts and the control group. It was also revealed that the source of the swing thought is important and should relate to the *actual* swing of the putt and not the set up of the putt. Jackson and Willson's (1999) results suggested that some level of conscious processing, in the form of swing thoughts, might actually facilitate performance. They argued that by using a higher level (global) cue word which represents explicit rules can help prevent regression to conscious control. To summarise, the three studies by Jackson and Willson provide support for reinvestment theory (Masters, 1992), which is supported by Liao and Masters (2002). In addition, the results support the notion that swing thoughts can assist in preventing performance decreases in conditions of high anxiety and the third study's findings suggest that there may be other factors or indeed multiple factors, which influence the effectiveness of certain concentration strategies and suggest that future research into the area of choking is required. There were however, a

number of issues with the Jackson and Willson (1999) studies, for instance in the second and third experiments, participants took part in all of the swing thought conditions. Although these would have been counterbalanced, for each participant there is still a chance that by taking part in each condition this could have impacted on the results and cross over effects may have taken place. In addition, no examples of the cues that were provided to the participants were provided, making it difficult to distinguish the nature of the cues for comparison in future research. Finally, there was no mention of any manipulation checks, making it hard to identify whether the participants actually made use of the cues that they selected. Therefore, the various limitations that have been highlighted in Jackson and Willson's (1999) studies were considered in the design of the current study.

More recently, Gucciardi and Dimmock (2008) compared a single global swing thought cue word, for instance "easy" or "smooth" with two other experimental groups in an attempt to test the predictions of the CPH and the alternative attentional threshold hypothesis (ATH; Hardy, Mullen & Martin, 2001). The other two groups involved in the study comprised of a task-irrelevant thought condition, which involved participants focusing on three colours, and a task-relevant condition consisting of three explicit cues that were related to golf putting technique (for instance arms, weight and acceleration). Twenty experienced golfers (handicaps between 0 and 12) were required to putt (3 x 10 putts) in each of the three experimental groups in low and high anxiety conditions. The predictions of the study stated that the use of a single global swing thought and three task-irrelevant cues should prevent performance decrements under high anxiety conditions and would thus provide support for the CPH (Masters, 1992), given that performance would deteriorate in the task-relevant condition. It was stated that if performance decrements were witnessed in the task-relevant and task-irrelevant groups then support would be found for the ATH. The results revealed a significant main effect for condition and a significant Anxiety x Condition interaction. Follow ups for the main effect for condition revealed that there was no significant difference in performance between the task-relevant condition and

the task-irrelevant conditions, but there was a significant difference between the swing thought condition and both the task-relevant and the task-irrelevant conditions, demonstrating that performance was generally better in the swing thought condition. Post hoc comparisons on the interaction revealed that the performance decrement observed between the low and high anxiety sessions in the task-relevant knowledge condition was significantly different from the lack of performance decrements in both the swing thought and the task-irrelevant conditions. The improvements in performance between the low and high anxiety sessions in the task-irrelevant and swing thought conditions were not significantly different from each other. The results indicated a number of other issues; firstly that the participants must have had sufficient attentional capacity available with which to assign to the putting task, given that both the task-relevant and the task-irrelevant groups attended to three cues while they were putting. Had the participants not had sufficient attentional capacity, then performance decrements would have been witnessed in both the task-relevant and the task-irrelevant groups and support would have been found for the ATH. In summary, the results support the CPH given that performance decrements only took place when the golfers were attending to task-relevant cues. This led to the suggestion, that it is the content of the cues (i.e. part process, holistic process or external) that induces conscious processing effects, as opposed to the number of cues (1, 2 or 3). As such, more research into the use and nature of cues in conditions of both low and high anxiety was considered of particular interest and deemed necessary. As already identified and discussed, Gucciardi and Dimmock (2008) compared a single swing thought with two other groups. A single swing thought could be juxtaposed to the use of a holistic process goal, but with no part process goal comparison it was felt that there was a gap in the apparent process goal paradox research given that no comparisons had been made between a single part process cue and multiple part process cues. It was therefore decided that an investigation which made a direct comparison between a single and multiple part process goals should take place. In addition, having reflected on studies 1 and 2 of this thesis, it

was revealed that the participants only had the opportunity to self select their goals in study 2, so in line with suggestions by Jackson and Willson (1999) the participants in the current study were encouraged to self select the part process cues that they used. Additionally, it was noted from the findings of Jackson and Willson (1999) that the source of the cues are of importance and should relate to the action of the task being executed and not the set up of the action, so measures were taken to ensure this was accounted for in the current study, (this was also the case in for the previous two studies). In light of the previous findings and given a number of perceived gaps in the current research, it was decided that a comparison was needed between multiple self selected part process goals that related to the action of the task. The purpose of the current study was to examine and compare the use of 1, 2 and 3 part process goals on tennis serve performance in low and high anxiety conditions. An attempt was made to identify how many part process goals are required to disrupt attention and induce conscious processing as within the research area, it was believed that no study had made this direct comparison. Studies 1 and 2 consistently showed that using a single part process goal helped maintain performance under high anxiety conditions so it was predicted that performance in the single part process goal condition would be unaffected but that the performance in the two and three part process goal conditions would be impaired in high anxiety conditions as conscious processing effects take place.

Method

Participants

Twenty-four tennis players from two British University tennis clubs and a tennis club located in Wales (sixteen males and eight females, M = 19.5 years, SD =2.29) were recruited for the study. Players were assigned to one of three part process goal conditions based upon an ability ranking system and therefore were assigned using stratified random assignment. All participants were considered to be of an intermediate level of ability in line with the criteria set out in the ARTST (Avery, Richardson & Jackson, 1979). Ethical

approval for the study was secured by the departmental ethics committee and informed consent was gained from each participant before commencing the study.

Measures

Performance

The ARTST was used as the test protocol on a standard sized indoor tennis court. The test measures ball placement, speed and the amount of spin on the ball when being served, using game like criteria. Two balls were used per set of serves with services made to both the right and left service areas and there was comparable credit for different services including flat, slice and spin serves. A score was awarded for ball placement which was then added to the "zone" score used to measure speed and spin and totalled to create an overall composite score. The maximum overall composite score a participant could receive per trial was 120. Cronbach's alpha coefficients were produced in the Avery et al. study and indicated reliability estimates between two trials of 0.74 for beginner males, 0.81 for beginner females, 0.64 for intermediate males and 0.70 for intermediate females. Such values recognise the ARTST to be a valid and reliable tool for assessing serving ability in tennis (Avery et al., 1979). For more detail on the ARTST see Appendix G.

Anxiety

Cognitive anxiety, somatic anxiety and self-confidence were measured using the Competitive State Anxiety Inventory-2 (CSAI-2; Martens, Burton, Vealey, Bump & Smith, 1990) but only the cognitive anxiety scores were used, in line with studies 1 and 2. The CSAI-2 is a sport specific, self report inventory that has been shown to be both reliable and valid in its measurement of cognitive anxiety, somatic anxiety and self-confidence. Alpha reliability coefficients range from 0.79-0.90 (Martens et. al., 1990). For the purpose of the study the instructions at the start of the CSAI-2 and some of the items were adapted to be more tennis serve specific. For example, "I am concerned about performing poorly" was altered to "I am concerned about serving poorly". Altering the instructions and items slightly made them more relevant to the participants involved without impacting on the

reliability or validity of the items. Participants rated their anxiety on a likert scale of 1 (*not at all*) to 4 (*very much so*) for each of the 27 items.

Experimental conditions

Participants were assigned to one of three part process goal conditions; a single part process goal, two part process goals or three part process goals. Each participant self selected their own part process goal(s) from a list, in line with Jackson and Willson's (1999) protocol and research which demonstrated that self selected goals / instructions are more effective than assigned or prescribed cues / goals. The list that the participants self selected the part process goal(s) from, was designed with the assistance of a Lawn Tennis Association (L.T.A.) performance accredited coach and in line with coaching manual guidelines on serving from a number of recognised tennis sources including Elliot and Alderson (2003), Bollettieri (2001) and Elliot and Saviano (2001). When the participants selected their part process goal(s) they were encouraged to shorten them to one or two words to enable them to be remembered and adhered to more easily. The researcher assisted the participants in shortening the part process goal(s) to ensure that the content of the goals did not alter and remained part process in nature. For a copy of the list of part process goals see Appendix H.

Manipulation check

On completion of the high anxiety condition, the participants were required to complete a manipulation check in order to identify whether they had focused on their part process goal(s) for the duration of the serves. Participants were asked a single question, 'During the serves did you focus your attention on the part process goal(s) that you selected?'. Participants who did not focus on the self selected part process goal(s) were asked to describe what they focused on. All of the participants reported that they focused on the part process goal(s) that they had selected for the duration of the serves in both the low and high anxiety conditions and no one reported any difficulties in focusing on the part process goals.

Anxiety intervention

To increase anxiety levels, participants were informed that they were taking part in a competition against their fellow university / club members. Each participant was informed of a "target" score that they had to try and achieve but this score had been yoked based on the participant's individual performance in the low anxiety condition, making the new "target" score a challenging, but not impossible score to attain. The participants were informed of their "target" score by being presented with five scores. The participant's own individual "target" score being presented below the third score but no worse than equal fourth in the list of the five scores presented. Participants were also told that they had the opportunity to win £20, £16, £14 or £12 for 1st, 2nd 3rd and 4th positions, respectively.

Procedure

The indoor tennis court was marked out according to the guidelines set out in ARTST (see Appendix G). All participants were tested individually and each participant took approximately one hour to complete the testing procedure. Participants were informed that the purpose of the study was to investigate how concentrating on different goals could impact on performance. Participants initially completed a warm up in which they were asked to warm up as they normally would prior to a training session and once physically warm they were instructed to take four serves in line with the warm up procedure from the ARTST, consisting of two practice serves to the right service court and two practice serves to the left service court. Participants were informed that they should serve as they would normally in a game situation, which resulted in all participants selecting a standard top spin serve. Following the warm up session, the structure of the experiment and the expectations of the participants were explained. Participants were then assigned to a part process goal condition; one part process goal, two part process goals or three part process goals. A prescriptive list of the technical steps of a tennis serve was then provided to the participants consisting of 32 technical steps (Appendix H). Specific care was made to ensure that all 32 technical points related to the actual serving action and not to the set up

of the serve based on the findings of Jackson and Willson (1999) which revealed that only instructions and cues related to the actual task and not the step up where found to be disruptive of performance. Depending on group assignment, the participants self selected one, two or three part process goals that they felt they could focus on while serving. After shortening their part process goal(s) with the help of the researcher, participants were informed that they could change their part process goal(s) between serves if they wanted to; however, none did.

Anxiety conditions

Both the low anxiety condition and the high anxiety condition comprised of 20 serves.

Low anxiety condition

Participant received instructions about the nature of the task and what they would be expected to do. Following this and before commencing the serves, participants completed the CSAI-2 (Martens et al., 1990). Participants then served as follows:

1. Five serves to the left half of the right service court
2. Five serves to the right half of the right service court
3. Five serves to the left half of the left service court
4. Five serves to the right half of the left service court

Participants only received a second serve if they faulted on the first serve; otherwise the first service was scored according to the prescribed criteria. Participants were instructed to verbalise, visualise and perform using their selected part process goal(s) between each serve. The part process goal(s) were also reinforced by the researcher between each set.

High anxiety condition

The procedure for the high anxiety condition was the same as the low anxiety condition only the anxiety intervention was administered prior to commencing the first serve in the high anxiety condition. The CSAI-2 was administered after the participants had read the competition instructions in order to try and capture their anxiety levels having just read what was expected of them in the high anxiety condition. Participants were then instructed

to continue to verbalise, visualise and perform using their part process goal(s). Following completion of the high anxiety condition, the manipulation check was administered.

Data analysis

In order to examine the effects of the number of part process goals on performance, dependent variables were examined using mixed two-factor ANOVA (3 x 2; Group x Anxiety Condition, with repeated measures on the second factor). Significant effects were followed up using Tukey's *post hoc* tests.

Results

Assumption testing

For all of the results, appropriate assumption testing took place in order to ensure normality, independence and sphericity of the data sets as well satisfying equality of covariance matrices. Where an assumption was not met, the appropriate correction method was employed. The manipulation check confirmed that all participants made use of their selected part process goal(s) to guide their service action throughout the experiment. Descriptive statistics for the anxiety scores can be found in Table 1. The anxiety intervention was highly successful with results of the two way ANOVA revealing a significant main effect for anxiety condition, with all groups increasing their cognitive anxiety levels from low anxiety to high anxiety conditions (F 1,21 = 23.21, $p < .001$, $\eta_p^2 = 0.53$). No significant interaction (F 2,21 = 0.06, $p > .05$, $\eta_p^2 = 0.01$) or main effect for group (F 2,21 = 0.83, $p > .05$, $\eta_p^2 = 0.07$) was found.

Table 1. Mean (SD) cognitive anxiety scores in low and high anxiety conditions

	Anxiety conditions	
Group	Low anxiety	High anxiety
One part process	16.13 (3.18)	20.5 (6.95)
Two part process	14.75 (2.92)	19.63 (4.10)
Three part process	18.13 (3.60)	22.25 (7.91)

Results of the two way ANOVA for performance revealed a significant main effect for group (F 2,21 = 15.58, p < .001, η_p^2 = 0.6). Tukey's follow up tests revealed that the significant differences lay between the group that made use of two part process goals and the other two groups (0.001) indicating that the participants making use of two part process goals performed better than those making use of one or three part process goals. No significant interaction (F 2,21 = 0.47, p > .05, η_p^2 = 0.04) and no significant main effect for anxiety condition (F 1,21 = 0.83, p> .05, η_p^2 = 0.04) were found. Table 2 presents the scores of the three part process goal groups in the low and high anxiety conditions and confirms that no significant performance decrements took place.

Table 2. Mean (*SD*) tennis serve performance scores for the three part process goal groups in low and high anxiety conditions

	Anxiety conditions	
Group	Low anxiety	High anxiety
One part process	84.63 (11.07)	84.50 (12.13)
Two part process	103.38 (6.78)	106.63 (7.39)
Three part process	81.00 (10.41)	81.88 (10.18)

Discussion

The aim of the current study was to examine and compare the use of one, two and three self selected part process goals on tennis serve performance in low and high anxiety conditions. Studies 1 and 2 consistently demonstrated that using a single part process goal did not lead to performance disruption under conditions of high anxiety, so it was predicted that making use of two or three part process goals may lead to performance decrements under conditions of high anxiety given larger pools of explicit knowledge being used to guide performance. The findings of the current study did not support the prediction that two or three part process goals would induce lapses in conscious processing and result in performance decrements, despite a successful anxiety intervention. As with the findings of studies 1 and 2, a single part process goal continued to prevent performance decreases in high anxiety conditions, supporting the findings of Jackson and Willson (1999), who revealed that the use of single verbal or visual cues could assist in the prevention of choking in high anxiety conditions in skilled golfers. No significant performance decrements were observed in any of the three groups supporting the findings of studies 1 and 2 of this thesis suggesting that the use of any type and number of goal is beneficial in preventing performance decrements in conditions of high anxiety. The current findings are therefore in contrast to that of Gucciardi and Dimmock (2008), who revealed that the use of three explicit task-relevant instructions led to a decrease in putting performance, whereas the use of three task-irrelevant cues and a swing thought did not result in performance decreases. No performance decrements were observed with three part process goals or a single part process goal.

Given that there were no performance decrements in any of the part process goal groups, it is possible that there are a number of other factors that might influence performance effectiveness when performers are placed in high pressure situations. One plausible explanation for the lack of performance decrements could be attributed to the self-confidence scores of the participants. Although these were not of initial interest,

further inspection of the data revealed a significant interaction for Self-confidence x Group indicating that across the low and high anxiety conditions there was an interaction between the two part process goal group and the three part process goal group. Self-confidence levels decreased in the high anxiety condition for the participants making use of two part process goals whereas self-confidence levels increased for the three part process goal group. This indicated that the use of two part process goals may be less effective at maintaining self-confidence levels in comparison to those who made use of one or three part process goals, Interestingly though, it was the participants in the two part process goal group who had the highest performance levels throughout, so essentially all three groups maintained performance levels regardless of anxiety level. Mullen and Hardy (2000) alluded to the use of self-confidence as being a way that participants may have overcome the disruptive influence of anxiety and continue to perform successfully. As highlighted by Mullen and Hardy (2000), neither the CPH nor the PET involves predictions about self confidence, which makes it hard to discuss how self-confidence may or may not fit in the context of performance decrements. It must be acknowledged though that most of the sport psychology research discusses self-confidence as relating to expectations of success, so the role of self-confidence requires further investigation within the current context if we are to further understand how it might interact and influence other variables and potentially have a part to play in performance decrements.

Another factor that may help explain a lack of performance decrements in the current study could be the role that effort has to play. Mental effort scores were not assessed in the current study as the self reported scores that were collected in the previous two studies had not mirrored the heart rate variability (HRV) data, therefore a decision was made to not include mental effort scores or make use of HRV measures in the current study. In hindsight, the absence of a measure of mental effort is a limitation to the present study. The type of task used could have been another variable for consideration in explaining why performance did not deteriorate in the high anxiety condition. Previous

studies investigating conscious processing effects have used a golf putting task (e.g. Masters, 1992; Hardy, Mullen & Jones, 1996; Mullen & Hardy, 2000; Mullen, Hardy & Tattersall, 2005). To what extent the task had an influence is difficult to establish; however, it would be interesting to note whether mainly static movements, such as a golf putt, are easier to manipulate than more dynamic movements that involve many phases of movement, such as tennis serve. For instance, a golf putt mainly consists of one gross, holistic, multi-jointed movement with a need for accuracy in order to connect with the ball. Whereas a tennis serve consists of several phases of partial movements including ball toss, racket movements, knee bending, back arching and follow through of the racket. Although this is slightly speculative, it is possible that the nature of the task could have had an influence on the part process goal manipulations.

In summary, the results from the current study are consistent with the results of studies 1 and 2 of this thesis and demonstrate that making use of part process goal(s), regardless of number appears to assist prevent performance from deteriorating under conditions of high anxiety. In order to try and understand why three part process goals failed to disrupt attention as was expected and predicted given that three task-relevant cues disrupted performance in previous research by Guccardi and Dimmock (2008), it would be necessary to try and understand how and why the part process goals where effective in assisting performance in the high anxiety condition. For instance, the content of the goals provided in the current study were designed to be part process in nature however, some participants could have *interpreted* and made use of these goals in a different, more holistically orientated manner. This may have resulted in the assigned part process goals being altered and used in a more "global" or holistically orientated way. For instance, when the participants were asked to shorten their part process goal(s) to just one or two words or a short phrase, some of them may have changed the part process goals to be more reminiscent of a holistic process goal, despite being instructed by the researcher to keep the goals part process in nature. For example, if a participant selected point eight from the

list of serving points (Appendix H), "tossing arm raises straight up the side of the body" and then the participant visualised and verbalised a shortened version of this, such as "arm straight up" which is still part process in nature as it focuses in on a part of the arm movement. However, the participant may have thought or interpreted these goals in a slightly different manner, such as "smooth arm toss" or "straight up" which effectively could be classified as being more holistically orientated. If this was the case, then this could have been part of the reason why lapses in conscious processing did not take place and overall performance was not impaired. To expand on this point, no additional control was made for what the tennis players taking part in the study thought about when serving under normal, non-experimental conditions. For instance, if some of the players already made use of a goal or word that was similar to the goal(s) that they selected from the prescribed list, then this would not have challenged the participant to think differently or more explicitly in any way and this could have actually assisted their performance. In a similar vein, some of the participants may have, under normal circumstance, struggled to focus their attention when serving. So by assigning them a part process goal (regardless of number) this too, may have assisted their performance rather than serving to induce conscious control.

Another explanation of why performance failed to decrease under pressure could be linked to the work of Wulf and colleagues who stipulate that the use of an external focus of attention serves to assist the performance of expert athletes under pressure (for a review, see Wulf, 2007). On closer inspection of the part process goal list, it may have been that the goals provided either were (or were interpreted to be) more externally than internally referenced. In line with Wulf's work, external focus of attention is beneficial for performance. For instance, technical point 31 on the list states; "initially racket follows the dominant side, then tracks across the body". Some of the participants may have considered this an internal focus of attention, as it is concerned with a bodily movement however, other participants may have viewed the emphasis on the racket to be important and used

the racket (a piece of apparatus) as an external focus to guide their performance. Careful consideration concerning the phrasing of cues and goals is needed to avoid such issues occurring in future research studies.

It is necessary to address the possibility that although the anxiety intervention was successful in significantly elevating cognitive anxiety levels, such levels may not have been ecologically valid enough to lead to performance decrements. Previous researchers have touched on this issue including Mullen, Hardy and Tattersall (2005). The use of more physiological methods of assessing cognitive anxiety could assist in reducing the impact of this in future studies. For instance additional measures such as heart rate, respiratory or sweat production could be used in tandem with the CSAI-2 (Martens et al., 1990) to ensure that anxiety levels are raised to a suitable level. Another issue that may have influenced the validity of the cognitive anxiety levels, concerns the use of sportsmen and women as participants. The use of sporting individuals can be a disadvantage at times, particularly if they bring their own competitive experiences with them, and as a result, could be desensitised to the effects of the intervention strategies and manipulations being used.

In conclusion, it could be that the performance of expert performers becomes fragile under conditions of high anxiety for reasons other than that directly linked to the process goal paradox or indeed the CPH (Masters, 1992). This can be stated given that the results of the first three studies of this thesis have all found support for the use of part process goals in preventing performance disruption in high anxiety conditions, opposing the main predictions of the CPH (Masters, 1992) and providing more support for alternative explanations such as PET (Eysenck & Calvo, 1992). For this reason, an alternative investigation into what causes performance impairments was deemed necessary and a final study was conducted in order to investigate the underlying mechanisms that lead to performance decrements in conditions of high anxiety.

CHAPTER 6

A QUALITATIVE INVESTIGATION INTO THE CAUSES AND MECHANISMS CONTRIBUTING TO PERFORMANCE FAILURE (STUDY 4)

Abstract

This study used semi-structured interviews focusing on a competition in which eight elite trampolinists reported experiencing a performance failure. Attention was given to the participants' thoughts, feelings and behaviours in three distinct time phases; pre-event, on the day of competition and at the time of the performance failure. Inductive hierarchical content analysis revealed eleven general themes. The performance failure time phase revealed five general themes including technical inaccuracies or faults, unusual movement kinaesthesia, attentional issues, lost moves and the role that effort played in the performance failure. The results are consistent with previous findings in this thesis and do not support conscious processing as an exclusive explanation for performance failure but suggest there are multiple mechanisms for performance failure.

Introduction

So far, this thesis has provided support for the use of part process, holistic process and external goals in preventing performance decrements in conditions of high anxiety. Failure to observe performance decrements so far in this research programme could have been attributed to a number of design issues including; the choice and length of tasks used, the interpretation of the cues assigned to the participants, or low ecologically validity associated with the cognitive anxiety levels. In addition, the first three studies made use of sports performers as participants and it is possible that they may have become over familiar with the anxiety interventions used as a result of being exposed to high anxiety levels on a regular basis. Alternatively the issues could have related to the participant numbers or the sample sizes may not have been large enough to achieve sufficient power and detect performance effects. Aside from these potential limiting factors, what should be acknowledged is that conscious processing effects did not take place under conditions of anxiety when participants made use of part process goals so. Having failed to successfully uncover evidence of performance decrements in studies 1, 2 and 3, it was acknowledged that expert performance needed to be examined from a slightly different perspective given that it is quite plausible that other factors have a role to play in performance deterioration. Through more thorough and detailed qualitative investigation it was decided that these

mechanisms could potentially be exposed in a manner that has not been done before, which would further our understanding of the topic area.

As with many research studies within the area of conscious processing, the first three studies in this thesis were laboratory-based experiments relying on experimental designs; however other researchers have used alternative approaches in order to achieve greater clarity and understanding of the role of competitive anxiety on sporting performance. Varying approaches including Hanton and Jones's (1999) staggered single-subject multiple baseline across subjects design used to investigate the affects of cognitive anxiety levels in swimmers, Collins, Morriss and Trower's (1999) use of a case study design to examine successful skill recovery in an elite javelin thrower and Edwards, Hardy, Kingston and Gould's (2002) qualitative investigation of catastrophic performance drops, all demonstrate alternative approaches to investigating psychological aspects of sport. Edwards et al. (2002) examined catastrophic drops in the performance of eight elite athletes. Athletes from canoe slalom, basketball, power lifting, gymnastics, swimming and sailing were questioned about their personal performance catastrophe experiences in recent competition. Data were collected using qualitative, semi-structured interviews which were centred on three time phases; pre-catastrophe, during the catastrophe and the post-catastrophe phase and included investigation of the coping strategies that the performers employed. A catastrophic drop in performance was defined as, "a performance that had begun in a normal fashion but that had dropped significantly" (p. 4). The aim of Edwards et al.'s study was to further explore the predictions of the cusp catastrophe model (CCM; Hardy & Parfitt, 1991) and also to examine the mechanisms underlying catastrophic performance failures. The CCM specifically addresses the interactive effects of cognitive anxiety and physiological arousal on performance as well as the associated notion of hysteresis (for a brief overview, see chapter 2 of this thesis and Hardy, 1996 for a more detailed review). Edwards et al. revealed that both cognitive anxiety and self-confidence were related to catastrophic drops in performance and it was suggested that if cognitive

anxiety and physiological arousal were high and self-confidence was low, then performance drops would be more likely to occur and to reoccur in the future, thus supporting the main predictions of the CCM. Edwards et al. were also interested in investigating the mechanisms underlying catastrophic performance failures and there were the number of findings that emerged from the study that are of interest to the current research programme; including the role that effort had to play in performance success or failure and the increase in conscious control over movements. The participants reported investing low amounts of effort into performance in the pre catastrophe phase but reported an increase in effort levels in the catastrophe phase, followed by a sudden drop in effort levels again post catastrophe. The discussion of effort in the context of this study was explained by processing efficiency theory (PET; Eysenck & Calvo, 1992). According to Edwards et al., by investing more effort into their performances the participants would have been likely to increase the intensity of their focus on their own performance. It is this increase in focus that Edwards et al. (2002) suggested could have encouraged higher levels of conscious processing. So, despite increases in effort to try and compensate for poor performance, this was believed to lead to an increase in conscious processing that resulted in performance failure. Edwards et al. were therefore able to highlight how PET and the conscious processing hypothesis (CPH; Masters, 1992) could be used in a complementary manner to explain the catastrophic performances of the athletes. This idea of using two seemingly opposing notions in tandem, is a position that has been suggested by several researchers, including Mullen and Hardy (2000) and Graydon (2002).

An alternative approach to the examination of performance impairment under pressure involves the “yips”, which are a form of disruption that affects individuals who perform finely controlled motor skills (Bawden & Maynard, 2001). The yips are regarded as being more debilitative than a one off catastrophic performance, given that the condition can last for several months, or even years (Sachdev, 1992). The yips are characterised by involuntary movements which occur throughout the execution of a skill, resulting in the

skill being disrupted. Research into the yips has been conducted by Bawden and Maynard (2001) who interviewed eight cricket bowlers, all of whom were currently experiencing the yips and wished to seek psychological advice on how to overcome their loss in performance. The interviews were centred on the cricketers' thoughts, emotions and feelings before, during and after their initial experience of the yips. Following the interviews, inductive content analysis revealed 15 general dimensions that were descriptive of the overall yips experience. In the time leading up to the onset of the yips, the bowlers revealed no physical issues or concerns with their bowling but reported feeling anxious, uncomfortable and were divided between those who had positive experiences and those who had negative bowling experiences prior to developing the condition; although, no bowler reported any of these positive or negative experiences to be of importance to the development of the yips. Anxiety was reported to have a prominent role to play when all eight bowlers first experienced the condition and it appeared to be closely linked with their feelings of "no control" over their bowling actions. Negative thoughts were also of prominence and these negative thoughts were believed to lead to an increase in conscious control over the bowling action. Additionally, self presentation concerns such as feeling embarrassed and self conscious, twinned with poor concentration levels were also perceived to lead to an inappropriate focus. Of particular interest, was the emergence of the higher order themes including cognitive anxiety, inappropriate focus, increased self consciousness and conscious control over movements. These higher order themes suggest that as an individual's self consciousness increased, so too did their inappropriate focus to the task, making the cricketer's less able to carry out the task effectively. The themes and comments related to conscious control and self consciousness link well with the notions of the CPH (Masters, 1992) and Bawden and Maynard (2001) saw the CPH as one plausible explanation for the yips in the bowlers. Bawden and Maynard (2001) also alluded to the work of Shea and Wulf (1999) and explained how an internal and external focus of attention influences learning, which was also used as a possible explanation for the

findings. Specifically, Bawden and Maynard suggested that the initial process of the "yips" has similar underpinning mechanisms to those associated with a choke (Baumeister, 1984) and that potentially the internal focus of attention may be the catalyst for reinvestment of controlled behaviour, resulting in the "yips".

Collins, Morriss and Trower (1999) and Day, Thatcher, Greenlees and Woods (2006) investigated a more severe performance debilitating related phenomenon; lost move syndrome (LMS). Lost move syndrome is primarily a psychological condition often considered an extreme form of the yips which results in the performer being unable to perform a skill that was once automatic to them. Lost move syndrome can last anything from a few weeks, to a number of months or even years and has the potential to be career destroying (Janelle, 1999). Collins et al. (1999) conducted a case study investigating LMS using an international javelin thrower and revealed that the main causes of this athlete's LMS could be explained by increased conscious control, injury concerns and an inability to access the correct motor program in order to produce the desired movement. Increases in conscious control of the movements were described in terms of the athlete potentially disrupting the execution of the movement because they were inducing too much conscious control in order to make changes to the movement pattern. By using a combination of physical drills, mental skills including imagery and the use of a biomechanist, Collins et al. (1999) assisted the successful recovery of the athlete.

More recently Day et al. (2006) investigated the causes of, and responses to, LMS by interviewing 15 elite level trampolinists who had all suffered from LMS for between three months to two years (M = 10 months). In total, six general dimensions emerged and included issues associated with skill acquisition (rushed / difficult or easy skill acquisition), a gradual increase in pressure to perform, poor coping strategies, self presentation concerns, changes in thought processes surrounding the movement and how to execute it. The participants described the change in movement perception as being a result of overanalysing skills that they previously never felt the need to think about. In other

words, a skill that was once automatic now needed conscious attention. To illustrate, one participant indicated, "I'd never really thought about them before, they just happened and now I was having to concentrate on what I was doing and where I was looking and it just sort of threw me" (p. 161). Day et al. (2006) explained that this increase in focus on a skill, which is likely to have elicited a degree fear and worry, may also have been initiating ironic mental processes (Wegner, 1994). In summary, a degree of conscious control through changes in thought processes and self presentation concerns emerged as prominent contributory mechanisms to LMS in both the Collins et al. (1999) and Day et al. (2006) studies. In conclusion, conscious processing appears to be a suitable explanation for performance impairment under pressure and has also emerged as a feature of other related concepts such as the yips and LMS; however, it is only one of several potential mechanistic explanations. There are a number of other equally plausible mechanistic explanations for anxiety-induced performance impairment which require further investigation using elite level athletes. These include PET (Eysenck & Calvo, 1992) and ironic processes of mental control (Wegner, 1992).

The aim of the current study was to take a "step back" from the dominant hypothesis testing approach adopted in the first three studies of this thesis and use an alternative research strategy to further investigate performance impairment. The purpose of this study was to explore the real life performance failure experiences of eight elite level trampolinists using qualitative semi-structured interviews that would allow the researcher to gather in-depth information regarding the participants' perceptions of the causes and mechanisms that contribute to performance impairments under pressure. This phenomenological approach (Creswell, 1998) would allow for a deep and detailed level of investigation, something quantitative research could not achieve.

Method

Participants

The participants were purposefully sampled using a number of methods (Patton, 2002). An initial screening was carried out on sports students (n = 106) actively competing for sports teams at a British University. Participants from team and individual sports were included with a range of sports being represented in the sample, including rugby, tennis, football, netball, hockey, athletics, trampolining and gymnastics. Athletes were required to complete the Competitive State Anxiety Inventory-2 (CSAI-2; Martens, Burton, Vealey, Bump & Smith, 1990). Having gathered the initial data, extreme sampling methods (Patton, 2002) were used in order to identify the final sample, conducted by identifying the participants who reported the highest cognitive anxiety scores during the data collection phase. Among the highest scoring participants were a group of elite level trampolinists, so a decision was made to focus on this homogenous group in order to obtain a detailed picture of the performance failure experiences. Permission from the coach was gained prior to approaching the participants to take any further part in the study. Permission and informed consent was granted from the coach and all the trampolinists prior to any additional data collection.

Eight participants, male (n = 4) and female (n = 4), between the ages of 18 and 23 (M = 20.75; SD = 1.83) were selected based on reporting high levels of cognitive anxiety. All of the participants had baseline scores averaging 20.71 (SD = 2.40) on the cognitive anxiety sub-scale which when compared to the other participants who completed the CSAI-2 this was considered high. All participants were competing in national grade one trampolining. In addition, one participant also competed at national level in double mini trampolining (DMT) and another was also a national level tumbler. The participants had an average of nine years competitive experience (M = 9.5, SD = 5.13). In qualitative research, sample selection should continue to the point of redundancy, that is, until no new themes

emerge (Patton, 2002). On completion of eight interviews, it was apparent that the data had reached saturation point and no further interviews were conducted. The participants were interviewed using a "self-selected paradigm" as opposed to a "researcher-selected paradigm" (Nicholls & Polman, 2007). The self-selected paradigm gave the participants a choice about which performance failure experience they wanted to discuss in the interview, as it was anticipated that the participants would be able to recall some performance failure experiences more accurately and vividly than others. Participants were encouraged to select an event that had occurred within the last 12 months, in order that recall was as accurate as possible in line with recommendations by Edwards et al. (2002). In the interviews, two of the eight participants reported a performance failure which related to a tumbling or a DMT experience rather than a trampolining experience. This data was recorded and considered valid for use in the current study.

Interview guide

The central focus of the interview was to identify the thoughts, feelings and behaviours of the participants before and during each individual performance failure experience. A semi-structured interview guide was developed in order to address the research question (Patton, 2002; Scanlan, Stein & Ravizza, 1989). The guide was designed to be flexible enough so that the participants did not feel constrained to certain areas of questioning (Patton, 2002), which allowed for a more detailed exploration of the performance failure experiences. The benefits of semi structured interviews include the same questions being asked to all respondents, making answers more comparable, reducing experimenter bias and allowing the interviewer a degree of structure to each interview (Patton, 2002). The completion of a pilot study on a 19 year old national tennis player allowed the interview guide to be tested and any appropriate amendments made.

The interview guide was divided into four main sections. Section one aimed to give the participants some background information about the study, its purpose and how the data would be used. All participants were informed that the interviews would be recorded

on tape in order to ensure accurate transcription. Section two focused briefly on the participant's initial involvement in sport and identified their individual level of experience. This section was designed to help the participants feel comfortable talking on tape and to the researcher. Section three investigated the details of the performance failure beginning with a definition of a performance failure which was, "think back to a time when you experienced a drop in your performance due to the pressure/stress that you were experiencing because of the importance of the competition or the situation". This definition was created and centred on both Edwards et al. (2002) definition of a catastrophic performance drop and Bawden and Maynard's (2001) definition of the yips in order to try and encompass the nature of a severe performance failure in a high cognitive state anxiety situation. In addition, the importance of the situation was included in the definition as it was important that the performance failure took place in a competition setting or a situation of importance such as a selection meet or when scouts were observing performance, rather than in training or a lower level competition. The instruction was provided to the participants one week prior to the interview so that the participants could have time to think about and recall accurately a relevant, detailed example for discussion in the interview. In the interview, participants were asked to recall thoughts, feelings and behaviours in the days leading up to the performance failure (pre-event), on the day of the competition (hours leading up to the actual performance) and when the performance failure actually took place. To conclude the interview, participants were asked whether they would like to add anything to the interview, whether they felt they had been led in any way by the researcher or whether there were any other comments that they would like to make at that stage. All of the participants felt they had a chance to convey their answers in a non-leading way and that they had reported everything that they felt they could about their individual performance failure experience. A copy of the interview guide is provided in Appendix I.

Procedure

Interviews were conducted face-to-face by the researcher in a neutral setting that enabled the natural flow of the conversation with the participant. Every attempt was made to avoid environmental bias (Hanton, Mellalieu, Neil & Fletcher, 2008). Participants were encouraged to provide a detailed and accurate account of their performance failure experience and where participants could not recall the relevant information, they were asked not to guess but rather to be honest with their responses. Where a participant did not give sufficient detail, or it was felt by the researcher that the participant could give more information, an elaboration probe was used. Where there was any degree of uncertainty surrounding the participant's comments, a clarification probe was used (Patton, 2002). Examples of elaboration and clarification probes included, "Could you elaborate on that a little more please?", "That's helpful. I'd appreciate a bit more detail" and "I'm not sure that I understand what you meant by that, could you elaborate please?". Specific elaboration and clarification probes allowed the athletes to expand on their responses (Patton, 2002) and provide the researcher with a more in-depth, accurate understanding of the participants' responses. Interviews lasted on average 60 minutes and were transcribed verbatim, which yielded more than 110 pages of single-spaced text. Participants were provided with the opportunity to read their personal transcripts to ensure content accuracy.

Data analysis

Interviews were analysed using inductive hierarchical content analysis (Glaser & Strauss, 1967), allowing themes and categories to emerge from the data (Patton, 2002). The analysis resulted in the collation of four hundred and eighty interview quotations. The quotations were examined within each of the three distinct time phases and raw data themes for each time phase were then clustered to create general themes (Biddle, Markland, Gilbourne, Chatzisavantis & Sparkes, 2001). Figures 1 and 2 show the inductive hierarchical content analysis according to the three time phases for the trampolinists and

the figures should be referred to closely throughout the presentation and discussion of the results.

Trustworthiness

Lincoln and Guba (1985) developed four criteria and associated techniques to determine the trustworthiness of qualitative research; credibility, transferability, dependability and conceivability. The associated techniques for credibility include prolonged engagement, persistent observation, triangulation, peer debriefing, negative case analysis, referential adequacy and member checks. The set criteria assist the researcher in identifying whether the inquirer can convince others that the findings of the study are worth paying attention to. Credibility was achieved through triangulation as two other investigators who were independent of the study and its findings, agreed on the themes highlighted in the analysis. The rapport with the participants was excellent as the researcher had some previous interactions with the trampolining club and the coach in a sport psychology support capacity, and both parties had built a good level of trust with the researcher. Prolonged engagement and persistent observation were also satisfied as the researcher had spent considerable time working within the sport of trampolining and carried out a period of observation with this group of athletes prior to conducting any of the interviews. Additionally, the researcher had a sound background in working with trampolinists and understood the demands of the sport, which assisted in developing a rapport with the group of trampolinists over the observation time period. Negative case analysis involves revising the data until all cases can be accounted for without exception (Lincoln & Guba, 1985). This was achieved, as any themes that did not seem to follow the same pattern as the majority of the groups of themes, were examined until they could either be classified as a dimension of their own, or under one of the already existing dimensions, thereby accounting for all the comments made by the participants. Referential adequacy is a notion that involves recording of the raw data so it is possible to inspect it at a later date (Lincoln & Guba, 1985) and this was achieved, as all of the interviews were tape recorded and

transcribed verbatim. Member checks were carried out informally with the participants throughout each individual interview and then again at the end of the interview, prior to departing from the interview area. This gave each participant an opportunity to clarify what they had said in the interview, add any additional details that they may have missed out and also add clarity to any answers that they had given if they or the researcher felt that it was required. In any instances where the interpretation was inaccurate, an amendment was made. Transferability is a common problem within naturalistic studies as the researcher can only provide a rich, thick description of information collected so that others can reach their own conclusions regarding the generalisability of the results (Lincoln & Guba, 1985). Detailed descriptions are provided within the results section and the full results are available from the author on request. Dependability and confirmability was achieved as detailed records were kept of all the data and the data analysis procedures including the raw data files, data reduction and analysis products, data reconstruction and data process notes. Overall, trustworthiness was achieved to a satisfactory standard.

Results

Preliminary analysis revealed that many of the identified themes manifested themselves in the pre-event phase and continued to present themselves on the day of competition. As a result, the two time phases leading up to the competition (pre-event and on the day of competition) will be described collectively, and given that the main focus of the study was on the causes of the performance failure, this phase is described separately. In the pre-event phase and on the day of competition the main themes identified were; training / technical issues, negative thought patterns, self presentation concerns, personal expectations, coach-athlete concerns, issues associated with imagery, narrowed focus, general behavioural and emotional disruption and an increase in somatic anxiety levels.

Pre-event and competition day experiences (refer to Figure 1).

Training and technical issues and negative thought patterns

All of the participants commented on how unsuccessful they felt their training had been in the lead up to the competition. It was evident that thoughts about how poorly training had been contributed to an increase in negative thought patterns among the participants. In addition to poor training, five participants alluded to previous unsuccessful performances in terms of "messing up" in either a previous competition or having already fallen off in the current competition and indicated that thinking about these previous unsuccessful performances contributed to the negative thoughts and feelings they had about the upcoming competition, both in the pre-event phase and on the day of the competition. Negative thinking associated with training, as well as the technical problems which were encountered in training, appeared to continue to be at the forefront of the participants' minds on the day of competition. For instance, two participants were injured in the pre-event phase which resulted in a decrease in quality and quantity of training time. This was associated with an increase in negative thought patterns about the competition and the participants' perceptions about their ability to execute their routines both in the lead up to, and on the day of competition. To explain, participant two had fallen off the trampoline in a previous competition making this her last opportunity to qualify for the National Championships. Her quote below demonstrates well how the two themes of training and technical issues and negative thought patterns link together:

> I wasn't having problems with my moves but I was falling off in competition, that competition was the first one I'd qualified in. I'd already done two competitions and I hadn't stuck on - I'd fallen off the trampoline so I hadn't qualified. So this one was like it, was one of the opportunities that I had down the road that I had to qualify in, so I was a bit stressed about that 'cause I hadn't qualified yet.

Training and technical issues continued to present themselves on the day of competition where four participants reported poor warm ups which were riddled with technical errors. This quote from participant five demonstrates this notion well:

> The first warm up I did three moves and landed on an end mat, and started again, did two or three moves and landed on the next trampoline where the men were jumping . . . they were a hell of a lot bigger than me so I wasn't really too happy about that. The second warm up I got through to about move six or seven and came off the corner and one of my mates caught me which was all right as I then landed on my feet, but I was a bit too shaky to take my control.

The thought of a poor warm up remained in the participant's thoughts throughout their preparation, 'I was probably thinking quite negatively . . . thinking that all this has gone wrong in the warm ups'. In contrast, participant six had a successful warm up but interpreted this as a negative precursor to her performance:

> I think it went too well…that's the thing with this sport if you have really good warm ups, then your not bound to have a bad one but you sort of use up all your good technique (laughs) and then you get really nervous in the competition . . . I think they went a bit too well.

In general, it appeared that both positive and negative previous experiences (both on the day of competition in the form of a poor warm up and previous competition experiences) were interpreted in a negative manner and resulted in an increase in negative thoughts about the forthcoming competition. Negative "what ifs" were common among the participants and came under the umbrella theme of negative thought patterns. To explain, participant five reported that following a poor warm up, in which he actually fell off the trampoline, he was concerned that he might fall off again in the actual routine. So was thinking "what if I fall off again". This negative train of thought was reported to be prominent in participant five's mind and caused him concern on the day of competition. Overall, training / technical issues, mainly interpreted in a negative manner, appeared to contribute to an increase in negative thoughts and negative "what ifs", resulting in concern on the day of competition for all of the participants.

Pre-event	Competition Day	
Raw Data	Raw Data	Theme
• Negative / unsuccessful training • Other commitments • Injury / illness • Already fallen off in competition • Hadn't qualified yet • Messed up in last competition	Poor warm up Technical errors in warm up Fell off Short in duration Felt rushed Good warm up	Training/ technical issues
• Interrupted images • Images turned negative • Negative thoughts caused by poor imagery • Poor imagery use • Ineffective use of imagery	Negative use of imagery	Imagery
• Comparing self negatively to others • Concerned about how others would evaluate performance		Self presentation concerns
• Point to prove to old club • Thinking about the score • Perfectionist tendencies	Heightened awareness of expectations of self and others	Personal expectations
• Wanted to impress new coach • Didn't want to let coach down • No coach • Team reliance	Concern over coach location	Coach-athlete concerns
• Thinking negatively about the competition • Thinking negatively about routine • Doubts about personal ability • Increased frequency of negative thoughts	Negative feelings about poor warm up Concerns about competing given poor warm up Overanalysing warm up Negative "what ifs"	Negative thought patterns
• Inability to focus on anything other than competition • Increased focus on the competition		Narrowed focus
• Couldn't sleep • Irritated • Unusual behaviour		General emotional & behavioural disruption
• Elevated heart rate • Inability to relax	Increase in nerves Fidgety Loss of appetite Localised muscle tension	Increase in somatic anxiety

Overall increase in pressure to perform

Pre-event	Competition Day	
Raw Data	Raw Data	Theme
	Unfamiliar competition set up / beds / spotters Restrictions on access and personal items Overcrowded Ambience of venue	Organisational stressors

Overall increase in pressure to perform

Figure 1. Pre-event and Competition day data and themes

Self presentation concerns, personal expectations and coach-athlete concerns

Another predominant theme highlighted by five participants related to the pressures and expectations that the participants placed on themselves and those that were put on them by significant others, to perform well at the competition. These types of pressures were identified as being a combination of self presentation concerns, personal expectations and expectations linked to the coach-athlete relationship that had manifested themselves in the pre-event phase and continued to be a concern on the day of competition. Participant six had high personal expectations as well as concerns about what other people thought about her performance. She indicated that other people would not have known that she had been injured and ill prior to competition and might judge her performance unfairly: “Not everyone knows I’ve been injured so to then go out and compete and people see that I’m not competing to my normal standard, I do worry about what they think”. Participant six spoke about a tumbling experience rather than a trampolining experience and explained that she felt that the expectation to perform was a pressure she put on herself but was also a pressure from her team mates(significant others) for whom the competition was also of importance. Three participants were in a medal winning position going into the final. Many would consider being in a medal winning position to be a positive experience; however, all three participants felt that their advantageous position contributed negatively to their personal levels of self expectation, as they wanted to maintain their performance in the final and win a medal. Participant three commented:

> I could see that I was lying in 3rd position after my 1st routine and I could see that after that I would have to do a really great routine. If I could like finish in 5th or something then I've got a really good chance after the 2nd flight go on and I'd still be in the final.

Participant six, who was in a similar situation commented:

> I was happy, because I had qualified, I was happy because I was coming 1st but then also like the pressure came on myself because I wanted to keep that that position and I was just . . . just overwhelmed but then I did have that pressure there . . . I was like happy and then I was like ahh like now I gotta do a final, you know..

For the remaining four participants, the expectation to perform was linked to the coach-athlete relationship and the desire to avoid letting their coach down. In summary, the expectations that the participants placed on themselves and the expectations that they perceived significant others to hold, appeared to have been prominent in the days leading up to the competition and on the day of the competition itself.

Imagery

All eight participants reported using imagery as part of their mental preparation for the competition both in the pre-event phase and on the day of competition. Generally, however the imagery skills of the participants were poor. The following quote by participant eight demonstrates poor imagery control, "The little stick man in my head usually falls over a lot …yea he doesn't like staying on. I do try but it just sorta over does it. Every time I try and visualise stuff it sorta happens". The quote indicates that the participant was able to create an image of their routine but the images were not vivid, controlled, positive or realistic, which ultimately indicated a lack of imagery ability. Four participants perceived themselves to have good imagery ability; however, participant two commented that although she thought she was good at visualising, she tended to lose concentration mid image and was not able to sustain the images in her mind. Two other participants reported that they could use imagery but that their images lacked control and clarity.

General emotional and behavioural disruption and increases in somatic anxiety

In the pre-event phase, three participants demonstrated a change in their general emotions including an increase in nerves that prevented them from sleeping and other emotional

changes such feeling irritated by significant others when they normally would not be. Four participants revealed that their everyday behaviour was normal or unaffected by the thought of the competition, but did not indicate either way if they viewed this as important towards their performance failure. This goes some way to highlighting the importance of the interpretation of somatic anxiety symptoms. On the day of competition, all eight participants indicated that they experienced an increase in general apprehension (mainly in the form of somatic anxiety / physiological arousal) and three participants classified the increases in somatic anxiety as difficult for them to control, including butterflies in the stomach, sweaty palms and being unable to sit still, leading the participants to "over think" their routines. In other words, the increases in somatic anxiety were interpreted as being debilitative towards performance, leading the participants to worry about their performance and over think their routine. This chain of events was reported to take place by all eight participants suggesting that the themes may be interlinked or have a degree of interactivity, given that all eight participants' performances ended in failure. Although the details of each participant's performance failure are subtly different, essentially all of the performance failures were underpinned by the same sequence of events.

Participant two reported:

> I was just feeling hot and uncomfortable, couldn't sit down for five minutes had to get up and walk and I just could not take my mind off it …that was it. I didn't eat (laughs) ummm . . . just tense, I get like tense in my shoulders and just go through my routine over and over again in my head and just really put myself off.

The participants were "over thinking" their routines or thinking about irrelevant things (which was the case for some of the other participants), leading to increases in cognitive anxiety levels. It was evident that increases in cognitive anxiety took place because thought processes such as over thinking the routine or thinking about irrelevant things, were not considered the norm for the participants and this was believed to have an overall negative effect on the participants' preparation. To further indicate how the themes are related and should not be considered in isolation to one another, seven participants

reported a general increase in the frequency of negative thoughts about the competition as well as thinking negatively about their own personal ability to perform well. These seven participants were also unable to think or focus on anything else, suggesting a form of narrowed focus.

The aforementioned symptoms, or themes as they have been referred to in the figures, were reported by seven out of the eight participants. In addition, other themes reported by all eight participants included an increase in self doubt and personal ability, not feeling ready or prepared to perform and thinking through the routine in a negative way. Given that all participants' performances ended in failure it suggests that there is a degree of interactivity among all ten the themes. This is reported as it is believed that had any of the themes were to be considered in isolation, the affects of any single one would be unlikely to have such a severe impact on performance, but when taken collectively resulted in performance failure.

Organisational stressors

Organisational stressors were only referred to on the day of the competition by three participants. The participants' inability to cope with these organisational stressors made for more concerns and worry on the day of competition. For instance, participant four spoke about a tumbling experience and indicated that the warm up area was not large enough in order to complete a sufficient warm up and this caused her additional concerns:

> I just remember standing there and sort of like "phew" 'cause there's always a massive queue of people and you never get a long enough warm up . . . And I always think like what am I going to do if I don't have enough time to warm up . . . or I know that when I'm cool it just goes completely wrong anyway, so I have to keep warm.

Such organisational issues were believed by some of the participants to contribute to the increases in physical apprehension on the day of competition, which in turn contributed the overall increase in pressure to perform and resulted in performance failure.

Overall increase in pressure to perform

All of the themes highlighted in the pre-event and on the day of competition were collectively identified as antecedents of an "overall increase in pressure to perform" experienced by all of the participants. This overall increase in pressure to perform appeared to manifest itself as a product of the experiences (expressed in themes) that each participant highlighted in the pre-event and day of competition phases. What is of significance at this stage is that all eight participants experienced most of the antecedents pre-event and on the day and it was this combination of antecedents that created the overall increase in pressure to perform. However, it must be noted that this increase in pressure to perform was slightly different for each participant but was underpinned through experiencing the aforementioned themes to varying degrees and intensities. For instance, participant three reported:

> I was happy, because I had qualified, I was happy because I was coming 1st but then also like the pressure came on myself because I wanted to keep that you know, that position and I was just…just overwhelmed just really happy that it had actually gone well the actually, the two routines and yea but *then I did have that pressure there*….Cause I was like happy and then I was like ahh like now I gotta do a final.

The quote captures a feel for participant three's experience of the overall increase in pressure to perform. She reported experiencing poor training times, poor imagery ability and thinking quite negatively about the competition in the pre-event and on the day of competition phases, which in isolation these factors appeared to have little negative effect on performance but collectively resulted in performance failure. Another participant reported many of the themes reported by the other participants in the pre-event and on the day of competition phases, including a narrowed focus, high personal expectations and organisational stressors. Again, in isolation, these themes seemed to have a small affect on his performance but it was only when all of the reported themes were considered together and in tandem with the pressure to perform that was reflective of the level of competition, that the magnitude of the effects were revealed and resulted in an overall increase in

pressure to perform. This lengthy piece of transcription from participant two aims to convey this idea more succinctly:

> No there was no really big pressure on me at all, I didn't put any pressure on myself apart from just to do two nice routines and then…on the day when I did do such a great set like, maybe like the best set I had ever done up until that point, then like something clicked and I put a huge amount of pressure on myself in my voluntary routine …so by the time it had got to that part when people were starting to competing then I think that's when the pressure started to build and I was like thinking I need to be *extremely* tight, how I would kick it out *sharp* to make this routine the best I could ever make it look …just like everything had to be perfect and I think that's why I kinda got maybe a little over stimulated and stuff and then …ummm choked in my voluntary routine. It just had to be better than I had ever done before and I had to concentrate even more, and visualising more than I had ever done before.

It is therefore evident that the themes the participants highlighted pre-event and on the day of competition, would probably be considered to elicit minimal damage on performance if considered in isolation. But, when taken collectively and in tandem with the pressures that are experienced just before actual competition, this led to an additional overall increase in pressure to perform. All eight participants reported feeling this additional increase in pressure to perform based on the reported antecedents that they perceived to influence their individual performance failures in the pre-event and on the day of competition phases. Essentially, the overall increase in pressure to perform should be viewed as a key contributing mechanism to the performance failure experiences.

Performance failure experiences (refer to Figure 2).

All of the performance failures were underpinned by the overall increase in pressure to perform combined with five additional themes that were uncovered at the time of the actual performance failure including; technical inaccuracies or faults, unusual movement kinaesthesia, attentional issues, lost move and the role of effort. In the same way as the themes uncovered in the pre-event and competition day phases could be considered influential of each other without being causal in nature, the themes in the performance failure phase all appear to be associated with one another.

Performance Failure

Raw Data	Theme
•Poor timing •Not jumping straight •Shaking •Poor technique	Technical inaccuracies or faults
•Movements forced and unnatural •Lost rhythm •Lack of flow •Felt like move had never been done before	Unusual movement kinaesthesia
•Thought too much about the routine as a whole •Not thinking about one move at a time •Too focused •Focused on irrelevant things •Thinking too much about one move •Thinking about finishing routine •Thinking about winning a medal •Thinking back to a poor warm up	Attentional issues
•Mind went blank •Couldn't "see" the move •Natural instinct took over	Lost move
•"Fighting" against the trampoline •Trying too hard •Increased effort to try and correct routine •Withdrew effort, gave up	Effort

Figure 2. Performance failure data and themes

Technical inaccuracies or faults and unusual movement kinaesthesia

Six out of the eight participants specifically focused on technical inaccuracies or faults through either making a mistake and / or not being able to execute the move properly at the time of the performance failure. What is of particular interest is that there were a variety of different reasons why each participant focused on technical issues. Participant three indicated:

> I think because I was like wanting it so bad that I just rushed it and then I think after about three or four moves, like it started to go wrong and I was like travelling lots and I wasn't lifting up nicely keeping the same rhythm, so I was rushing and it was getting faster and faster and I just like didn't do a very good routine at all.

Four participants indicated that the reason they felt unable to execute the move properly was because of how forced and unnatural their movements felt as they started to experience a drop in their performance. Participant three commented: "It felt like I was trying hard and I was working really hard, but that's not right, it shouldn't have felt like that, it should feel easy and relaxed but I just kept fighting against the trampoline". Participant one reported something similar to participant three and indicated that his movements were not natural and did not feel as natural as they should have:

> No, it was all forced, it didn't feel natural it didn't feel right, it didn't feel like training at all . . . it felt I was fighting a losing battle…almost as far from natural and not me and I tried to force my way through.

It was evident that the participants' experience of the movements during competition had changed significantly from training. The movements were reported to feel less automatic and this appeared to register consciously with the participants at this point as they became aware of their lack of automaticity.

Attentional issues

Attentional issues presented themselves in a number of different ways, including thinking ahead, being distracted by negative thoughts or images, thinking back to a poor warm up or overanalysing a certain move. Two participants indicated that they thought too much about finishing the routine and a third became distracted by the thought of finishing the routine once the "hard" part was over. Participant seven commented:

> I vaguely remember because I was going all over the trampoline and being so shaky, I was just trying to concentrate on getting through it and doing my ten. . . cos before you start you think about all the bad things, as soon as the routine starts you just think about finishing it.

The "ten" that participant seven is referring to is a trampolining term for the routine, which is made up of ten moves.

Participant two was distracted and stated:

> I think it got to the point where I had done the hard bit of the routine and I was just probably like 'ahh I've done the hard bit now you know, I can just do the easy bit at the end' and I think then that's when . . . cause I probably relaxed and then I just went to take off for it and it didn't happen.

Two other participants became more concerned about being in the final and the chance of a medal, which appeared to divert their thoughts away from the routine and caused them to think ahead to the outcome. Participant three commented;

> That's what I was focusing on …like how perfect I could make this routine look…to get the scores I needed and to beat some of the other people. Yea and I was not thinking about the right things. So like maybe you could describe that as a lapse in concentration, I wasn't concentrating on the right things, I was concentrating really hard but not on the right things…more like irrelevant things.

Participant five had an extremely poor warm up resulting in him overanalysing one particular move in an attempt to execute the move successfully in the actual performance. It was this narrow focus that he believed contributed heavily to his performance failure and is the only example in the study of potential controlled processing of a move:

> Then I got to move five which is the one I came off on before. . . did that move fine, the next move of all moves to fall off on was a tuck jump. . . I did this tuck jump and because I'd over shot on the move before, I was leaning back and as I was coming out of the tuck jump I just couldn't get the next move out. . . I think that's what I was doing into the Rudi … I was thinking too much and messed up the tuck jump … it had a knock on effect sorta thing".

In summary, there were variations on the attentional issues experienced by the participants. What is interesting though is that all eight commented on at least one form of attentional issue that put demands on their attention and made it difficult for them to deal with when they were anxious.

Lost move

Two participants reported that they went "blank" at the time of the performance failure and reported having no thoughts in their mind at that time. These two participants described how natural instinct took over and this resulted in them performing a move that should not even have been included in the set routine. Participant one commented:

> And I couldn't cope . . . I think that's why I went blank because I was trying to think of the whole routine at once instead of the first 2 moves which is what I do now. You don't need to think about the little details, especially when you have had enough practice because it's not necessary you can do it. . . . that's what I sort of think to myself now.

Participant two reported:

> It's just completely bizarre you just take off for it and usually you get the feel of the move and stuff like that and I just got there and brain just went "vzoom" completely blank and then it was just like what am I doing? I think its such a strange feeling I've never really had it before you just completely . . . subconsciously you don't realise its happening but you just go up and just your brain's just blank and you cant see it and then you've just got to decide at that point what to do to carry on so I just changed it to a straddle jump and then carried on.

Effort

Six out of the eight participants commented on the amount of effort they invested in their performance. Three participants, all of whom also reported that they were thinking too much about the routine in some way, claimed to increase the amount of effort they were putting into their routine once they realised their performance was deteriorating. Participant four commented: "I think it was just I was trying to put in everything I had but putting in too much, trying too hard". And participant three said: "I think I just like tried too hard kinda thing … I wasn't relaxed … I wasn't comfortable, like flowing through the routine nicely or anything like that". Two other participants indicated that once they noticed a drop in their performance, they withdrew their efforts and a third found herself just going through the motions of the routine with little effort being assigned to the routine. Participant two revealed:

> I was just carrying on the routine . . . just thinking . . . I wasn't putting in like the thought in the proper thoughts into the rest of the routine I kinda in a way . . . not had given up, but was just not trying as much because I had that at the back of my mind thinking ah what did I do that for kinda thing . . . just wanting to end quickly, just wanting to get it over with just to get off the trampoline.

To summarise, despite some participants increasing their effort levels whilst others decreased theirs, so it appeared that no amount of change in effort level, at that stage, could prevent the performance failures from taking place.

Discussion

The purpose of this study was to use an alternative research approach to the experimental paradigm used in the previous three studies of this thesis, to try to uncover the cause(s) of performance failure when skilled athletes experience high levels of cognitive state anxiety.

The current study successfully revealed ten themes in the pre-event and on the day of competition time phases that, when considered collectively, contributed to and resulted in an overall increase in pressure to perform, which was interpreted as a key contributory mechanism in the performance failure experiences of the eight elite trampolinists interviewed. Overall, the findings suggest that performance impairment appears to be the result of the interplay of several factors.

Given the different number of time phases in the current study and the large amount of information being presented, the pre-event and day of competition themes will be discussed first, before moving onto the main focus of the discussion, which centres on the participants' perceptions of what happened at the time of the actual performance failure. In general, the results suggest that there appear to be multiple causes for performance failure under pressure, including strong evidence for an attentional explanation, as explained by theories such as PET (Eysenck & Calvo, 1992) with some stronger evidence for the recently developed attentional control theory (ACT; Eysenck, Derakshan, Santos & Calvo, 2007). Some evidence was revealed to support the CPH (Masters, 1992), but not to a large extent, which adds consistency to the findings of the thesis as a whole.

Starting with the pre-event and on the day of competition phases, ten themes were identified and viewed collectively as antecedents to the overall increase in pressure to perform, as reported by all eight participants in varying degrees and intensities. Some of the reported themes are indicative of antecedents found within the wider cognitive anxiety literature. For instance, the antecedents of multidimensional anxiety include perceived readiness to perform and the athlete's attitude towards their previous performances (Hardy, Jones & Gould, 1996). Attitude towards previous performances could be explained by looking at the wider anxiety literature such as Jones, Hanton and Swain's (1994) study investigating elite and non-elite swimmers. It was revealed that despite little differences between the intensity of pre-performance cognitive and somatic anxiety, elite performers

interpreted their cognitive and somatic anxiety as being more facilitative to performance. The participants in the current study were of an elite level which according to Jones, Hanton and Swain (1994) should have meant that they were more likely to interpret their feelings as facilitative towards performance, but no mention is made as to whether the same principle applies for how a performer interprets their pre-competition experiences. Further investigation of the interpretation of pre-competition experience could add clarity to this area of research. Additionally further investigation of pre-competition experiences may be explained by the notion of interpretation, which sits with Lazarus' transactional perspective of stress and cognitive-motivational-relational theory (CMR) of emotions (Lazarus, 1990; Lazarus & Folkman, 1984). This suggests that performers may experience any number of emotions, including anxiety, but that these can be caused by different appraisals of a variety of stressors that may have diverse action tendencies (Hanton, Neil & Mellalieu, 2008). Hanton and colleagues incorporated the idea of direction into the study of emotions, in that emotions can be viewed as facilitative or debilitative towards an upcoming competition. Although the current study reported antecedents, Lazarus (2000a, b) has suggested that each emotion is caused by the manner in which individuals appraise their environment, in explaining that stress is an ongoing transaction between the environmental demands and a person's resources with strain (negative emotions) resulting in an imbalance between demand and resources (Hanton et al, 2008). Put simply, appraisal of the athletic environment influences emotion and vice versa, meaning that the antecedents uncovered in the pre-event and on day of competition phases would have been likely to influence how the participants appraised their individual situations and subsequently, their emotions. This links closely to the notion of relational meaning (the conjoining of the environmental demands and personal characteristics; Hanton et al., 2008) which generates cognitive–evaluation reactions which would have influenced the participants' views on their performance failure experiences. In the current study, the range of antecedents, albeit not all emotions, reported by the participants were generally viewed

as debilitative towards the upcoming competition and were appraised in a negative manner when reported in the context of their performance failure. With more appropriate strategies, the participants may have been able to view these antecedents in a more facilitative manner which may have resulted in a different outcome for the participants. To further explain, the participants in the current study may have ascribed the antecedents that they reported to contribute to the performance failures, purely because those antecedents occurred prior to that particular performance failure and not necessarily because the reported antecedents *actually* led to the performance failures. Although this is difficult to state without knowing what antecedents the trampolinists might report give a successful performance.

Further research would be warranted in order to ascertain whether the antecedents uncovered in the current study are common in other performance failure experiences across other situations and indeed across other sports. One piece of research that could give more insight on the appraisal of stressors across different sports, is that recently conducted by Mellalieu, Neil, Hanton and Fletcher (2009), who investigated the performance and organisational related demands experienced by twelve athletes (6 elite and 6 non-elite) when preparing for competition. Mellalieu et al. (2009) investigated the sources of performance and organisational stress in the preparation phase prior to competition (one hour prior to competition). Five performance stressors were revealed including; preparation, injury, expectations, self presentation and rivalry and five organisational stressors; factors intrinsic to the sport, roles in the sport organisation, sport relationships and interpersonal demands, athletic career and development issues and organisational structure and climate of the sport. Similar performance stressors were unveiled in the pre-event and on the day of competition phases of the current study, including issues associated with; preparation, expectations and self presentation. Participants in both studies referred to inadequate physical preparation as a contributory stressor towards their upcoming performance with Mellalieu et al's. (2009) participants' reporting the

preparation issues to be related to "inappropriate technical preparation" and "inadequate physical preparation". Both studies participants' alluded to expectations (of self and others), self presentation concerns and injury in the time period leading up to the competition, as well as various organisational stressors indicating concerns about factors intrinsic to the sport such as the competition set up and lack of familiar settings. Given that similar sources of stress have been revealed in the current study, it highlights the strength of the current research findings, which both support previous research but add further to our understanding of the antecedents of pressure to perform and competition stress.

The findings of the current study also support the recent work of McKay, Niven, Lavellee and White (2008) in their investigation of 12 elite UK track athletes. McKay et al. (2008) used semi-structured interviews to identify sources of strain. McKay et al. defined strain in line with recommendations of Fletcher, Hanton and Melleliau (2006), as "the negative psychological, physical and behavioural responses to stressors" (p. 145). In addition, stressors were viewed as "the environmental demands of the situation" (p. 145). Three domains of strain were identified; competitive, organisational and personal. Competitive concerns included issues such as self doubt, lack of confidence, injury concerns, self presentation concerns, to name a few, all of which are consistent with themes identified in the current study. In terms of organisational concerns, many of these were related to training issues, negative interpersonal relationships (including coach, media, team mates and parents) and personal concerns included injury, motivation and lifestyle demands, all of which are similar to the concerns highlighted in the current study. Of particular interest to the current study, were the 4 core sources of strain identified by McKay et al. (2008) including; competitive concerns, pressure to perform, lifestyle demands and negative aspects of interpersonal relationships. Competitive concerns and pressure to perform were common to the current study, suggesting that such strains can be deep rooted in the lead up to competition and are therefore influential on performance.

Future research is warranted, to see if there are links between the sources of strain and how these are perceived to impact on performance failures in competition.

Another antecedent of prominence that was reported to contribute to the overall increase in pressure to perform was the use of imagery which was generally considered to be poor among the participants. On the day of competition negative imagery influenced, and subsequently lead to, the increase in negative thought patterns reported by the participants. These findings are supportive of Day et al. (2006) who reported that an increase in negative imagery was a contributory factor to the development of LMS. The current findings also provide evidence for the emergence of negative thinking as a key variable and this was revealed to be a contributory factor to the development of the yips in Bawden and Maynard's (2001) study.

With the overall increase in pressure to perform underpinning the performance failure experiences we now move to the main focus of the discussion, the participants' perceptions of what took place at the time of the actual performance failure experience. Five themes were reported by the participants to contribute to the performance failure. These included; technical inaccuracies or faults, unusual movement kinaesthesia, attentional issues, lost moves and the role of effort. Each of these themes, in particular technical inaccuracies or faults and attentional issues, suggests a degree of threat to the performances that were taking place. If the participants had been performing automatically then it would have been unlikely that they would have picked up on technical inaccuracies or attentional issues. It is therefore suggested that participants reported technical inaccuracies or faults because they had become distracted by task-irrelevant thoughts or task-threatening stimuli at the time of their performance failure. For example, the participants reported registering that their movements felt less automatic and different to that experienced in training as well as being distracted by thinking about wanting to perform well. With reference to the attentional issues theme, it was clear that distraction from the movements being carried out was manifested throughout the entire performance

failure, but in a variety of different guises, including thinking too much about one move, thinking back to previous poor performances and thinking about finishing the routine. Although these attentional explanations are all slightly different, they each go some way to explaining why the participant's movements felt different to how they had felt in training, or how they "should" have felt when the performance was going well. Moran (1996) highlighted a number of reasons for choking under pressure that are of relevance to the current findings, and include distraction through "fortune telling" and thinking about the future, both of which were reported by the participants in the current study. Distractions like these provide some evidence for an attentional based explanation given that performance pressure creates a distracting environment which might cause performers to shift from task relevant to task-irrelevant thoughts (Wine, 1971; Baumeister & Showers, 1986).

Both technical inaccuracies and faults and attentional issues, highlight a form of distraction, which fails to support predictions of the CPH, and given that the PET does not make specific theoretical assumptions about the effects of distracting stimuli on performance, our attention is drawn to attentional control theory (ACT; Eysenck, Derakshan, Santos & Calvo, 2007) for an explanation. Attentional control theory has recently made advances and built on the limitations of the PET (Eysenck & Calvo, 1992) by providing more precise predictions about which functions of the central executive are most adversely affected by anxiety. Attentional control theory suggests that anxiety impairs processing efficiency because it reduces attentional control and this is most prevalent in the presence of threat-related stimuli, resulting in the processing resources that are available for the task being diverted from the task-relevant stimuli to task-irrelevant stimuli. This process mainly involves the inhibition and the shifting functions of the central executive and takes place under conditions of high anxiety, when task demands on the central executive are high (as would be expected in a highly complex skill such as trampolining). This notion of distraction is something that the PET failed to make any

assumptions about, but the findings of the current study suggest that the participants were distracted by a number of different issues, all of which could be perceived to be threatening to performance. What is also of interest is the nature of the distractions or perceived threatening stimuli reported by the participants where all internal in nature (worrisome thoughts about how the moves felt, how much effort was being expended etc). Eysenck et al. (2007) report mainly external threatening stimuli in their discussion of ACT but reported that the same theoretical assumptions could be used to explain why internal distracting stimuli attract attention away from the task and impair performance. Therefore it seems plausible that neither the CPH or PET should be considered as wholly appropriate theories with which to explain performance failures. More research into the recently advanced ACT should be considered as a possible explanation.

The unusual movement kinaesthesia reported by the participants can be better explained by increases in conscious control. Increases in conscious control were also reported in previous research by Bawden and Maynard (2001), Collins et al. (1999) and Day et al. (2006), so these findings are supportive of previous research in the area. Increases in conscious control were mainly reported to lead to lack of natural movements and a lack of flow. Flow is described as being a positive psychological state that occurs when an individual perceives there to be a balance between the challenges of the situation and their ability to meet these demands (Csikszentmihalyi, 1990). A number of dimensions to flow have been identified in the literature including; skill balance, merging of action and awareness, clear goals and feedback, total concentration on the task at hand, sense of control, loss of self consciousness, time transformation and an autotelic experience (Csikszentmihalyi, 1990; Jackson & Csikszentmihalyi, 1999). Flow is said to be difficult to attain under conditions of high anxiety so again, given the conditions under which the participants were performing, it makes sense for the participants to have perceived there to be a lack of flow in their movements at the time of their personal performance failure. Jackson (1992, 1995) investigated the notion of flow among elite athletes and revealed that

they felt it was something that could be controlled. Jackson investigated what facilitated flow and revealed that in order to achieve flow an athlete must be confident in their ability to meet the challenge of the situation. In addition, preparation was considered to be key, with more highly prepared athletes having flow states. Lack of physical preparation or readiness was considered to be an obstacle to flow (Jackson, 1992, 1995) as well as inappropriate focus in the form of thinking too much, not being focused enough or worrying about the competition, all of which were reported by the participants in the current study.

Effort is the fourth of the five themes uncovered during the performance failure time phase. Certain types of distraction include those that lead to a shift in attentional demand, which can stem from a lack of motivation and can also be linked to effort. Typically, increases in effort are said to occur when the individual perceives themselves to have at least a moderate chance of success (Eysenck & Calvo, 1992). Out of the eight participants in the current study, three reported that they increased the amount of effort they put into their performance given the position that they found themselves in. Edwards et al. (2002) found in their study that some participants withdrew their efforts once they started to experience a dramatic drop in their performance. It is worth noting that motivation and effort are two notions that are central to PET (Eysenck & Calvo, 1992) and ACT (Eysenck et al., 2007). Eysenck and Calvo believe that cognitive anxiety produces a motivation to avoid adverse consequences and a reduction in effort is believed to take place when the individual does not perceive them self at having a chance of success at the task. Some of the participants in the current study may have believed themselves to have a chance of success at the task and this therefore helps explain why they invested large amounts of effort whereas some participants, once they realised that their performances were starting to deteriorate, withdrew their efforts.

Finally, the notion of lost moves was reported as a factor that some of the participants believed contributed to their performance failure. The notion of LMS is still

relatively under researched but Day et al. (2006) made significant contributions to this field and to furthering our understanding of the phenomenon. What is of interest is the fact that lost moves was reported in the current study and this could potentially act as an early warning sign for more severe lost moves in future performances. Future research in the specific area of LMS is warranted.

To summarise the main findings, the current study uncovered an overall increase in pressure to perform, underpinned by ten antecedents identified in the pre-event and on the day of competition phases. This overall increase in pressure to perform appeared to be a key contributory factor to the actual performance failures. It appeared that increases in distracting thoughts, such as task-irrelevant and threatening stimuli also contributed largely to the explanations provided by the current participants for their performance failures. In light of this ACT (Eysenck et al., 2007) may be considered the most plausible explanation for the performance failures however little research has been conducted into this theory and given that controlled processing and the role that effort had to play was also reported by the participants, it remains plausible, that both self focus and attentional models should be considered when looking to explain performance failures in conditions of high anxiety, rather than viewing them in isolation.

With particular reference to the antecedents revealed in the pre-event and on the day of competition phases, there appears to be a need for a number of intervention strategies to be implemented during the stages of preparation for competition. These include increasing athlete's knowledge and practical use of basic mental skills. The participants in the current study referred to a number of psychological factors being difficult to manage, including controlling negative thoughts, imagery ability, coping and then at the time of the performance failure a lack of skills to deal with the overall increase in pressure to perform and being able to remain focused on current performance due to various attentional problems, including task-irrelevant stimuli consuming attentional capacity. Basic mental skills training could have potentially altered some of the

participant's appraisal of the overall increase in pressure to perform, through strategies that could assist in reducing their negative thoughts and images such as replacing negative thoughts with more positive ones through cognitive restructuring or thought stopping techniques (Hardy, Jones & Gould, 1996). Such strategies have already been implemented successfully in recent experiments by researchers including Thomas and colleagues (Thomas, Hanton & Maynard, 2007). At the time of the performance failure itself, participants in the current study reported thinking ahead or thinking about a previous performance and this appeared to switch their attention away from their current performance. This could potentially be controlled and managed through the use of process goals (Kingston & Hardy, 1997). Support was found for the use of holistic process, part process and externally referenced goals in preventing performance decrements under stress in studies 1, 2 and 3 of this thesis. Educating athletes and coaches on how to devise and use process goals that are relevant to their specific sport, could give athletes something to focus their attention on and may assist in preventing individuals from becoming distracted by task-irrelevant stimuli such as thinking back to previous performances or ahead to finishing their routines. Most importantly however, could be the need for athletes and coaches to manage and interpret pressure or other sources of stress such as previous performances and organisational sources of stress, in a more facilitative manner (c.f. Hanton et al., 2008; Neil et al., 2007). Had the participants had been able to manage and control some of the reported antecedents that contributed to the overall increase in pressure to perform, and had been able to put such pressures into perspective, the antecedents may not have manifested themselves as severely and resulted in performance failure.

Future research needs to consider the real life experiences of elite level performers and make more use of qualitative methods in order to get a more complete understanding of the mechanisms underlying performance failure in conditions of high anxiety. Intervention strategies in the form of educational workshops based on dealing with some of the antecedents of pressure to perform and some of the other highlighted performance

failure factors could serve to educate athletes, coaches and parents on how best to prepare for such eventualities or at least inform them of what the possible warning signs are. Good psychological mental skills training, particularly in visualisation and thought stopping techniques could be implemented and also the benefits of using simulation training (Stratton, Cusimano, Hartman, & DeBoom, 2005) and dual-task focused environments (Beilock, Carr, MacMahon & Starkes, 2002) could help athletes cope with potential performance failure situations, should they be faced with them and reduce the risk of performance failures reoccurring in the future. Additionally, education in these areas could also potentially prevent the development of more severely debilitating issues such as the yips or LMS.

In conclusion, the results of the current study revealed a number of themes that were perceived to occur in the pre-event and day of competition phases and which acted as antecedents to an overall increase in pressure to perform. Overall, the participants reported that they experienced distractions along with their movements feeling forced, un-natural and lacking in flow, and of which was underpinned by an overall increase in pressure to perform which resulted in the performance failure experiences reported. The emergence of possible conscious control notions are supportive of the findings of Day et al. (2002), Bawden and Maynard (2001) and that of Collins et al. (1999) who all highlighted an increase in conscious control as a contributory factor to their participants breakdown in performance, so conscious processing should be considered as potential partial explanation for aspects of some of the performance failures in the current study. Stronger support however, was revealed for an attentional based explanation, such as that of PET (Eysenck & Calvo, 1992) and ACT (Eysenck et al., 2007) and distraction based explanations should be considered the most plausible explanation for the performance failures reported in the current study. The findings of the current study therefore suggest that there are several mechanisms that appear to explain what causes performance failures in conditions of high anxiety.

CHAPTER 7

SUMMARY AND CONCLUDING COMMENTS

Introduction

The purpose of the final chapter is to draw together the findings of the thesis with some concluding thoughts, comments and recommendations. This section is divided into five parts: (1) a synopsis of the aims and major findings of the research programme, (2) an examination and discussion of the theoretical issues derived from the results, (3) a discussion of the applied implications of the research programme, (4) an identification of the strengths and limitations of the research and (5) recommendations for future research and concluding thoughts.

Synopsis of the aims and major findings of the thesis

The purpose of the current research programme was to examine the process goal paradox and the conscious processing hypothesis (CPH; Masters, 1992) as an explanation for performance decrements in conditions of high anxiety. The goal setting literature suggests that the use of process goals, which are typically defined as the behaviour that an individual engages in during task execution, can be of benefit to performance (Kingston & Hardy, 1997). However, when process goals are placed in the context of the CPH, part process goals present an apparent paradox as they encourage individuals to focus consciously on parts of their performance that would normally be performed automatically (Hardy, Jones & Gould, 1996). It may be that process goals serve differing functions depending on the ability level of the anxious performer, in that part process goals may actually serve to enhance performance in less skilled performers and may be less beneficial for more expert performers. Examination of the process goal paradox, subsequently allowed conscious processing effects to be examined whilst controlling for any alternative attentional explanations. This has been something that previous research has failed to do, with only Mullen, Hardy and Tattersall (2005) been successful in isolating the effects of conscious processing and attentional threshold explanations.

The current research programme aimed to further develop research that has examined the CPH. In line with Mullen et al (2005), psychophysiological measures of mental effort were used to measure mental effort and included heart rate variability (HRV) via spectral analysis of the cardiac signal and a self report measure, the rating scale of mental effort (RSME, Zijlstra, 1993). Other studies in the area of conscious processing have made use of task-relevant and task-irrelevant cues to induce or inhibit conscious processing, but the current programme wanted to specifically investigate the process goal paradox as a means of isolating and investigating conscious processing effects, without invoking alternative attentional explanations. In doing so, this allowed the current research programme to both add to existing theory and provide new insights into the area of investigation. Overall however, despite the fact that the CPH has long stood as an established and plausible explanation for the performance disruption of skilled but anxious performers remains unsupported in the current research programme. The results of the current research suggested that the use of part process goals did not induce conscious processing effects in the way they were predicted to and little evidence was found to support the notions of the CPH. As a result of the lack of support for the CPH this reinforced the need for alternative research methods to be used when investigating the phenomenon on performance decrements.

In the final study an alternative strategy was employed to investigate eight elite level trampolinists' perceptions of the causes and mechanisms for performance failure, given a lack of performance decrements in studies 1, 2 and 3. The alternative perspective taken in the final study demonstrated the researcher's ability to use a range of methods and tools to examine a specific research question. Overall, the thesis has provided consistent support for the use of process goals; part, holistic and externally focused in nature, in preventing performance decrements in conditions of high anxiety, which contradicts the predictions of the CPH (Masters, 1992) and has therefore added progressively to the understanding of an issue that has long been of interest in the field of sport psychology. In

addition, a more in-depth investigation of the mechanisms underlying performance failures produced support for attentional threshold explanations, including processing efficiency theory (PET; Eysenck & Calvo, 1992) and the more advanced and recent attentional control theory (ACT; Eysenck, Deraksham, Santos & Calvo, 2007), which furthered the understanding of the nature of performance failures in "real life" settings. Overall the findings added to existing theory and contributed some new information to the area of performance failures in high anxiety.

Study 1

Study 1 examined the process goal paradox using a single part process goal, a single holistic process goal, an external goal and a discovery learning group in a driving simulation task in both an acquisition phase and across neutral and competition conditions. Participants completed laps of track whilst attending to one of the goal conditions to guide their performance. A significant main effect for block in the acquisition phase revealed that all groups improved their performance across the acquisition phase. The HRV data in the high frequency band (HRVHF) revealed a significant main effect for block and the heart rate (HR) data revealed a significant main effect for group, with the part process goal group having higher activity levels in comparison to the external group. Across low and high anxiety conditions (competition phase), cognitive anxiety and self-reported mental effort increased and driving performance improved significantly. Additional significant support was found for the use of a holistic process goal over a part process goal in producing the highest performance improvements across low and high anxiety conditions. In addition, the HRV data indicated that using part process goals may have produced a different activation state compared to the other conditions.

Overall, the findings of study 1 support the use of all goal conditions in improving performance across acquisition and high anxiety conditions but at the expense of processing efficiency, given mental effort scores increased. Additional support was found for a holistic process goal being the most effective in improving performance across low

and high anxiety conditions. A lack of performance decrements was therefore attributed to increases in mental effort and can be further explained by PET (Eysenck & Calvo, 1992). The results of study one failed to find any support for conscious processing effects and therefore failed to support the CPH. As a means of exploring why performance decrements failed to take place, a number of limitations and reasons were considered before study 2 was conducted. One of these limitations stemmed from earlier recommendations by Mullen, Hardy and Tattersall (2005) who suggested that conscious processing effects may be more common in tasks that are highly demanding of motor control; including a basketball free throw. Additionally, it was considered interesting to test whether the effects found in study 1 could be replicated using novice and expert performers given that the practice time in study 1 may not have been sufficient to ensure a degree of expertise at the driving simulation task.

Study 2

Study 2 further investigated the process goal paradox using the same goal setting conditions as study 2; a single part process goal, a single holistic process goal and an external goal. In light of the limitations highlighted in study 1, novices and experts performed a basketball free throw in low and high anxiety conditions. The results were similar to those found in study 1, as any type of goal (part process, holistic process or external) prevented performance from deteriorating in the high anxiety condition, but no significant performance improvements were observed in study 2. In terms of expertise, the only significant finding indicated that, in general, experts performed better than the novices, as predicted. Cognitive anxiety and mental effort scores increased in the high anxiety condition, indicating a successful anxiety intervention and suggesting that the participants may have made use of effortful strategies to compensate for the potentially harmful effects of anxiety. As in study 1 however, the increases in mental effort were not mirrored in the HRV data. The HRV data in the mid frequency band (HRVMF) revealed a significant Level x Group interaction which was likely to be the result of a difference in

the novice group between the external and the holistic process goal groups, with the external group having higher activity levels than the holistic process goal group. Overall, despite significant increases in anxiety and additional effort being assigned to the basketball free throw task, performance was maintained at a level similar to that produced under conditions of low anxiety, providing more support for PET (Eysenck & Calvo, 1992).

In summary, studies 1 and 2 both revealed that the use of process goals, regardless of content (part, holistic or external) assisted in preventing performance decrements in conditions of elevated anxiety. In light of the findings of study 2 there was yet again little evidence to suggest that conscious processing is an exclusive underpinning explanation for performance decrements. It was at this stage of the research programme that the researcher felt it was necessary to look at the number of part process goals in order to determine whether it was the number, or the nature of the goals, that induced conscious processing effects in conditions of high cognitive state anxiety. Study 3 was born out of both the findings of studies 1 and 2 as well as some recent research conducted by Gucciardi and Dimmock (2008), who found that the use of three task-relevant cues resulted in a drop in performance under conditions of high anxiety, whereas the use of a single global swing thought or three task-irrelevant cues did not disrupt performance.

Study 3

Study 3 examined the impact of using a varying number of part process goals when performing under high and low anxiety conditions in expert tennis players. Tennis players completed the Avery Richardson Tennis Serve Test (ARTST; Avery, Richardson & Jackson, 1979) whilst focusing on one, two or three part process goals. A significant increase in cognitive anxiety scores demonstrated a successful anxiety intervention and the results revealed that the number of part process goals did not result in performance impairment. A significant main effect for group revealed that the use of two part process goals appeared to produce better performance than either one or three part process goals,

but no significant main effect for anxiety condition indicated that performance did not change significantly in the high anxiety condition. The findings of study 3 were consistent with studies 1 and 2 of this thesis, providing support for the use of part process goals in preventing conscious processing and significant performance decrements under conditions of high anxiety. Given that no evidence for performance decrements were witnessed and no evidence of conscious processing effects were uncovered as a result of using part process goals, the mechanisms that underpinned performance decrements under high cognitive anxiety still lacked clarity and demanded a more thorough investigation. It was at this stage that an alternative approach was required to help uncover what other underpinning mechanisms were taking place when performance was breaking down under stress.

Study 4

Having failed to successfully uncover evidence of performance decrements in studies one two and three, the final study took a different investigative approach. Study 4 aimed to ascertain the causes and mechanisms that contribute to performance failure under pressure. The personal performance failure experiences of eight elite trampolinists were examined in order to reveal a more thorough understanding of the underlying causes for performance failures. Semi-structured interviews were used to identify the participants' thoughts, feelings and behaviours in the pre-event phase (weeks and days leading up to the competition), on the day of competition and at the time of the actual performance failure. Study 4 uncovered a number of key mechanisms that underpinned the personal performance failure experiences of the participants interviewed. Ten themes were uncovered in the pre-event and on the day of competition phases including; training and technical issues, negative thought patterns, self presentation concerns, personal expectations, coach-athlete concerns, imagery use, general emotional and behavioural disruption and organisational stressors. It was believed that these ten themes served as antecedents of an "overall increase in pressure to perform" as experienced by all eight

participants. The participants all believed that the identified themes played a significant part in their performance failure experience. The overall increase in pressure to perform was a central pivotal factor in the performance failure experiences and contributed to five additional themes that were reported to manifest themselves at the actual time of the performance failure. These five themes included technical inaccuracies and faults, unusual movement kinaesthesia, attentional issues, lost moves and effort. The overall increase in pressure to perform as determined by eleven antecedents, twinned with the five themes identified at the time of the performance failure provide a detailed and comprehensive insight to the personal performance failure experiences of a homogenous sporting group. A number of the themes reported in study 4 were also identified in previous research (Bawden & Maynard, 2001; Collins, Morriss & Trower, 1999; Day, Thatcher, Greenlees & Woods, 2006) and more recent work on performance and organisational stressors (Mellalieu, Neil, Hanton & Fletcher, 2009). The results of study 4 were consistent with previous findings in this thesis in that they did not fully support conscious processing as an exclusive explanation for performance decrements in conditions of elevated anxiety. It must be noted however, that some comments made by the participants did suggest that conscious processing notions should not be ruled out completely. It was argued however, that attentional issues and technical faults are more indicative of attentional-based explanations, such as PET (Eysenck & Calvo, 1992) with some supporting evidence for the recently advanced attentional control theory (ACT; Eysenck, Derakshan, Santos & Calvo, 2007). The participants' responses indicated that shifts in attention took place from task-relevant to task-irrelevant stimuli that were perceived to be threatening towards their overall performance, which may provide support for the adverse effects on anxiety on the inhibition and shifting functions of the central executive, as predicted by ACT. Overall, the results of study 4 appeared to fit more suitably with distraction based explanation and to a less extent, a more general self focus explanation as a means of describing performance

decrements. This demonstrates that performance decrements do not appear to be able to be attributed to one explanation alone.

Theoretical Issues

A number of theoretical issues emerged from the current research programme and are considered fundamental to explaining the affect that anxiety has on performance, including: (1) a lack of unequivocal evidence to support the CPH as a plausible explanation for the effects of anxiety on motor performance, (2) the use of effort as an asymmetry factor in catastrophe models of the anxiety-performance relationship, (3) the influence of an individual's predisposition to reinvest and how this impacts on the anxiety-performance relationship, and (4) the use of interdisciplinary research in the thesis.

Lack of support for the conscious processing hypothesis

This section aims to demonstrate the range of explanations for why performance becomes disrupted under high anxiety, indicating that conscious processing is not an exclusive explanation for performance disruption, as demonstrated in the current research programme. As has already been established, performance disruption under pressure can be explained from a number of different perspectives, however the two most prominent types are; distraction based theories, where a performer's attention becomes focused on task-irrelevant stimuli (Eysenck & Calvo, 1992; Sarason, 1988; Wine, 1971) or self focus based theories (Beilock & Carr, 2001; Lewis & Linder, 1997; Masters, 1992, Mullen & Hardy, 2000). Conscious processing hypothesis is one type of self focus theory, but other types exist (Masters & Maxwell, 2008). The different subtypes of self focus explanations that exist are united by definition, in that they all attribute performance decrements to an increase in focus on the self. However, there are a number of subtle differences that distinguish one self focus sub type from another and these subtle differences need clarification in order to avoid the reader assuming that all self focus explanations imply

conscious processing. Such notions are slightly speculative but highly probable given the fine, often grey line that distinguishes one subtype of self focus from another.

Within the school of the self focus subtypes are explicit monitoring theories (e.g., Beilock & Carr, 2001), which suggest that conscious attention assigned to a task results in performance disruption. This is a slightly different subtype to conscious processing, however and, as highlighted by Jackson, Ashford and Norsworthy (2006), there is a conceptual distinction between explicitly monitoring and consciously controlling a movement. A further type of self focus is concerned with an internal and external focus of attention (Wulf, 2007). Information detailing the research on internal and external focus of attention is included in chapter 2 of this thesis. In brief, Wulf and colleagues describe an internal focus of attention as an inward focus on bodily movements that serve to guide performance (Wulf, 2007). In contrast, an external focus of attention focuses on the effects of a performer's movements on the environment. Wulf and her colleagues argue that an internal focus of attention encourages conscious control of movements and an external focus encourages more automatic movements. As with the different subtypes of self focus, subtle differences in the content of instructions given to participants when taking part in experiments warrants careful attention. Within Wulf's work, no declarative knowledge was provided in the focus of attention instructions, making it difficult to establish whether an internal focus of attention actually induced any conscious control to the assigned movement or whether explicit knowledge is needed in order to induce conscious control. Researchers should take note as to the subtleties of the different subtypes of self focus as well as understanding whether explicit knowledge is guiding attention or if attention is merely being focused to the self. In other words, inconsistent use of the subtypes of self focus or varied instruction giving could lead to misleading and inaccurate accounts of results that imply conscious processing effects, when in fact they are explicit monitoring effects. In summary, the findings of the current research programme suggest that the CPH (Masters, 1992) is not an exclusive explanation for performance decrements under

conditions of high anxiety and other explanations should be more seriously considered. Ideally, several explanations should be viewed in tandem with each other in order to give a more thorough explanation for performance decrements. This is recommended as it is believed that performance decrements are not the result of one explanation alone, but typically are the result of the interplay of a number of factors. Too often, only one explanation is used as a means to describing or failing to describe what is taking place when performance breaks down, but frequently, and from the results of the current research programme (and in particular study 4), it is evident that performance decrements may be the result of the interplay of several factors.

Effort

Effort appeared to have an influential role in contributing to the findings of studies 1 and 2. Significant increases in effort paralleled with the absence of performance decrements in conditions of high cognitive state anxiety in both studies, lead to the suggestion that conscious processing and processing efficiency effects are complementary, rather than contradictory. In recent support of this complementary view, Hardy, Beattie and Woodman (2007) proposed the notion of two cusp catastrophe models. The first being the original model which looks at the interactive effects of cognitive anxiety and physiological arousal on performance, and a second which considers the use of effort as an asymmetry parameter that interacts with cognitive anxiety to impact on performance. Following some criticisms of the original cusp model and the notion of hysteresis, Hardy et al. (2007) suggested that the increases in physiological arousal suggested in the original cusp may have actually been induced by increases in task-related effort. To further explain, the PET suggests that increases in effort to a task increase available working memory and may enhance performance (Eysenck & Calvo, 1992); however, this is only believed to take place if the individual believes him or herself to have at least a moderate probability of success. Hardy et al. (2007) used PET (Eysenck & Calvo, 1992) to provide one explanation of how performance catastrophes might take place. According to PET, as worry (as induced by

cognitive anxiety) and effort increase, there will eventually come a point where the performer will no longer perceive to have a chance at success at the task, resulting in a withdrawal of effort. Such notions seem plausible, as the increases in effort reported in studies one and two of this thesis were not accompanied by performance decrements. Equally though, the findings of study 4 uncovered variations in the use of effort with some participants demonstrating increases in effort to the task and others reporting a withdrawal of effort levels, providing some evidence to suggest that effort levels may have an optimum level, at which each individual performer makes a decision about whether to continue to invest effort or remove effort altogether. The current thesis reveals some findings that are in line with Hardy's (1999) initial proposition that an interaction could take place between cognitive anxiety and effort to impact on performance and Hardy et al's (2007) more recent suggestion although further research would be warranted.

Individual differences and predisposition to reinvest

The likelihood of conscious processing effects having a greater impact on performance over distraction based effects may be determined by individual differences, such as an individual's predisposition to reinvest. Predisposition to reinvest has been suggested to be a function of personality (Masters, Maxwell & Eves, 2003). If an individual is likely to reinvest then it has been suggested that they are likely to be more susceptible to conscious processing effects. Jackson, Ashford and Norworthy (2006) investigated field hockey players and soccer players in different conditions of attentional focus under high and low anxiety conditions and examined the predictive validity of the Reinvestment Scale (Masters, Polman & Hammond, 1993). Jackson et al. (2006) found that individuals who were prone to reinvesting, had higher reinvestment scores and were therefore predicted to have a greater chance of their skills failing under pressure than individuals who had low reinvestment scores. Predisposition to reinvest could be viewed as an additional factor for consideration when trying to gain a better understanding of performance failures under pressure.

Interdisciplinary research

An interdisciplinary approach was used in studies 1 and 2 of this thesis by incorporating the use of spectral analysis of heart rate variability (HRV) as a psychophysiological measure of mental effort in conjunction with the rating scale of mental effort (RSME; Ziljistra, 1993). Interdisciplinary research has the advantage of bringing together different areas of expertise to assess a specific research problem. The prediction that decreases in activity in the mid frequency band would mirror the increases in the participant's perceived mental effort were not supported. Had HRV been used in conjunction with another measure such as blood sampling, then these two methods could have been used to further investigate changes in mental effort and physiological arousal in the participants. Blood sampling can be used to detect increased activation of the sympathetic branch of the autonomic nervous system and if used in tandem with traditional psychological measures such as the Competitive State Anxiety Inventory-version 2 (CSAI-2; Martens, Vealey, Bump & Smith, 1990), could create a more accurate overall picture for future researchers to base their findings on. Additionally the use of saliva cortisol could also be considered as an additional psychophysiological measure. Cortisol is a glucocortical hormone produced in the adrenal cortex and is believed to be a major indicator of altered physiological states in response to stressful situations (Veltman, 2002). Recent research using ACT (Santos, Wall & Eysenck, 2006) made use of functional magnetic resonance imaging (fMRI) to assess brain activation under conditions of high state anxiety. As shifts in attention take place, greater activation in the right lateral prefrontal cortex is detected. By using this method, within a sporting context, researchers may be better placed to identify the adverse affects of anxiety with specific reference to distraction based explanations related to the inhibition and shifting functions of the central executive. Future research should consider making use of such alternative measurement methods in order to continually improve and refine current methods, whilst also being able to account more accurately for what causes performance to fail under pressure.

Applied Implications

The findings of the current research programme highlight several practical issues of interest to performers, coaches and sport psychologists, including: (1) distractions and possible distraction techniques, (2) recommendations for basic psychological skills training and (3) methods to identify the underpinning mechanisms that contribute to performance failures. Additionally, throughout the current research programme support has been found for the use of goals, both part process, holistic process and externally focused in maintaining performance standards under conditions of high anxiety across a range of ability levels and a number of sporting tasks. Such findings support the applied sport psychology literature, which suggests that the use of process goals can be used as a method for retaining focus during performance (Bull, Albinson & Shambrook, 1996; Kingston & Hardy, 1997). Further research is recommended however, before suggestions would be made to coaches and athletes regarding which type of process goal would be best placed to make use of when executing movements under conditions of high anxiety.

Distractions and possible distraction techniques

Study 4 uncovered a convincing argument for attentional based theories as a potential explanation for performance decrements under conditions of high anxiety. Although distractions alone could not be considered an exclusive explanation for the performance decrements experienced by the eight elite trampolinists, it was found to be the most frequent explanation and many of the comments made referred to being distracted by "irrelevant thoughts", for example thinking about finishing the routine or thinking back to a poor warm up or performance, thinking about winning, self presentation concerns and personal expectation concerns. All of these comments suggest that the performers were distracted by task-irrelevant stimuli of varying types when they experienced their performance failures, which provides support for distraction-based explanations. To reiterate, distraction-based theories state that performance pressure creates a distracting environment which causes the performer to shift their attention from task-relevant to task-

irrelevant thoughts (Beilock & Carr, 2001; Wine, 1971). These descriptions related to irrelevant thoughts are supportive of ACT (Eysenck et al., 2007), which suggests that anxiety impairs efficiency on tasks involving the inhibition function, especially with threat-related distractors. Interventions that inform and guide athletes and coaches about how best to deal with distractions could be beneficial in reducing the impact that distractions may have on performance, or at least reduce the degree of threat that the participants may associated with such task-irrelevant thoughts or stimuli. Two strategies that could alleviate the effects of distractions may include over learning and simulation training (Stratton, Cusimano, Hartman & DeBoom, 2005). Over learning of skills could assist by encouraging automaticity and therefore reduce the impact of distraction or an increase in attentional demands in the face of high anxiety. As suggested by Mullen, Hardy and Tattersall (2005), expert performers are more likely to maintain performance effectiveness despite attentional depletion. Simulation training is one technique that can be used in an attempt to familiarise the performer with the various types of distractions or additional attention demanding variables that might present themselves at a competition or other high pressure situations. Utilisation of such techniques may enable athletes in becoming more familiar with the potential distractions, making them less susceptible to the effects of distractions if faced with them in conditions of high anxiety. According to Stratton, Cusimano, Hartman and DeBoom (2005) simulation training allows athletes to develop and master the skills that they will need in order to maintain optimal focus and perform at their best in competition.

Basic psychological skills training

Without further research, no recommendations would be made to coaches or athletes with regards to ways to assist performance across low and high anxiety conditions. Overall though, support for any type of goal was found throughout the thesis so further research could add clarity to exactly which type of goal should be recommended and may uncover variations in the effective use of process goals depending on sport type and ability. Careful

consideration of the phrasing of the goals would be required in order to ensure that the performer understands, interprets and makes use of the assigned or self selected goals in the correct manner. Other basic psychological skills training that might have had an impact on preventing performance failures could include imagery sessions in order to improve focus and performance. This recommendation is made based on the comments from study 4 which suggested that had the participants been educated in how to use imagery, they could have potentially reduced the impact that negative thoughts and images had on contributing to the performance failures. Additionally, the participants in study 4 may have benefited from strategies that are designed to help performers deal with the pressure associated with a competition. For instance, exposure to competition-like-conditions, outside of actual competition, may assist in the management of thoughts, feelings and behaviours.

Positive identification and early detection of the antecedents of performance failures

As there were no performance decrements in studies 1, 2 or 3, this recommendation is based mainly on the results of study 4. The proposal centres on encouraging athletes and coaches to become more aware of the antecedents of pressure to perform identified in study 4. In doing so, this could enable early identification of the antecedents of pressure to perform which, in the opinion of the trampolinists interviewed, had a large and significant part to play in the build up to their personal performance failures. If coaches and athletes are aware of some of the key antecedents identified and are then given tools that assist them to be better able to manage them, then it is possible that the severity of the performance failures could be reduced. For instance, if athletes and coaches are more aware that factors such as negative training experiences and poor use of imagery might lead to performance failures in competition, then it is probable that more time would be invested in preventing or reducing these factors, in an attempt to minimise the risk of performance failure under pressure. Raised awareness and early detection of the antecedents is something that a coach and sport psychologist could work on in tandem with

the athlete. Minimising the impact of factors such as negative training experiences could be relatively straightforward and could include investing in psychological skills training such as the development of imagery skills (c.f Callow & Hardy, 2004; Holmes & Collins, 2002), simulation training (Stratton, Cusimano, Hartman & DeBoom, 2005) and more controlled training conditions to ensure positive pre-competition experiences. Additionally, by identifying possible organisational stressors that may present themselves on the day of competition and then dealing with these in the form of "what if" scenarios, the impact of the overall increase in pressure to perform may be reduced. This could place less unfamiliar demands on the performer in the competition environment and making the competition experience itself more valuable to all involved (e.g. Mellalieu, Neil, Hanton & Fletcher, 2009).

Research Strengths

The main strengths of this research programme have been the interdisciplinary nature and the range of research methods employed to focus on a specific research question. From an interdisciplinary perspective, the use of HRV is of particular note, given that only a small number of previous studies within sport psychology have made use of this method to measure mental effort, with its use mainly being reserved for physiology based research programmes. The use of both quantitative and qualitative research methods demonstrates the researchers' ability to conduct both lab and field based experiments, demonstrating creativity and a desire to develop a range of research skills throughout the research programme period. An additional strength of the research project was the range of sporting tasks used to investigate the research question. Each study's task was purposefully chosen to be similar in level of difficulty despite being different in terms of physical execution. Regardless of task type, all of the tasks used uncovered consistent results supportive of the use of process goals in assisting performance under conditions of high anxiety and in preventing performance decrements. The research programme has a number of recommendations for future research, including continued consideration of both positive

and negative effects of anxiety upon performance (Hardy & Jones, 1990), further consideration of performance and organisational stressors in the lead up to competition (Mellalieu et al., 2009) and greater use of interdisciplinary research (Morgan, 1989).

Research Limitations

The research project was not without its limitations and a number of these have been identified and discussed throughout the thesis. It is recommended that future research should consider and address the following limitations: (1) anxiety interventions and measurement issues, (2) the nature and content of process goals and (3) sample sizes and statistical power.

Anxiety interventions and measurement issues

Wilson, Smith, Chattington, Ford and Marple-Horvat (2006) highlighted the use of ego-threatening manipulations as being successfully used in a number of research studies including Hardy, Mullen and Jones (1996) and Murray and Janelle (2003), and therefore similar methods were used throughout the current research programme. Realistically however, it would be inaccurate to think that the anxiety levels recorded and measured in studies 1, 2 and 3 would be as high as the anxiety levels that would be experienced in real competition. In light of that, study 4 aimed to avoid issues associated with unrealistic levels of anxiety by using real life competition examples which revealed more in depth, rich results. It is recognised, that this is a limitation of studies 1, 2 and 3 but is considered a common issue in anxiety intervention based research. In terms of measurement issues, the use of the CSAI-2 has also received some recent attention questioning its factorial validity when compared to the Competitive State Anxiety Inventory–version 2 revised (CSAI-2r; Cox, Martens & Russell, 2003). The CSAI-2r has recently been found to be more psychometrically sound, in that the use of the word “concern” could be interpreted in a number of different ways, both negatively and positively (Wilson et al., 2006, Woodman & Hardy, 2001). For example, items such as “My hands are clammy” would be expected to be of more importance to sports such as rock climbing or golf in comparison to swimming

or trampolining (Woodman & Hardy, 2001). This validity concern was addressed in the current research programme, as the pilot test for study 1 made use of both the CSAI-2 and the CSAI-2r and found no differences in the scores and responses of the individuals involved and for this reason the CSAI-2 was selected for use in the current research programme.

The nature and content of process goals

The process goal instructions provided by the researcher might not have been interpreted as originally intended, particularly amongst the basketball and tennis experts in study 2 and study 3 respectively. For instance, instructions that were intended to focus the participant's attention to parts of the movement such as "push fingers up and forward through the ball at release" or "snap the wrist just before release", could have been overtly different to what they would normally focused their attention on. Thus, focusing on something different to the "norm" may have succeeded in shifting the participant's attention, but not necessarily towards the process goals or in a way that was intended by the researcher. To further explain, if an expert basketball player usually (under non-experimental conditions) focuses his attention on a part process goal then getting him to think about another part process goal could have facilitated performance. In addition, the assigned goals may not have been able to replace the normal, automatic pre-performance routine of the experts and this too could explain why no performance decrements were observed. However, if the basketball player didn't normally have a specific focus when taking free throws, then the assignment of a part process goal may also have assisted his focus and ultimately his performance, despite expectations that a part process goal should induce conscious processing. It may have been helpful to have known what the more expert participants normally thought about when performing free throws before assigning them to groups and this should be considered for future research programmes investigating similar issues. Finally, some of the participants may have interpreted the process goal instructions in a manner that was not intended. For instance, some may have interpreted a part process goal in a more holistic

manner or altered the instructions in order to suit their needs and aid remembering the instructions. Although manipulation checks were in place this is still a concern and future research should ensure that manipulation checks continue to be used to help minimise such issues in subsequent studies.

Samples size and statistical power

The sample sizes and the number of trials used in each experiment were in line with that of previous research in the field but, based on the evidence from the current research programme, were deemed inadequate. On reflection the lack of performance decrements in the high anxiety conditions in studies 1, 2 and 3 could have been attributed to small sample sizes; however, it could also have been attributed to the nature of the tasks, the anxiety interventions or a number of other factors. The absence of counterbalancing in the experiments may have also had an impact on the results. Future research should also consider using larger sample sizes, more realistic anxiety interventions or indeed tasks which put greater demand on the participants and are more likely to be disrupted under conditions of high anxiety.

Future research directions

It is evident that future research into the causes of performance failure under pressure is required, both from a quantitative and a qualitative perspective. There are many unexplored avenues that future research could consider specifically; the investigation of an individual's predisposition to reinvest and how this may exert an influence on the affects of anxiety on performance. Further investigation into the underpinning mechanisms that contribute to performance failure could add support to the findings of the current research programme. As demonstrated in the current research programme there is a call for more qualitative investigations, as the information uncovered using qualitative techniques is more rich and in-depth, providing a more detailed perspective to performance failures, which would ultimately help aid sport psychologists', coaches' and athletes' understanding

of the phenomenon that can have such a dramatic affect on performance. An investigation into the use of effort as an asymmetry parameter is also warranted.

Conclusion

The results from this thesis have shown support for the use of part process, holistic process and external goals in preventing performance from deteriorating under conditions of high anxiety, providing no support for the CPH as an explanation for performance breakdown under pressure. The findings support previous research in the area by Mullen et al. (2005) who also failed to find support for the predictions of the CPH, which furthers supports the notion that CPH is not an exclusive explanation for performance decrements under conditions of high anxiety. In addition, the findings of study 4 provide support for distraction-based theories to explain the perceived performance failures of the eight elite trampolinists interviewed. Some small value was given to the notion that conscious processing should not be completely ruled out as a partial explanation, as it appeared to have a minor part to play in performance failures. This again demonstrates that explanations for performance decrements should view multiple notions and consider the potential complementary nature of such notions, if advances are to be made in more clearly understanding the area of performance decrements. The research programme has successfully extended the information available in the area of performance failures but has also brought some original thinking to the field by investigating performance failures from a qualitative perspective; a method that future researchers should consider using in order to add depth, substance and a greater level of understanding to the research area.

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